EUROPEAN UNION

SPREP
Secretariat of the Pacific Regional Environment Programme

PacWastePlus
PACIFIC WASTE MANAGEMENT

This initiative is supported by **PacWastePlus**-a 72 month project funded by the European Union (**EU**) and implemented by the Secretariat of the Pacific Regional Environment Programme (**SPREP**) **to sustainably and cost effectively improve regional management of waste and pollution.**

Regional Waste Audit Analysis Report

August 2023

Waste data analysis and reporting for the Pacific Regional Waste Audit Analysis Report was guided by the overarching Regional Waste Data Collection, Monitoring, and Reporting (DCMR) Framework for the Pacific Island Countries and Territories (PICT).

SPREP Library Cataloguing-in-publication data

Regional waste audit analysis report – August 2023.

Apia, Samoa : SPREP, 2022.

59 p. 29 cm.

ISBN: 978-982-04-1230-9 (print)

978-982-04-1231-6 (ecopy)

1. Recycling (Waste, etc.) – Technical reports – Oceania.

2. Waste management – Refuse and refuse disposal

– Oceania. 3. Hazardous wastes – Auditing – Oceania.

I. Pacific Regional Environment Programme (SPREP).

II. Title.

363.7280961

Disclaimer: This publication was produced with the financial support of the European Union. Its contents are the sole responsibility of SPREP and do not necessarily reflect the views of the European Union. This document has been compiled in good faith, exercising all due care and attention. SPREP does not accept responsibility for inaccurate or incomplete information.

Acknowledgment: The PacWastePlus programme acknowledges the MRA Consulting Group for their contributions towards the development of the regional waste data collection, monitoring and reporting framework.

PO Box 240

Apia, Samoa

T: +685 21929

E: sprep@sprep.org

W: www.sprep.org

Our vision: A resilient Pacific environment sustaining our livelihoods and natural heritage in harmony with our cultures.

Table of Contents

PacWaste Plus Programme

The Pacific – European Union (EU) Waste Management Programme, PacWaste Plus, is a 72-month programme funded by the EU and implemented by the Secretariat of the Pacific Regional Environment Programme (SPREP) to improve regional management of waste and pollution sustainably and cost-effectively.

About PacWaste Plus

The impact of waste and pollution is taking its toll on the health of communities, degrading natural ecosystems, threatening food security, impeding resilience to climate change, and adversely impacting social and economic development of countries in the region.

The PacWaste Plus programme is generating improved economic, social, health, and environmental benefits by enhancing existing activities and building capacity and sustainability into waste management practices for all participating countries.

Countries participating in the PacWaste Plus programme are: *Cook Islands, Democratic Republic of Timor-Leste, Federated States of Micronesia, Fiji, Kiribati, Nauru, Niue, Palau, Papua New Guinea, Republic of Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu*.

Key Objectives

Outcomes & Key Result Areas

The overall objective of PacWastePlus is "*to generate improved economic, social, health and environmental benefits arising from stronger regional economic integration and the sustainable management of natural resources and the environment*".

The specific objective is "*to ensure the safe and sustainable management of waste with due regard for the conservation of biodiversity, health and wellbeing of Pacific Island communities and climate change mitigation and adaptation requirements*".

Key Result Areas

- **Improved** data collection, information sharing, and education awareness
- **Policy & Regulation** - Policies and regulatory frameworks developed and implemented.
- **Best Practices** - Enhanced private sector engagement and infrastructure development implemented
- **Human Capacity** - Enhanced human capacity

Learn more about the PacWaste Plus programme by visiting

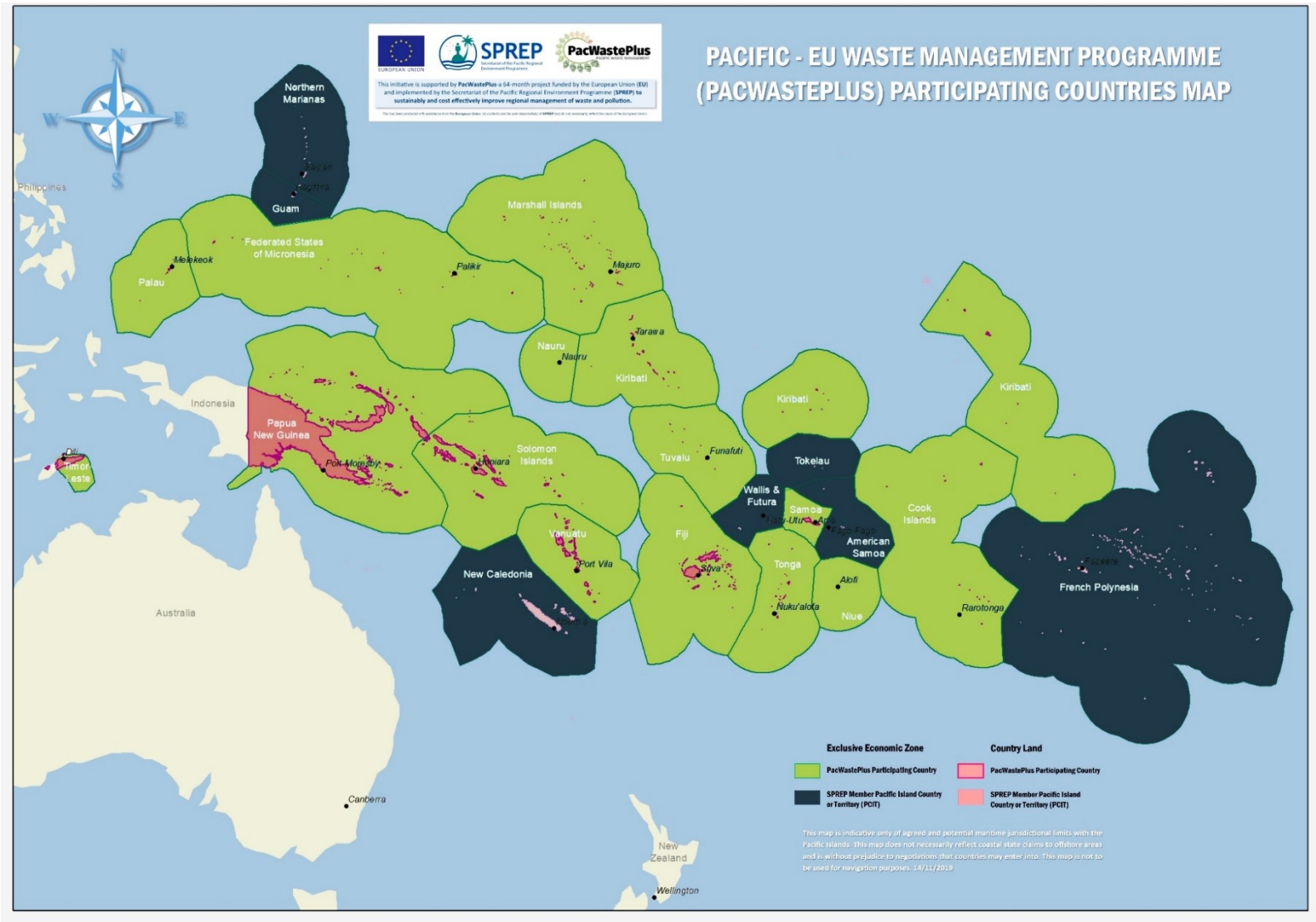
EUROPEAN UNION

SPREP Secretariat of the Pacific Regional Environment Programme

PacWastePlus PACIFIC WASTE MANAGEMENT

www.pacwasteplus.org

Map of the Pacific Islands



Glossary

Acronym	Definition
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CLiP	Commonwealth Litter Program
C&D	Construction and Demolition (Waste)
C&I	Commercial and Industrial (Waste)
CDL	Container Deposit Legislation
DCMR	Data Strategy & Collection, Monitoring, and Reporting (Framework)
WBG	World Bank Group
FSM	The Federated States of Micronesia
KPI	Key Performance Indicator
MEA	Multilateral Environmental Agreement
MSW	Municipal Solid Waste (i.e., waste originating from the general public that is typically managed by local government entities, excludes commercial / business waste)
PICT	Pacific Island Countries & Territories
P&C	Paper & Cardboard
PNG	Papua New Guinea
PRIF	Pacific Regional Infrastructure Facility
WBG	World Bank Group
UNEP	United Nations Environment Programme
SPREP	Secretariat of The Pacific Regional Environment Programme

Terminology	Definition
Capacity	The total maximum waste storage and processing that can take place at a facility (as capped by license conditions).
Capture rate	The proportion of total waste generated that is successfully captured and disposed or recovered in an environmentally responsible manner (e.g., by a formal collection service or self-hauled to a licensed facility)
Coverage	The proportion of total households that have access to a regular waste collection service.
Modern	A 'modern' facility employs 'sound waste management practices' (as defined by the UNEP) and results in minimal adverse impacts on the environment. A 'modern' facility must be licensed, staffed, and have access to equipment and machinery such as a bulldozer. A landfill or dumpsite must employ a leachate management system and a daily cover routine. A recovery facility should have fire prevention and control measures in place, and appropriate stormwater runoff controls. Facilities must not be exceeding their maximum storage capacity.
Per capita	Units measured on a per person basis (i.e., to allow for extrapolation over a national population).
Recovery	Any activity that diverts waste material from landfill, including processing of dry recyclables (such as paper, cardboard, metal and plastics such as PET and HDPE), organics recovery, and energy recovery.
Unregulated	Typically, unlicensed waste facilities which do not follow international frameworks, rules, and guidelines to protect the health of the environment and community.
Waste facility	'Waste facilities' involved in the handling, disposal, or recovery of waste streams above a minimum processing threshold determined on country basis (i.e., tonnes of waste received per year). Can include landfills or dumpsites (that primarily rely on burying waste in a controlled manner), recycling / recovery facilities for dry recyclables (and e-waste), organics recovery facilities, and waste-to-energy facilities. Incinerators are not included in this analysis.

Executive Summary

Waste data analysis and reporting for the Pacific Regional Waste Audit Analysis Report was guided by the overarching Regional Waste Data Collection, Monitoring, and Reporting (DCMR) Framework for the Pacific Island Countries and Territories (PICT). The implementation of the DCMR Framework ensures that waste data is collected, analysed, and reported in a consistent and reliable way across the Pacific.

Building on this data overtime ensures the PICTs possess the necessary information to enact effective waste management and informed decision-making. It allows a data driven approach to justifying investment targets (i.e., for investment in waste and recycling education, programs and infrastructure) and identifying priority needs in each country and across the region.

Overall, data availability for reporting to key performance indicators (KPIs established as part of the DCMR Framework) was sufficient for regional reporting purposes. No data was available to report to Supplementary KPI 6 (Awareness of waste management services) and Supplementary KPI 10 (Weight of disaster waste disposed). See ***Section 3*** of this report for data availability results by PICT.

Table (a) below summarises the regional baseline results for each KPI from the DCMR Framework.

Table (a) Summary of Key Performance Indicators (KPIs) for the Pacific Island region

Core KPIs	Result	Supplementary KPIs	Result
1. Count / capacity of modern waste facilities	8 facilities / unknown capacity	1. Cost of disposal to landfill ($/annum)	USD 38.82
2. Count / capacity of unregulated waste facilities	80 facilities/ unknown capacity	2. Weight of waste disposed (tpa)	416,541
3. National recovery rate (%)	15.33%	3. Weight of waste recovered (tpa)	5,937
4. Per capita waste generation rate (kg/capita/year)	101.3	4. Volume and type of stockpiled hazardous waste (m^3)	***See Figure 16***
5. Municipal Solid Waste (MSW) composition (%)	***See Figure 8***	5. Marine plastic pollution potential (tpa)	133,200
6. Household waste capture rate (%)	65.83%	6. Awareness and support of waste management services (%)	No data
7. Household collection service coverage (%)	64.66%	7. Proportion of strategic waste management initiatives implemented (%)	82.27%
8. Fulfillment of MEA reporting requirements (%)	31.23%	8. Commercial waste capture rate (%)	Limited data
		9. Commercial collection service coverage (%)	51.89%
		10. Total weight of disaster waste disposed (tpa)	No data

Note: 'No data' indicates that the audit did not capture the parameters / measurements necessary to calculate the KPI.

1 Introduction

1.1 Background

Pacific Island Countries and Territories (PICTs) share a region that is vast, covering over 800 million square kilometres[1], comprising thousands of islands with varying landscapes, unique cultures, and rapidly changing economic conditions. Despite this diversity, many Pacific Island nations share similar waste management challenges.

Common barriers to effective waste management include:

- Limited resource availability;
- Limited available land area for management infrastructure;
- Small waste tonnages and economies of scale, with limited access to suitable temporary and permanent waste collection, recovery and disposal facilities;
- High reliance on export for recycling and processing of waste materials and so highly sensitive to changing commodity prices and market changes;
- Varying waste collection and servicing arrangements (private and public) with different data collection processes and access requirements;
- High susceptibility to climate change-related weather events including cyclones and sea level rise;
- Varying implementation effectiveness of waste management policies, regulations and strategies given the above considerations; and
- Low public awareness and education on effective waste management for reduced risk to human and environmental health.

These challenges, alongside many other barriers effecting the management of waste, result in informal waste management practices being widespread across the region. Burying, burning, and dumping of waste is practiced in many communities across the PICTs, leading to environmental degradation and creating health hazards for local communities. This is compounded by the impact of climate change, where rising sea levels, increasing frequency and severity of extreme weather events, and ocean acidification, place the region under further pressure.

1.1.1 PacWaste Plus Programme

To address these challenges, PICTs are collaborating to improve waste management practices and build sustainable waste management systems via the PacWaste Plus Programme. Implemented through the Secretariat of the Pacific Regional Environment Programme (SPREP) and funded by the European Union, PacWaste Plus works to improve waste management activities across the islands and strengthen the capacity of governments, industries, and communities to manage wastes to better protect human health and the environment.

The outcomes of the PacWaste Plus Programme project identified the need for reliable and comparable waste data. Access to high-quality waste data guides investment and helps policymakers and government make informed decisions on the management of wastes.

1.1.2 Regional Waste DCMR Framework

The waste data available at this time for regional analysis has been sourced from waste audits undertaken for the PICTs as part of various projects ranging from the years 2018 to 2021. Some of the waste data is dated, has been reported across differing years and/or collected using differing methodologies. Current data is thus fragmented, making region-wide comparison difficult.

The Regional Waste Data Collection, Monitoring, and Reporting Framework (the DCMR Framework) has been designed to provide a consistent and reliable reporting process for the Pacific.

The implementation of the DCMR Framework will assist the region and the PICTs to collect relevant and comparable waste data, perform data quality checks, and track waste management progress and trends over time.

Figure 1 Implementation of the Regional Waste DCMR Framework

1.2 Purpose and Aim

The purpose of this Regional Waste Audit Analysis report is to establish a baseline of information on regional waste data and waste management systems. An analysis of waste management behaviours throughout the Pacific will assist countries and development partners to anticipate waste management issues and identify key opportunity areas at a regional or sub-regional level.

The aim of this regional audit analysis report is to:

- Collate validated national waste audit data for each of the 15 PICTs;
- Establish a baseline for the region's waste data and waste management systems;
- Build regional waste insights based on newly established key performance indicators (KPIs) to understand waste management trends for the Pacific Islands region; and
- Demonstrate waste management behaviours to identify current and future waste issues and opportunities.

1.3 Scope

This report presents waste data and analysis for the following PICTs:

1. The Cook Islands	9. The Republic of The Marshall Islands
2. The Federated States of Micronesia (FSM)	10. The Independent State of Samoa
3. The Republic of Fiji	11. Solomon Islands
4. The Republic of Kiribati	12. The Democratic Republic of Timor-Leste
5. The Republic of Nauru	13. The Kingdom of Tonga
6. Niue	14. Tuvalu
7. The Republic of Palau	15. The Republic of Vanuatu
8. The Independent State of Papua New Guinea (PNG)	

Waste streams examined include municipal solid waste (MSW) (i.e., waste generated in households and by the public), commercial and industrial (C&I), disaster waste and landfill waste. Landfills / dumpsites may receive a broad array of waste types, including construction and demolition (C&D) waste, hazardous waste, and as such is considered a separate waste stream.

The analysis and conclusions presented in this report were developed by examining a series of waste audit reports and their corresponding datasets available for each PICT.

All audits were conducted between 2018 and 2021 and were undertaken by:

- The United Kingdom Government's Centre for Environment, Fisheries and Aquaculture Science (Cefas) Commonwealth Litter Programme (CLiP);
- PacWastePlus;
- The Pacific Regional Infrastructure Facility (PRIF) – Regional Recycling Network;
- World Bank (WBG) – Regional Recycling Network;
- United Nations Environment Programme (UNEP) – Global Environment Facility.

