State of the 3Rs in Asia and the Pacific

United Nations
Centre for Regional Development

Country Chapter

State of the 3Rs in Asia and the Pacific

Pacific Region

November 2017

Authors:
Ms. Ma. Bella Guinto
Secretariat of the Pacific Regional Environment Programme (SPREP)
Mr. Tsukiji Makoto
IGES Regional Centre

Member of Drafting Committee of State of the 3Rs in Asia and the Pacific

Co-ordinated by:
The Secretariat of the Regional 3R Forum in Asia and the Pacific,
United Nations Centre for Regional Development (UNCRD),
Institute for Global Environmental Strategies (IGES)
Financially Supported by:
Ministry of the Environment, Government of Japan

Disclaimer

This country chapter for Pacific Region was prepared as an input for the 8th 3R Forum in Asia and the Pacific. Purpose of this country report is to assess the status of 3R implementation in Asia and the Pacific and to share the knowledge of 3R activities among the region.

ACKNOWLEDGEMENT

This publication is intended to provide expert-based assessment of regional progress of 3R policy implementation in selected countries and regions in Asia and the Pacific, particularly in response to the Hanoi 3R Goals (2013-2023) adopted at the 4th Regional 3R Forum in Asia and the Pacific in Hanoi in March 2013.

The State of the 3Rs in Asia and the Pacific project is a collaborative initiative involving Institute for Global Environmental strategies (IGES) and United Nations Centre for Regional Development (UNCRD), supported by the Ministry of Environment. We acknowledge expert contributions from the Institute for Global Environmental Strategies (IGES), Institute of Developing Economies – Japan External Trade Organization (IDE-JETRO), Kyoto University, Tottori University, University of Tokyo, National Institute for Environmental Studies (NIES) of Japan, Japan Waste Management & 3Rs Research Foundation, ISPONRE of Viet Nam, Green Amity Co., Ltd., Chulalongkorn University, Tsinghua University, University of the Philippines Los Baños (UPLB), North South University, BRAC University, SPREP, Anna University, Royal University of Phnom Penh, CSIR Indian Institute of Petroleum, National Environment Agency of Singapore, University of Malaya (UM), Asia Institute of Technology (AIT) and Institut Teknologi Bandung.

Special acknowledgement for the authors of this Country Chapter, Ms. Ma. Bella Guinto and Mr. Tsukiji Makoto. We also express gratitude for drafting works made by the Institute for Global Environmental strategies (IGES). This project is financially supported by the Ministry of the Environment of Japan (MOEJ) with intention to support the policy consultations at the Regional 3R Forum in Asia and the Pacific.

United Nations Centre for Regional Development (UNCRD)

Authors

Ms. Ma. Bella Guinto	Secretariat of the Pacific Regional Environment Programme (SPREP)
Mr. Tsukiji Makoto	Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management in Pacific Island Countries (J-PRISM), JICA (-2016) IGES Regional Centre (2017-)

Editor

Dr. Chen Liu	IGES
Dr. Yasuhiko Hotta	IGES
Mr. Yoshiaki Totoki	IGES

Editorial Support

Ms. Emma Fushimi	IGES
Ms. Miki Inoue	IGES

Coordinated by:

The Secretariat of the Regional 3R Forum in Asia and the Pacific,
United Nations Centre for Regional Development (UNCRD)
Nagono 1-47-1, Nakamura-ku, Nagoya 450-0001, JAPAN
Tel: (+81-52) 561-9377
Fax: (+81-52) 561-9375
E-mail: 3R@uncrd.or.jp

Institute for Global Environmental Strategies (IGES)
2108-11, Kamiyamaguchi, Hayama, Kanagawa, 240-0115, Japan
Tel: +81-46-855-3700 Fax: +81-46-855-3709
E-mail: iges@iges.or.jp
URL: http://www.iges.or.jp

ABBREVIATION

AFD	Agence Française de Développement
ACM	Asbestos containing materials
ALDFG	Abandoned, lost or discarded fishing gears
AS	American Samoa
CBA	Cost Benefit Analysis
CDL	Container Deposit Legislation
CI	Cook Islands
CNMI	Commonwealth of the Northern Mariana Islands
DBC	Deposit beverage containers
DFAT	(Australian) Department of Foreign Affairs and Trade
EPR	Extended Producer Responsibility
EU	European Union
FJ	Republic of Fiji
FP	French Polynesia
FSM	Federated States of Micronesia
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEF-PAS	Global Environment Facility Pacific Alliance for Sustainability
GHG	Greenhouse Gas
GU	Guam
HCW	Healthcare Waste
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
JICA	Japan International Cooperation Agency
J-PRISM	Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management in Pacific Island Countries
KI	Republic of Kiribati
MARPOL	Marine Pollution
MFAT	Ministry of Foreign Affairs and Trade
MSW	Municipal Solid Waste
NA	Republic of Nauru
NC	New Caledonia
NI	Niue
ODS	Ozone Depleting Substance
PA	Republic of Palau
PACPLANS	Pollution Prevention and Response Plans
PACPOL	Pacific Ocean Pollution Prevention
PacWaste	Pacific Hazardouse Waste Management
PET	Polyethylene terephthalate
PICs	Pacific Island Countries

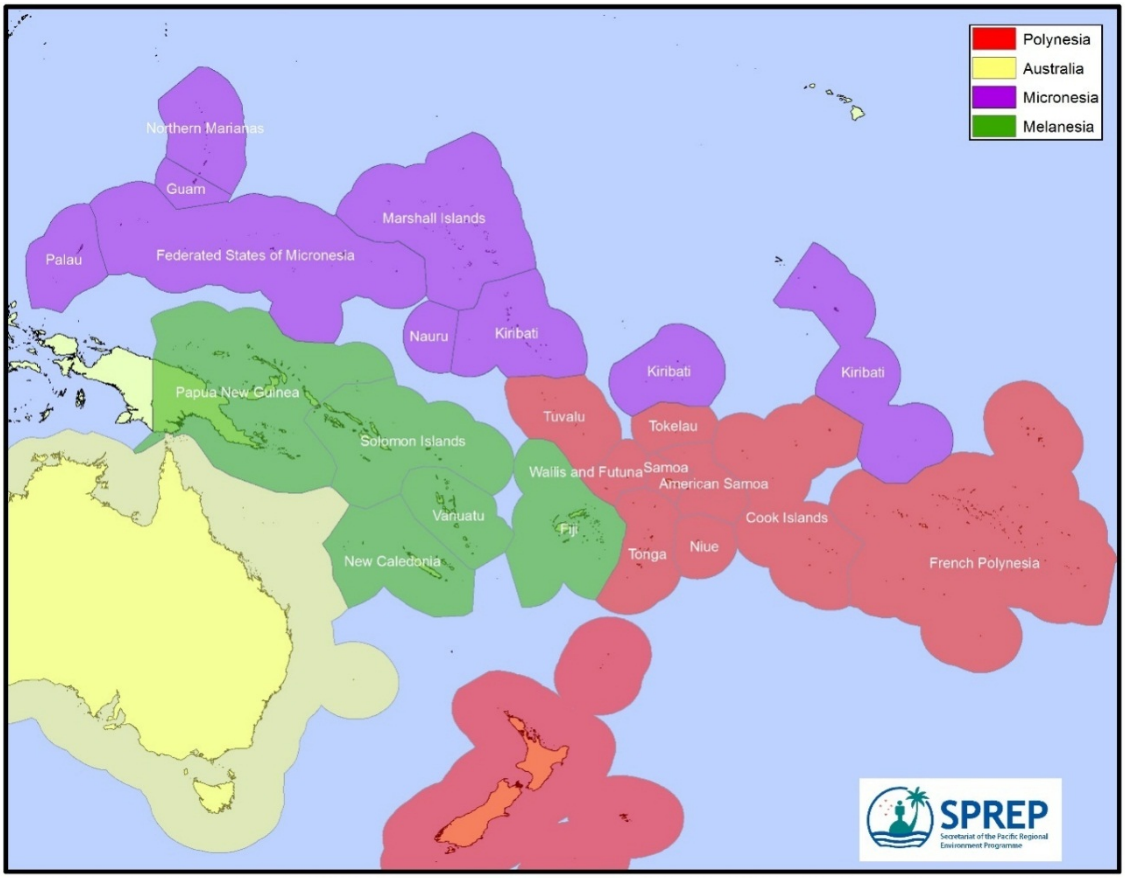
PICTs	Pacific Island Countries and Territories
PNG	Papua New Guinea
POPs	Persistent Organic Pollutants
PPE	Personal protective equipment
RMI	Republic of the Marshall Islands
RWG	Recyclable waste goods
RWM	Recycled waste materials
SA	Samoa
SAICM	Strategic Approach to International Chemicals Management
SI	Solomon Islands
SIDS	Small Island Developing States
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
TK	Tokelau
TO	Tonga
TV	Tuvalu
uPOPs	Unintentionally produced Persistent Organic Pollutants
VU	Vanuatu
WCP	Waste, Chemicals and Pollutants
WF	Wallis and Futuna
WHO	World Health Organization

CONTENTS

A: INTRODUCTION

I. The Pacific Region

The Pacific islands region is located in the western, northern, and central Pacific Ocean and consists of 14 independent countries and eight territories delineated into three major ethnic regions: Melanesia, Micronesia, and Polynesia (Figure A-1). The region has a population of around 10.57 million inhabitants that occupy just over 550,000 km^2 of land ranging from large volcanic landforms to low-lying atolls, and raised coral islands (Table A-1). The land mass comprises only 2% of the region's exclusive economic zone of almost 30.55 million km^2 (SPC, 2015a). So many small islands across a vast oceanic area contributes to the remoteness of many PICTs, which creates many constraints to economic development and to systems that rely on external inputs and supplies (SPREP, 2016)



Source: SPREP

Figure A-1 Map of the SPREP Region

Table A-1 2013 General characteristics of the Pacific Islands

	Country/Territory	Land area (km²)	Mid-2013 population	Density (persons/ km²)	2013-2020 Growth rate (%)	Gross Domestic Product (in current prices)		Primary Island Type(s)
						Per capita (USD)	Year	
MELANESIA	Fiji	18,333	859,200	47	0.5	3,639	2011 P	High islands
	New Caledonia T	18,576	259,000	14	1.2	36,405	2010	High islands
	Papua New Guinea	462,840	7,398,500	16	2.3	18,437	2011 P	High islands
	Solomon Islands	28,000	610,800	22	2.4	1,676	2012	High islands
	Vanuatu	12,281	264,700	22	2.2	3,099	2011	High islands
MICRONESIA	Federated States of Micronesia	701	103,000	147	-0.2	3,031	2011 P	High islands
	Guam T	541	174,900	323	1.7	25,420	2010	Raised limestone with volcanic formations
	Kiribati	811	108,800	134	2.0	1,651	2011	Atolls
	Marshall Islands	181	54,200	299	0.4	3,158	2011	Atolls
	Nauru	21	10,500	499	1.6	8,379	2010–11	Raised coral island
	Northern Mariana Islands T	457	55,600	122	1.1	11,622	2010	High islands
	Palau	444	17,800	40	0.4	10,314	2011	High islands and coral islands
POLYNESIA	American Samoa T	199	56,500	284	0.5	9,333	2010	High islands
	Cook Islands	237	15,200	64	0.3	17,565	2011 P	High islands and atolls
	French Polynesia T	3,521	261,400	74	0.5	26,667	2011 e	High islands
	Niue	259	1,500	6	-1.9	15,807	2011	Uplifted coral island
	Pitcairn A,T	47	57	1	NA	NA	-	Volcanic, uplifted coral, and atolls
	Samoa	2,934	187,400	64	-0.1	3,680	2012	High islands
	Tokelau T	12	1,200	98	-0.8	NA	NA	Atolls
	Tonga	749	103,300	138	-0.1	4,557	2011–12 P	High islands, coral islands
	Tuvalu	26	10,900	420	1.7	3,407	2011	Atolls
	Wallis & Futuna T	142	12,100	85	-0.2	12,324	2005	High islands
	TOTALS	551,265	10,566,500					

Sources: SPC. (2015). 2013 Pacific Islands population poster. Retrieved from http://www.spc.int/prism/.

SPC. (2015). 2013 Pocket statistical summary. Retrieved from http://www.spc.int/prism/.

Legend: A = Not a member of SPREP; T = Territory; NA = Data is "Not Available"; P = Provisional figure

Owing to the huge expanse of ocean, Pacific Islanders remain highly dependent on marine resources and healthy ecosystems for survival. Most economies of PICTs are dependent on fishing, agriculture, and tourism. Some Melanesian countries have significant mineral resources and forestry assets. Commercial agriculture (mainly sugar, copra, taro, bananas, and beef cattle production) accounts for over 85% of foreign exchange earnings in PICTs, contributes substantially to employment (40–80%), and represents 20–40% of gross domestic product (GDP) and over 50% of exports. In most PICTs, only a small fraction of land mass is suitable for agriculture, and much of the agriculture is confined along coastal plains, river deltas and valleys (Koshy, Mataki, & Lal, 2008, p. 20). The inadequacy of manufacturing and processing industries triggers high dependence on importation of goods with non-biodegradable packaging materials.

The weighted average distance of Pacific SIDS from major global markets located in Asia, North America, North Europe, the Mediterranean, Western Asia, and the Indian subcontinent is around 11,500 km (United Nations Conference on Trade and Development, 2014). Several factors combine to make shipping services to and from Pacific SIDS relatively expensive, including long distances between ports and low trade volumes which make it difficult to take advantage of economies of scale; widely varying quality of port facilities, with a general lack of major cargo-handling infrastructure that mandates the use of relatively expensive geared container vessels (i.e. with on-board cranes); and often extreme trade imbalance (with exports far outweighed by imports), which means costly container repositioning [1] (Asian Development Bank, 2007). These challenges combine to generally raise the costs of goods, and the costs of returning recyclable commodities to foreign recycling facilities.

