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The research was conducted by Anne Prince and Debra Mackeen, following desktop data analysis, extensive consultations and visits to Fiji, Palau, Samoa and American Samoa, Solomon Islands and Vanuatu.

The project is managed by Jack Whelan, Secretariat Manager, PRIF Coordination Office, guided by a technical implementation committee including specialists from PRIF member agencies and in partnership with the Secretariat of the Pacific Regional Environment Programme (SPREP). The Asian Development Bank provided administrative support.

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Foreword

This compendium of Pacific Country and Territory Profiles in the solid waste and recycling sector is published as part of a PRIF sponsored study that seeks to identify and quantify the opportunity to improve the resource recovery of fifteen common commodities[1] present in the solid waste stream in fifteen Pacific island countries and territories[2] (PICs).

The first phase of the study conducted a material flow analysis of imports and exports, estimated the available materials for recovery and quantified the expected increase in commodities based on various policy interventions. The study also identified waste disposal infrastructure and service provision, reviewed current institutional frameworks, identified port infrastructure and shipping logistics and estimated plastic marine debris in the Pacific nations.

The Country and Territory Profiles were prepared detailing country-specific information which was used to inform other elements of the research. The study examined further the potential to establish a regional network to improve the recovery, and where feasible, recycling of solid waste, in a manner that meets economic, social and environmental objectives.

Pacific island countries face significant challenges in providing sustainable management systems for an increasing and diversifying range of waste materials, driven mainly by changing urbanisation patterns, globalised markets, wealth redistribution and the resultant changing lifestyles. Most countries across the world are facing similar barriers to achieving cost-effective and efficient waste and recycling systems. However, these challenges are magnified for the PICs as a result of their unique circumstances, including:

- geographical isolation;
- limited availability of environmentally suitable land for the construction of waste management infrastructure;
- high costs of servicing small and largely dispersed populations;
- an inability to achieve critical mass due to a relatively small consumer base;
- relative financial disadvantage where eight of the 15 countries are in the lower to middle gross national income bracket.

Additionally, many PICs are heavily reliant on imported goods, international development assistance and are often remote from international recycling markets. These countries are also extremely vulnerable to the impacts of climate change and severe weather events which can generate shock loads to normal waste levels.

1 *PET (plastic) beverage containers; Glass bottles; Steel cans; Aluminium cans; Paper and cardboard; Electronic 'E-waste'; White goods; Used oil; Used lead-acid batteries; Lithium batteries; Scrap steel, ferrous and non-ferrous metals; Tyres; End-of-life vehicles; End-of-life renewable energy equipment, for example, solar panels and inverters; plastic shopping bags.*

2 *Cook Islands, Fiji, Federated States of Micronesia (FSM), Guam, Kiribati, New Caledonia, Palau, Papua New Guinea (PNG), Republic of the Marshall Islands (RMI), Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu, Vanuatu.*

Background

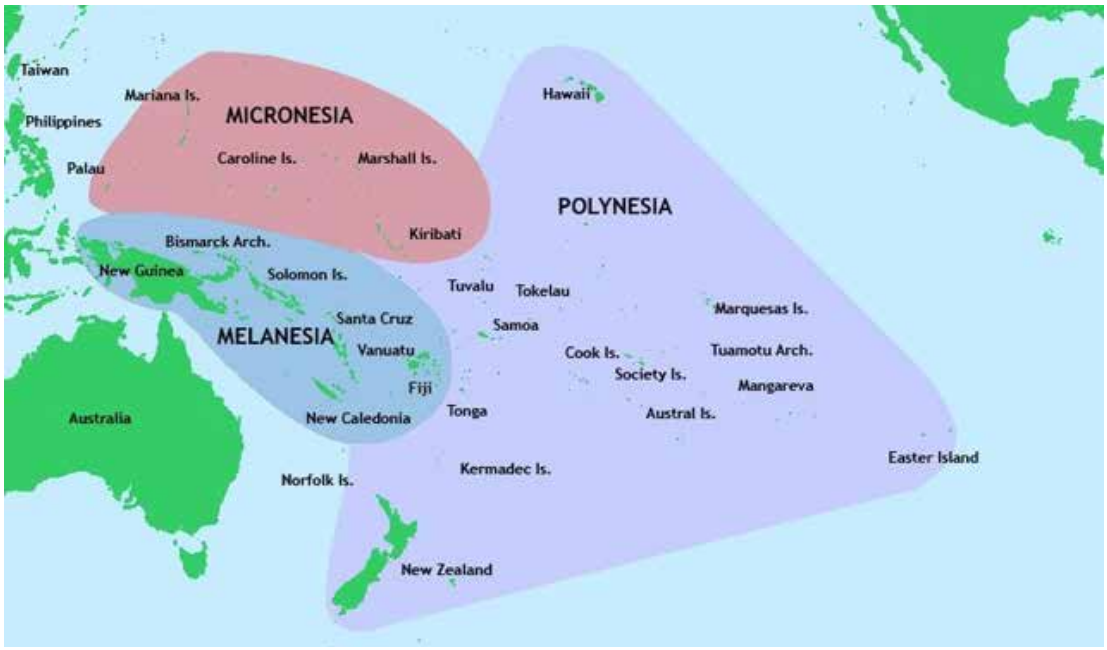
The PRIF study *'Regional Resource Circulation and Recycling Network'* is focused on fifteen Pacific island countries and territories (PICs) located in the three regions of the South Pacific:

Micronesia region: Guam, Federated States of Micronesia (FSM), Kiribati, Republic of the Marshall Islands (RMI) and Palau

Melanesia region: Fiji, New Caledonia, Papua New Guinea (PNG), Solomon Islands, Timor-Leste and Vanuatu

Polynesia region: Cook Islands, Samoa, Tonga and Tuvalu.

Regional map sourced from Google Maps, Oceania – Wikipedia



All PICs are facing critical challenges in managing increasing and diversifying wastes due to changing lifestyles and the continuing concentration of populations in urban centres. While the basic issues may be considered universal, PICs have unique and somewhat magnified issues to confront when trying to achieve integrated and efficient waste management systems. PICs are highly susceptible to natural disasters and equally vulnerable to the impacts of climate change, such as sea level rise. PICs also have waste streams that are becoming increasingly pervasive environmental problems, such as used packaging, plastics, e-waste, end-of-life vehicles, batteries and end of life renewable energy equipment. Plastics, in particular, easily become marine debris adversely affecting the natural coral reef, beach and mangrove environments, threatening the growing tourism sector and jeopardising the existence of local fisheries, seabirds and marine mammals.

The study examined the current annual import and export data for the fifteen recyclable materials, with estimates of approximately 4.7 million tonnes imported annually into the region with only 1 million tonnes exported. 60 per cent of the imports are motor oil or cooking oil whereas 84 per cent of the exports consist of used motor/cooking oils. The conclusion drawn from the data is that a large proportion of the imported study materials are staying onshore and should therefore be available for recovery and recycling.

Projections for recovered materials used estimated consumption rates for urban, rural and outer island locations combined with predicted rates of recovery i.e. low (15%), medium (40%) and high (60%). The analysis found an estimated annual resource availability of 41,843 tonnes in the Micronesia region, 150,289 tonnes per annum in the Melanesia and 14,068 tonnes per annum in the Polynesia region.

Many Pacific island countries have identified or adopted policy mechanisms to finance improved waste management systems and equitably distribute the costs of managing end-of-life materials. Mechanisms already in use include extended producer responsibility (EPR), container deposit schemes (CDS), advance disposal fees (ADF), environmental taxes and levies, user-pays or pay-as-you-go fees, product bans or a combination of measures to stimulate the Reduce, Reuse, Recycle, Recover and Return philosophy that is key to developing a 'circular economy'. This study recommends Pacific region-wide CDS and EPR programs using a regional agreement framework. Such agreements would benefit from development partner support to develop binding agreements based on Multi-lateral Environmental Agreement principles and provide funding dependent on regional participation.

The margin of profitability for recyclers exporting materials to international markets is highly variable given the market volatility for globally traded commodities. Geographic isolation, high export shipping costs, changing end markets, pricing and quality specifications all create uncertainty for recycling enterprises. A high-level analysis of the estimated gross margin for the recycling trade using projected recovery tonnages, market pricing and commercial shipping rates found an overall gross margin deficit of -US$21,780,941 for the 15 PICs combined.