1.4 Regional Overview

The Pacific Islands span across both the Northern and Southern hemispheres and are typically broken into three main ethno-geographic subregions consisting of Melanesia, Micronesia, and Polynesia (see map provided page 4). Along with the traditional grouping of the Pacific Islands region, this study also includes Timor-Leste, located in the Indonesian archipelago. The islands are of varying sizes and unique geographies, ranging from small atolls to larger volcanic islands like Fiji, Samoa, and Vanuatu.

The population distribution of PICTs is highly varied, with some countries having very small populations of under 20,000 people (such as the Cook Islands, Niue, Nauru, and Tuvalu) while countries like Papua New Guinea host populations numbering in the millions. In general, PICTs have small and dispersed populations, with most people living in rural areas.

This carries implications for waste management, with the scattered and remote nature of many communities making it challenging to provide efficient waste collection and disposal services.

Additionally, the rapid economic growth, tourism and urbanisation occurring in some countries is contributing to increasing amounts of waste, leading to further strain on already limited resources and infrastructure.

PICTs are prone to natural disasters, such as cyclones, earthquakes, and tsunamis, which can have significant impacts on waste infrastructure. Many of the islands have limited land area, which can make the creation and expansion of waste management facilities challenging. The remoteness of some islands can also pose logistical challenges for waste collection and transportation.

The availability of usable land for waste management in PICTs can be a challenge due to limited land area and competing land uses. Many of these countries have small land areas and are heavily populated, which makes finding suitable sites for waste disposal and management difficult. Additionally, some islands are characterised by rugged terrain and volcanic soil, which may limit the availability of suitable land for waste management.

PICTs generate a relatively small amount of waste compared to other regions, but the lack of adequate waste collection and waste management infrastructure and systems, combined with the extent of coastline (and the proximity of populations and waste management infrastructure to the coastline), poses a significant risk to human and environmental health.

1.5 Population

The population of each country, according to most recent National Census completed for each country, is given below in **Figure** 2**.** (See **Table 1** for the year that each census was completed.)

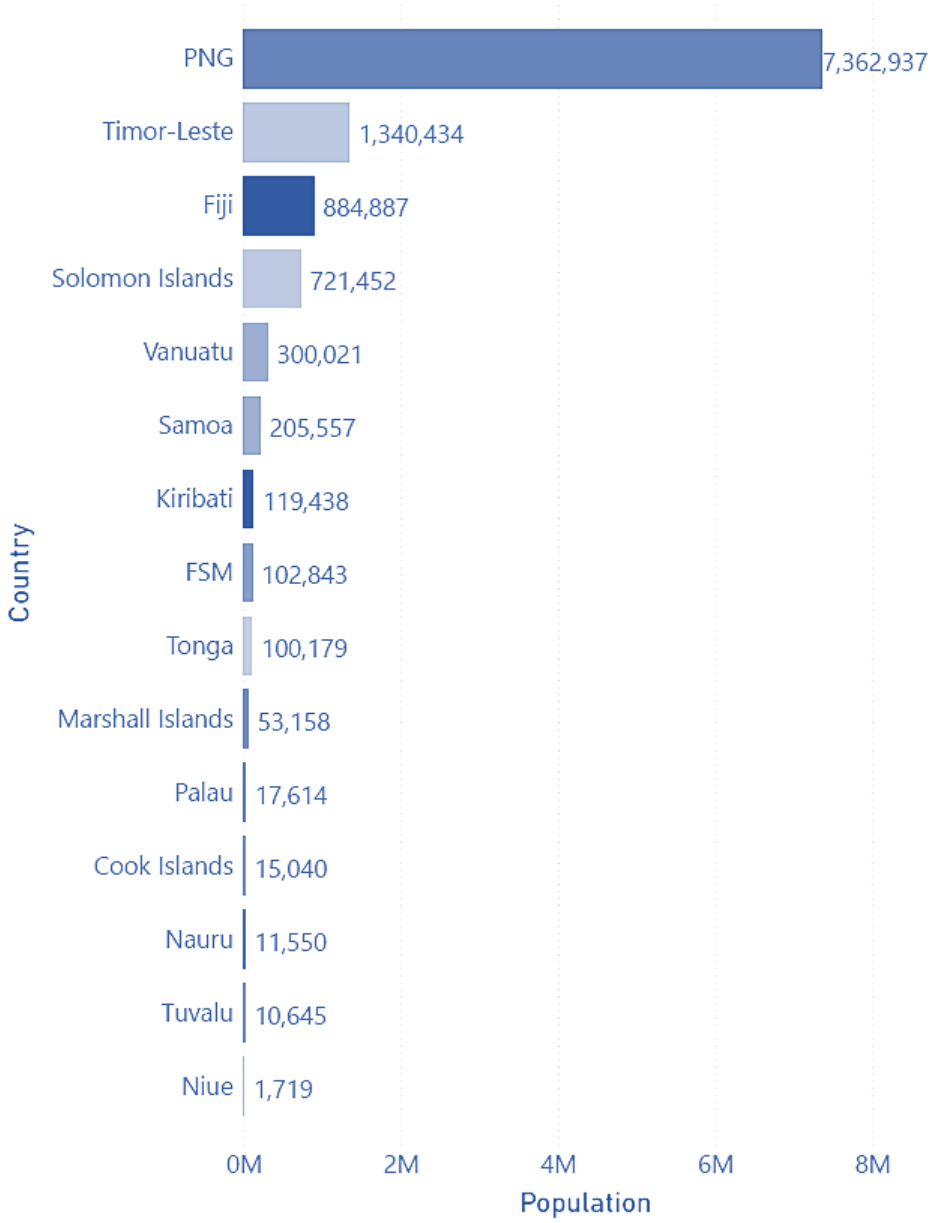


Figure 2 Population by country (M = million people), National Census 2010 to 2022

2 Methodology

Waste data collation, analysis and reporting was guided by the overarching Regional Waste DCMR Framework for PICTs. The data sources and data analysis methods used to report on regional waste data are outlined in this section along with any limitations.

2.1 Data Sources

The data collated and examined for the purposes of this report was sourced from each country's audit reports, including from the raw audit data (where available) and using each country's most recent publicly available census data.

2.1.1 Census Data

Census data shown in **Table 1** was primarily used to provide information on population and housing in each country. Census information for some countries is greater than 10 years old.

Table 1 National census years by country

National census year	Countries
2010	FSM
2011	PNG, RMI
2017	Fiji, Niue, Tuvalu
2019	Nauru (mini census), Solomon Islands
2020	Kiribati, Palau, Vanuatu
2021	Cook Islands, Samoa, Tonga
2022	Timor-Leste (preliminary results)

2.1.2 Waste Audits

The analysis and conclusions presented in this report were developed by examining a series of waste audit reports and their corresponding datasets available for each PICT.

All audits were conducted between 2018 and 2021 and were undertaken by:

- The United Kingdom Government's Centre for Environment, Fisheries and Aquaculture Science (Cefas) Commonwealth Litter Programme (CLiP);
- PacWaste Plus;
- The Pacific Regional Infrastructure Facility (PRIF) – Regional Recycling Network;
- World Bank (WBG) – Regional Recycling Network;
- United Nations Environment Programme (UNEP) – Global Environment Facility.

2.1.2.1 Audit Methodologies

Audit methodologies differ between audits undertaken for each separate party. Waste audits undertaken for the PICTs are outlined in **Table 2** along with the year of the audit, the project partner and the audit methodology adopted.

Some countries had multiple audits completed under different projects (e.g., Solomon Islands and Vanuatu).

Table 2 Summary of waste audits

Audit methodology	Project partner	Country	Year of audit
PRIF Waste Audit Methodology: A Common Approach	PacWastePlus	FSM	2021
		Niue	2021
		PNG	2021
		RMI	2021
		Solomon Islands	2021
		Nauru	2020
		Timor-Leste	2020
		Vanuatu	2020
	PRIF	Fiji	2021
		Cook Islands	2020
	WBG	Kiribati	2021
		Tonga	2021
		Samoa	2020
PRIF Pilot Waste Audit Methodology	UNEP	Palau	2019
	PRIF	Tuvalu	2019
Cefas Consultant Methodology	CLiP	Solomon Islands	2018
		Vanuatu	2018

2.1.2.2 Timeline of Waste Audits

A timeline showing the years that each waste audit was completed is given in **Figure 3**. The timing of the COVID-19 pandemic is also shown to illustrate the number of waste audits that would have been impacted by this event.

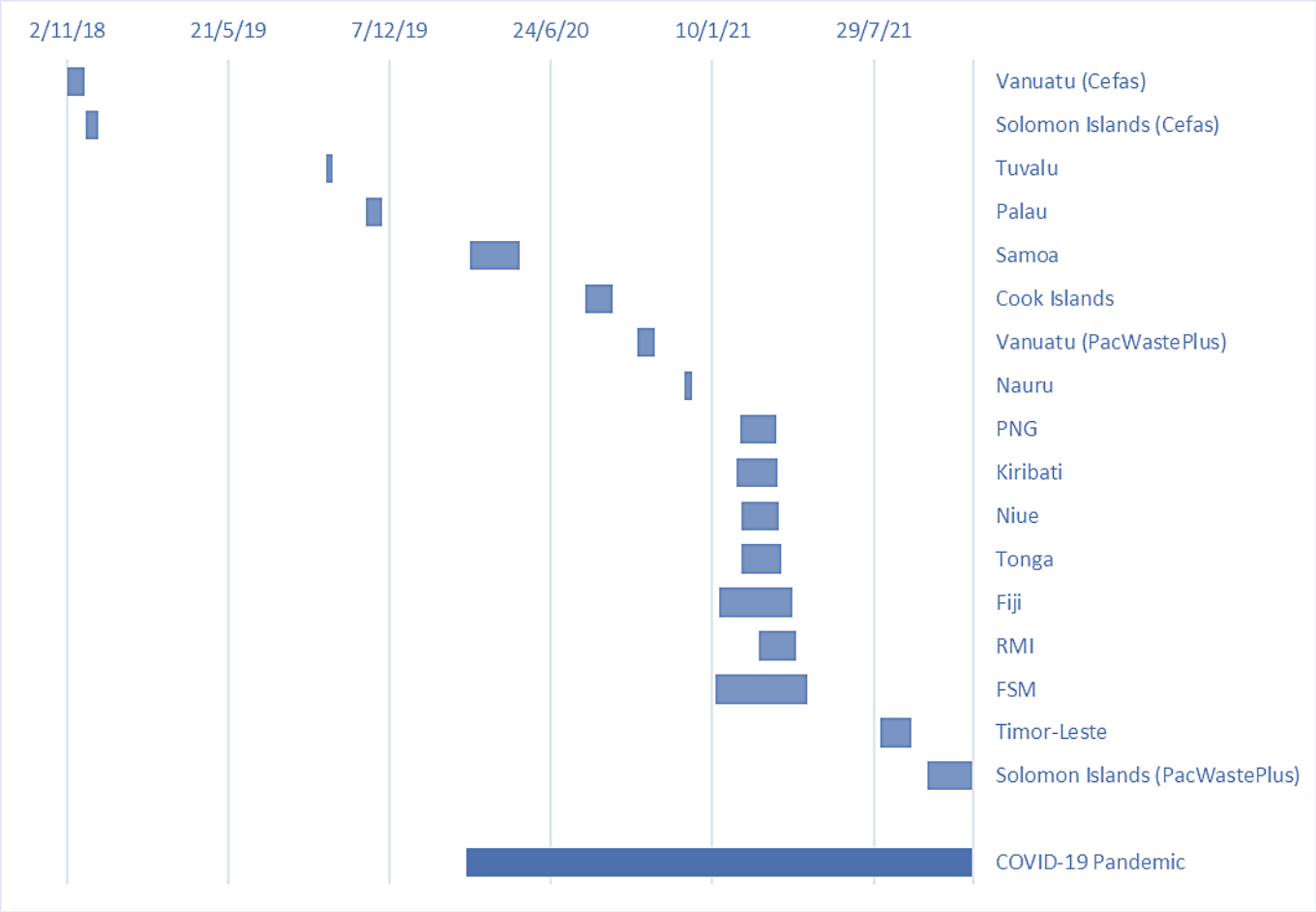


Figure 3 Timeline of waste audits

2.1.2.3 Common Outcomes of Waste Audits

Despite the timeframe differences and the different methodologies applied, several outcomes were common across waste audit reports, including:

- The composition, and measurements of weight or volume of landfilled waste;
- Household and total national waste generation rates;
- The location and size of waste stockpiles;
- Household and business waste compositions;
- The coverage, and public perception of waste collection services for households, and some commercials;
- Identification of potentially recyclable materials in household and commercial waste streams;
- Estimates of materials entering and exiting countries using customs data; and,
- Broad overviews of institutional capacity to support waste management via legislation and policy review.

2.1.3 Data Limitations

Data limitations of the census data used, and waste audit data analysed are outlined in **Table 3** below.

Table 3 Data limitations of census data

Census data	Description
Varying data availability by location	Some audit locations were not represented in census data, requiring estimation or extrapolation to provide relevant population and housing estimates
Varying data types collected	The range of reported information for census programs differed from country to country. For example, the Vanuatu census was the only census to collect information on populations with access to a waste collection service
Time frames	The year of census publication varied significantly depending on the country (see **Table 1**). Populations may have changed significantly since census publication.

There was a moderate degree of variation in the information reported across waste audits due to the different methodologies applied and approaches taken. These variations are identified in **Table 4**.

Table 4 Data limitations of waste audit data

Waste audits	
Diverse sampling locations	Audits varied in scope, with some focusing on towns and municipalities, while others examined waste in large cities, entire islands, or across regions
Variation in geographical classifications	Most audits categorised sampling locations as urban, peri-urban, and rural, but some audits used income levels (low, medium, high) as a basis for grouping
Varying waste composition categories	Dependent on the audit, composition analyses recorded different waste categories
Inconsistent reporting units	Metrics such as stockpile size or the amount of waste sent to landfill per annum were reported in different units dependent on the audit (e.g., cubic metres, square meters, tonnes, or counts)
Incomplete data collection	Not all audits were able to obtain the same information, with some reports missing key elements such as municipal solid waste compositions, operational costs for waste facilities, or landfill audit data
Inconsistent data measurement and criteria	Dependent on the audit, the analyses conducted varied due to distinct project goals, audit objectives and barriers to data collection (e.g., different interview questions were asked during household and business surveys)
Data quality	Raw audit datasets were not available for all countries, and when available, missing data entries and inconsistencies between dataset estimates and report figures lowered data quality. For countries lacking raw datasets, all measurements were sourced from audit reports, which varied in detail
Time frames	Audits were conducted between 2018 and late 2021. The effectiveness of comparing results is reduced due to changes in population, socio-economic conditions, and waste management systems. (i.e., the impact of COVID-19, disaster events, or otherwise were not experienced by all audit teams).

Additionally, audit teams across different audit programs often faced challenges in collecting comprehensive data due to factors outside of the audit teams' control (see **Table 5**).

Table 5 Major limitations of waste audits

Waste audits	Description
Inaccessibility to major urban population centres	Certain audit teams could not collect data from key areas (e.g., Suva was not sampled during the Fiji waste audit due to the impacts of COVID-19 and Cyclone Ana) and had to choose alternative locations
Unconducted analyses	Due to COVID-19, weather events, or security concerns, some audits could not perform certain analyses such as landfill audits
Limited transparency	A small number of referenced or interviewed parties were unwilling to provide information requested by audit teams
Data collection challenges	Some audit teams faced significant obstacles, such as COVID-19 restrictions, weather events, and security concerns, which limited data collection. Not all countries could report information of relevance to their audit methodology or approach

2.2 Data Analysis

Each country's audit reports, audit data, and other relevant data sources were inspected for relevant information which was subsequently collated into country specific databases. These databases were then used to calculate the DCMR Framework key performance indicators (KPIs).

KPI reporting followed the calculation methodologies detailed in the DCMR Framework. Each of the KPIs were designed to be reported to using corresponding data collection methodologies.

These comprise of:

- a waste facility register;
- household waste audits and community surveys;
- business waste audits and surveys;
- a policy survey; and,
- landfill and stockpile audits.

2.2.1 Data Analysis Limitations

Synthesising the available data for a regional level analysis was made challenging due to the range of factors outlined in **Section 2.1.3.**

A range of assumptions were necessarily implemented during analysis of audit data to provide standardisation where possible, so that data could be collated and compared more effectively at the regional scale.

2.2.2 Main Assumptions

Given the varying availability of relevant data, calculation, and reporting to KPIs for each country required inclusion of a range of assumptions and data substitutions. Specific assumptions for each country's KPI calculations are available in their corresponding country audit reports. The results of these calculations have been carried into this regional analysis.