Many PICTs, by virtue of their geographic location in the *Ring of Fire*[2], have high exposure to seismic hazards such as earthquakes, tsunamis and volcanic activities. The Pacific region is also subject to a range of hydrometeorological hazards including tropical cyclones, severe storms, storm surges, floods/flash floods, landslides, droughts, and fires. The vulnerability to climate change is considered to be one of the greatest threats to the livelihoods, security and well-being of the peoples of the Pacific. Among the most vulnerable are small island states, in particular the Marshall Islands, Kiribati, Tuvalu, Tonga, FSM, and the Cook Islands (as cited in SPREP, 2016) which are are only a few meters above present sea level and may face serious threat of permanent inundation from sea-level rise. The predicted effects of climate change could have significant impacts on efforts to manage waste, chemicals, and pollution in the Pacific region. Coastal inundation and floods could damage waste management infrastructure and release harmful chemicals and leachate that pollute the land and groundwater; and intensified tropical cyclones could generate increased volumes of disaster debris and waste that overwhelm existing management capacities.

For many Pacific island communities, rapid development and population growth has outpaced capacity to deal with waste. Plastics, discarded or lost fishing gear, and other marine litter pollute shorelines and marine waters and have negative impacts on ecosystems, including entanglement of marine animals, ingestion of marine litter by wildlife with potential for associated toxic chemical transfers; introduction of invasive species through use of marine litter as rafting habitats; and damage to important and fragile coastal ecosystems such as coral reefs and mangroves (Richardson, 2015).

---

[1] Container repositioning refers to movement of empty containers to the nearest hub for reuse.
[2] The Ring of Fire refers to a string of underwater volcanoes and earthquake sites around the edges of the Pacific Ocean (National Oceanic and Atmospheric Administration, 2013)

II. Scope

The succeeding country report will cover selected countries in the Pacific that are members of the Secretariat of the Pacific Regional Environment Programme (SPREP). SPREP is mandated to promote cooperation in the South Pacific Region and provide assistance in order to protect and improve the environment and to ensure sustainable development for present and future generations. SPREP focuses on four key areas: biodiversity and ecosystems management, climate change, environmental and monitoring governance, and waste management and pollution control.

The role of SPREP in improving Members' technical capacity to manage wastes, chemicals and pollutants through provision of training, technical advice and support is reinforced by donor-driven projects. The Japan International Cooperation Agency (JICA) played a pivotal role in progressing solid waste management in the Pacific since 2000. Other donors like the European Union (EU), New Zealand Aid (now Ministry of Foreign Affairs and Trade – MFAT), Australian Aid (now Department of Foreign Affairs and Trade – DFAT), the French Development Agency (AFD), among others have provided technical and financial backstopping to the countries. These allowed countries to review policies and redirect systems to a cleaner, healthier and safer Pacific.

B: WASTE DEFINITION AND CATEGORIZATION

There is no generic consistent definition of wastes in most Pacific Island regulations, policies and strategy documents. Papua New Guinea simply defines *waste as a product that is no longer suited for its intended use. It may be worn out or may be an unwanted by-product of a process* (Office of the Auditor-General of PNG, 2010).

The Environmental Management Act 2005 of Fiji explicitly defines *waste to include litter, garbage, refuse, excavated and dredged spoil, and other discarded materials including any derelict motor vehicles or parts, waste materials from residential, commercial or industrial facility and from community activities (excluding religious offerings), solid or dissolved material in domestic sewage or other substances in water sources, such as silt, dissolved or suspended solids in industrial wastewater effluent, dissolved materials in irrigation return flows or other common water pollutants*. This definition, however, closely relates to solid waste. The Act did not provide any definition for solid waste but regarded *hazardous waste as toxic, inflammable, corrosive, reactive, infective or explosive waste, and includes waste which is potentially hazardous to human health or the environment;*

The case is the same with Tonga which generally refers to *waste as garbage, household refuse, rubbish, scraps and trade waste; and any other matter or thing determined from time to time by an approved Authority to be waste in the waste management service area under its control* while *hazardous waste includes any waste materials which are, or which have the potential to be, toxic or poisonous, or which may cause injury or damage to human health or the environment* (Kingdom of Tonga, 2005). Samoa describes waste in a similar fashion (Government of Samoa, 2010) with specific exclusion of human waste except in the form of sludge or any other form intended for final disposal as a waste product. Vanuatu (Waste Management Act, 2014) and Tuvalu (Waste Operations and Services Act, 2009) refer to the same definition above as solid waste.

Owing to multilateral environmental treaties which most Pacific Island countries (PICs) are parties to, waste is categorized as either solid or hazardous in most regulations.

The Public Health Act 2004 of Cook Islands defines *solid waste to include the following: a) Garbage, refuse, or litter; b) Hazardous waste; c) medical & bio-waste; d) Building and demolition waste; e) Other discarded or superfluous things industrial, commercial, mining, agricultural, community, or other activities; f) that is not of a liquid or gaseous nature in its raw form.* On the other hand, *hazardous waste is any waste that is likely to be a health hazard if released into any water and includes the following: animal waste, medical waste or sewage sludge, other by-products, or other waste from devices, facilities, plants or other systems that treat water, sewage, or pollution (for example, septic tanks, other sewage treatment facilities, water treatment plants or sewage treatment plants); [and] any other waste declared by the Queen's Representative by Order in Executive Council to be hazardous waste for the purposes of the Act.*

The first Solid Waste Management Strategy for the Pacific Region (SPREP, 2005) defines *solid waste as any solid or semi-solid garbage, refuse or rubbish, sludge and other discarded material including any* *contained liquid or gaseous material remaining from industrial, commercial, institutional activities and residential or community activities*. On the other hand, *hazardous waste is a waste with properties that make it dangerous, or capable of having a harmful effect on human health and the environment. These wastes require special measures in handling and disposal due to their hazardous properties (e.g. toxicity, ecotoxicity, carcinogenicity, infectiousness, flammability, chemical reactivity) and are generally not suitable for direct disposal in a landfill.*

Samoa explicitly specifies *hazardous waste to include the waste and substances specified in Schedule 2 of the Waste Management Act (2005) if they are prohibited in Samoa under the applicable international conventions, or have been imported or used in Samoa in a manner which breaches the relevant conventions, and:*

a) any waste which is, or which have the potential to be, toxic or poisonous, or which may cause injury or damage to human health or the environment;
b) any specific substance, object or thing determined under section 6 to be hazardous waste; and
c) any other matter or thing deemed under international conventions to be hazardous wastes or to have the characteristics of hazardous waste

Tuvalu (Waste Operations and Services Act, 2009) adopted the same definition of hazardous waste as Samoa but specifically included engine oils or other lubricating oils used in relation to machinery, and oil based paints and any chemical used in relation to paints. Vanuatu (Waste Management Act, 2014) included all persistent organic pollutants in the definition of hazardous wastes.

Papua New Guinea (Office of the Auditor-General of PNG, 2010) categorized waste as follows:

a) *Non-hazardous (Solid Waste) "or garbage"* is non- hazardous waste that can cause harm or damage to people's health and environment;
b) *Hazardous waste* has inherent chemical and physical characteristics (toxic, ignitable, corrosive, and carcinogenic) and can cause significant adverse effects; and
c) *Radioactive waste* is highly toxic; exposure to radiation can cause illness and even death.

Further categorization can be found in the regulations (as stated above) in the following countries:

Fiji:

a) Packaging waste means any packaging or packaging material discarded as waste;
b) "Special waste" means white goods discarded as waste including waste from chemical metal processing and pharmaceutical or agrochemical waste;

Tuvalu:

a) Bulk waste includes: vehicle bodies, or any part of them; vehicle engines, or any part of them; tyres; vehicle or marine batteries, or any of their component parts; refrigerators, freezer units, stoves and cookers, washing machines, and similar household or commercial appliances; paint tins and other containers; and any other item to be disposed of which cannot be effectively disposed of by regular waste collection services provided to residential or commercial premises.

Vanuatu:

a) Bulk wastes includes: vehicle bodies, or any part of them; vehicle engines, or any part of them; retreaded or second hand tyres; vehicle or marine batteries, or any of their component parts; refrigerators, freezer units, stoves and cookers, washing machines, and similar household or commercial appliances; paint tins or empty cylinder drums; construction or demolition waste; or any other item to be disposed of which cannot be effectively disposed of by regular waste collection services provided to residential or commercial premises.

The Regional Solid Waste Strategies (SPREP, 2005, 2010 & 2016) provided further definitions of solid and hazardous waste:

a) Green waste – Plant debris such as coconut husk, palm fronds, tree branches, leaves, grass clippings, and other natural organic material discarded from yards or gardens
b) Kitchen waste – food scraps either from food preparations or kitchens, from household restaurants or such.
c) Commercial waste – Solid waste generated from premises engaged in business, trade or sporting activities.
d) Difficult waste – large items of wastes, wastes for which there are no viable recycling options, and wastes which require special disposal because of particular hazards. Difficult wastes include asbestos, car bodies, tyres, domestic white goods, low-grade scrap metal, non-recyclable plastics, disposable diapers/nappies, and disaster wastes.
e) Industrial waste – waste which is produced by industrial activity such as that of factories, mills and mines.
f) Institutional waste – general solid wastes produced by institutions such as schools, universities, prisons, government offices, and other public buildings
g) E-waste - Discarded or waste electrical and electronic equipment that no longer serves its original purpose.
h) Healthcare waste - The by-product of healthcare provision that includes sharps (needles, scalpels, etc.), blood, body parts, chemicals, pharmaceuticals, medical devices and radioactive materials.
i) Marine Litter - Any persistent, manufactured or processed solid material that enters the ocean from any source. May also be referred to as Marine Debris.
j) Microplastics - Plastic pieces or fibres measuring less than 5mm in size. Sources of microplastics include the degradation of larger pieces of plastics, microbeads from cosmetic products, synthetic clothing, and virgin plastic pellets.
k) Municipal Solid Waste - All solid waste, except industrial and agricultural wastes, generated from residential households, commercial and business establishments, institutional facilities and municipal services. Municipal solid waste may include construction and demolition debris and other special waste that may enter the municipal waste stream. Generally excludes hazardous waste.

Pacific Island countries through their national waste strategies determine composition of wastes through various waste streams depending on the scope of the strategy (Table B-1) In order to streamline waste characterization, solid and hazardous waste are now integrated into one Strategy, the Cleaner Pacific 2025 (SPREP, 2016).

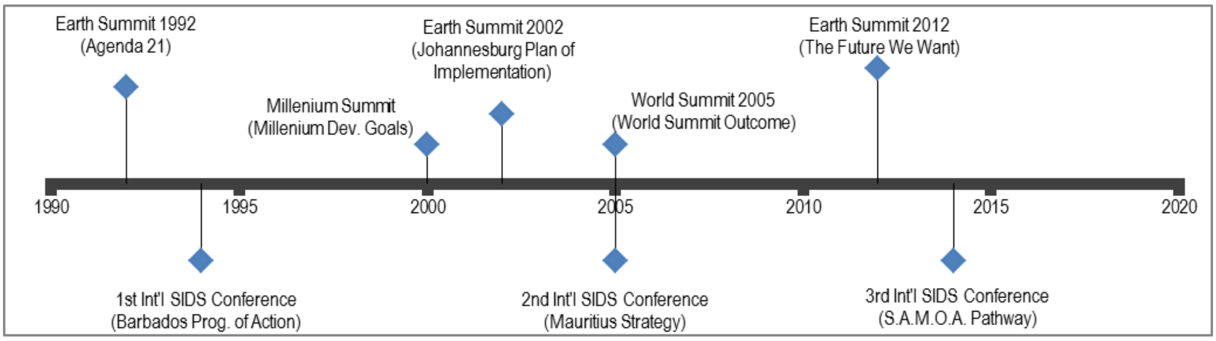
Table B-1 2013 Waste Streams in selected Pacific Island countries

Country	Waste Types	Source
Cook Islands	Organic, Paper/cardboard, wood, plastic, glass/ceramics, textile/rubber, ferrous metals, non-ferrous metals	Cook Islands National Solid Waste Management Strategy 2013 - 2016
Federated States of Micronesia	Vegetable/ biodegradable, Garden waste, Paper, Textile, Leather/rubber, Plastic, Metal: mixed, Metal: Aluminum, Metal: Steel, Glass/ceramic, Potentially hazardous, Construction & demolition, Miscellaneous	Federated States of Micronesia National Sold Waste Management Strategy 2010 - 2014
Republic of Kiribati	All organics, paper, plastics, glass/ceramics, all metals, textile/rubber, miscellaneous	Kiribati National Solid Waste Strategy 2008 - 2011
Republic of the Marshall Islands	Wood/leaves/grass, plastics, paper, disposable diapers, kitchen wastes, metals, textiles, glass/ceramics, leather/rubber, others/miscellaneous	Republic of the Marshall Islands Draft National Waste Management Strategy 2012 - 2016
Republic of Nauru	Plastics, metals, paper, nappies, glass, organics, others	Republic of Nauru National Solid Waste Management Strategy 2011 - 2020
Niue Island	Organics, metals, paper, diapers, plastics – bags, plastics – bottles, plastics – other, textiles, glass, others	Niue Island National Integrated Waste Management Strategy 2010 - 2015
Republic of Palau	Paper, plastic, glass, metals (ferrous), biodegradables (food/kitchen), aluminium, garden (green waste), textiles, construction debris, hazardous, other	Republic of Palau Draft of National Solid Waste Management Plan, 2008
Samoa	Green waste, food scraps, plastics, metals, papers, cardboards, textiles, others	Ministry Of Natural Resources & Environment Draft National Solid Waste Management Strategy 2008-2018
Solomon Islands	Paper, Metals, Glass,/Ceramics, Textile, Plastics, Bones, Miscellaneous(small pieces of mostly organic matter)	National Solid Waste Management Strategy, 2009
Tonga	Organic (garden and kitchen wastes), paper and cardboards, recyclables, diapers, others	National Integrated Waste Management Strategy for Tonga, 2013
Vanuatu	Kitchen waste, plastics, glass/ceramics, paper, metals yard waste, other textiles hazardous	Vanuatu National Waste Management Strategy and Action Plans 2011 - 2016

C: BASIC POLICY DIRECTION (PAST AND FUTURE)

I. International Sustainable Development Frameworks

Waste and chemicals management, and terrestrial and marine pollution control, have been formally recognised as special sustainable development issues for small island developing states (SIDS) since the first global conference on sustainable development in 1992 (the Earth Summit).