The main assumptions applied to KPI reporting for this regional analysis are as follows:

- The latest publicly available national census data was used for each country to obtain population, and household count and size estimates for relevant performance indicators. Although publication years vary, the censuses used are the most current publicly available resources. Consequently, regional analysis combines performance indicator results based on population and housing data ranging from 2010 to 2022, dependent on the country (see **Table 1**).
- Countries with insufficient audit data to determine specific KPIs at the national level were excluded from the regional-level analysis of the corresponding KPIs.
- The general threshold rule for proceeding with extrapolation to the national scale was that audit data had to be available for both urban and rural areas. This was particularly relevant for reporting to Core KPIs 6 and 7.
- Some performance indicators were determined directly from figures presented in the audit reports or data when appropriate, without calculation via DCMR framework methodology.
- KPI results have been rounded to two decimal places for percentages and cost data, and to 3 significant figures for whole numbers.
- Municipal Solid Waste (MSW) categories presented in this regional analysis correspond to those used in the PRIF's Waste Audit Guidelines[3]. Composition data from audits which recorded different categories were converted to the PRIF categories to allow for a regional composition comparison and analysis.
- Volumetric measurements (made in m^3) used in performance indicator calculations were converted to weight (tonnes or kilograms) using the Material Density Conversion Factors provided by the Australian New South Wales Environment Protection Authority[2].
- For Supplementary KPI 5, all waste plastics which are not managed in an environmentally sound manner are assumed to have the potential risk of polluting oceans and estuarine waterways.
- Commercial waste service coverage reporting has relied primarily on survey information conducted during audits of commercial business waste.
- The cost of disposal to landfill for each country was converted from currencies presented in the audit reports to USD for regional analysis (see **Table 6** below).

Table 6 Currency exchange rates

Currency	Equivalent to USD $1.00	Date of exchange rate
NZ $	$1.61	27 Mar 1:03 am UTC
FJ $	$2.22	26 Mar, 8:37 pm UTC
AUD $	$1.50	27 Mar, 1:04 am UTC
PGK K	K 3.53	26 Mar, 12:21 pm UTC

Access to more reliable data in the future will mitigate the need for assumption and substitution during KPI calculation, giving results that are more representative of reality.

2.3 Key performance indicators

The DCMR Framework introduces a series of KPIs (see **Table 7**). The KPIs were developed to guide data analysis with the aim of improving the efficiency of data collection activities by building on pre-existing data collection practices across the region.

Table 7 Key Performance Indicators (KPIs) from the DCMR Framework

Core KPIs
 1. Capacity of modern waste facilities
 2. Capacity of unregulated waste facilities
 3. National recovery rate
 4. Per capita waste generation rate
 5. Municipal Solid Waste (MSW) composition
 6. Household waste capture rate
 7. Household collection service coverage
 8. Fulfillment of MEA reporting requirements
Supplementary KPIs
 1. Cost of disposal to landfill (per tonne)
 2. Weight of waste disposed
 3. Weight of waste recovered
 4. Volume & type of stockpiled hazardous waste
 5. Marine plastic pollution potential
 6. Awareness and support of waste management services
 7. Proportion of strategic waste management initiatives implemented
 8. Commercial waste capture rate
 9. Commercial collection service coverage
 10. Weight of disaster waste disposed

3 Audit Analysis Results

3.1 Summary of data availability

The extent to which there was adequate data and information to calculate the KPIs is represented in **Table 8** and **Table 9.**

Table 8 Summary of Core KPI results

KPIs	KPI 1	KPI 2	KPI 3	KPI 4	KPI 5	KPI 6	KPI 7	KPI 8
Cook Islands								
Fiji								
FSM								
Kiribati								
Nauru								
Niue								
Palau								
PNG								
RMI								
Samoa								
Solomon Islands								
Timor-Leste								
Tonga								
Tuvalu								
Vanuatu								

Legend

Sufficient data	Limited data	No data

The results indicate there was:

- **Sufficient data** (generally) for reporting to Core KPI 4 to KPI 7 (each KPI associated with household waste audits and surveys). Exceptions to this include Tuvalu (no MSW compositional audit was undertaken), Samoa (composition proportions reflective of all waste streams, not just household waste), Palau (no breakdown of collection service coverage by area), Fiji and Timor-Leste (detail below);
- **Insufficient data** for reporting to Fiji's Core KPIs 4 to 7 to the national level due to restricted access to audit locations (and no access to Suva) following the COVID-19 pandemic and Cyclone Ana;
- **No data** available to report to Core KPI 6 and 7 (Household waste capture and collection service coverage) for Timor-Leste. At the time of waste audit, no formal waste collection service had been established in Timor-Leste aside from the collection points in Dili;
- **Limited data** for reporting to Core KPI 1 and 2 (count and capacity of modern and unregulated facilities); and
- **Limited to no data** (generally) for reporting to Core KPI 3 (the national recovery rate) at the national scale, with no data for 7 out of 15 PICTs.

Table 9 Summary of Supplementary KPI results

	KPI 1	KPI 2	KPI 3	KPI 4	KPI 5	KPI 6	KPI 7	KPI 8	KPI 9	KPI 10
Cook Islands										
Fiji										
FSM										
Kiribati										
Nauru										
Niue										
Palau										
PNG										
RMI										
Samoa										
Solomon Islands										
Timor-Leste										
Tonga										
Tuvalu										
Vanuatu										

Legend

Sufficient data	Limited data	No data

The results indicate there was:

- **Limited to no data** to report to Supplementary KPI 4 (volume and type of stockpiled hazardous waste) and KPI 8 (commercial waste capture rate).
- **No data** available (generally) to report to Supplementary KPI 3 (total weight of waste recovered) for 7 out of 15 PICTs, and for KPI 6 (awareness of waste management services) and KPI 10 (weight of disaster waste disposed) for all PICTs.

Core KPI 1 & 2: Count and capacity of modern and unregulated waste facilities

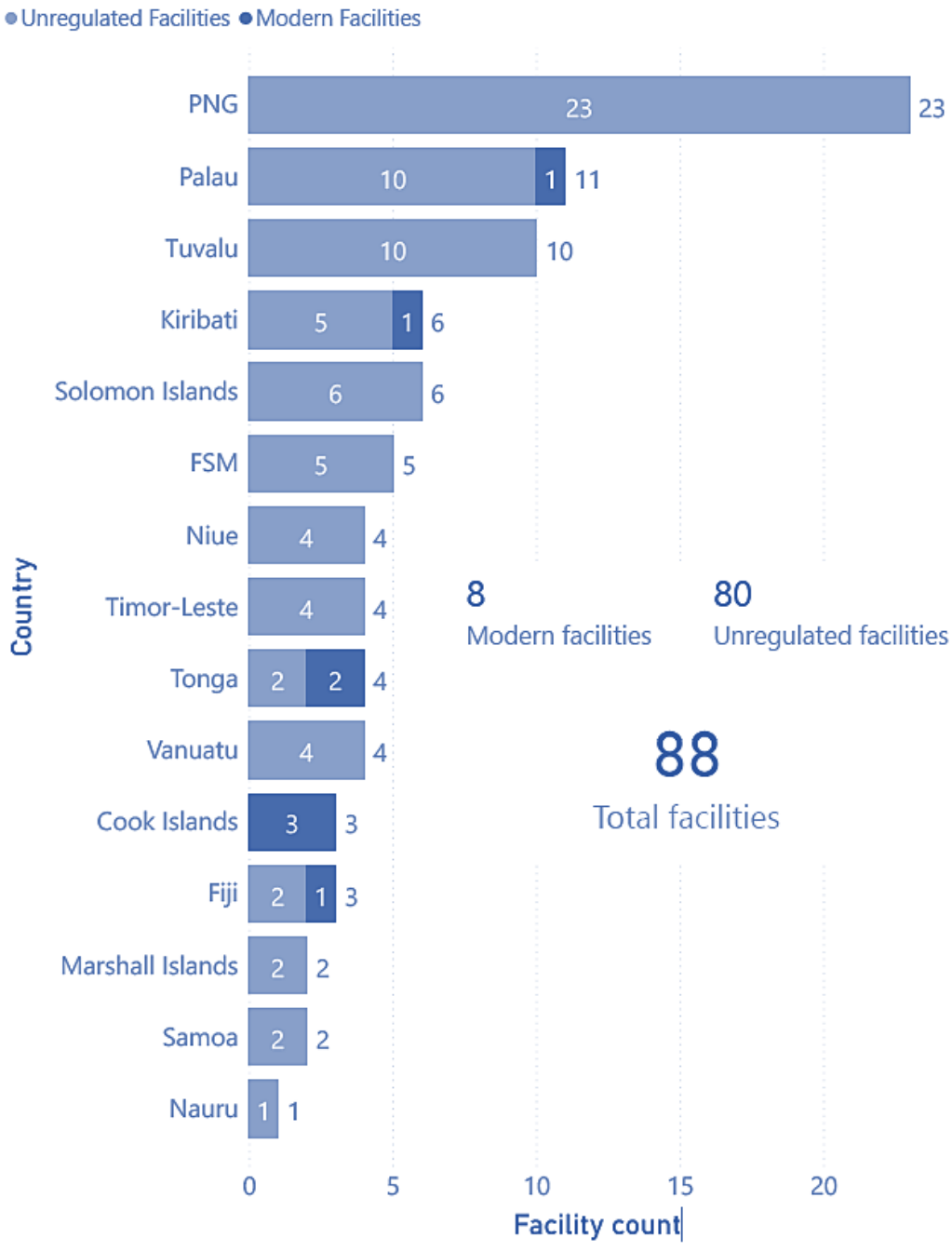


Figure 4 National count of modern and unregulated waste facilities

Results:

- The baseline regional assessment identified 88 waste facilities, including 8 modern facilities and 80 unregulated facilities.
- The true count of total waste facilities is in some countries is unknown. There were also several waste facilities that were either under construction or due to be closed at the time of the audit.
- The count of unregulated facilities versus modern facilities, and the total facility count, is expected to change significantly in the future as more reliable data is collected.
- The vast majority of waste facilities in the Pacific were classified as 'unregulated'. Many facilities have inadequate leachate management systems and/or lack of a daily/intermittent cover system being implemented on site.
- Where there was insufficient data to determine the classification of a facility, the facility was generally classified as 'unregulated', except in cases where evidence could be located to support a 'modern' classification.
- There was limited data available to determine the capacities of modern and unregulated waste facilities at both the country and regional scale.

Key considerations:

- It is recommended that the number, location, name and operations of all landfills/dumpsites and recovery facilities are collated for future reporting to this performance indicator.
- When estimated / measured capacities for each facility are better understood, regional analysis can help to determine the infrastructure capacity needs for each country and across the region.
- The results indicate that the potential for hazards to the environment and community due to contamination and waste material flow (given the lack of environmental controls at most facilities) is high.
- The World Bank's "Trends in Solid Waste Management" (worldbank.org)[5] states that "open dumping accounts for about 31 percent of waste, 19 percent is recovered through recycling and composting, and 11 percent is incinerated for final disposal". The global treatment and disposal of waste (percent) is provided in **Figure 5**.
- Incineration is typical for land-constrained countries. For incineration to meet with best practice it should be operated to EU standards for incineration and comply with USEPA emission standards for incineration. Incineration facilities are outside the scope of this report, but it is recommended that they be included for future KPI reporting given they form part of the waste management baseline.

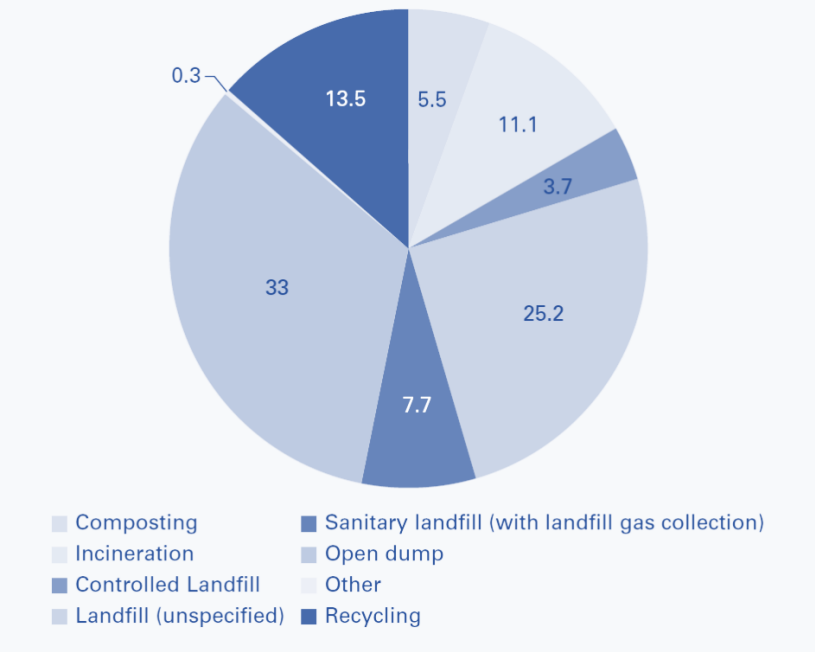


Figure 5 Global treatment and disposal of waste (percent), World Bank

Core KPI 3: Regional recovery rate

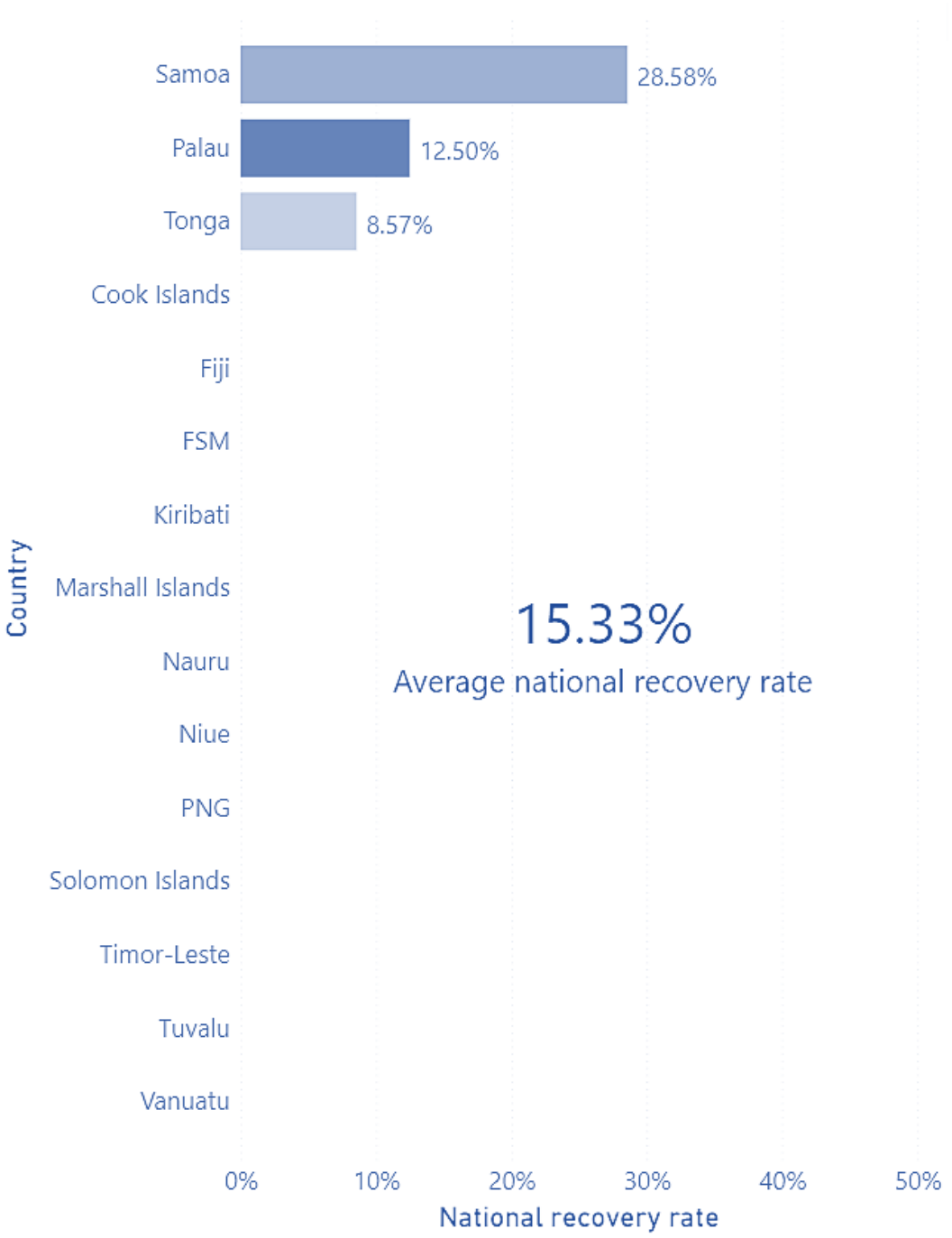


Figure 6 National recovery rate (%)

Results:

- The baseline regional recovery rate is just over 15%. It has been calculated based on the national results for 3 PICTs. These countries had sufficient data to allow calculation and extrapolation of a resource recovery rate to the national scale.
- Not all recycling and recovery efforts could be counted toward a national recovery rate. For example, performance reporting for resource recovery activities implemented at a local community scale, or at certain facilities servicing one area, or for certain materials or programs, may not be representative of the performance of the rest of the country. Some examples of this are outlined below:
  - Kiribati has achieved a recovery rate of 49.5% as part of its Koaki Maange Program
  - Tuvalu has achieved a recovery rate of 34.79% for garden organics
  - Vanuatu has achieved a recovery rate of close to 12% via a privately-operated recycling program.