Source: SPREP (2016). Cleaner Pacific 2025: Pacific Regional Waste and Pollution Management Strategy 2016 -2025

Figure C-1 International Sustainable Development Frameworks

The importance of the issue, and the need for SIDS to be supported to tackle emerging priorities has been frequently reinforced at subsequent global conferences (Figure C-1), the most recent being the third International SIDS conference in 2014, at which the SIDS Accelerated Modalities for Action (SAMOA) Pathway (2014) was adopted (SPREP, 2016).

II. Policies and Legislation

The Pacific Regional Waste and Pollution Management Strategy 2016-2025 (Cleaner Pacific 2025) is a comprehensive long-term strategy for integrated sustainable waste management and pollution prevention and control in the Pacific islands region. This was unanimously endorsed by SPREP members during the 26th SPREP meeting in September 2015. It provides a strategic management framework to address waste, chemicals, and pollutants (WCP) that will reduce associated threats to sustainable development of the region. Priority areas for management include municipal solid waste (MSW), asbestos, electrical and electronic waste (E-waste), healthcare waste, chemicals (such as persistent organic pollutants (POPs), ozone depleting substances (ODSs) and mercury), used oil and lubricants, marine litter, ship-sourced pollution, disaster waste, and liquid waste (such as sewage and trade waste).

Cleaner Pacific 2025 integrates strategic actions addressing priority waste and pollution issues, and incorporates lessons learnt from the implementation of regional strategies that it replaces, specifically: the Pacific Regional Solid Waste Management Strategy 2010-2015 (SPREP, 2010); An Asbestos-Free Pacific: A Regional Strategy and Action Plan 2011 (SPREP, 2011); Pacific E-waste: A Regional Strategy and Action Plan 2012 (SPREP, 2012); Pacific Health Care Waste: A Regional Management Strategy and Action Plan 2013-2015 (SPREP, 2013); and the inclusion of the Pacific

Ocean Pollution Prevention (PACPOL) Strategy 2015-2020 (SPREP, 2015).

To improve uptake of Cleaner Pacific 2025 at the national level, Pacific Island countries and territories (PICTs) are urged to table the regional strategy through appropriate national processes in order to obtain national endorsement at the highest level. This is expected to improve the mainstreaming of PICT-level activities from Cleaner Pacific 2025 into national and corporate work programmes and budgets, thereby improving implementation.

Cleaner Pacific 2025 will undergo a participative mid-term review in 2020 coordinated by SPREP, with the active involvement of PICTs and other stakeholders. The main purpose of the mid-term review is to verify and evaluate the relevance of the 15 strategic actions to the waste, chemicals and pollution agenda in the Pacific. The mid-term review shall also identify necessary corrective actions and strategic recommendations for the second half of the strategy period (2021-2025).

Adoption and implementation of strong and effective policies and strategies continue to be a challenge for PICTs. In previous years, PICTs have been assisted to prepare draft national strategies and policies addressing waste, chemicals, and pollution management. However, many have yet to be endorsed at the ministerial level. Some endorsed strategies have not been effectively implemented as they have not been integrated into government and corporate planning cycles. In the absence of a policy framework which articulates nationally-agreed priorities, donors may be reluctant to support major projects, because the risks of project failure are too great. The Cleaner Pacific 2025 (SPREP, 2016) summarizes the status of relevant policies and strategies in PICTs in the table below (Table C-1):

Table C-1 Status of wastes, chemicals and pollution policies in PICTs

National policies, strategies and plans	AS	CI	FSM	FP	FJ	GU	KI	RMI	NA	NC	NI	PA	PNG	SA	SI	TK	TO	TV	VU	WF
Waste Policy Statement		X					X			X										
Solid Waste		X*	X		O	X	D*	D*	D	X	D*	X*		D*	X*	X*	D*	O	X*	X
Healthcare Waste		X*	X*		D		D*	D*		O	D*	X*		X	D*	X*			X*	X
Other hazardous Waste		X*	X*		O		D*	D*		X	D*	X*		D*		X*	D*			X
Liquid Waste		D*	X[1]		O		X*	X*	D*			X*	X*	X	X[1]	X*	D*	X*	X*	
Chemicals		C[2]	X		C[2]		C[2]	C[2]	C[2]				C[2]	D	C[2]		C[2]	C[2]		
Oil Spill Contingency	X	X	D	X	D	X	D	D	D	X	D	D	D	D	D	D	X	D	D	X
Air Pollution			X		O															

Legend: C = preparation has commenced; D = document has been prepared but not yet endorsed; O = endorsed document is no longer current; X = document has been endorsed and is current; * = part of an integrated policy, strategy or plan; 1 = for sanitation only; 2 = for POPs only

SPREP (2016). Cleaner Pacific 2025: Pacific Regional Waste and Pollution Management Strategy 2016 -2025

The successful implementation of Cleaner Pacific 2025 in PICTs and the region will require significant financial and technical resources at both national and regional levels, mobilisation of which will require collaboration between PICTs and SPREP. The proposed Clean Pacific Roundtable (Strategic Action 13 in Cleaner Pacific 2025) is expected to enhance resource mobilisation efforts by providing a forum that facilitates dialogue on waste and pollution management needs and priorities; promotes networking between PICTs, donors, development partners, civil society, regional organisations, and private sector; and disseminates information on new and existing funding opportunities.

Some of the suggested resource mobilisation strategies for Cleaner Pacific 2025 include:

- Mainstreaming waste and pollution management considerations into other priority development areas such as climate change, biodiversity conservation, agricultural development, and tourism development. This promotes not only open up new funding avenues, but also improvement of cross-sectoral and multi-stakeholder engagement in waste and pollution management, and enhance the sustainability of outcomes.
- Building awareness of the importance of improving waste and pollution management with politicians, decision-makers, and communities. Informed politicians and decision-makers are more likely to prioritise funding for waste and pollution management, whilst an informed populace is more likely to support relevant initiatives.
- Formal adoption of Cleaner Pacific 2025 at the national level and incorporation of relevant strategic actions and activities into national waste and pollution management strategies, and national and corporate work programmes and budgets. This will ensure alignment between the agreed priorities and the work that gets done.
- Leveraging available national funding allocations for waste and pollution management. The capacity of national governments to implement incremental improvements to waste and pollution management through national funding allocations should not be underestimated. Every effort should be made to leverage such national project funding allocations to secure additional external co-financing to expand the scale and extent of planned projects.

In addition to the foregoing strategies, it is vitally important that national waste and pollution management projects, and regional projects and programmes such as JICA-funded Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management in Pacific Island Countries (J-PRISM), EU-funded Pacific Hazardous Waste Management (PacWaste) Project, Pacific POPs Release Reduction through Improved Solid and Hazardous Wastes Management Project funded by the Global Environment Facility – Pacific Alliance for Sustainability (GEF-PAS), the Integrated Technical Cooperation Programme funded by the International Maritime Organization (IMO) are successfully implemented and produce tangible results to demonstrate to donors and development partners that investing in waste and pollution management in the Pacific bears results.

D: 3R INDICATORS

I. Total MSW Generated and Disposed and MSW Generation Per Capita

1. MSW Generation Per Capita

The municipal solid waste (MSW) generation rates for several PICTs are summarised in Table D-1. It should be noted that most of the data is not comparable across PICTs as it represents various years and has been collected using different methodologies. Nonetheless, computing the unweighted mean daily household waste generation rate is found useful and reveals an indicative average generation rate of about 0.5 kg per person, and a total daily urban MSW generation rate approaching 1.3 kg per person.

The Cleaner Pacific 2025 aspires to develop standard methods of data collection and management to assist countries in having more robust baseline and monitoring data to achieve key performance indicators.

2. Total MSW Generated and Disposed

Assuming that the estimated waste generation rate increases proportionally with the gross domestic product (GDP), the indicative waste generation for the entire Pacific urban population would have totalled over 1.16 million tonnes in 2013, and is projected to be more than 1.59 million tonnes by 2025 (see Table D-1). With an estimated average of 88% collection coverage in the region **Invalid source specified.**, the indicative waste disposed for the entire Pacific urban population would have totalled over 1.02 million tonnes in 2013 based on total urban waste generation of 1,164,645 tonnes/year.

Table D-1 Urban municipal solid waste (MSW) generation and disposal in PICTs

	Endnotes	1999	2013	2025
Average GDP per capita (constant 2005 US$) for 10 PICs	1, 2	2,450	2,660	-
Growth in GDP per capita (%)		-	9%	
Total PICT population (number of people)	3	7,712,749	10,236,327	12,545,542
Urban population (number of people)	3	1,686,226	2,199,777	2,795,985
Estimated mean urban waste generation rate (kg/person/day)	4, 5	1.3	1.5	1.6
Total urban waste generation (tonnes/year)		822 271	1,164,645	1,589,057
Total urban waste disposed (tonnes/year)	6		1,024,888	

Endnotes:

1. PICs: Fiji, Kiribati, RMI, FSM, Palau, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu
2. Source: World Bank. 2014. *GDP per capita (constant 2005 US$).* Retrieved from http://data.worldbank.org/indicator/NY.GDP.PCAP.KD?display=graph
3. Source: UNDESA Population Division. 2014. World Urbanization Prospects: The 2014 Revision, CD-ROM Edition.
4. Source for 1999 data: Raj, S.C. 2000. Solid waste education and awareness in Pacific island countries. Apia: SPREP
5. Estimates for 2013 and 2025 are based on the waste generation rate increasing at the same rate as GDP growth for the 1999-2013 period (i.e., 0.6% annually)
6. Collection coverage - 88% (SPREP, 2016, Appendix E)

II. Overall Recycling Rate and Target (%) and Recycling Rate of Individual Components of MSW

1. Overall Recycling Rate and Target (%)

Unlike most countries in Asia, waste recycling in the Pacific islands is limited to the collection, compaction and shipping of recyclable waste to a recycling facility that is usually located off-island (SPREP, 2010). Table D-2 shows small-scale recycling activities in the PICTs. Unfortunately, there is no established reporting mechanism yet to determine the rate of recycling in these countries so information is not readily available. Data management and dissemination will be one of the focus of the next Regional Strategy (Cleaner Pacific 2025).

Table D-2 3R activities in the PICTs

Recyclable waste	PICT	Markets for Recyclables
Aluminium cans	CNMI, Cook Islands, Fiji, Guam, Kiribati, Niue, Palau, PNG, RMI, Samoa, Solomon Islands, Tokelau, Tonga, Vanuatu	Australia, California-USA, New Zealand
Scrap metal (ferrous metal)	Cook Islands, Fiji, Niue, Palau, PNG, RMI, Solomon Islands, Tonga, Vanuatu	Australia, China, Hong Kong, Mauritius
Paper/cardboard	Cook Islands, Fiji, Palau, Tonga	Australia, Local, New Zealand
Glass	CNMI, Cook Islands, Palau, Tonga	Local
Plastics (includes foam)	CNMI, Cook Islands, Fiji, Palau, RMI, Samoa, Tonga	Australia
Lead-acid batteries	CNMI, Cook Islands, Fiji, Kiribati, Niue, Palau, PNG, RMI, Samoa, Tonga, Vanuatu	Australia, China, New Zealand
Used oil	CNMI, Cook Islands, Fiji, Palau, Tonga, Vanuatu	Fiji, Indonesia, Nauru, New Zealand, Philippines
Tyres	CNMI, Fiji, Palau, PNG, Tonga	Indonesia, Malaysia, Korea, Vietnam
Organic waste (composting)	Cook Islands, Fiji, Palau, RMI, Samoa, Tokelau, Tonga, Tuvalu	Local

Source: Richards, Esther and Haynes, David. (2014). Solid Waste Management in Pacific Island. In P. Agamuthu and M. Tanaka (eds.), Municipal Solid Waste Management in Asia

The absence of government policies supporting recycling activities in addition to major obstacles such as lack of national recycling and re-processing facilities and small quantities of recyclable volumes makes recycling in the Pacific Islands uneconomical in most cases due to fluctuation in the global price of recyclable materials (Richards and Haynes, 2014). This is further compounded by the absence of a regional recycling mechanism which is also highlighted in the new Regional Strategy, Cleaner Pacific 2025 (SPREP, 2016).

There are, however, a few initiatives in some countries which are working well although not fully documented, e.g. beverage container recycling in Palau (details provided in Section 4.4), Kiribati, New Caledonia and FSM (Kosrae and Yap), and various 3R activities in Fiji (paper, market and home composting).