Key considerations:

- To report to this KPI at the national scale, the total amount of waste generated, and the total amount of waste recovered (in a country or for sufficient representative areas within the country), must be able to be calculated.
- Not all facilities in each country were captured in audits. While audit reports did contain some information on recycling operations in several PICTs, waste recovered at waste and recovery facilities, or by recovery operators, was not regularly quantified throughout the audit reports.
- Container Deposit Legislation (CDL) systems have been established in Kiribati, FSM, RMI, Tuvalu (though commenced after the country's last waste audit) and Palau. Palau has achieved an 85-90% recovery rate for beverage containers through its CDS programme. Other subsidy programmes were also in place or in planning for Fiji, Samoa, Solomon Islands and Vanuatu for PET bottles and/or glass beer bottles. Some of these schemes are privately managed which can make it difficult to obtain data on recovery.
- The majority of PICTs rely on export for the recycling and processing of recovered wastes however export arrangements were heavily impacted around the time of the waste audits by recycling market fluctuations and COVID-19 restrictions. Delays in exports of materials leads to greater stockpiling of recyclable materials putting pressure on already limited storage space.
- The volatility of global markets for recycled waste means the profitability of small recycling markets in the Pacific Islands are vulnerable to fluctuations. This leaves the PICTs open to risk (i.e., risk of export arrangements and overseas recycling contracts ceasing to operate, excessive material stockpiling). Part of improving waste management and resource recovery for each PICT will be determining how the region can increase economies of scale to help make recycling a more economically viable solution.
- For comparison, international recovery rates were in the order of 30% or less prior to the introduction of significant waste legislation and regulation (e.g., prior to implementation of the waste levy in various states and territories in Australia). In 2015, New Zealand achieved a recovery rate of 35% (on a volume basis) across its MSW, C&D and C&I waste streams, and 32% resource recovery from its MSW waste stream[5].

Core KPI 4: Per capita waste generation rate

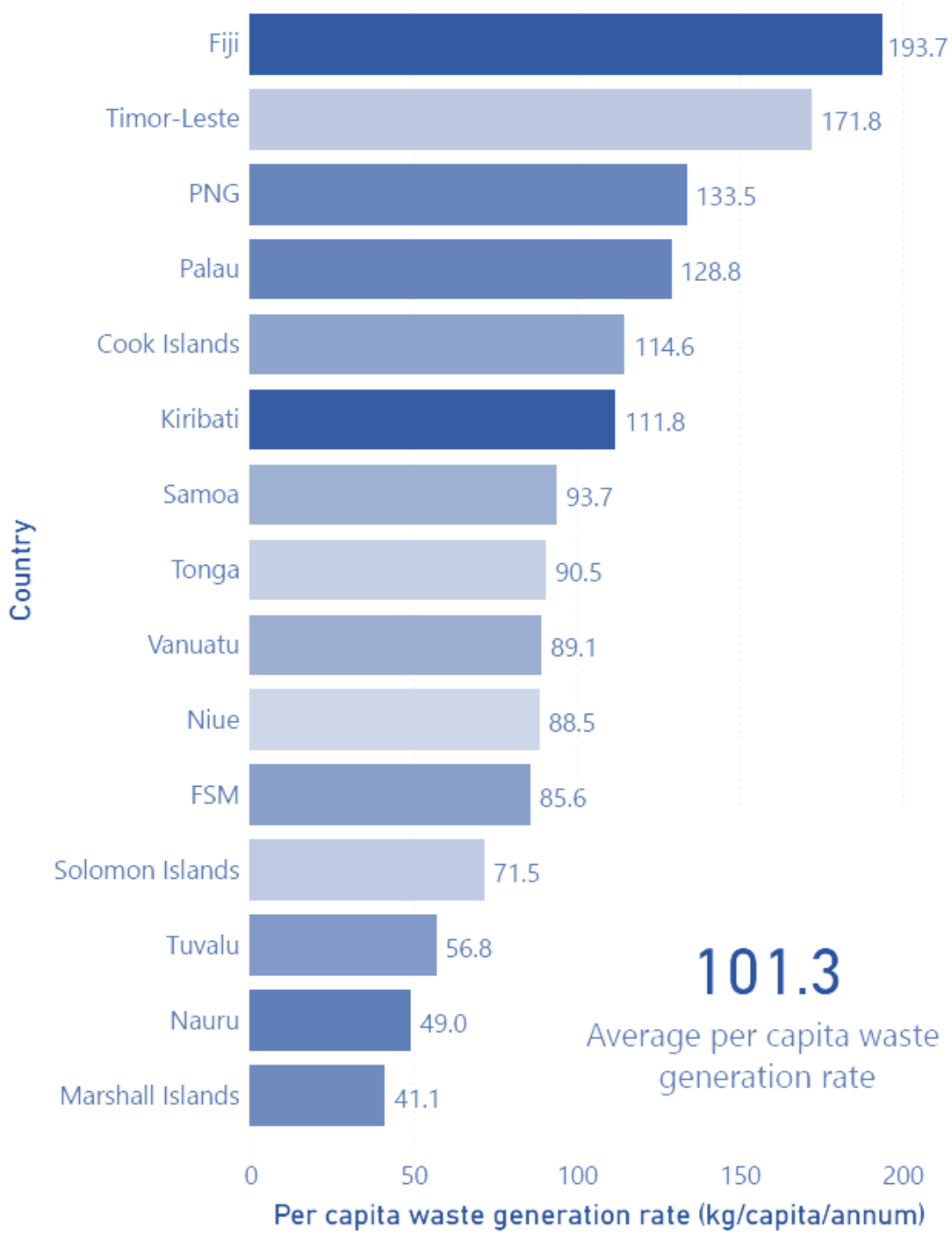


Figure 7 National per capita waste generation rate

Results:

- The regional baseline per capita waste generation rate for the Pacific is about 100 kg/capita/year. This is about 0.28 kg/capita/year.
- According to available data, Fiji, Timor-Leste, and PNG have the highest per capita waste generation rates in the region (a maximum of more than 190 kg/capita/year).
- This baseline provides a starting point for comparison of per capita generation rates from year to year and to other countries (regionally and internationally). This result will change in the future as more reliable or updated data is collected.

Key considerations:

- Monitoring changes in per capita waste generation rates over time can be used to track the effectiveness of waste management and education programs, analyse progress towards waste reduction targets and identify countries with higher, lower, or volatile per capita generation rates.
- According to the World Bank Global Trends analysis, waste generated per person per day globally averages 0.74 kilogram (or 270 kg/capita/annum) but ranges widely, from 0.11 (40 kg/capita/annum) to 4.54 (1,643 kg/capita/annum). The Pacific Island regional baseline per capita waste generation rate is therefore less than the global average and sits at the low end of the scale.
- The World Bank Pacific Economic Update[6] states that "after seeing almost no tourism activity in 2020, 2021 and much of 2022 (due to the travel restrictions associated with the COVID-19 pandemic), tourism numbers are on the rise in many Pacific economies, already driving economic growth up to 15% in Fiji in 2022, with Palau to see 18% growth in 2023". It is likely that waste generation rates and audit results obtained between 2020 and 2022 were affected by reduced tourism and as such this KPI result, and the result of many other KPIs, can be expected to change significantly with a return to typical tourism numbers.

Core KPI 5: Municipal Solid Waste (MSW) composition

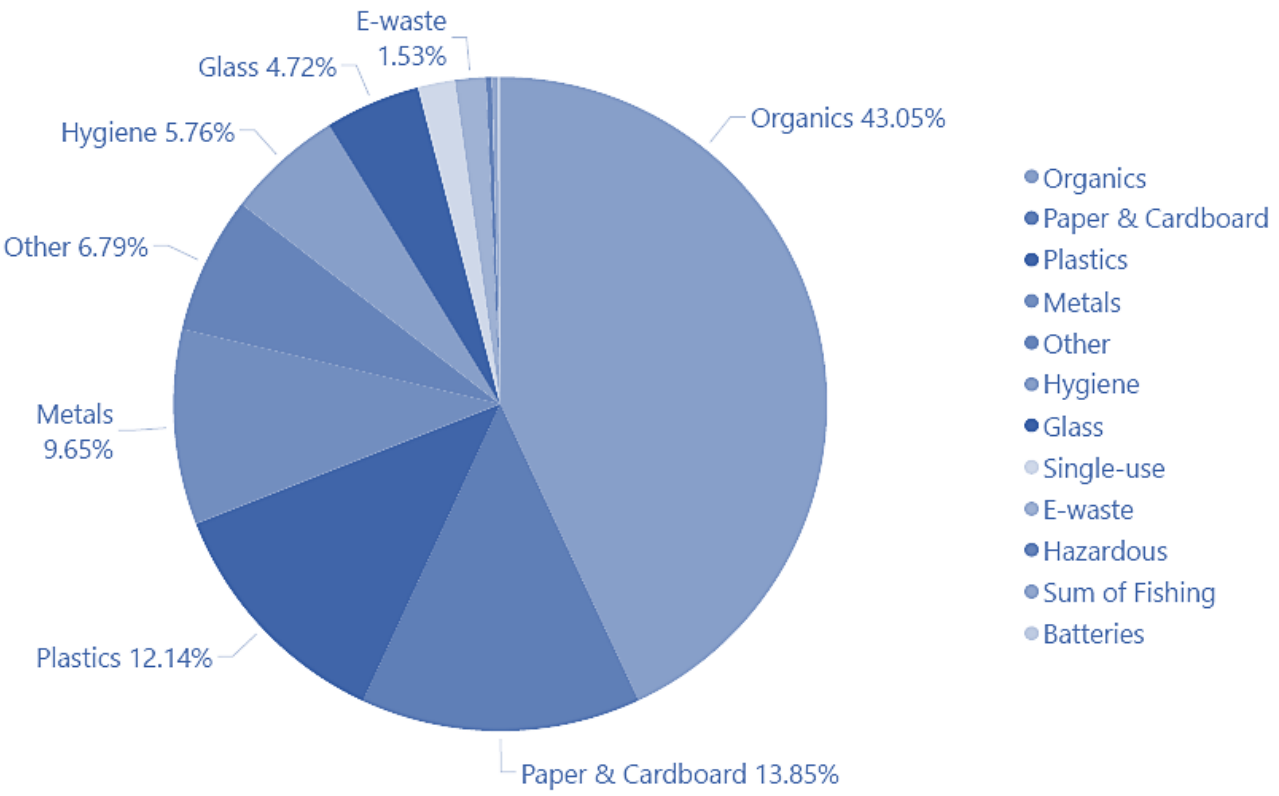


Figure 8 Average MSW composition for the region (% by weight)

Results:

- The most prevalent waste types in the MSW stream across the Pacific Islands region were:
  - Organics: 43.05%
  - Paper & cardboard: 13.85%
  - Plastics: 12.14%

Key considerations:

- It is recommended that composition analyses in the future all endeavour to capture and report to the same waste categories to improve data quality for ease of comparison (from year to year, across the region).
- The prevalence of organics in the household waste stream is likely due to reliance on local subsistence agriculture throughout rural communities across the Pacific. As rural communities often have fewer options for imported and bought food and goods, there can be a greater reliance on locally grown or produced items. Organics recovery systems, such as local or national composting services could help support subsistence farmers and reduce the amount of organic waste destined to be sent to landfill or improperly managed, with the corresponding decrease in greenhouse gas emissions.
- Plastic waste management is a critical challenge globally. However, the prevalence of plastic waste in the MSW stream is of significant concern for PICTs and highlights the need for effective plastic waste management strategies. Due to the low collection service coverage and household waste capture rates in the Pacific, there is an increased risk of plastic waste entering the environment. As plastic is inert in landfill, increasing the capture rate of waste plastic would also contribute to the mitigation of damage caused by unmanaged plastic waste.

- Targeting paper and cardboard waste for recovery may be a viable option for some PICTs. Due to the high proportion of paper and cardboard waste found in the MSW waste stream, and the production of methane gas when paper and cardboard is landfilled, effective recovery should help to reduce the total amount of waste being sent to landfill and lower greenhouse gas emissions.
- Metal waste makes up close to 10% of the overall waste generated by households in the Pacific. There are management options identified in the audit reports such as container deposit legislation (CDL) and schemes which have been successful in diverting items such as aluminium cans from landfill. Implementing CDL programs in countries with limited recycling could be a first step towards improving waste recovery rates.
- A comparison of the MSW compositions of the PICTs show:
  - Organics was the highest MSW component for Kiribati and Solomon Islands comprising over 60% of their MSW compositions.
  - Vanuatu had a high hygiene waste component (37%) relative to the rest of the countries, with Cook Islands having the second highest (about 26% of MSW composition).
  - The Plastics category of waste was highest for FSM, RMI and Fiji comprising close to 20% of MSW compositions.
  - Single Use was highest for Nauru (about 19% of MSW composition).
  - Hazardous waste was highest in the MSW waste stream for FSM and RMI (both close to 8%).
- The impacts of the COVID-19 pandemic and climate change / weather events may have changed the dominant waste types sourced from households. For example, the pandemic would have increased medical waste (e.g., testing kits, syringes and COVID-19 surgical masks) and packaging present in waste streams, whilst climate change and weather events such as cyclones would have disrupted waste management systems and introduced an influx of disaster waste. Updated waste audits will assist in providing accurate assessment of current waste composition in these regions, so that gaps in materials processing capacities can be estimated for prioritised collections, infrastructure, and other waste management arrangements.
- The Pacific Islands waste composition results are comparable to global averages (see **Figure 9**). The World Bank Global Trends report[4] states that "waste composition differs across income levels, reflecting varied patterns of consumption. High-income countries generate relatively less food and green waste, at 32 percent of total waste, and generate more dry waste that could be recycled, including plastic, paper, cardboard, metal, and glass. Middle- to low-income countries generally generate more organics" at above 50% of total waste.