In a study conducted by JICA, the potential of implementing a reverse logistics network to support and enhance recycling activities in Fiji, Samoa, Tonga, Tuvalu, and Vanuatu was assessed (JICA, 2013). The study reported a recycling rate of 48% in 2011 for potentially recyclable goods (Table D-3). The data also included recycling in French Polynesia, a French territory within the Pacific Region, in order to cover representative countries within the region. The combined recycling rate for potentially recyclable goods in these six PICTs is estimated to be 47%.

The definition of *recycling rate as the amount exported or recycled/reused locally (such as vehicles, white goods, furniture, etc.) divided by potentially recyclable waste (scrap metal, pet bottle, paper and cardboard, etc.)* was also adopted in the Cleaner Pacific 2025 (SPREP, 2016) as a key performance indicator. The formula used is:

$$Recycling\ rate\ (\%) = \frac{amount\ reused, recycled, returned}{amount\ recyclable}$$

The 2014 baseline of 47% is used with a target recycling rate of 60% by 2020 and 75% by 2025.

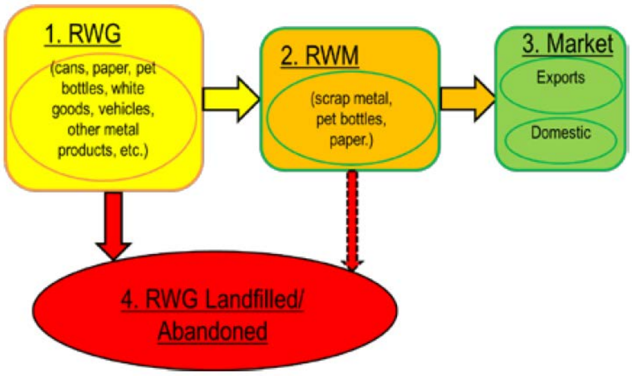
Table D-3 Recycling rate in selected PICTs

Country/Territory	Potentially recyclable waste (tonnes)	Amount exported or recycled/reused locally		Quantity landfilled or dumped (tonnes)	Data source	Comments
		(tonnes)	(%)			
Fiji	66,788	38,081	57%	28,707	1	End-of-life vehicles, white goods, cans, PET bottles, paper and cardboard
Samoa	13,308	4,741	36%	8,567	1	As above
Tonga	6,567	598	9%	5,969	1	As above
Tuvalu	685	103	15%	582	1	As above
Vanuatu	12,591	4,642	37%	7,949	1	As above
French Polynesia	16,300	6,300	39%	10,000	2	Cans, PET bottles, paper and cardboard, glass
Total	116,239	54,465	47%	61,774	-	-

Sources:
[1] JICA. 2013. Data collection survey on reverse logistics in the Pacific Islands: Final report. JICA.
[2] Completed country profile questionnaire submitted by Department of Environment (DIREN).

2. Recycling Rate of Individual Components of MSW

Despite the fact that a number of PICTs have waste composition reflected in their national strategies, the data is quite outdated and does not reflect current trends in recycling in the region. The JICA study in 2013 which investigated reverse logistics on how materials flow in and potentially out of the Pacific Region, provided information as to the amount of recycled materials diverted away from the landfill (Table D-4). Figure D-1 shows the typical flow of recyclable materials from which recycling rate was estimated.



Source: JICA. (2013). Data Collection Survey on Reverse Logistics in the Pacific Islands

Figure D-1 Schematic presentation of RWG and RWM flow

Based on the generated information, Fiji generated 57% recycled waste materials which placed them in good standing in terms of recycling. The rest of the other countries (Samoa, Tonga, Tuvalu and Vanuatu) had more potentially recyclable materials ending up disposed in landfills or abandoned. The significantly high percentage of recyclable wastes ending up in landfills in Tonga and Tuvalu offers opportunities to promote recycling in view of limited lands available for disposal. However, these countries are constrained with less domestic shipping despite people disbursed in the outer islands. A cost-benefit analysis of establishing a landfill as opposed to resource recovery would allow governments to explore which options suit them most considering very limited resources in the region.

Most of the recycled materials are exported with little or no domestic market to receive these materials. This creates an impact on the ability of countries to enhance recycling and highlights the need to encourage more domestic shipping and local markets to engage in the recycling business although the supply of inputs to the business may not be encouraging at this stage.

Metal gets the biggest share of potentially recyclable materials from goods coming in the countries. Fiji achieved a recycling rate of 54% through scrapping of metals from vehicles and white goods which have reached their end-of-life. The prospect of metal scrapping in the region is huge considering the price in the international market.

Despite the huge recycling potential of PET bottles and paper/cardboard in most countries, the recycling rate is low or nil due to low market demand. The presence of a paper recycling company in Fiji may have attributed to the share of the local market in the recycling business. However, considering the high potentially recyclable paper (21%) coming into the country, only 2% gets into the recycled material market. This huge gap indicates the need for Fiji to improve recycling operations considering the opportunity it has in this particular waste stream.

Table D-4 Recyclable waste goods amounts in 2011

	Items	Fiji		Samoa		Tonga		Tuvalu		Vanuatu	
		Amount (ton)	Share (%)	Amount (ton)	Share (%)	Amount (ton)	Share (%)	Amount (ton)	Share (%)	Amount (ton)	Share (%)
1	**Recyclable waste goods (t/yr)**	66,788	100%	13,308	100%	5,969	100%	685	100%	12,591	100%
	- Vehicles share of total RWG	11,614	*17%*	2,752	*21%*	2,400	*40%*	58	*8%*	2,751	*22%*
	-White Goods	2,146	*3%*	256	*2%*	194	*3%*	17	*2%*	215	*2%*
	- Other Metal Products	33,649	*50%*	6,645	*50%*	1,639	*28%*	377	*57%*	5,847	*47%*
	- Steel Cans	1,875	*3%*	582	*4%*	373	*6%*	49	*7%*	412	*3%*
	- Aluminum Cans	1,405	*2%*	366	*3%*	327	*5%*	8	*1%*	412	*3%*
	- Pet bottles	2,345	*4%*	1,313	*10%*	336	*6%*	17	*2%*	916	*17%*
	- Paper & Cardboard	13,754	*21%*	1,394	*10%*	700	*12%*	159	*23%*	2,038	*16%*
2	**Recycled waste materials (t/yr)**	38,081	*57%*	4,741	*36%*	598	*10%*	103	*15%*	4,642	*37%*
	- Scrap Metal share of total RWM	36,002	*54%*	4,728	*36%*	598	*10%*	103	*15%*	4,642	*37%*
	- Pet Bottles	704	*1%*	13	*0*	0	*0*	0	*0*	0	*0*
	- Paper & Cardboard	1,375	*2%*	0	*0*	0	*0*	0	*0*	0	*0*
3	**Recycled Material Market**	38,081	*57%*	4,741	*36%*	598	*10%*	103	*15%*	4,642	*37%*
	- Export share of total Market	37,531	*56%*	4,741	*36%*	598	*10%*	103	*15%*	4,642	*37%*
	- Domestic share of total Market	550	*1%*	0	*0*	0	*0*	0	*0*	0	*0*
4	**RWG to Landfill or Abandoned**	28,707	*43%*	8,567	*64%*	5,371	*90%*	582	*85%*	7,949	*63%*

Source: JICA (2013), Data Collection Survey on Reverse Logistics in the Pacific Islands

The economy of scale of recycling in the Pacific is one challenge which countries are facing in this region. The opportunities to recover substantial amounts of waste resources need to be assessed in terms of financial, environmental and social costs. It is now vital to look at cost-benefit analysis (CBA) of the different waste streams to guide small island developing countries in their decision-making process. Currently, SPREP is piloting waste CBAs in selected PICs (Pacific Island countries).

III. Amount of Hazardous Waste Generated and Disposed in Environmentally Sound Manner

1. Healthcare Waste

Healthcare waste (HCW) is an unavoidable consequence of community healthcare and includes general waste (comparable to domestic waste), and hazardous waste, which includes syringes, infectious waste, body parts and fluids, chemical waste, and expired pharmaceuticals. According to the World Health Organisation (WHO, 2014a as cited in SPREP, 2016), general waste comprises approximately 75-90% of the waste produced by healthcare activities, whilst 10-25% of HCW is regarded as hazardous waste.

According to a regional baseline assessment of HCW in 14 PICs completed during the PacWaste Project, the indicative average hazardous HCW generation rate for PICs is approximately 0.8 kg per occupied bed as shown in Table D-5 (ENVIRON Australia Pty Ltd, 2014). The regional assessment also evaluated HCW management practices in 37 hospitals spread across the 14 PICs, and noted the following regional inadequacies:

- Lack of documented waste management planning system or significant gaps present in 32 hospitals (84%);
- Sub-standard HCW segregation and containment practices and auditing programs in 29 hospitals (78%);
- Inadequate facilities for storage of HCW before treatment in 29 hospitals (78%);
- Treatment infrastructure incapable of definitively destroying the HCW infection risk in 15 hospitals (41%);
- Inappropriate PPE, and irregular use of PPE by HCW handlers in 14 hospitals (38%); and
- No structured training programs for HCW management stakeholders in 25 hospitals (68%).

Table D-5 Hazardous healthcare waste generation in selected PICs

	Pacific island countries															Pacific island territories					
	Cook Islands	Fiji	FSM	Kiribati	RMI	Nauru	Niue	Palau	PNG	Samoa	Solomon Islands	Tonga	Tuvalu	Vanuatu	**All Pacific island**	American Samoa	Tokelau	Guam	French Polynesia	New Caledonia	Wallis and Futuna
Average Daily HCW (kg/occupied bed)	0.5	0.8	0.9	0.2	2.8	1.4	1.2	1.4	0.7	0.6	1.1	1.0	0.3	1.0	0.8	ND	ND	ND	360 T/yr	324T/yr	ND
Stockpiles (tonnes)	0	0	0	0.75	76	0	0.02	ND	ND	0.2	ND	0	0	0	~76	ND	ND	ND	0	ND	ND

Source: ENVIRON Australia Pty Ltd. 2014. Baseline study for the Pacific Hazardous Waste Management Project – healthcare waste. Report submitted to SPREP. Apia: SPREP.

Legend: ND = no data; T/yr = tonnes per year

Other issues of concern identified by the baseline assessment include:

- Poor record-keeping of waste volume data by hospitals;
- Poor maintenance of existing incinerators due to insufficient funding provisions and lack of appropriate maintenance expertise;
- Insufficient allocation of resources for general management of HCW;
- Little understanding of HCW treatment costs; and
- Breakdown in communication between national regulatory bodies (Ministries of Health) and principal HCW generators (hospitals);

The regional PacWaste project funded by the European Union and implemented by SPREP will address many of these issues for priority hospitals, within the available budget. However, there will continue to be a need for additional interventions (e.g., hospitals not covered by PacWaste, or healthcare wastewater) to further reduce the public health risks.

3. Asbestos

Asbestos-containing materials (ACM) such as cement water pipes, corrugated roof sheets, floor tiles, wall claddings, and insulation (e.g. boiler insulation), were widely used in the construction sector in PICTs, prior to being phased-out due to health concerns. Exposure to asbestos fibres causes human cancer of the lung, larynx, and ovaries, and other diseases such as mesothelioma, asbestosis, and plaques (WHO, 2014b as cited in SPREP, 2016). Pacific islanders may unknowingly become exposed to asbestos fibres when working with ACM (e.g., during roof repairs, or boiler repairs), or during the aftermath of a natural disaster involving disturbance and dispersal of ACM.

Based on a regional assessment of 13 PICs (PNG excepted) completed as part of the PacWaste Project, more than 285,784 m2 and 267 m3 of ACM are estimated to be distributed across PICs in stockpiles, abandoned infrastructure, and occupied buildings. Of the total amount, 87% is considered high risk with significant potential for release of asbestos fibres if disturbed and significant health risk to occupants of affected buildings (Table D-6). ACM in Nauru accounts for 74% of the total regional ACM, and all of it is considered high risk.

Asbestos waste is a hazardous waste stream, with no economic value. Minimising public exposure to asbestos fibres will entail urgent and environmentally-appropriate disposal of stockpiles and stabilisation of asbestos in occupied buildings, where appropriate, prior to its eventual removal and disposal.

Table D-6 Confirmed asbestos-containing materials in PICTs

PICT	Estimated quantities of confirmed ACM (m^2)				
	High Risk	**Moderate Risk**	**Low Risk**	**Very Low Risk**	**Total**
American Samoa	No data	No data	No data	No data	No data
Cook Islands	1,450	5,070	0	0	6,520
FSM		823	584	2,150	3,557
Fiji	100	1,720	220	260	2,305
French Polynesia	No data	No data	No data	No data	No data
Kiribati	4,336	5,160	11,196	9,000	39,992
Marshall Islands	0	160	400	300	860
Nauru	21,677	29,492	1,705	0	52,874
New Caledonia	No data	No data	No data	No data	No data
Niue	1,250	45,1753	0	0	46,428
Palau	0	0	513	2001	2,514
PNG	No data	No data	No data	No data	No data
Samoa	520	3955	785	0	5,260
Solomon Islands	0	1,600	1,550	0	3,150
Tokelau	No data	No data	No data	No data	No data
Tonga	2,550	2,020	280	0	4,850
Tuvalu	0	120	130	1	251
Vanuatu	2,000	17,000	300	30	19,330
Wallis and Futuna	0	0	0	0	0
Regional	**33,883**	**112,295**	**17,666**	**13,742**	**187,891**

Source : Contract Environmental Ltd, Geoscience, 2015

Note: High risk = significant potential to release asbestos fibres if disturbed and significant health risk to occupants of affected buildings.

Additional findings from the PacWaste regional asbestos assessment are summarised below:

- Asbestos removed from buildings are typically buried on-site or taken to waste disposal sites.
- There is a good contractor base in most PICTs to support ACM clean-up operations, however, the level and appropriateness of ACM-remediation training and expertise is uncertain, but likely to poor.
- Only a few PICTs have enacted legislation to ban the importation of new asbestos materials.
- Awareness of the negative health effects of asbestos exposure is low among those with high exposure risks.

The PacWaste project will support removal and disposal of stockpiles, and in-situ remediation of ACM in the highest-risk PICs within the available budget. There is likely to be a need for continued ongoing support to address lower-risk ACM, particularly in the face of increased climate change impacts, such as cyclones, which could increase infrastructure damage and dispersal of ACM.

IV. Indicators Based on Macro-level Material Flows

Pacific Island Countries and Territories (PICTs) are small, remote islands, spread over a large geographical area of 30 million square kilometres (SPREP, 2010). Only 2% of the area is land mass with 500 of 7,500 islands inhabited. The population in these islands are typically small. The region's geographical isolation and high vulnerability to natural disasters and impacts of climate change makes economic growth very volatile. The inadequacy of manufacturing and processing industries result in dependence to imported goods with substantial packaging. This contributes to increased generation of wastes.

As a consequence, these communities have unique issues to confront when managing wastes at different levels of the stream, whether it be resource recovery using the 3R + Return practices, treatment or disposal. However, these same limitations drive communities to minimise generation of wastes through environmentally sound systems outweighing the cost considerations of treatment and disposal. The flow of waste materials then becomes the determining factor for resource efficiency and sustainable process.

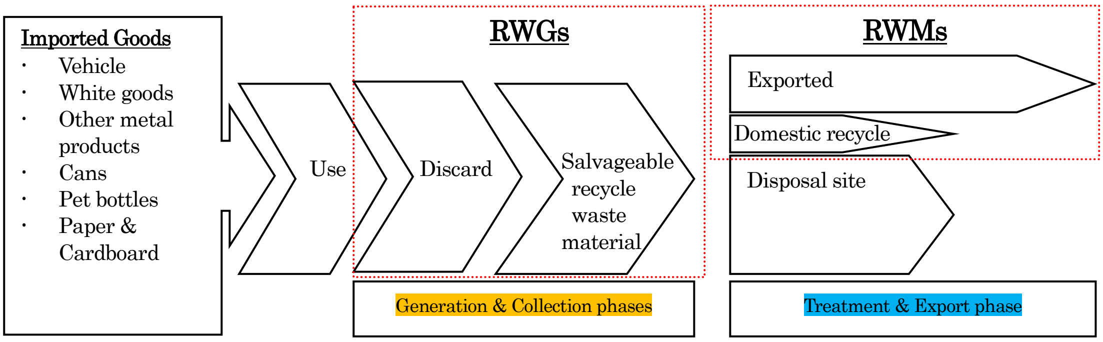
The report on a study on reverse logistics (JICA, 2013) shows a kind of material flow from "recyclable waste goods" to "recycled waste material". The targeted materials are shown in Table D-7.

Table D-7 Targeted recyclable waste goods and recycled waste materials

Recyclable Waste Goods (RWGs)	Recycled Waste Materials (RWMs) suitable for Reverse Logistics
Vehicles	Metal (ferrous, non-ferrous), plastic
White Goods (electrical appliances used in homes and offices)	Metal (ferrous, non-ferrous), plastic
All other metal products that have metallic components excluding the above. Examples of these products include construction equipment, ships, furniture, gas cylinders, heavy equipment,	Metal (ferrous, non-ferrous)
Cans	Aluminum and tin cans
Pet bottles	Plastic
Paper & cardboard	Paper & cardboard

Source: JICA. (2013). Data Collection Survey on Reverse Logistics in the Pacific Islands

The concept of this material flow based on the RWGs and RWMs focuses on specific materials and traverses into two phases: a) Generation and Collection phase and b) Treatment and Export phase (Figure D-2).



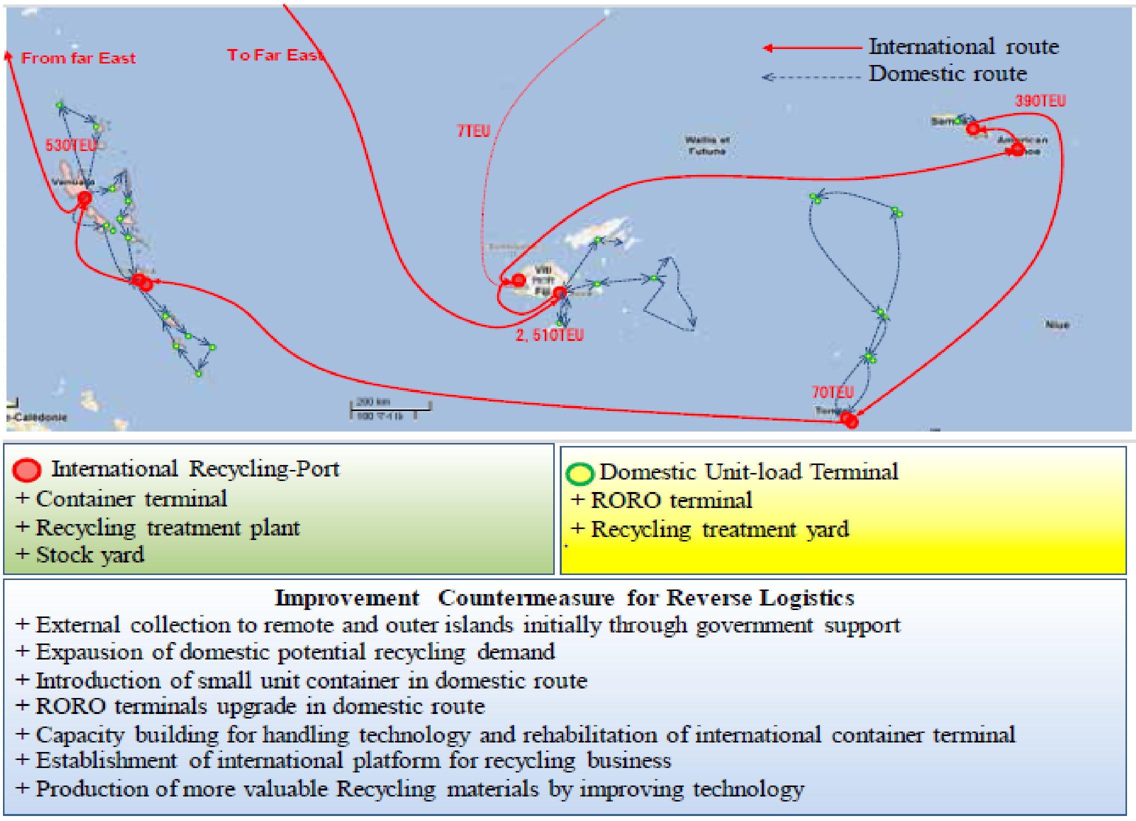
Source: JICA (2013). Data Collection Survey on Reverse Logistics in the Pacific Islands

Figure D-2 Material flow for recyclables

Currently, the flow of materials within the region is not very promising considering the following limitations (JICA, 2013):

- There is no fixed system of collection of RWGs, hardly any source separation and very limited collection in the outer and remote islands.
- The recycling companies do not inject sufficient investments in their operations which affects the quality of their work and low salvage rate for potentially recyclable materials, e.g. from vehicles and white goods.
- There is hardly any domestic demand of the RWGs
- There is none or little international demand for paper and cardboard and pet bottles
- The recycling companies do not meet the requirements of potential international buyers for proper separation of the RWMs
- There is little government support to promote international markets for RWMs originating from the PICs.
- Issues on water transport and port handling, e.g., freight cost, quarantine regulations, access for domestic transport to international ports.

The formation of reverse logistics in the PICs was investigated. The following regional framework was developed. RWGs generated in local islands are expected to be collected and transported to an international port in the main island by domestic shipping. The accumulated RWGs are cleaned, selected, and sorted as commercial commodities and then, stocked in the international port or its vicinity until finally being exported by international shipping.



Source: JICA, 2013, Data collection survey on reverse logistics in the Pacific Region

Figure D-3 Regional framework of reverse logistics in the Pacific Islands

Based on recycling activities and transport of RWGs, the five countries investigated for reverse logistics were categorised (JICA, 2013). Recommended measures to be taken to improve current recycling are shown in Table D-8.

Table D-8 Targeted RWG items and measures to be taken by category

Items	Category I Fiji	Category II Samoa, Vanuatu, Tonga	Category III Tuvalu
Vehicles, White Goods, Heavy Equipment, Cans (Scrap Metals)	· Maximization of international export	· Maximization of international export	· Establishment of intra-regional and international export of RWG
PET Bottles	· Improvement of export, · Examination of domestic recycling business	· Establishment of a collection and export system	· Determination of recycling
Paper, Cardboard	· Maximization of domestic recycling business, · Improvement of international export	· Establishment of a collection system, · Establishment of intra-regional and international export	· Determination of recycling

Source: JICA, 2013, Data collection survey on reverse logistics in the Pacific Region

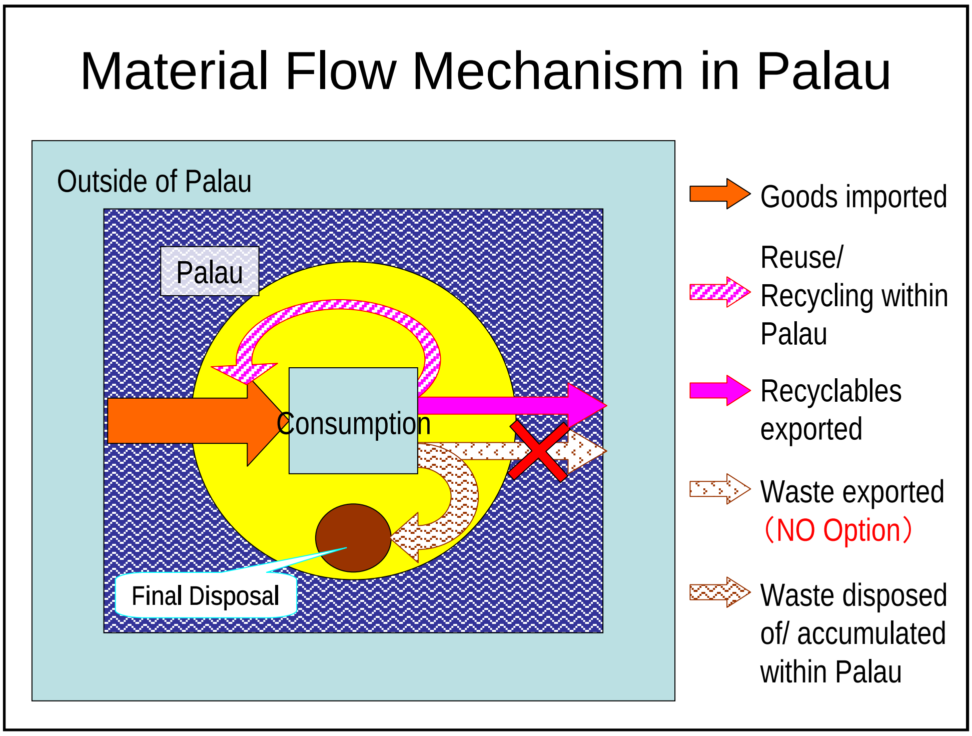
The above targeted items are projected to increase assuming that recycling companies will become more active and respective governments will undertake corrective measures to support the recycling business. The assumed recycling rates based on the same study (JICA, 2013), assumed are shown in Table D-9. The assumed rates are based on estimation methods designed for the reverse logistic study.

Table D-9　Assumed recycling rates in 2011 and 2020

Item	Fiji		Samoa		Tonga		Tuvalu		Vanuatu	
	2011	2020	2011	2020	2011	2020	2011	2020	2011	2020
Vehicles discarded	65%	70%	50%	70%	25%	50%	20%	30%	40%	70%
White goods discarded	20%	50%	30%	40%	10%	20%	20%	20%	30%	40%
Other metal products	85%	90%	50%	60%	1%	5%	20%	25%	60%	70%
Cans	40%	60%	30%	60%	15%	30%	30%	30%	30%	60%
PET bottles	30%	40%	1%	10%	0%	10%	0%	0%	0%	10%
Paper & Cardboard	10%	30%	0%	10%	0%	0%	0%	0%	0%	10%

Source: JICA, 2013, Data collection survey on reverse logistics in the Pacific Region