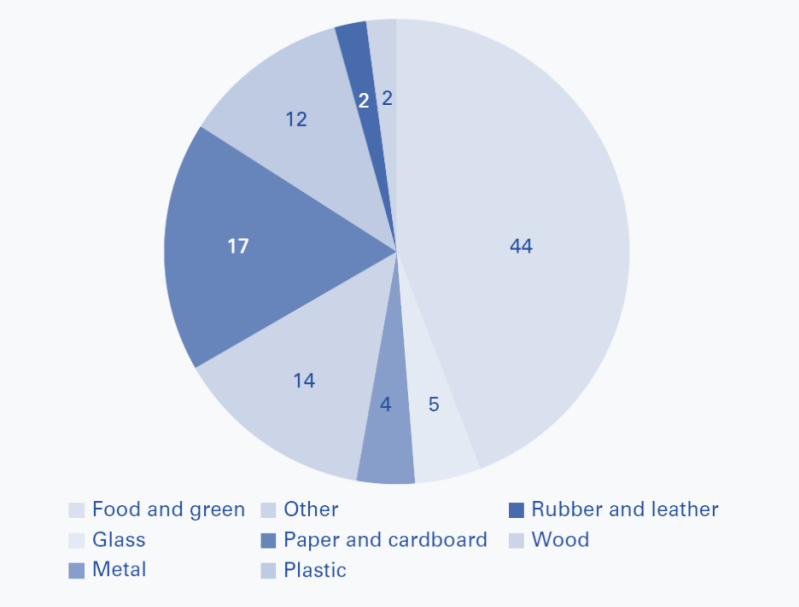


Figure 9 Global municipal waste composition (percent), World Bank

Core KPI 6: Household waste capture rate

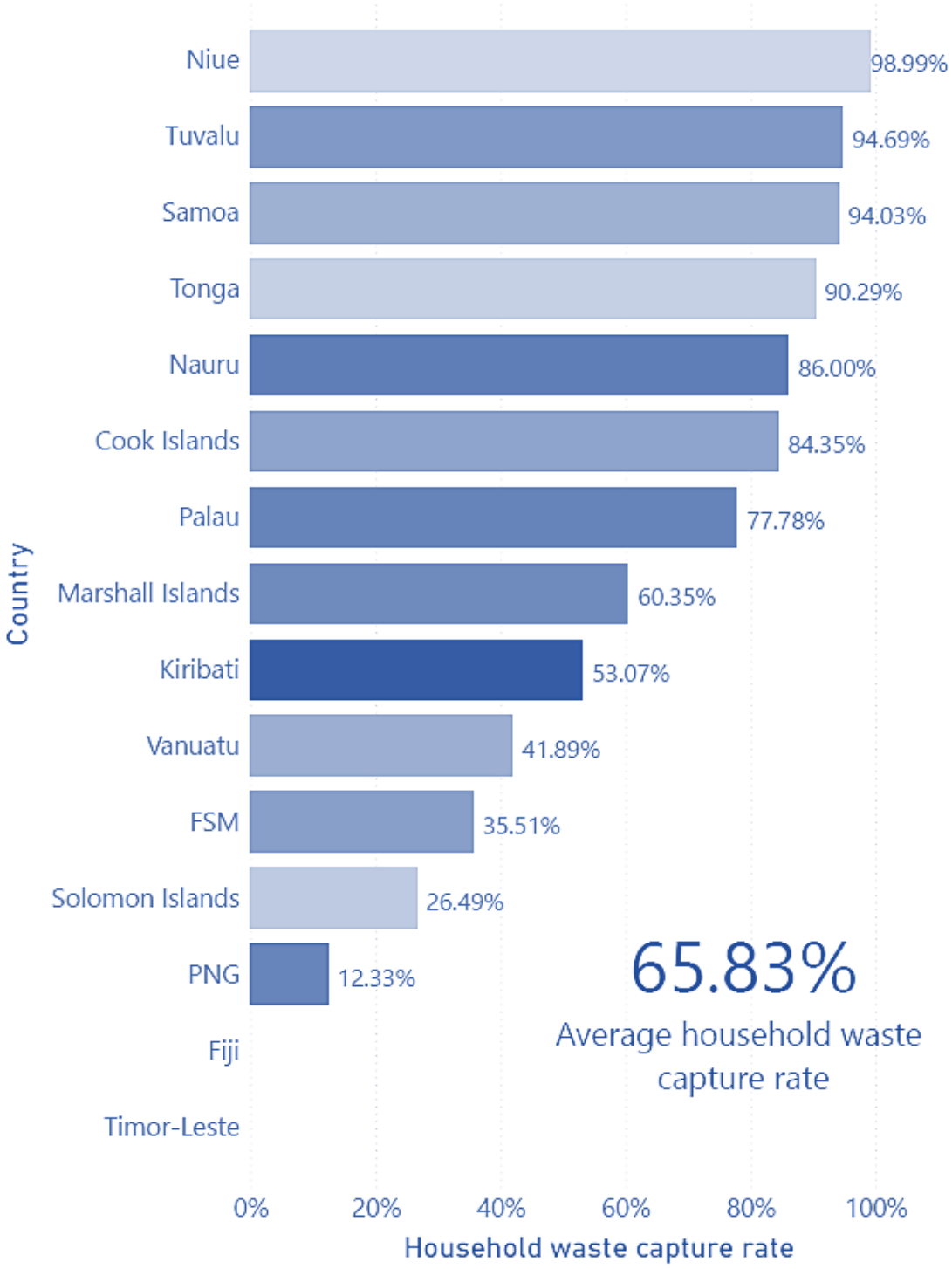


Figure 10 National household waste capture rate (%)

Results:

- The regional baseline household waste capture rate is an average of approximately 65%.
- The regional household waste capture rate quantifies waste material captured by some form of waste management service, including household collection services and waste that is self-hauled to a waste facility or drop-off site. As such, it measures the weight of waste effectively captured by collection services.
- Almost all PICTs offer waste collection services to households and small businesses. Large businesses are generally required to self-haul their waste to landfills / dumpsites.
- A total of four PICTs achieved household waste capture rates of greater than 90%.
- Limited information gathered regarding the availability of other waste capture methods (e.g., self-haul, drop-off points).

Key considerations:

- Waste that is not collected (a regional average of 35%) is considered to have a high risk of being mismanaged, which could mean that the remaining waste is burned, buried, littered, or dumped, and plastics are more likely to contribute to potential marine pollution.
- It is recommended that future reporting to this KPI provides a breakdown of average waste capture and coverage rates for 'urban' and 'rural' areas of each PICT given the unique requirements and challenges of each.

Core KPI 7: Household collection service coverage

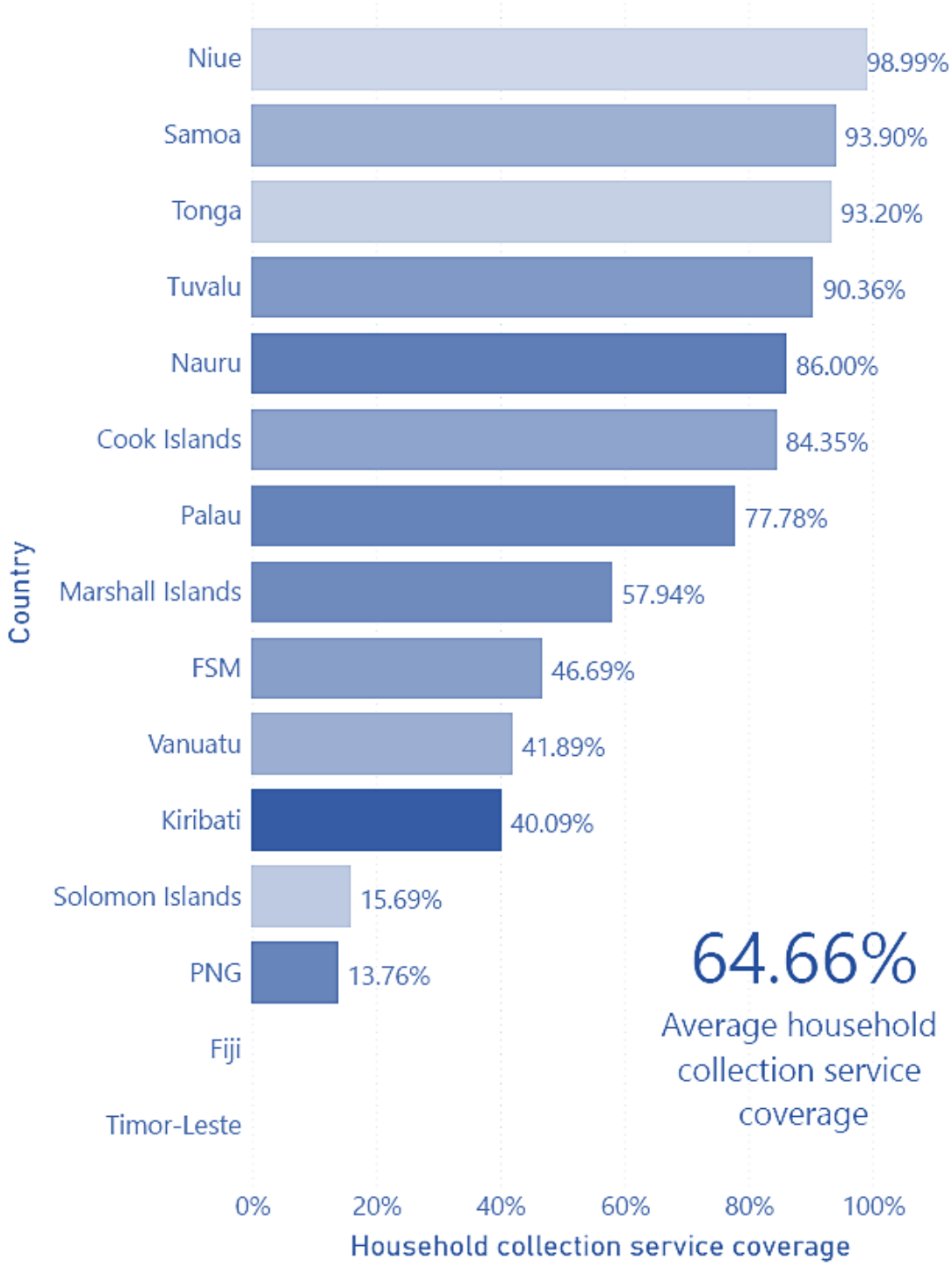


Figure 11 National household collection service coverage (%)

Results:

- The baseline regional household collection service coverage is an average of approximately 65%. This result represents the proportion of households in a country, and across the region, that have access to a waste collection service.
- A total of four PICTs has achieved household collection service coverage of greater than 90%. These are Niue, Samoa, Tonga, and Tuvalu.
- Almost all PICTs offer waste collection services to households and small businesses (the exception being Timor-Leste). Large businesses are generally required to self-haul their waste to landfills / dumpsites.

Key considerations:

- Collection service coverage has been historically challenging in remote, isolated, and sparsely populated regions, or in areas that are difficult to access. And expanding collection services requires investment in infrastructure, equipment, personnel, and policy. The results emphasise the need to find cost-effective and efficient waste collection strategies for hard-to-reach areas that are traditionally difficult to service.
- A recent report from the World Bank[4] states that "waste collection is a critical step in managing waste, yet rates vary largely by income levels". It reports that "upper-middle- and high-income countries provide nearly universal waste collection" and "low-income countries collect about 48 percent of waste in cities, but this proportion drops drastically to 26 percent outside of urban areas".
- It is recommended that future reporting to this KPI provides a breakdown of average waste capture and coverage rates for 'urban' and 'rural' areas of each PICT given the unique requirements and challenges of servicing each location type.

Core KPI 8: Fulfillment of Multilateral Environmental Agreement (MEA) reporting requirements

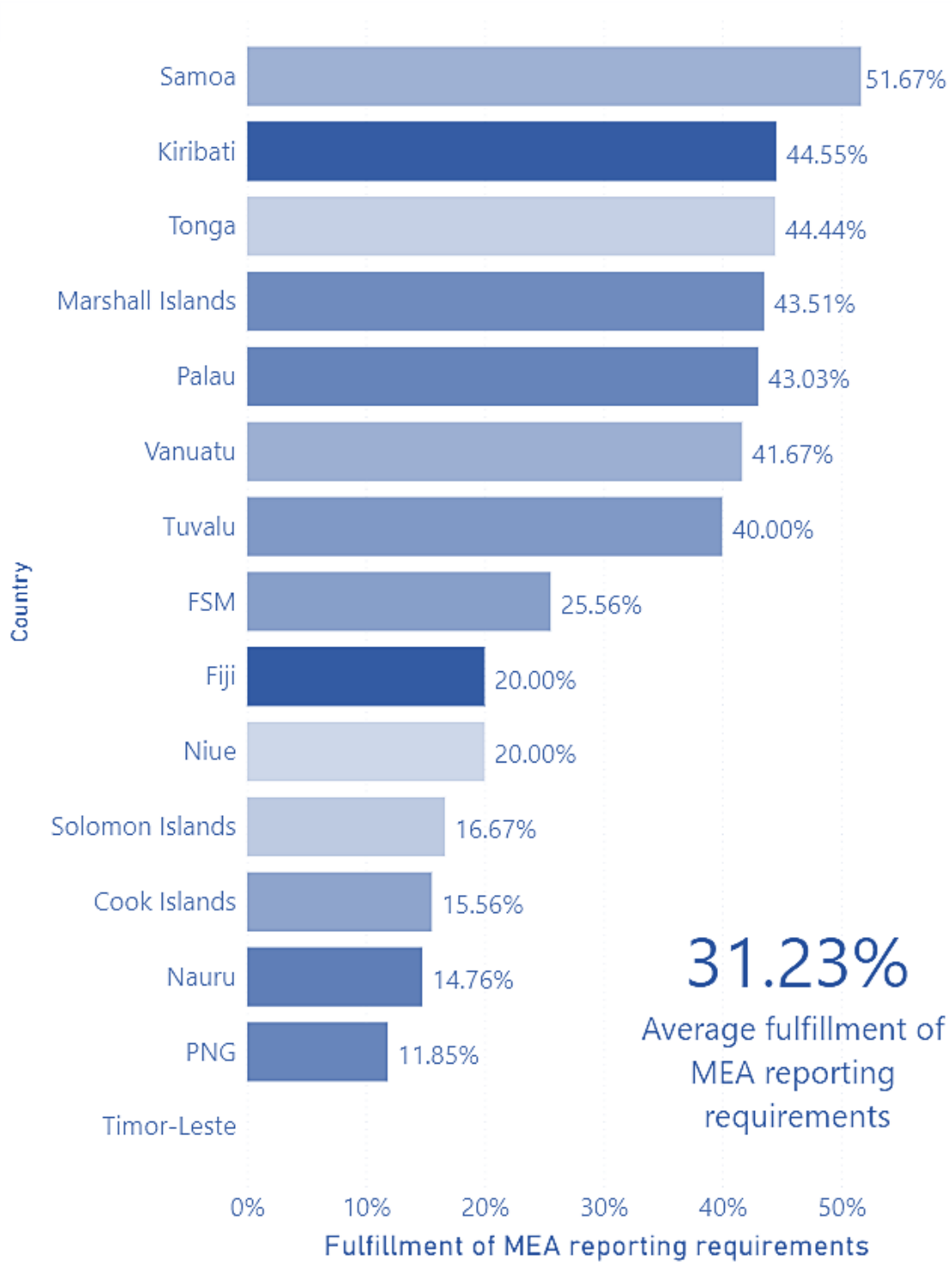


Figure 12 National fulfillment of MEA reporting requirements (%)

Results:

- The regional baseline result is about a 30% average fulfillment of MEA reporting requirements.
- Meeting MEA reporting requirements is a legislative requirement (countries are obligated to make reports) and reporting to this KPI assists the region to monitor progress towards achieving waste management goals in the Pacific.

Key considerations:

- The specific MEAs agreed to in the region varies by country. Additionally, this performance indicator only analysed MEAs with strict and defined reporting requirements (i.e., even though a country may have reported to a waste-related MEA, such as the Rotterdam Convention, the count of reports and the Rotterdam Convention itself, were not quantified as part of the performance indicator calculation).
- The MEAs examined consisted of:
  - The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal;
  - The Minamata Convention on Mercury;
  - The Stockholm Convention on Persistent Organic Pollutants.
- The years that a country has been party to a specific MEA changes the total number of reports they are required to submit, depending on the frequency and duration of reporting periods specified for each convention. For example, the Basel convention requires member countries to submit a national report annually. Countries which were party to the convention in 2004 would have been required to submit a total of 18 reports, whilst a country that became a member in 2018 would have needed to submit four.