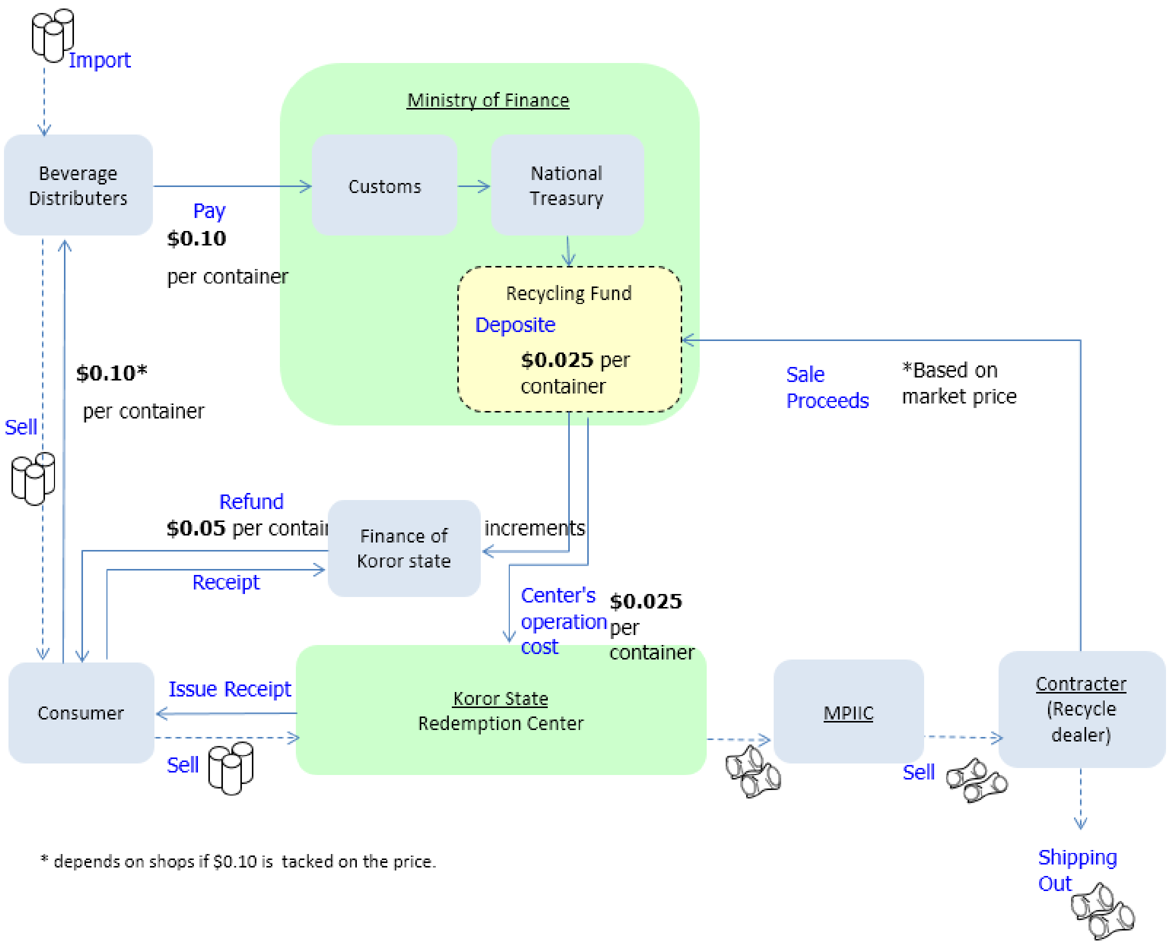
An example of a typical material flow in most PICS is shown in Figure D-4 (Republic of Palau, 2008).



Source: Republic of Palau (2008). Draft of National Solid Waste Management Plan

Figure D-4 Material flow mechanisms in Palau

The Republic of Palau also demonstrates a good flow of recyclable materials which contributes to the success of their recycling initiatives. Through their Beverage Container Recycling Regulation, the Container Deposit Programme in Palau is considered as the most successful sustainable financing mechanism in the Pacific Region. The material flow is shown in Figure D-5.



Source: Republic of Palau. (2008). Draft of National Solid Waste Management Plan

Figure D-5 Flow of beverage containers in Palau

Based on the proper enforcement of the existing regulations in Palau, more than 90% of imported beverage containers are redeemed in the established redemption centre. Table D-10 shows the redemption rate in recent years.

Table D-10 Deposit beverage containers (DBC) redeemed in Palau

FY	No. of DBC Imported	No. of DBC Redeemed	Redemption Average Rate (%)
2011	6,663,590	0	0.00
2012	14,386,027	18,925,157	131.55
2013	15,459,266	15,369,174	99.42
2014	15,798,713	14,678,332	92.91
Total	52,307,596	48,972,663	93.62

Source: JICA (2015). J-PRISM Progress Report

Kiribati also gained national and regional recognition for their Te 'Kaoki Maange' recycling project, which exports aluminum cans, PET bottles and wet cell batteries. As a result, these waste items are now hardly seen lying around on the island and the project helps create jobs and livelihood/additional income for the local community. The following data (Table D-11) were collected from December 2013 to September 2014 (Bwaraniko, 2014).

Table D-11 Redeemed cans and batteries in Kiribati (Dec 2013 to Sept 2014)

Weeks	Collected cans (paid@4cents)	Collected car batteries (paid@$5)
1 – 10	564,070	479
11-20	180,225	490
21-30	483,734	375
31-40	568,765	398
Total estimate of cans collected.	1,796,794 (1.7 million cans)	1,742

Source: Bwaraniko (2014). Kaoki Maange Update

The above data is significantly lower than the previous years as shown in the Table D-12 below. The decrease is attributed to increasing consumption of locally produced kava drink and maintenance issues of the baler equipment which prevented the facility from accepting further cans – lack of enough storage space

Table D-12 Redeemed cans in Kiribati in previous years

Year	Total Al can collection
2011	4180000
2012	4160000
2013	4120000

Source: Bwaraniko. (2014). Kaoki Maange Update

V. Amount of Agricultural Biomass to be Used

The waste composition in the Pacific Island constitute about 43.6% organic waste generally reflected as food and yard waste (SPREP, 2016). In some countries like Vanuatu and Fiji, more than 70% of waste is organic. Unfortunately, waste characterization in the PICs only involve wastes generated by households. There has been no effort, so far, to determine the amount of waste generated specifically by the agricultural sector.

Because of the significant volume of green waste filling up disposal sites in the Pacific Region, composting or chipping are regarded as most attractive waste reduction solutions and practical means to extend the life span of landfills. A number of regional projects identified the implementation of composting programmes as key outcomes, e.g. J-PRISM, GEF-PAS, uPOPs

(Unintentional persistent organic pollutants), Reduction Project.

Table D-13 Organic waste management programmes in PICTs

Country/Territory	Major organic waste management programmes	
	Number	Comments
American Samoa	-	No known composting programmes
Cook Islands	1	Compost programme on Rarotonga, operated by Titikaveka Growers Association
FSM	2	Existing composting site at the College of Micronesia; NGO-based composting effort in Pohnpei
Fiji	5	Composting programmes in several municipal areas: Ba, Lautoka, Nadi, Sigatoka and Suva
French Polynesia	1	Large-scale compost programme on Tahiti, operated by Technival
Guam	1	Composting programme at University of Guam for training purposes
Kiribati	1	Pilot-scale composting programme in South Tarawa implemented through J-PRISM project
RMI	1	Pilot-scale composting programme in Majuro implemented through J-PRISM project
Nauru	-	No known composting programmes
New Caledonia	5	Compost programmes in Pouembout, La Foa, Voh, Houailou and Poya municipalities
Niue	1	Composting programme recently launched
Palau	1	State compost programme at the Koror State Recycling Centre
PNG	1	Pilot-scale composting programme for Port Moresby market waste implemented through J-PRISM project
Samoa	2	Small-scale composting programmes operated by Women in Business Development Inc., and the Ministry of Natural Resources and the Environment
Solomon Islands	2	Composting programme operated in Honiara by Kastom Garden Association (local NGO); pilot-scale programmes introduced in Honiara through the J-PRISM project
Tokelau	-	Majority of organic waste is fed to animals or placed around plants to decompose naturally
Tonga	-	No known composting programmes
Tuvalu	-	No known composting programmes
Vanuatu	2	Composting programmes in Port Vila and Luganville operated by the municipal councils
Wallis and Futuna	1	Small-scale separation and natural decomposition of organic waste at the Wallis landfill.
Total	**27**	

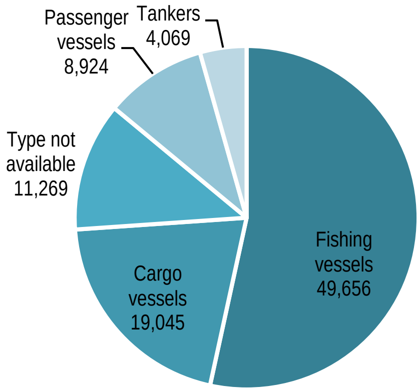
Source: SPREP, 2016

A summary of organic waste recycling programmes in PICTs is provided in Table D-13. There is now a need for further development of national organic waste recycling programmes that also integrate management of other organic waste streams such as animal waste. This is particularly important in atoll environments, where compost has a vital role to play in supporting agricultural development by improving the nutritional profile and physical properties of native soils, and where poorly managed animal (and human) waste is a major pollutant of ground water and lagoon environments.

VI. Marine & Coastal Plastic Waste Quantity (Primary)

1. Marine Pollution

The total amount of shipping traffic (number of movements) in the Pacific islands region in 2013 was 92,963 as shown in Figure D-6 (SPREP, 2015a).



Source: SPREP (2015a). Pacific ocean pollution prevention programme (PACPOL) 2015-2020: strategy and work plans

Figure D-6 Shipping traffic in PICTs

The Pacific islands are particularly susceptible to shipping impacts, due to the special value and sensitivity of their coastal environments and the current inadequacy of regional and national capacity to address marine pollution. The issues related to ship-sourced marine pollution in the Pacific region include:

- Severe pollution of water and sediments in many ports in the region;
- The leaching into the sea of toxic chemicals from anti-fouling paints on ships' hulls;
- The disposal at sea of ships' wastes (including waste oil, sewage, plastics, and other garbage) and other wastes (as defined by the London, MARPOL, and Noumea Conventions);
- Marine litter including plastics, general garbage, and abandoned, lost and/or otherwise discarded fishing gear (SPREP, 2014);
- Inadequate facilities to receive ships' waste in regional ports (SPREP, 2015b);
- Potential major source of oil pollution from the sunken wrecks from the Second World War;
- Vessel grounding and sinking, which may result in physical damage to fringing coral reefs, in addition to shipping accidents sometimes resulting in catastrophic releases of oil and other contaminants;
- The potential inaccuracy of navigation charts, the poor standards of navigation aids, and the relatively low standards of maritime training compared to other regions of the world;

- The translocation and introduction of marine species attached to ships' hulls and within ships' ballast tanks across environmental barriers (SPREP, 2006); and
- Coastal and marine environmental impacts from the development and operation of ports which serve the shipping industry.

The capacity of PICTs to prevent and respond to shipping impacts is currently limited, and most countries do not have adequate pollution prevention and response plans (PACPLANs). In addition, several PICs have not become Party to the various conventions and protocols relating to the protection of the marine environment, including the MARPOL, London, and Noumea Conventions.

To address these inadequacies, SPREP has been implementing the Pacific Ocean Pollution Prevention Programme (PACPOL) in partnership with the IMO since 1998. The first and second PACPOL strategies were approved in 1998 and 2009 respectively, and the third and current PACPOL strategy (SPREP, 2015) was approved by SPREP Member governments in 2014 to cover the 2015-2020 strategic period.

The 2015-2020 PACPOL strategy was approved as a stand-alone document prior to the development of this integrated waste and pollution strategy; consequently, the key elements of PACPOL have been adapted and incorporated into this integrated strategy.

2. Marine Litter

With 98% of the SPREP region covered by ocean, marine litter impacts to ecosystems and coastal communities are heightened by the reliance of island countries upon healthy ocean ecosystems and services. PICTs can be particularly vulnerable to marine litter impacts due to financial and institutional challenges in properly managing waste before it is transferred to the marine environment and from the negative socioeconomic impacts of marine litter, especially on poorer coastal communities (Richardson, 2015).

The extent of the marine litter problem (quantities of litter, dispersal pathways, and fate) in the Pacific region has not been comprehensively documented, however, the limited information that is available strongly suggests that marine litter is not appropriately managed in most Pacific island communities. Additionally, many PICTs have no current systematic management plan or system for marine litter prevention, management, and clean up/recovery (Richardson, 2015).

While marine litter can be found everywhere in the Pacific region, there is often very little awareness of this problem as an environmental and socioeconomic issue or about its impacts upon local communities. Raising awareness of the marine litter issue among Pacific islanders can create incentives for greater investment in, and prioritization of this issue among a variety of stakeholders including governments, industry, academia, NGOs and citizens (Richardson, 2015).

Very little research has been done on land- and sea-based sources, fate and impacts of marine litter in the Pacific region, which can be used to inform regional and national strategies and policymaking. Of particular relevance is the need for modelling and monitoring; investigations into ALDFG including Fish Aggregating Devices; and identification of major marine litter accumulation and hot spot areas in the region to allow for targeted recovery and clean-up efforts (Richardson, 2015).

Marine litter minimization and management programmes and projects require financing for appropriate coverage and success. This is especially the case for projects that target extensions of plastic waste management infrastructure to decrease sources of marine plastic litter. There are currently no national budgets allocated for marine litter management in the Pacific islands region (Richardson, 2015).

Recently, SPREP launched pilot litter boom projects in Samoa and Solomon Islands which intend to control and assess the amount of wastes potentially thrown in the coastal areas. The Samoa project was a collaborative undertaking with the government of Samoa through its health and environment ministries in preparation for the 3rd UN SIDS conference held in Samoa in September 2014.

VII. Amount of E-waste Generation, Disposal and Recycling & Existence of Policies and Guidelines for E-waste Management

The precise scale of the E-waste problem in PICTs is difficult to quantify due primarily to the limited availability of importation, recycling, and disposal data in individual PICTs. Nonetheless, conventional wisdom dictates that the importation of electrical and electronic equipment will increase and E-waste will grow with the economic development of PICTs. Expansion in the provision of power, telecommunication, health, and educational services in PICTs will also contribute to the growth of E-waste from unwanted domestic appliances, mobile phones, electrical and electronic medical equipment, and computers.

Baseline E-waste assessments in 9 PICTs were completed in 2013 (Leney, 2013) and 2014 (Leney, 2014) with funding support from the PacWaste Project, and the small scale E-waste project carried out in the Cook Islands, Kiribati, and Samoa utilising funding from the Strategic Approach to international Chemicals Management (SAICM).

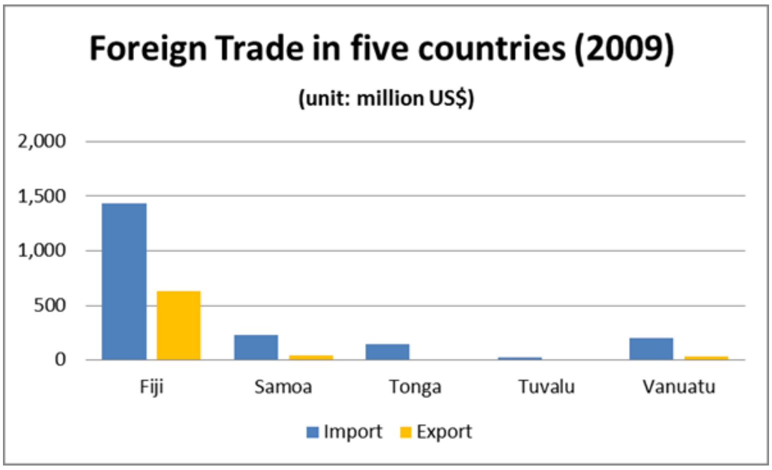
Current E-waste management practices in PICTs include repair and cannibalisation of spare parts by privately-run service shops; acceptance, dismantling, and export by private recyclers; and disposal in dumps and landfills with domestic rubbish. There are no known regular collection programs for E-waste in PICs, and most E-waste that is recovered is brought in by the public (private individuals, institutions, commercial entities), or separated at the disposal site tipping face by waste pickers, and sold to recyclers. Whilst E-waste stockpiles exist (typically in government institutions and some commercial establishments), the specific quantities have not been measured.

In December 2010, the Cook Islands implemented an E-day resulting in the collection and export of 5,154 items of E-waste (without dismantling) to New Zealand for safe recycling and disposal at a total cost of US$ 78,987, not including the cost of significant local business sponsorship, and raffle prizes to encourage E-waste drop-offs (Leney, 2013 as cited in SPREP, 2016). The Cook Islands E-day proved to be an expensive exercise not likely to be replicable in other PICTs, however, it yielded data that could be used to inform the development of sustainable E-waste recycling programmes, and also helped to publicise the importance of the issue in the region.

General E-waste management is deemed a priority for Cook Islands, Fiji, Kiribati, Palau, Samoa, Solomon Islands, Tonga and New Caledonia, while addressing the management of mobile phones is a priority for the Solomon Islands and Vanuatu. Priorities for the development of sustainable E-waste management programmes in the region include the introduction of extended producer responsibility schemes supported with an advance recycling fee that creates a value chain for E-waste; and capacity development of the private waste recycling sector to execute safe and cost-effective E-waste recycling operations. As of 2015, New Caledonia is the only PICT implementing an EPR scheme for E-waste, with potentially useful lessons for the rest of the region. New Caledonia's EPR scheme is executed by a non-profit environmental organisation (TRECODEC) that collects e-waste through voluntary drop-off receptacles and from authorised dumps. Consumers making new equipment purchases can also bring in their old equipment for recycling.

VIII. Existence of Policies, Guidelines, and Regulations Based on the Principle of Extended Producer Responsibility (EPR)

As mentioned earlier, the volatility of the economies of Pacific Island countries limit opportunities to produce own goods. This results in very heavy dependency on importation of consumer goods (Figure D-7). Various commodities, food, machines, clothes and transportation vehicles are imported. Only first industry production, sugar, fish and copra are export commodities (JICA, 2013).



Source: International Trade Statistics 2010, UN

Figure D-7 Foreign trade statistics in selected PICTs

The number of registered vehicles in some countries is steadily increasing. In Fiji, 2000 vehicles are registered each year and the total reached over 81,000 in 2011. Samoa started importing a lot of vehicles in 2009 and registered vehicles increased from 11,500 in 2009 to 16,394 in 2011 (JICA, 2013).

These imported vehicles apart from other bulky wastes such as white goods are likely to be disposed in the countries when they reach their end-of-life. It is, therefore, very important for the PICs to start exploring options to manage these wastes in the future including resource mobilisation. The extended producer's responsibility (EPR) principle is believed to be a viable option to consider. However, countries in the Pacific Region have not adopted any specific policy on EPR yet, let alone a regional guidance to support the PICs on making informed decisions in this respect. New Caledonia, a French territory in the Pacific, adopts the EPR principle in most of its hazardous substances and is keen to improve the EPR chain to include other goods.

The vast majority of recycling activities in PICTs are led by the private sector and are driven by prices in the international recycling commodity markets. Whilst recycling plants exist in Fiji for paper and lead acid batteries, and in Palau for converting plastics to oil, the vast majority of recycling activities are limited to the consolidation, and export (typically to East Asia, Southeast Asia, Australia, and New Zealand) of valuable commodities such as aluminium beverage cans, ferrous and non-ferrous scrap metal, and used lead acid batteries.

Selected PICTs have successful recycling programmes as mentioned elsewhere, e.g. Kiribati, FSM (Yap and Kosrae States), New Caledonia, and Palau. These recycling activities are incentivised by container deposit legislation (CDL). Countries implementing the CDL programme are already considering expansion of the programme targeting other goods such as vehicles, white goods and e-wastes apart from beverage containers. This and other sustainable financing mechanisms will definitely help to sustain the recycling programme in the region in the face of fluctuating commodity prices.

IX. GHG Emission from Waste Sector

While climate change is the top priority issue in the Pacific, the linkage between climate change and waste is very weak. There are very limited regional programmes which can investigate resilience to climate change and disasters through proper disaster waste management or assessment of emissions resulting from waste services such as collection, transport and disposal.

Currently, there is no measurement and tracking of greenhouse gas (GHG) emissions from the waste sector in the Pacific although it is assumed that GHG from waste in the Pacific constitutes a minute fraction. The regional waste and pollution management strategy or Cleaner Pacific 2025 (SPREP, 2016), however, considers assessment of GHG footprint of waste, chemical and pollutant (WCP) management activities as a strategic action required and a number of countries committed to undertake this, i.e. Cook Islands, Marshall Islands, Palau, Tuvalu, Solomon Islands, New Caledonia and Federated States of Micronesia.

The 3R activities and proper waste management are cost-effective climate adaptation and GHG mitigation strategies, since less waste means reduced pressure on landfills and fewer GHG – emitting management steps during collection, treatment, and disposal. In 2012, SPREP in collaboration with J-PRISM implemented a component of the International Climate Change

Adaptation Initiative Project (AdaptWaste). This is funded by Australian Department of Foreign Affairs and Trade (DFAT) which sought to demonstrate the integration of climate change adaptation into the waste management sector, in terms of 'climate-proofing' a dumpsite and coping with disaster wastes in Fiji. The following outputs were delivered from this pilot project.

- An open dumpsite improvement in Labasa, Fiji using the semi-aerobic landfill system was completed with J-PRISM Technical Assistance.
- The landfill operational manual was developed and the landfill operators were trained to comply with the procedures in the manual.
- A review of options for climate change adaptation in the waste sector was completed.
- The disaster waste management guidelines was developed and submitted for endorsement by the National Disaster Management Office of Fiji with the aim of integrating disaster waste management in the overall disaster management plan.

SPREP is now putting priority on disaster waste management as a collaborative undertaking between its Climate Change Division and Waste and Pollution Control Division. Disaster waste management is also one of the key strategic actions in the next 10-year regional strategy (SPREP, 2016).

It is recognised that semi-aerobic landfill contributes to reductions in GHG through the production of carbon dioxide over the more potent methane gas. This method is accredited as a new emission-reduction method under the Clean Development Mechanism of the UNFCCC.

JICA and subsequently through J-PRISM supported the rehabilitation of disposal sites in the Pacific, particularly in Samoa, FSM, Palau, PNG, Solomon Islands, Vanuatu, Fiji, and Tonga through conversion of open dumpsites to semi-aerobic landfills through the Fukuoka method. Unfortunately, the impacts of these changes on reduction of GHG emissions have not been investigated yet and no data are presented to validate the claim.

Estimates of potential GHG emissions from 2016 to 2025 using waste data from Baruni Landfill in Port Moresby reveal that the rehabilitation of the said landfill using Fukuoka or semi-aerobic landfill method can potentially lower the amount of GHG emission from 88,635 of CH_4 (tCO_2/yr) to 49,857 of CH_4 (tCO_2/yr) which equates to a reduction of 38,778 of CH_4 (tCO_2/yr). This implies that the use of semi-aerobic landfilling system can significantly contribute to the reduction of GHG emissions. However, this estimate is quite crude and needs more thorough investigation. The outcome of the estimation is shown in Table D-14. The estimation was done using the data from the draft Solid Waste Management Plan of the National Capital District Commission District (2015) for the period 2016 – 2025 and calculation was based on the equations extracted from IPCC (2006) as shown below. The parameters used for calculation are shown in Table D-15.

$$PE_{with} = 0.9 \times (1-f) \times 21 \times (1-OX) \times \frac{16}{12} \times 0.5 \times 0.5 \times MCF \times \sum_{x=1}^{y} \sum_{j}^{n} W_{j,x} \times DOC_j \times e^{-k_j(y-x)} \times \left(1 - e^{-k_j}\right)$$

$$BE_{CH4,SWDS,y} = \varphi \times (1-f) \times GWP_{CH4} \times (1-OX) \times \frac{16}{12} \times F \times DOC_f \times MCF \times \sum_{x=1}^{y} \sum_{j}^{n} W_{j,x} \times DOC_j \times e^{-k_j(y-x)} \times (1-e^{-k_j})$$

$$= 0.9 \times (1-f) \times 21 \times (1-OX) \times \frac{16}{12} \times 0.5 \times 0.5 \times MCF \times \sum_{x=1}^{y} \sum_{j}^{n} W_{j,x} \times DOC_j \times e^{-k_j(y-x)} \times (1-e^{-k_j})$$

Where:
BE - the amount of GHG emissions without rehabilitation of the landfill
PE - the amount of GHG emissions with rehabilitation using semi-aerobic landfill method
BE-PE=the total amount of GHG reduction by rehabilitation (tCO_2) per year.

Table D-14 Estimate of GHG emissions from the Baruni Landfill from 2016 to 2025

Activity	Potential GHG emissions (tCO_2/yr)
Without rehabilitation	88,635
With rehabilitation	49,857
Amount of GHG potentially reduced	38,778

Source: Calculated estimates by Tsukiji Makoto based on equation used in the JICA Report (2009a).

Table D-15 Parameters used to calculate potential GHG emissions

Parameter	Without	With
φ	0.9	0.9
f	0	0
F	0.5	0.5
DOCj	Default, 2006 IPCC guidebook National GHG Inventories, Volume 5 “Waste” Table 2-4	
DOCf	0.5	0.5
MCF	0.8	0.5
GWPCH4	21	21
OX	0	0.1
Wj,x	NCDC Solid Waste Management Plan 2016 - 2025 (Draft) and the estimation calculated by Mr. Riad, J-PRISM expert, 2015	
kj	Tropical (MAT*>20°C) Wet (MAP*)>=1,000mm)	
j	1. Grass/leaves/woods, 2. Paper, 3. Food, 4. Textiles, 5. Inert material	
x	2016 - 2025	
y	2025	2025

Sources: JICA Report, 2009a, (http://open_jicareport.jica.go.jp/pdf/11937349_03.pdf)

E: EXPERTS ASSESSMENT ON 3R POLICY IMPLEMENTATION

The limitations and challenges faced by countries in the Pacific Region in all respects make it difficult to implement ideal waste management systems which have worked well in Asia or any other more developed regions in the world. As in most countries, economic, social, cultural, political and environmental issues come into play.

The economies of most Pacific Island countries are very volatile. Because of geographical isolation, trade and business becomes very limiting due to high shipping costs, low demand for certain products owing to low population and certain land tenure issues which investors have to factor in when considering setting up businesses in a certain area. This leaves countries with no option but to import goods which accounts for trade imbalances with imports substantially outdoing exports. This results in having goods with high potential waste generation to remain in the countries. With limited resources (financial and human) to manage waste, this overburdens disposal sites.

The Pacific Region is mostly marine with only 2% land mass and only 500 of the 7500 islands habitable so this restricts further development of new disposal sites or even expansion of existing sites. This creates a major challenge for countries. In fact, most atoll countries are forced to use the ocean or lagoons as disposal sites with a certain degree of intervention that will minimise marine pollution. The availability of coral sand in these countries seem to blend well creating a buffering barrier between the disposal site and the ocean. This worked well in Tarawa, Kiribati and water quality outside the disposal site surrounded by coral sand bags seem to be acceptable. This is one area which SPREP would want to collaborate with research institutions on having more science-based waste management systems.

The limited availability of land for disposal also calls for countries to look into diverting as much waste as possible from the landfill. The driver to implement 3R in the Pacific Region is very obvious yet logistical considerations seem to be not working in favour of these environmentally sound systems. For one, very high freight costs would not allow shipment of certain recycled wastes out of the countries. The oftentimes non-profitable recycling business environment prevents international or local ventures. The study on reverse logistics involving five countries representative of the Pacific Region presents some good options to provide cost-effective shipment of incoming recyclable goods and outgoing recycled wastes.

The composition of waste in the region consists of about 44% organic wastes and 43% potentially recyclable wastes such as plastics, metals and paper. The significant amount of organic wastes generated offer huge opportunities to process most wastes within the countries with no requirement to ship out. If processing of green waste and food waste is pursued by countries, there will be huge benefits to using the resulting compost or mulch to improve soil health and increase the productivity of agricultural lands. Almost all the countries in the Pacific Region have agriculture-based and tourism-based economies. Providing more opportunities for agricultural development will definitely boost rural livelihood, food security and improve trading status. More importantly, diverting organic waste will allow control of pollution emanating from disposal sites and will extend the life span of the landfills.