Supplementary KPI 1: Cost of disposal to landfill

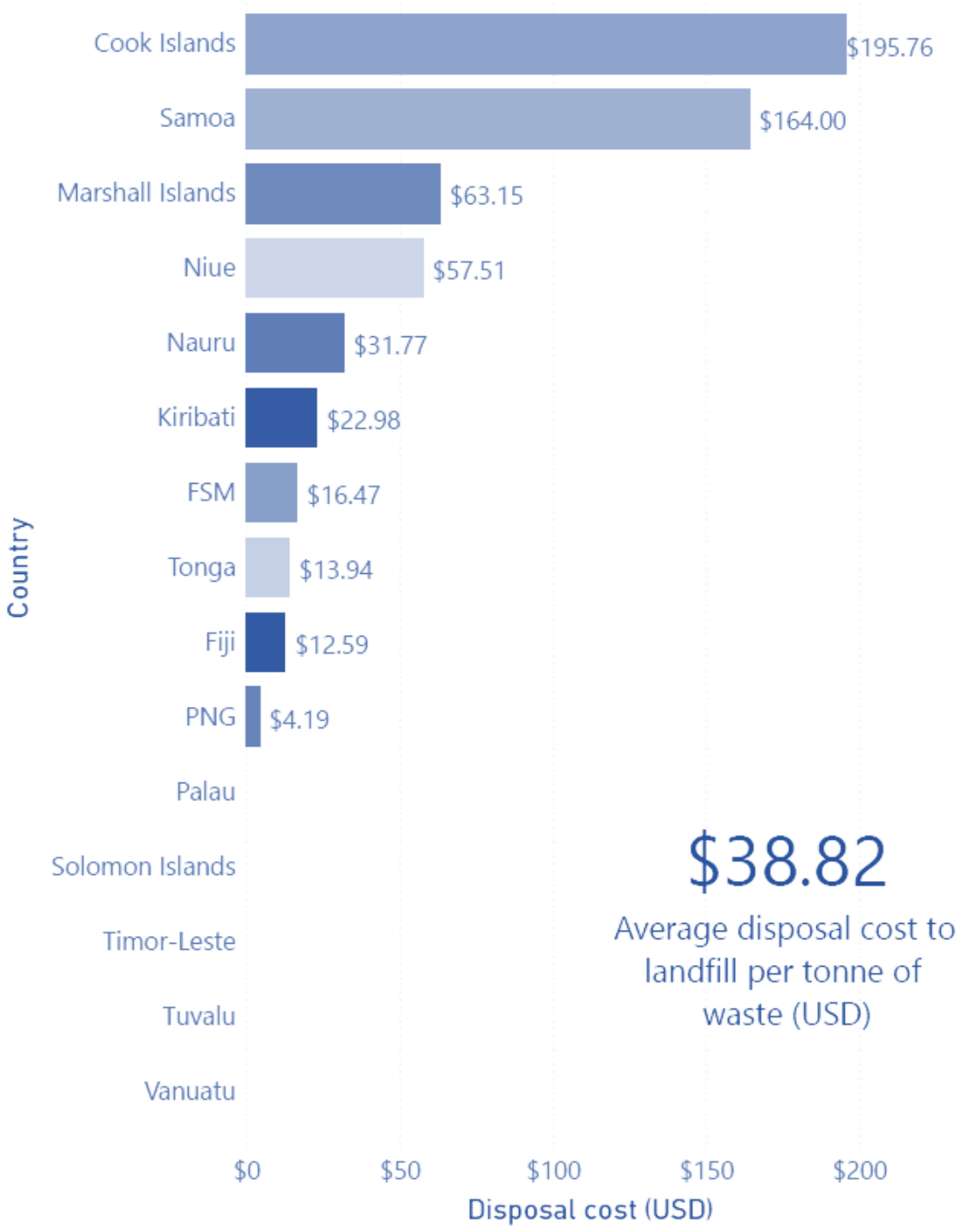


Figure 13 National disposal cost to landfill (USD per tonne)

Results:

- The regional baseline result is an average disposal cost to landfill of just under $40 per tonne of waste (USD). National results range from $4 to $196 dollars per tonne. The cost of disposal in PICTs varies depending on factors including population size, waste generation rates, landfill infrastructure and the amount of available disposal sites.
- Disposal costs could not be determined.
- Several audit reports provided the cost of operation for only some of facilities in a country. For example, the PNG waste audit report identifies a total of 22 waste facilities, but only provides an annual tonnage and cost of operation for one of them. Given the limited data available, reported costs of landfill operations are assumed to be representative of all facilities in country.

Key considerations:

- The World Bank Global Trends Report[6] states that "in high-income countries, operating costs for integrated waste management, including collection, transport, treatment, and disposal, generally exceed $100 per tonne. Lower-income countries spend less on waste operations in absolute terms, with costs of about $35 per tonne and sometimes higher, but these countries experience much more difficulty in recovering costs". The regional KPI average cost of disposal per tonne sits comparable to the lower end of the costs reported.
- Additionally, it reports "Waste management is labour intensive, and costs of transportation alone are in the range of $20–$50 per tonne. Cost recovery for waste services differs drastically across income levels. User fees range from an average of $35 per year in low-income countries to $170 per year in high-income countries, with full or nearly full cost recovery being largely limited to high-income countries. User fee models may be fixed, or variable based on the type of user being billed. Typically, local governments cover about 50 percent of investment costs for waste systems, with the remainder coming mainly from national government subsidies and the private sector."
- It is recommended that future waste audits and KPI reporting look to include the cost of collection (per tonne) in combination with this KPI.
- The cost of disposal to landfill may have implications for the sustainability of waste management practices in PICTs. High disposal costs may incentivise waste reduction and recycling efforts, while low disposal costs such as those seen in PNG and Fiji may encourage landfilling as alternatives (if available) may be expensive or not profitable.
- To reduce the cost of disposal, PICTs may need to explore alternative waste management options, such as composting, recycling, or energy recovery. These options may require investment in infrastructure and technology, as well as policy and regulatory changes to support the development of these systems.

Supplementary KPI 2: Total weight of waste disposed

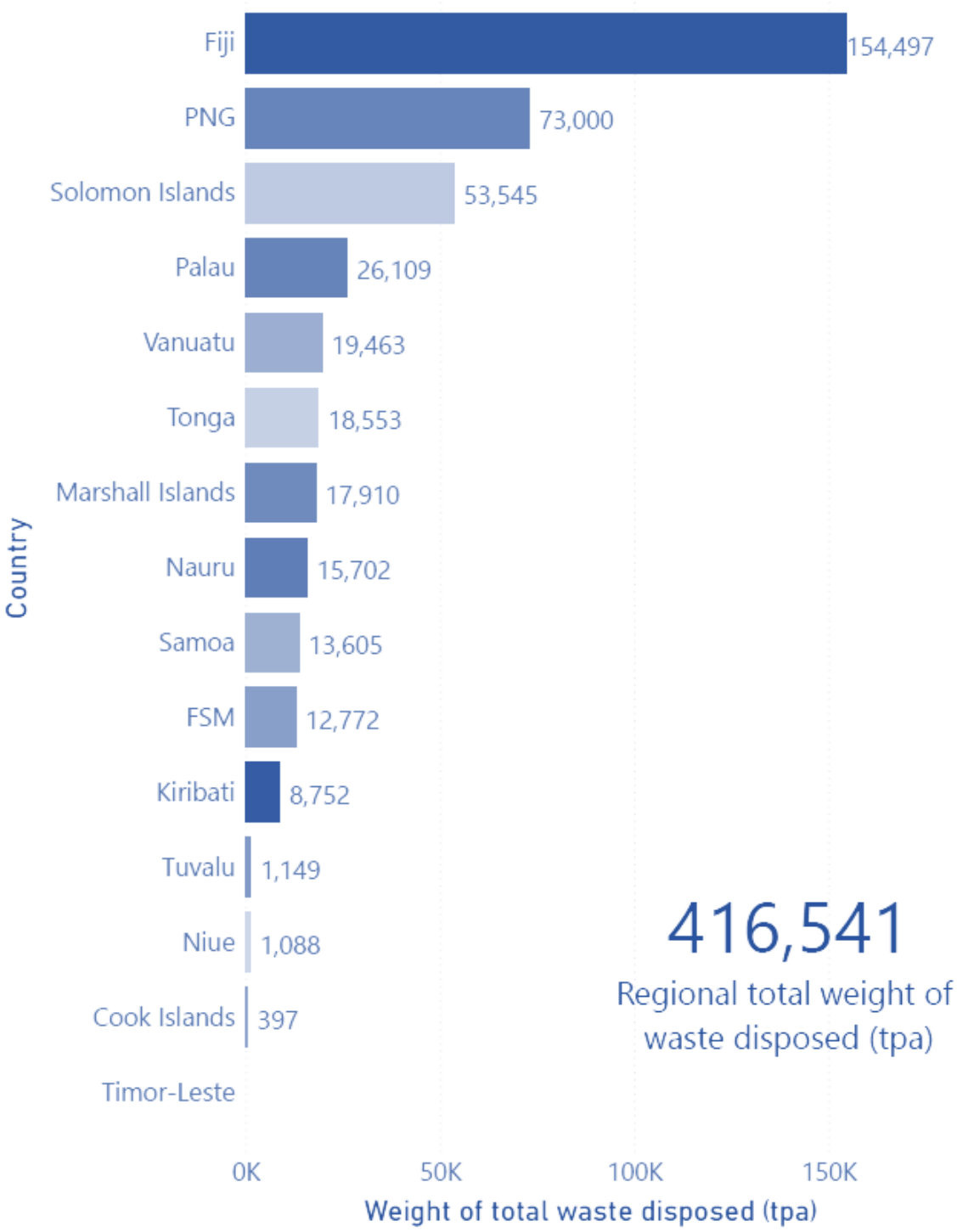


Figure 14 National weight of total waste disposed (tpa)

Results:

- The baseline regional result is a total of about 416,550 tonnes per annum (tpa) of waste disposed.

Key considerations:

- This indicator represents the aggregate of all reported estimates of waste, measured in tonnes per annum, that have been disposed of at waste management facilities across each country.
- These figures may not accurately reflect the total amount disposed per year due to incomplete data in some audit reports. For example, not all facilities identified within the audit reports had disposal estimates. The PNG audit report included a disposal estimate from just 1 of 23 facilities in the country, which is insufficient to present a national total.
- The result of this indicator highlights a significant gap in our understanding of the total amount of waste being directed to waste facilities across the region.
- This measurement is expected to change considerably once data is collected for more facilities in the future using the waste facility register suggested in the DCMR Framework.

Supplementary KPI 3: Total weight of waste recovered

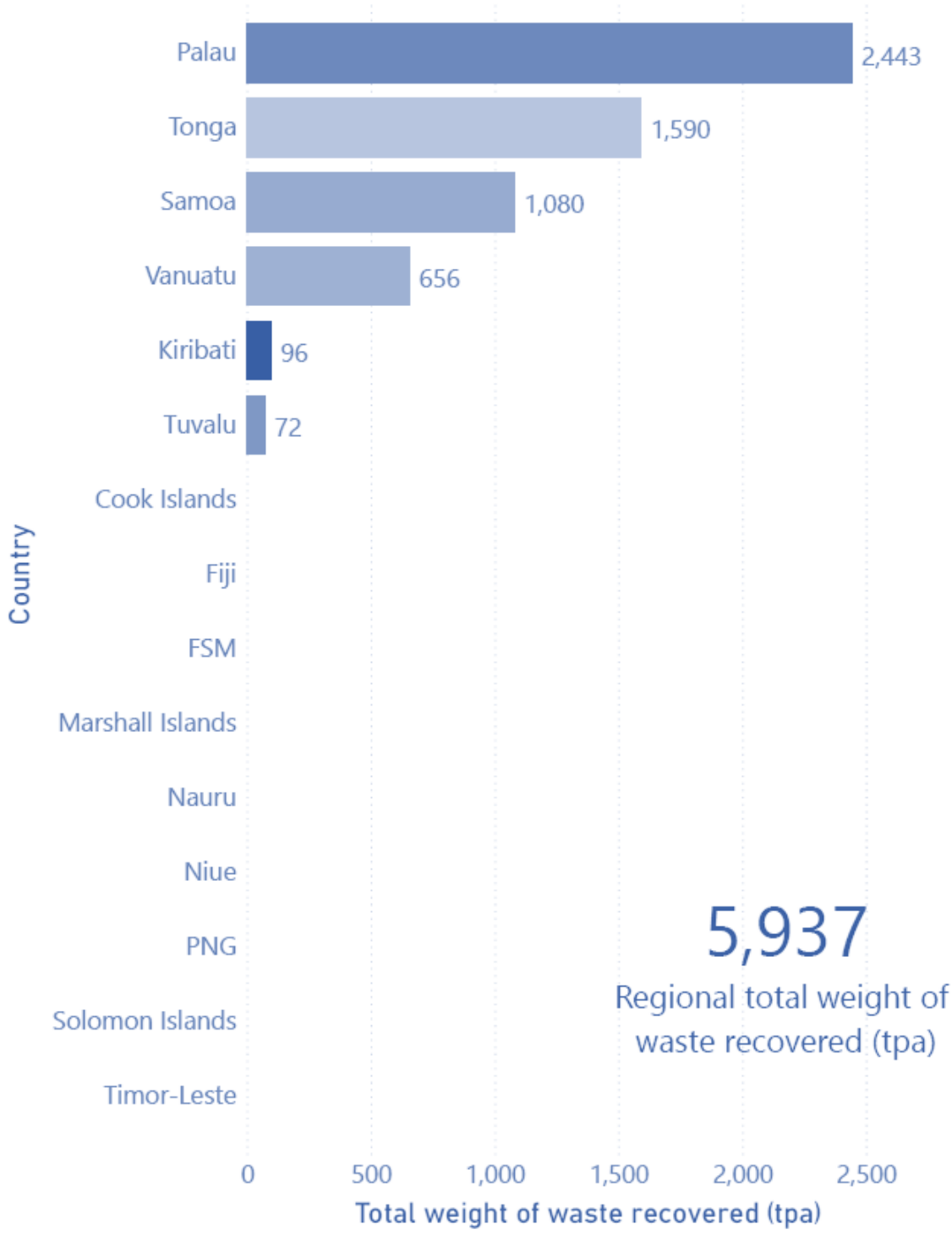


Figure 15 National total weight of waste recovered (tpa)

Results:

- The baseline regional result is a total of about 5,940 tonnes per annum of waste disposed. This represents an average of 65 tpa per identified facility (assuming 91 facilities are operational in the region).

Key considerations:

- This indicator represents the aggregate of estimates of recyclable waste, measured in tonnes per annum, that have been recovered across each country. The national and regional result demonstrates that waste recovery is yet to become a standard for the region.
- It should be noted that audit reports identified several recycling operations across the region, including operations that could not be included for the calculation of this KPI due to limited (or no data) being reported for the estimated volume or weight of waste recovered. For example, the Solomon Islands audit report identifies a number of small-scale private recycling operations but does not give an indication of the amount of waste they are able to recover.
- This KPI result reflects the tonnages of waste recovered in the region based on available data. The result of this indicator highlights a significant gap in our understanding of the total amount of waste being recovered across the region.
- The completion of the waste facility registers with the inclusion of data for any recovery facilities operating across the region allows for this indicator to be further populated.
- This measurement is expected to change as data becomes more readily available in the future.

Supplementary KPI 4: Volumes and types of stockpiled hazardous waste

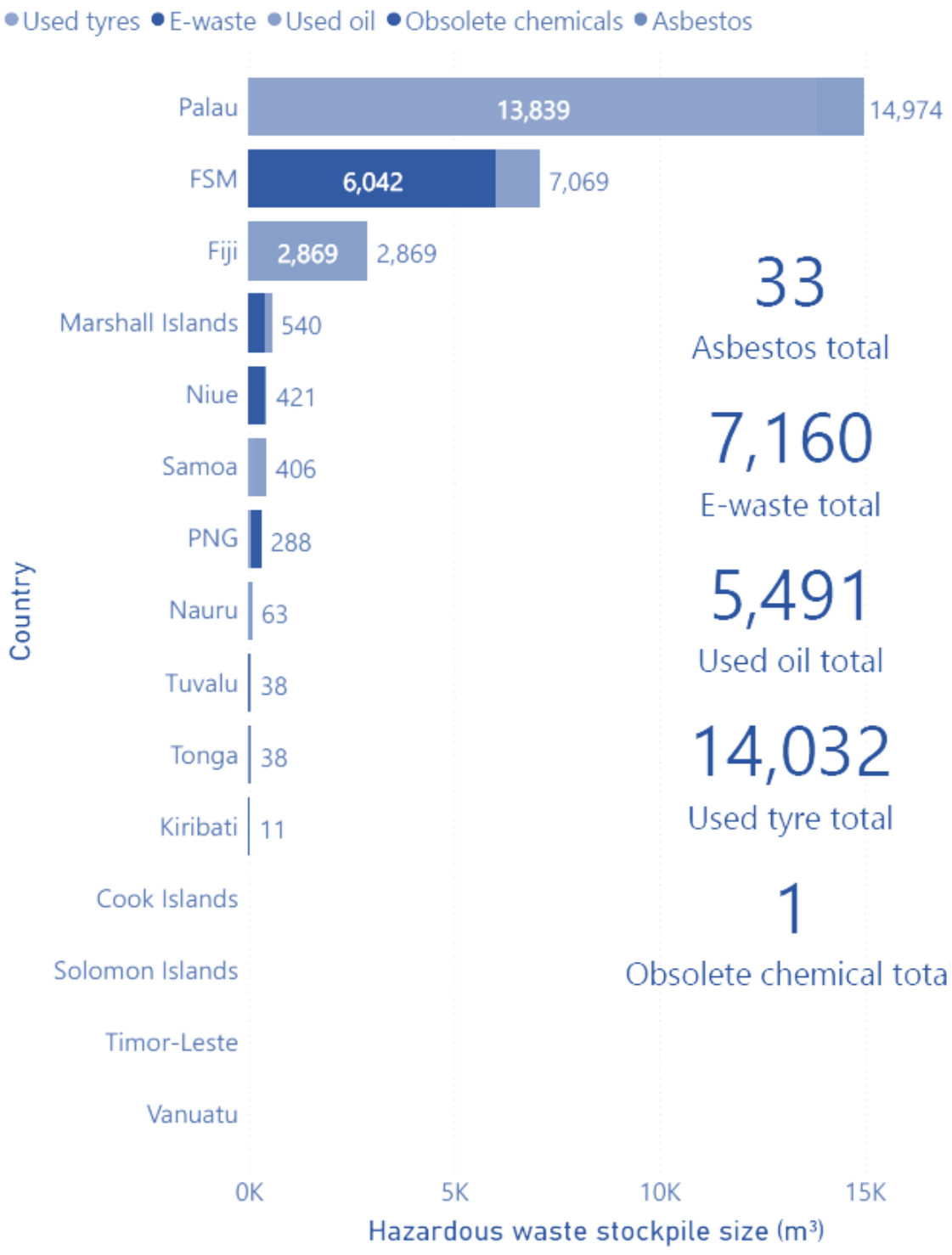


Figure 16 National volumes and types of stockpiled hazardous waste (m³)

Results:

- The largest hazardous waste stockpile in the Pacific is in Palau, with nearly 14,000 m^3 of tyres currently present in the country. This is followed by a 6,000 m^3 stockpile of e-waste in the FSM and a 2,900 m^3 stockpile of e-waste in Fiji. Additional stockpiles and storage sites are assumed to exist for the majority of PICTs.

Key considerations:

- No audit data was available on for the presence of healthcare and pharmaceutical waste stockpiles. Most countries were found to have incinerators specifically for this waste stream.
- Many audits did not prioritise hazardous waste stockpiles, instead measuring stockpiles of potential recyclables or other material types. Stockpile sizes were also reported using a variety of unit measurements, from volumes to tonnes, or count of items. Some stockpiles of hazardous waste types reported during audits were not included in the above reported volumes due to this variation.
- Landfill audits, stockpile assessments, and the completion of the waste facility register as proposed by the DCMR Framework will provide the necessary information to make future calculation of this KPI more accurate. As more reliable data becomes available, governments and other stakeholders will be better able to execute proper waste management actions for stockpiled hazardous wast es across the region.

Supplementary KPI 5: Marine plastic pollution potential

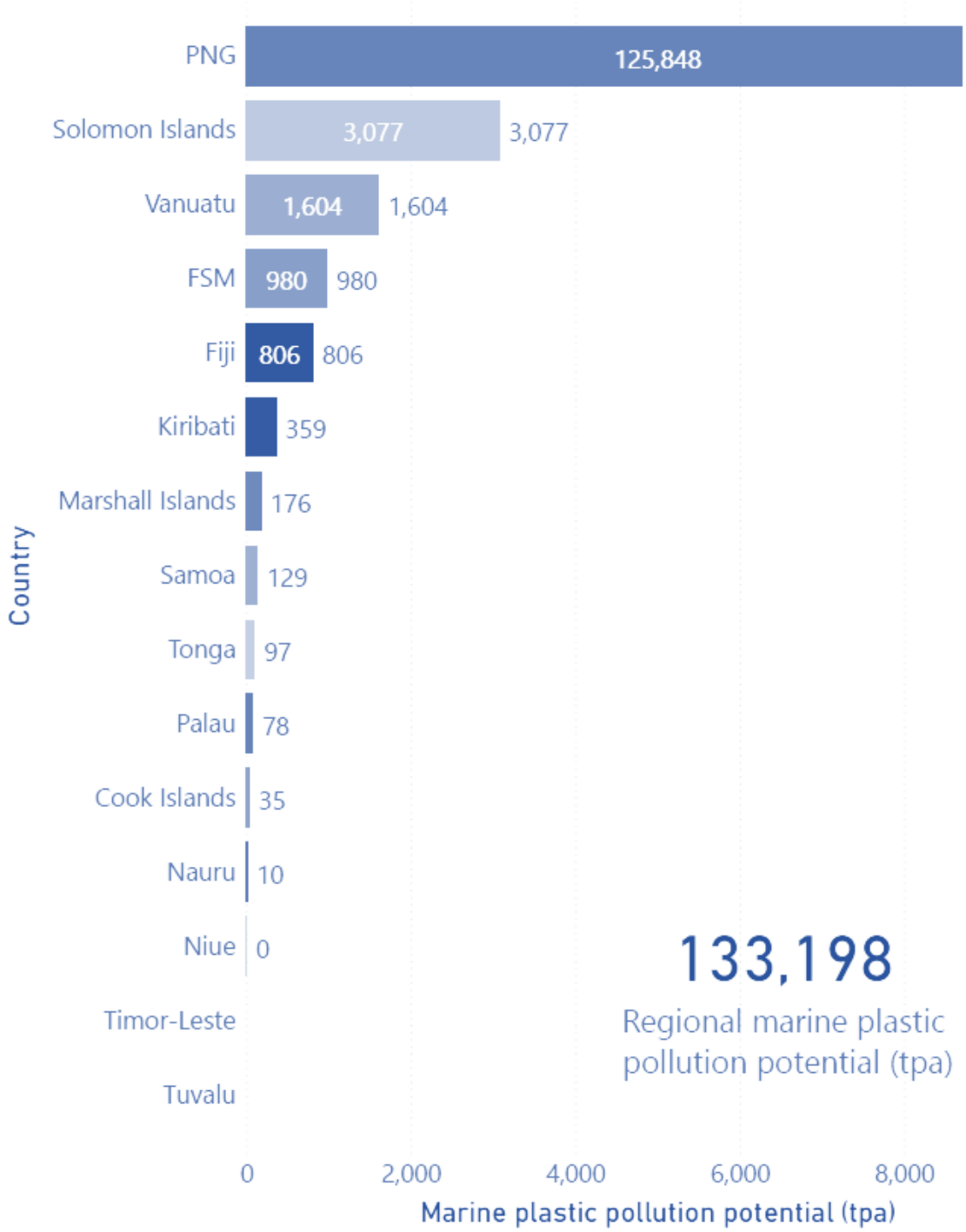


Figure 17 National marine plastic pollution potential (tpa)

Results:

- The regional baseline result is a marine plastic pollution potential of close to 133,200 tonnes per annum.
- The regional marine plastic pollution potential is heavily skewed by the pollution potential for PNG. PNG had both the lowest household waste capture rate and the greatest household waste generation rate, which significantly impacts the regional total.
- Reporting to this KPI currently assumes a national weight of mismanaged waste, based on household audit samples and the proportion of plastics in the MSW composition. (Calculation uses the total weight of waste generated, subtracted by the weight of waste captured by collection services. The difference is the estimate for mismanaged waste used in this calculation.)
- Mismanaged waste is defined as all waste which is not captured in collection services, and ends up buried / burned / littered etc.

Key considerations:

- This KPI is only a theoretical measurement - it does not quantify the actual rate of marine plastic pollution. The purpose of this KPI is to quantify the potential plastic waste that could end up in the marine environment due to mismanagement.
- About 80% of plastic found in oceans comes largely from the land[7]. Surface run-off, rivers, and sewage outfalls are important pathways for the transfer of waste from land to the sea, particularly in countries with high coastal populations. The world's greatest contributors of plastics to our oceans do not have appropriate waste collections systems in place and so plastic is either dumped into the ocean or blown / leaked into the ocean from waste storage and landfill / dump sites.
- Compositional analysis shows that plastic waste materials comprise approximately 12% by weight of household wastes (about 20% for FSM). Some PICTs (e.g., FSM) have implemented bans on the import of single use plastic, and most PICTs are introducing single use bans to reduce plastic waste.

Supplementary KPI 6: Awareness of waste management services

Results:

- No data available to report to this KPI at this time.

Key considerations:

- Completion of the community survey is required to report to this KPI and provides an indication of the success of education initiatives and effective use of existing waste management services.
- . The community survey will gather responses on:
  - Number of positive responses indicating awareness;
  - Number of available services; and
  - Number of survey participants.

Supplementary KPI 7: Proportion of strategic waste management initiatives implemented

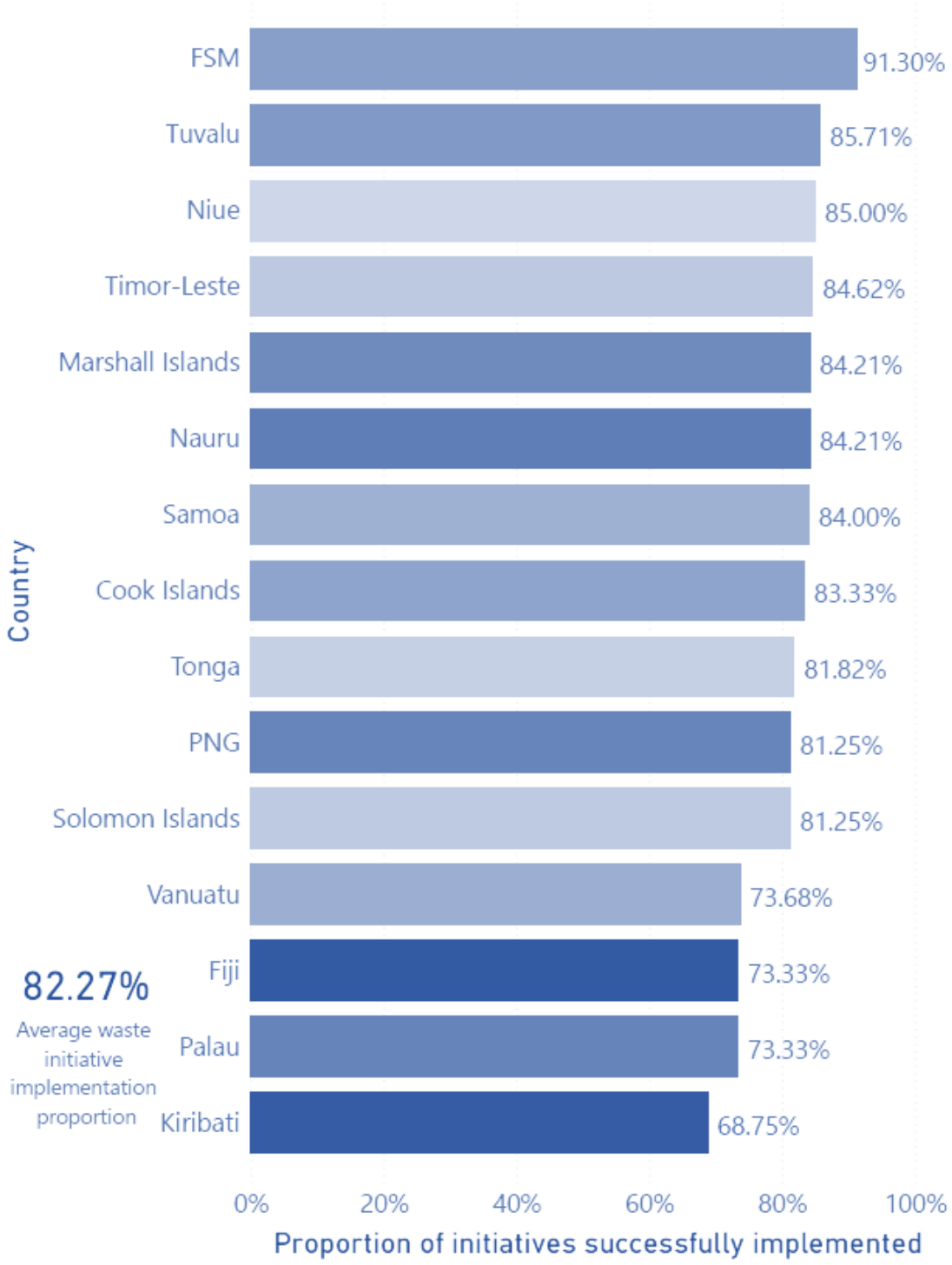


Figure 18 National strategic waste management initiatives implementation (%)

Results:

- The baseline regional result is an average waste initiative implementation of just over 80% across all PICTs.
- Waste initiatives can include waste management legislation, regulation, policy, strategy or plans. The majority of PICTs are planning to implement single use bans.

Key considerations:

- This baseline should be updated each time a PICT enacts new legislation or policy that impacts waste management.
- For comparison on a global scale, the World Bank Global Trends report[4] states that "about two-thirds of countries have created targeted legislation and regulations for solid waste management, though enforcement varies drastically."
- In addition, that "in most countries, solid waste management operations are typically a local responsibility, and nearly 70 percent of countries have established institutions with responsibility for policy development and regulatory oversight in the waste sector."

Supplementary KPI 8: Commercial waste capture rate

Results:

- No data to report to this KPI at this time.

Key considerations:

- Measured as the fraction of the total waste captured through formal waste management services over the total waste generated by businesses.
- Accurate calculation relies on an estimate of total numbers of businesses in the country categorised by business type, and an estimate of the commercial waste generation rates for each business type.
- Completion of business surveys suggested in the DCMR Framework will provide an indication of how many businesses are using collection services, and to what extent these businesses access the service.

Supplementary KPI 9: Commercial collection service coverage

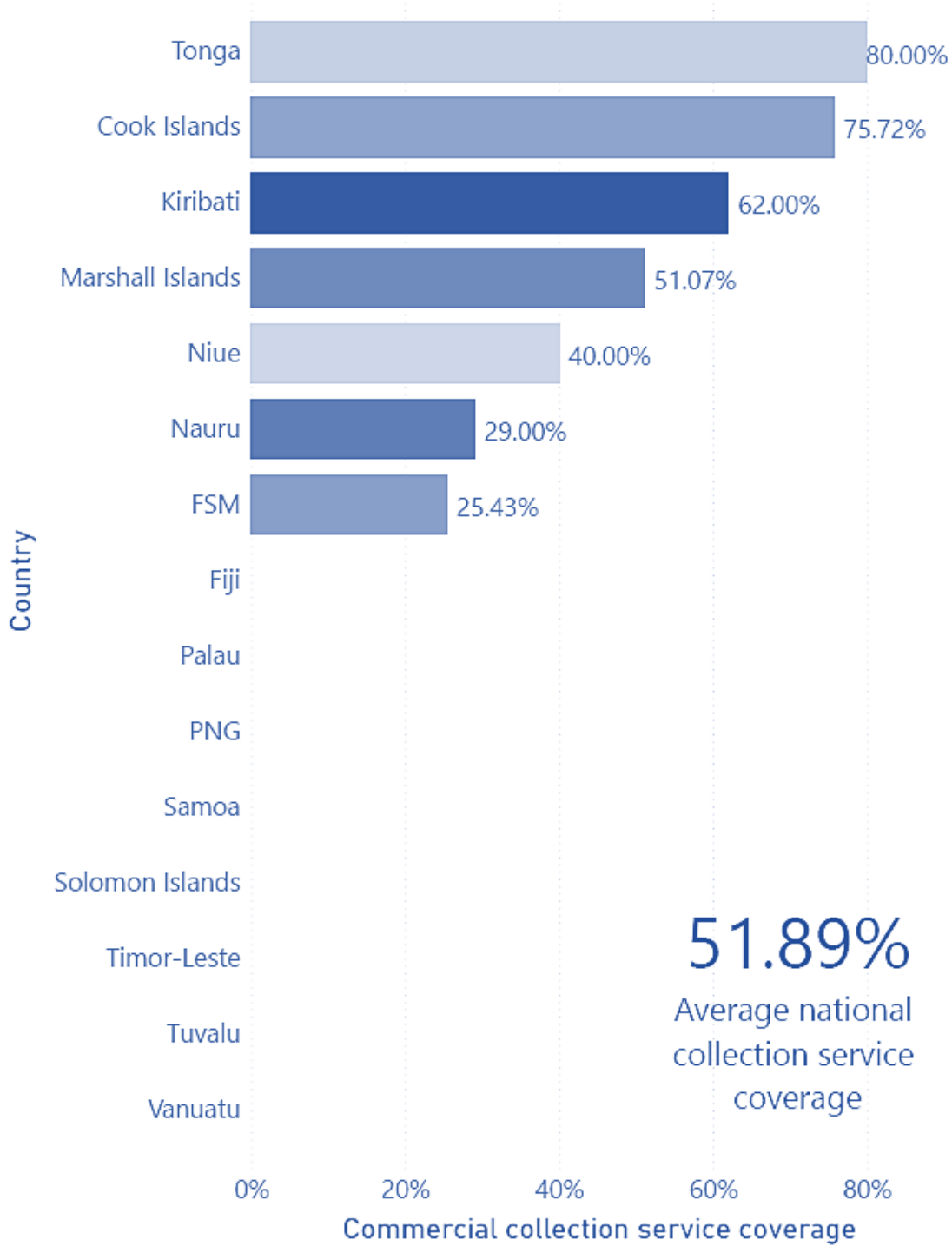


Figure 19 National commercial collection service coverage (%)

Results:

- The baseline regional result is an average commercial collection service coverage of about 52%.

Key considerations:

- Some of the PICTs carry out commercial waste collections together with residential collections. Most countries have user pay, by request collection services available to large commercial businesses however these larger businesses typically self-haul their waste to landfill.
- Accurate calculation relies on understanding the total number of businesses participating nationally, and specific collection service coverages for businesses.
- Completion of business surveys suggested in the DCMR framework, would provide an indication of how regular, accessible, and affordable collection services are for businesses.