The recovery of resources from waste has been promoted globally and the region is espousing the same desire to minimise waste amidst the challenges described above. Although beset with the issue of economy of scale, the 3R initiatives, if well planned, implemented and driven by public-private partnerships can lead to more sustainable management of waste in the Pacific. J-PRISM also advocates the principle of an extended 3R+return principle which is very adaptable to Pacific's unique conditions. The advocacy is to extend resource recovery to returning the recycled materials (compost and recyclables) to where they originate, i.e. the soil for composts and the manufacturers of goods for recyclables.

Amidst the challenges faced in running waste processing and recovery systems to reduce volumes of wastes coming to the landfills, there are a number of avenues to provide sustainable financing mechanisms such as EPR, user pay system, polluter pays system, import levy, etc. However, there may be political and social implications attached to the implementation of these mechanisms but the long-term benefits will outweigh the short –term impacts these may cause on the stakeholders. Well-financed and well-planned waste management systems can assure stakeholders of a cleaner and safer environment in the future and the basic essence of sustainable development, i.e. not compromising the resources for future generation, will be achieved.

The Pacific Region, since the inception of regional waste management projects including the adoption of the first Regional Solid Waste Strategy in 2005 apart from being parties to International Conventions, has made great progress in the waste sector. A number of critically sensitive disposal areas have been rehabilitated, waste policies have been adopted, waste management strategies and plans have been developed and implemented, composting and recycling programmes have been piloted, waste collection services have been improved and coverage expanded, waste shipments organised, inventory and remediation of certain hazardous wastes undertaken and a whole lot of community awareness programmes have been implemented with the aim of instituting behavioural changes.

Despite these successes, there remains a lot more to be progressed, e.g. waste data collection and management, exploring options for atoll wastes, integration of disaster waste management in the overall disaster response procedures, removal of radioactive wastes, shipwrecks, sustainable financing mechanisms, implementation and dissemination of best practices in waste management, building up of institutional capacities of countries including training of waste service providers and a whole array of actions that will result in the further improvement of waste management in the Pacific.

The most recent Pacific Regional Waste and Pollution Management Strategy (Cleaner Pacific 2025) clearly sets strategic and tactical direction which will assist countries in prioritizing waste, chemical and pollutant (WCP) activities with the vision of having a much cleaner Pacific environment in 2025. The clear goals are there yet the waste sector has to struggle to raise the profile of waste management in the region because it is still widely believed that the issue of climate change in view of more frequent disasters occurring in the region takes priority.

Countries in the Pacific Region are very passionate in expressing their desire to improve their environment but most of them have their hands tied due to insufficient resources to allow things to happen. Hopefully, in the recently concluded Clean Pacific Roundtable held in Fiji (25 to 28 July 2016), there will be better donor coordination mechanisms and resource mobilisation based on identified gaps and opportunities. The Roundtable is meant to be institutionalised with the intent of monitoring and reporting the progress of the Cleaner Pacific 2025.

REFERENCES

Asian Development Bank. (2007). Oceanic voyages: Shipping in the Pacific. Philippines: Asian Development Bank. Retrieved from http://www.adb.org/sites/default/files/publication/29760/shipping-pacific.pdf

Australian Bureau of Meteorology and CSIRO. (2011). Climate Change in the Pacific: Scientific Assessment and New Research. Volume 1: Regional Overview.

Bwaraniko. (2014). Kaoki Maange Update. Tarawa: PPU/MELAD.

City of Noumea. (2013). Diagnostic Territorial: Programme Local de Prévention des Déchets [Territorial diagnostics: Local waste prevention programme]. Retrieved from http://www.nouvelle-caledonie.ademe.fr/sites/default/files/files/domaines-intervention/dechets/diagnosticeterritorial-plan-action-ville-noumea.pdf

Contract Environmental Ltd, Geoscience. (2015). Survey of the regional distribution and status of asbestos-contaminated construction material and best practice options for its management in Pacific island countries. Report prepared for SPREP. Contract Environmental Ltd.

Cook Islands . (2013). National Solid Waste Management Strategy 2013 - 2016.

Cook Islands. (2004). Public Health Act 2004.

D'Este, G., Clause, A., Hamilton, D., Moala, P., & and Tupou, K. (2012). Tonga National Infrastructure Investment Plan 2013-2023. Kingdom of Tonga.

ENVIRON Australia Pty Ltd. (2014). Baseline study for the Pacific hazardous waste management project - healthcare waste. Report submitted to SPREP. Apia: SPREP.

Fedearated States of Micronesia. (2010). National Solid Waste Management Strategy 2010 - 2014.

Fiji. (2005). Environmental Management Act 2005.

FSM Office of Statistics, Budget, Overseas Development Assistance and Compact (SBOC). (2011). Summary analysis of key indicators from the FSM 2010 census of population and housing. Pohnpei: SBOC.

Government of Samoa. (2010). Waste Management Act 2010.

Government of Tuvalu. (2009). Waste Operations and Services Act 2009.

Government of Vanuatu. (2014). Waste Management Act 2014.

Ha Noi 3R declaration: sustainable 3R goals for Asia and the Pacific for 2013 ‐ 2023. (2013). Retrieved from United Nations Centre for Regional Development: http://www.uncrd.or.jp/content/documents/659Hanoi-Declaration_Eng.pdf

IMO. (2015). IMO: marine environment. Retrieved from http://www.imo.org/OurWork/Environment/Pages/Default.aspx

IPCC. (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5: Wastes. Retrieved from http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html

JICA. (2009). Waste minimisation and recycling promotion project in the Republic of the Fiji Islands. JICA.

JICA. (2009a). http://open_jicareport.jica.go.jp/pdf/11937349_03.pdf. Retrieved from http://open_jicareport.jica.go.jp/pdf/11937349_03.pdf

JICA. (2013). Data Collection Survey on Reverse Logistics in the Pacific Islands. The Overseas Coastal Area Development Institute of JAPAN.

Kingdom of Tonga. (2005). Waste Management Act 2005.
Kiribati. (2008). National Solid Waste Strategy 2008 - 2011.
Koshy, K., Mataki, M., & Lal, M. (2008). Sustainable development - a Pacific islands perspective: a report on follow up to the Mauritius 2005 review of the Barbados Programme of Action. Apia: UNESCO Cluster Office for the Pacific States.
Leney, A. (2014). E-waste country assessments: e-waste generation and recycling, and the potential for interventions by PacWaste. Report prepared for SPREP. Apia: Samoa. Apia: SPREP.
Leney, A. (2013). Review of regional e-waste recycling including a model product stewardship approach for Pacific island nations. Report prepared for SPREP. Apia: Samoa.
McIntyre, A., Bell, B., & Uta, S. (2012). Tuvalu Infrastructure Strategy and Investment Plan. Funafuti: Government of Tuvalu.
Ministry of Environment, Lands and Agricultural Development. (2012). The Real Rubbish News, June 2012. Retrieved from http://www.solutionexchange-un.net/repository/pc/ccd/cr14-res1.pdf
Murzilli, S., Almodovar, N., Deschamps, L., Flenet, L., Egretaud, C., Jouvin, B., & Laplane, L. (2012). Evaluation of waste disposal and analysis of the waste management system in French Polynesia (in French). Tahiti, French Polynesia: Ministère de l'environnement, de l’énergie et des mines.
National Capital Commission District. (2015). Draft Solid Waste Management Plan 2016 - 2025. NCDC & J-PRISM.
National Capital District Commission. (2014). How much solid waste are Port Moresby citizens generating? Retrieved from http://www.jica.go.jp/png/english/activities/c8h0vm00008t3uoe-att/activity13_04.pdf
National Oceanic and Atmospheric Administration, 2013. Ocean Explorer. Retrieved from http://oceanexplorer.noaa.gov/facts/rof.html
Niue Island. (2010). National Integrated Waste Management Strategy 2010 - 2015.
Office of the Auditor-General of PNG. (2010). The Effectiveness of Solid Waste Management in Papua New Guinea: Performance Audit Report No. 01/2010. Retrieved from https://pngexposed.files.wordpress.com/2011/08/report.pdf
O'Reilly, M. (2014). Luganville waste characterisation report. Luganville, Vanuatu: Luganville Municipal Council.
Overseas Coastal Area Development Institute of Japan. (2013). Data collection survey on reverse logistics in the Pacific islands: final report. Report prepared for JICA. Tokyo: JICA.
Pacific Regional Infrastructure Facility (PRIF). (2011). Pacific Infrastructure Performance Indicators. Sydney: PRIF.
PIFS. (2014). Framework for Pacific regionalism. Suva: PIFS.
Pratt, C., & Govan, H. (2010). Framework for a Pacific oceanscape: a catalyst for implementation of ocean policy. Retrieved from http://www.forumsec.org.fj/resources/uploads/embeds/file/Oceanscape.pdf
Raj, S.C. (2000). Solid waste education and awareness in Pacific island countries. Apia: SPREP.
Republic of Nauru. (2011). National Solid Waste Management Strategy 2011 - 2020.
Republic of Palau. (2008). Draft of National Solid Waste Management Plan.
Republic of the Marshall Islands. (2012). Draft National Waste Management Strategy 2012 -

2016.
Richards, Esther and Haynes, David. (2014). Solid Waste Management in Pacific Island. In P. Agamuthu and M. Tanaka (eds.), Municipal Solid Waste Management in Asia, Environmental Science and Engineering, Singapore.
Richardson, K. (2015). The need for a regional approach for marine litter minimization and management. Unpublished report prepared for SPREP.
Roadmap Technical Working Group. (2014). Strategy for Climate and Disaster Resilient Development in the Pacific. Retrieved from http://www.pacificdisaster.net:8080/Plone/roadmap
Samoa Ministry of Natural Resources & Environment. (2008). Draft National Solid Waste Management Strategy 2008 - 2018.
SIDS Aaccelerated Modalities of Action (S.A.M.O.A) Pathway. (2014). Retrieved from http://www.sids2014.org/index.php?menu=1537
Solomon Islands. (2009). National Solid Waste Management Strategy.
SOPAC, & ADB. (2003). Pacific regional action plan on sustainable water management. Retrieved from http://www.pacificwater.org/userfiles/file/Pacific%20RAP%20on%20SWM.pdf
SOPAC, & SPREP. (2001). Pacific wastewater framework for action. Retrieved from http://iwlearn.net/iw-projects/3181/reports/pacific-wastewater-framework-for-action
SOPAC, & SPREP. (2001). Pacific wastewater policy statement. Retrieved from http://pacificwater.org/userfiles/file/water%20publication/WastewaterPolicy.pdf
SPC. (2005). Pacific islands regional ocean policy and framework for integrated strategic action. Suva: SPC.
SPC. (2015a). Member Countries. Retrieved from http://gsd.spc.int/member-countries
SPREP. (2005). Solid Waste Management Strategy for the Pacific Region. Apia: SPREP.
SPREP. (2006). Shipping-related introduced marine pests in the Pacific islands: a regional strategy. Retrieved from https://www.sprep.org/Waste-Management-and-Pollution-Control/Marine-Terrestrial-Pollution/
SPREP. (2010). Pacific Regional Solid Waste Management Strategy 2010 - 2015.
SPREP. (2011). An Asbestos-Free Pacific: A Regional Strategy and Action Plan.
SPREP. (2012). Pacific E-waste: A Regional Strategy and Action Plan.
SPREP. (2013). Pacific Healthcare Waste: A Regional Management Strategy and Action Plan 2013 - 2015.
SPREP. (2014). Marine debris pollution in the Pacific. Retrieved from https://www.sprep.org/Waste-Management-and-Pollution-Control/Marine-Terrestrial-Pollution/
SPREP. (2015). Pacific Ocean Pollution Prevention (PACPOL) Strategy 2015 - 2020.
SPREP. (2015a). Pacific Ocean Pollution Prevention Programme (PACPOL) 2015-2020: strategy and work plans. Apia: SPREP.
SPREP. (2015b). SPREP region regional reception facilities plan: draft. Retrieved from https://www.sprep.org/Waste-Management-and-Pollution-Control/Marine-Terrestrial-Pollution/
SPREP. (2016). Cleaner Pacific 2025: Pacific Regional Waste and Pollution Management Strategy 2016 -2025. Apia: Samoa: SPREP.

Tonga. (2013). National Integrated Waste Management Strategy for Tonga.
UNDESA Population Division. (2014). World Urbanization Prospects: The 2014 Revision. CD-ROM Edition.
United Nations Conference on Trade and Development. (2014). Small island developing states: Challenges in transport and trade logistics, TD/B/C.I/MEM.7/8. Retrieved from http://unctad.org/meetings/en/SessionalDocuments/cimem7d8_en.pdf
Vanuatu. (2011). National Waste Management Strategy and Action Plan 2011 - 2016.
WHO. (2005). Pacific framework for action on drinking water quality and health. Retrieved from http://www.pacificwater.org/userfiles/file/DWQ%20and%20Health.pdf
WHO. (2014a). Safe management of wastes from health-care activities, Second edition. (Y. Chartier, E. Jorge, U. Pieper, A. Pruss, P. Rushbrook, R. Stringer, R. Zghondi, Eds.) Geneva: World Health Organization.
WHO. (2014b). Asbestos: elimination of asbestos-related diseases, Fact sheet No 343. Retrieved from http://www.who.int/mediacentre/factsheets/fs343/en/
World Bank. (2014). GDP per capita (constant 2005 US$). Retrieved from http://data.worldbank.org/indicator/NY.GDP.PCAP.KD?display=graph