Supplementary KPI 10: Weight of disaster waste disposed

Results:

- No data to report to this KPI at this time.
- No disaster waste data was recorded by the examined country waste audits.

Key considerations:

- Measured as a sum of the recorded weight of disaster waste disposed to landfill or received and stockpiled at waste facility following a disaster event.
- Only captures disaster waste which ends up disposed of or stored at waste facilities, including landfills, disposal sites and recovery facilities.
- Calculating this KPI can be undertaken by regularly updating the waste facility register. Tracking the vehicle capacity and percentage fullness of the load of any 'disaster waste' carrying vehicles entering the facility will help reconcile waste amounts disposed if these wastes are not managed separately.

4 Stakeholder Workshop 2023

Two stakeholder workshops were undertaken in April 2023 to gather feedback from PICT representatives on the Regional Waste DCMR Framework, the Framework's KPIs and their associated data monitoring and collection requirements.

4.1 Workshop dates and attendees

Dates and attendees for each workshop are outlined below.

Table 10 Stakeholder workshops

Date of workshop	Representatives
5 April 2023	FSM, Solomon Islands, Tuvalu
17 April 2023	Kiribati, PNG, Tonga, Vanuatu

4.2 Purpose of the workshop

The intent of the workshop was to:

- Introduce the DCMR Framework as a framework to work towards;
- Validate the key metrics developed for reporting and capturing waste management performance;
- Refine and improve metrics and methodology; and
- Gain insight on areas that may require greater support during implementation.

4.3 Collated feedback from PICT representatives

The main discussion points of the workshops are summarised below.

1. Capacity

- The limited resources and difficulty of data collection encountered in the region was acknowledged.
- In developing the Regional Waste DCMR Framework, the PICTs current data monitoring and reporting requirements were reviewed. Instead of creating additional or duplicate work for the PICTs, the DCMR Framework looks to bolster and refine existing systems to improve the quality of the data most necessary for guiding investment and informing decision making.

3. Cost reporting

- It would be useful to ask for cost data that discriminates between the cost of collection and the cost of landfilling. Knowing the cost of collection per tonne collected, and disposed of at landfill, would be a useful metric as it shows the effectiveness of the collection operation / operator. Waste collection operators are often not affiliated with or operating the landfills / dumpsites.
- Closer communication with civic councils or private operators in charge of collection and disposal will be required to undertake the data collection and reporting methods outlined.
- Cost to landfill is currently measured for one PICT via cost per truckload, depending on the size of the vehicle.

4. Waste facility register

- It would be useful to have volumetric surveys of landfills (and dumpsites) performed to establish the volumetric measurements of these sites. Surveying the shape of the landfill has become easier with drone and GIS technology advancements.
  - If surveys are performed regularly (particularly post compaction) the data generated could be used to measure changes to capacities over time to monitor and estimate landfill expiry.
  - Reasonable parameters can be set to calculate density from these volumetric surveys.

- To report on tonnes of waste disposed at the facility, there are a few factors to consider such as material composition, daily cover volumes and the level of compaction. Most islands do not have weighbridges or the capacity to weigh waste. Standardised densities for different categories of vehicle waste loads can be used to estimate the weight of waste disposed per transaction.

5. Waste audits

- Conducting waste audits is a significant investment. It may be cost prohibitive for many countries to be conducted every 4 years.
- The cost-benefit to conduct a comprehensive audit may not be necessary for all countries. It may be reasonable to revise the scope of the waste audits to extrapolate enough meaningful data to report on each KPI to achieve a balanced cost outcome.

6. Economic indicators

- Using economic indicators (such as reporting on GDP, counts of business & rates of urbanisation), could be investigated as a potential alternative method / additional metric for reviewing the amount of waste likely to be generated per capita or in total without requiring comprehensive waste audits.

7. Ongoing resources and support

- The type of resources and support PICTs would receive to deploy the DCMR Framework.

5 Recommendations for KPI Reporting

As part of the regional and national waste audit data analysis process, a series of recommendations for the next round of data collection and reporting were identified. These recommendations include workshop feedback provided by PICT representatives.

The Waste Wise Cities Tool (WACT)[8] by UN-Habitat was identified by MRA at an advanced stage of the project. MRA considers a strong correlation between this project the WACT. MRA recommends a review of the DCMR Framework against the WACT to ensure reporting alignment.

Table 11 provides recommendations related to improving the data collection process and ensuring effective deployment of the framework.

Table 11 Recommendations for data collection

Data collection methodology	Recommendations
Waste facility register	• Develop standardised data logging material (facility register, national register & regional register) to be issued to data collectors (facility operators) and aggregators (country representative & SPREP). • Ground-truth data logging material by trialling the method at several facilities. Use any feedback from data loggers in trial to update data logging material. • Develop a train-the-trainer program to train data collectors and aggregators to appropriately use the material. • Implement an annual review process by a third-party organisation to assure data and process quality. Non-conformances can be noted through this process to be incorporated as part of a continual improvement.
Waste audits and surveys for households and businesses	• Review waste audit methodologies to determine a tiered scope to accommodate varying country budgets. This will allow countries to balance value for money against the delivery of KPIs. • Review KPI methodologies to accommodate the tiered waste audit scope. • Investigate collecting and utilising economic indicators (such as reporting on GDP, counts of business & rates of urbanisation) as a potential alternative method / additional metric for reviewing the amount of waste likely to be generated per capita or in total. Economic indicators, supplemented by baseline audits/surveys may help provide a general indication the current waste generation for households and businesses, without requiring comprehensive waste audits.
Policy survey	• Develop standardised policy register for individual country representatives. • Conduct handover of policy register to country representatives and SPREP.
Landfill and stockpile audits	• Review feasibility and cost to implement volumetric surveys of landfills (and dumpsites) using drones vs traditional surveying.

Table 12 and **Table 13** provide specific recommendations to improve reporting of the KPIs. There are instances where they may reiterate, in greater detail, recommendations outlined in **Table 11** and how it will directly impact the KPI. The text in the square brackets [ ] denotes where the recommendation should be applied.

Table 12 Recommendations for reporting to Core KPIs

Core KPIs	Recommendations
KPI 1. Count / capacity of modern facilities (tpa) /	• [Landfill audits] The number, location, name and operations of all landfills/dumpsites and recovery facilities should be collated for future reporting to this performance indicator.
KPI 2. Count / capacity of modern and unregulated facilities (tpa)	• [Landfill audits] Volumetric surveys of landfills (and dumpsites) using drones should be evaluated as a method of volumetric measurements of these sites. Performing regular (once yearly) surveys post compaction can be used to measure changes to waste processing and capacities over time, including the rate at which available landfill capacity is being consumed and the management of stockpiles of waste awaiting recycling or processing. – A 'baseline survey' must be undertaken first to establish the total design capacity of the facility and to identify structures that may limit the capacity of the site (i.e., perimeters of the site, active landfilling areas, identification of stockpiles using unique identification numbers, identification of buildings, roads, fences, leachate ponds etc). The 'baseline survey' sets the benchmark against which all other surveys will be compared. – 'Routine volumetric surveys' should then be undertaken once a year (at a similar time each year). A qualified surveyor must be used. – For this type of survey, a 'Tolerance' of +/- 0.2m (the accuracy measure) is considered reasonable. Contour lines should be shown. • [Regional report] Future reporting should graph the national waste facility capacities as this data becomes available. The average processing capacity and the maximum storage capacity of waste facilities at a national level should also be reported. This KPI can help determines the infrastructure capacity needs for each country across the region. • [DCMR Framework] The scope of this KPI should include a count and the capacity of incinerators (particularly those used for hazardous medical waste). Incineration is typical for land-constrained countries. Reporting should identify the operational environmental controls employed. For incineration to meet with best practice it should be operated to EU standards for incineration and comply with USEPA emission standards for incineration. • [DCMR Framework] Further evaluation of the environmental controls required to apply a 'modern' classification to a recovery facility must be identified. For recovery facilities to meet with best practice, it should have leachate / stormwater runoff capture systems and fire prevention and control measures. The site should not be exceeding capacity.

Core KPIs	Recommendations
KPI 3. National recovery rate (%)	• Not all recycling and recovery efforts could be counted toward, or gave meaningful scale, to a national recovery rate. Resource recovery activities implemented by a local community or at one facility servicing just one area is unlikely to be representative of the performance of the rest of the country. – [National reporting] The progress of these smaller scale programs should still be reported on in national reporting rounds. Include in brackets along with the type of program or area it applies to. – [National and regional reporting] For regional reporting, it is recommended that the performance of any CDS is reported on separately to monitor its progress. Recovery rates for different waste material types such as e-waste, and bulky wastes such as tyres could also be reported on separately. Results would be reported as the total amount stored for recycling or recovered as a proportion of the total amount of the specific waste type generated or collected. • Not all facilities in each country were captured by waste audits. While audit reports did contain some information on recovery facilities and recycling operations in several PICTs, waste recovered at waste and recovery facilities, or by recovery operators, was not regularly quantified throughout the audit reports. – [Landfill and stockpile audits] If no recovery or only limited recovery of waste is being undertaken, quantities and activities associated with these waste facilities should still be reported on for future national reporting rounds. If not representative of the national story, data can still be reported in brackets along with the facility it applies to.
KPI 4. Per capita waste generation rate (kg/capita/annum)	• [Waste audits for households] Waste generation per capita rates for both 'urban' and 'rural' populations should be captured where possible given the significant differences between the consumption rates of these two categories.
KPI 5. Municipal Solid Waste (MSW) composition (% by weight)	• [Waste audits for household and businesses] All future waste composition analysis should endeavour to capture and report to the same waste categories adopted by the PRIF waste audit guidelines to improve data quality and to make comparison from year to year, and across the region easier to apply. • [Waste audits for households and businesses] Continued regular waste audits will assist in providing accurate assessment of current waste compositions so that gaps in materials processing capacities can be estimated for prioritised collections, infrastructure, and other waste management arrangements. – The impacts of the COVID-19 pandemic and climate change / disaster weather events may have changed the dominant waste types sourced from households. For example, the pandemic would have increased medical waste (e.g., testing kits, syringes and COVID-19 surgical masks) and packaging present in waste streams, whilst climate change and weather events such as cyclones may would have disrupted waste management systems and introduced an influx of disaster waste. – For some PICTs, the most recent household and business waste audits were undertaken in 2018 (5 years ago). These PICTs should be considering next steps for measuring changes to waste compositions.

Core KPIs	Recommendations
	• [Waste audits and surveys for households and businesses] Alternative waste audit approaches could be carried out where physical weight-based waste audits are cost prohibitive to undertake on a regular 4-yearly basis as recommended by the DCMR Framework. • This could include a visual assessment audit approach to indicate qualitatively how waste compositions and/or bulk weight-based sampling to understand how waste generation rates may have changed. This would be performed alongside the standard waste audit survey questions.
KPI 6. Household waste capture rate (%) /	• [Waste audits for households] Provide household waste capture and coverage rates for both 'urban' and 'rural' categories. Consider including data for the 'peri-urban' / 'semi-rural' category as well. If waste collection services are note offered, main barriers to services being provided to households should be identified.
KPI 7. Household collection service coverage (%)	• [National reporting & waste audits for households] A threshold rule was used to determine if waste audit data could be used to represent the national result. This required that at least one 'rural' and one 'urban' area were audited so that extrapolation up to the national level could be undertaken. Exploration of the 'peri-urban' category is also recommended for future waste audits alongside 'rural' and 'urban'.
KPI 8. Fulfillment of Multilateral Environmental Agreement (MEA) reporting requirements (%)	• [DCMR Framework] This KPI is designed to help identify barriers to completing reports required by legislation. It is recommended that defined 'barrier categories' (e.g., staff resources and capacities, significant weather / health / political event, legislation and regulation, cost prohibitive) are constructed to standardise identification of barriers so that sufficient information is available to decision-makers.

Table 13 Recommendations for future reporting to Supplementary KPIs

Supplementary KPIs	Recommendations
KPI 1. Cost of disposal to landfill ($/annum)	• [Landfill and stockpile audits] Future reporting should attempt to include the cost of collection (per tonne). Data that discriminates between the cost of collection and the cost of landfilling would be a useful to show the effectiveness of the collection operation / operator. Additionally, waste collection operators are often not affiliated with or operating the landfills / dumpsites.
KPI 2. Weight of waste disposed (tpa)	• [Waste Facility Register] As per recommendations in **Table 11** – Waste Facility Register and Table 12 – KPI 1 & 2.
KPI 3. Weight of waste recovered (tpa)	• [Waste Facility Register] As per recommendations in **Table 11** – Waste Facility Register and Table 12 – KPI 1 & 2.
KPI 4. Volume and type of stockpiled hazardous waste (m3)	• [Landfill and stockpile audits] Count and characterisation of hazardous, healthcare and pharmaceutical waste stockpiles should be prioritised for future waste audits. – No audit data was available on for the presence of healthcare and pharmaceutical waste stockpiles. Many audits did not prioritise hazardous waste stockpiles, instead measuring stockpiles of potential recyclables or other material types. Most countries were found to have incinerators specifically for this waste stream. • [Landfill and stockpile audits] Stockpile sizes were reported on using a variety of unit measurements, from volumes to tonnes, or count of items. Future waste audits and surveys should measure stockpiles using same measurements or give detail to enable conversion into cubic metres for reporting to this KPI, and at the regional scale.
KPI 5. Marine plastic pollution potential (tpa)	• [DCMR Framework] The method for measurement of this KPI should be evaluated over time keeping up to date on international efforts and processes used to measure plastic in our oceans in case a more accurate metric arises to be used in combination with / instead of the current metric. • [DCMR Framework / External] It is recommended that PICTs undertake a baseline exercise to map (visually) and identify routes of plastic to the ocean (using GIS / land mapping) to help identify 'hot spots' for plastic leakage to the ocean for improved community education, and capture and management of this pollution type.
KPI 6. Awareness and support of waste management services (%)	• [Waste surveys for households and businesses] A standardised line of survey questioning, as per the DCMR Framework, should be included in all future household and commercial / community surveys.
KPI 7. Proportion of strategic waste management initiatives implemented (%)	• [National reporting] This KPI refers to actions (usually in the form of projects, policy interventions or new regulation) that are established by national and regional waste strategies in a country. Reporting to this KPI requires establishing an accurate baseline of the total number of implemented actions (successfully executed during a reporting period) and planned initiatives that each PICT has adopted. Future reporting will require an established list to be verified by each country for baseline comparison purposes.
KPI 8. Commercial waste capture rate (%)	• [National reporting] Accurate calculation relies on an estimate of total numbers of businesses in the country (established through review of business licenses or other such process) categorised by business type, and an estimate of the commercial waste generation rates for each business type.

Supplementary KPIs	Recommendations
	– A set of standardised waste generation rates should be developed / adopted for businesses for use by each PICT. – An agreed process for determining the total number of businesses operating in the country / province / region / state will need to be established on a per country basis. – Reporting should provide a breakdown of this information by state / region / province where possible.
KPI 9. Commercial collection service coverage (%)	• [National reporting] Accurate calculation relies on understanding the total number of businesses participating nationally in a waste collection service, and specific collection service coverage for businesses. Reporting should provide a breakdown of this information by state / region / province where possible.
KPI 10. Weight of disaster waste disposed (tpa)	• [Waste Facility Register] Waste facility register suggested in the DCMR Framework to be completed to address data capture and reporting requirements for this KPI. If volumetric surveys are employed, identification and numbering of disaster waste stockpiles will be required to keep track of these waste stockpiles.

6 References

1. The New South Wales Environment Protection Authority's "Disposal-based audit - Commercial and industrial waste stream in the regulated areas of New South Wales, Appendix D - Material Density Conversion Factors" which sources "Methodology for the 2014 C&I Waste Stream Audit in the Regulated Areas in NSW, 2008 C&I report methodology, # Industry sources: 2014.
2. The Pacific Region Infrastructure Facility (PRIF) "Waste audit methodology: A common approach", Apia, Samoa: SPREP, 2020.
3. Trends in Solid Waste Management (worldbank.org), https://datatopics.worldbank.org/what-a-waste/trends_in_solid_waste_management.html, webpage updated 2023
4. State-of-Play-Resource-Recovery-and-Waste-Discussion-Document-March-2021.pdf (tewaihanga.govt.nz)
5. World Bank Pacific Economic Update, February 2023 (worldbank.org)
6. APSN | Burning ambition: Timor-Leste's waste management problem (asia-pacific-solidarity.net)
7. UN-Habitat (2021) Waste Wise Cities Tool (https://unhabitat.org/wwc-tool)

ISBN 978-982-04-1230-9