China's recent announcement regarding its intention to ban a number of import materials will have a significant and immediate impact on the global trade of commodities. The world economy does not have enough established alternative end markets to enable existing volumes of recyclables to be redirected to new markets. A potential glut of some commodities is likely to ensue, leading to increased stockpiling, lower prices and stringent quality specifications further highlighting the need for localised and regional recycling/remanufacture industries.

The study found an increasing move toward the development of specific solid waste management legislation (now adopted in 40% of the PICs). The remaining PICs operate under broader domestic environmental management legislation. Marine pollution control and prevention legislation has been adopted by 6 PICs, and 10 PICs have either proposed, drafted or adopted legislation to tax, regulate or ban the imports of plastic bags and other plastic products.

Populations living within 50 kilometres of the coastlines within the PICs generate an estimated 311,090 tonnes of waste plastics each year, of which 227,880 tonnes may potentially become marine debris through either littering, passage by inland waterways or windblown into the ocean from uncontained disposal sites. The impact of a regional CDS on used beverage containers on the level of plastic marine debris is small and a comprehensive suite of public policy is needed to address the issue. Legislation to control the import of non-biodegradable plastics bags, polystyrenes and single-use plastics has been introduced in three PICs and is potentially under development in a further six countries.

Cook Islands

Introduction

The increasing presence of plastic marine debris in the South Pacific Ocean is focusing attention on strengthening recycling policies and systems in the region. Unique challenges associated with shipping commodities of low value over long distances to recycling markets, however, reduce the economic viability to do so. This country profile includes the current technologies, material flow, logistics, public policies, institutional framework, financial mechanisms, and initiatives that are being designed or have been implemented to strengthen recycling systems in the Cook Islands.

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The Cook Islands are made up of 15 islands and atolls that cover a total area of 237km^2. A combined coastline of 120km is spread over 2 million km^2 in the Polynesian region of the mid-Pacific Ocean.

The islands consist of two main groups – the Northern Cook Islands and the Southern Cook Islands. Avarua is the country's capital city, with the largest population, and is located on the island of Rarotonga.

Socioeconomic background

The Cook Islands, a self-governing territory in free association with New Zealand, expects to become the Pacific's first "green" destination. The *Cook Islands Renewable Energy Chart Implementation Plan 2012-2020 (GoCI, 2012)* commits the Government of the Cook Islands to increase the contribution of renewable energy to 100% of total demand across inhabited islands in the country by 2020.

A NZ$260 million programme supported by the Asian Development Bank, New Zealand Ministry for Foreign Affairs and Trade and the European Union has realised the installation of solar photovoltaic power systems on the Northern Group Islands (2012) and in Rarotonga (2014). A further six solar plants are planned for up to six islands in the Southern Group Islands *(ADB, 2015)*. The Pacific Islands Renewable Energy Investment Program will also be installing battery storage systems in the near future.

Increasing numbers of visitors are drawn to the Cook Islands each year to experience low-impact, eco-friendly tourism activities such as diving, kayaking, hiking, bird and whale watching. Tourism takes advantage of the 120km coastline of the Cook Islands. In 2016, tourists to the Cook Islands numbered 146,473 *(SPTO, 2017)*, representing an increase of 17% on the previous year. The country's 93 resorts and accommodation facilities predominantly are located on the seaside and beachfronts of the main islands, as follows:

- 13 on Aitutaki
- 2 on Atiu
- 77 in Rarotonga
- 2 on Mangaia

Improved waste management practices are considered to be a critical factor in retaining tourism as a key driver of economic growth. Tourism in 2012 accounted for approximately 54% of gross domestic product *(ADB, 2014)*.

The country's trade balance in 2015 was in deficit by A$102 million, with exports at A$23.7 million (+8.1% annualised) and imports at A$126 million (+1.7% since 2010).

The primary export market destinations in 2015 were the People's Republic of China, Germany, Japan, Poland and Thailand. The main import origins in the same year were Australia, the People's Republic of China, Fiji, New Zealand and Turkey. *(OEC, 2017)*.

In 2016, the estimated resident population - including short-term visitors - was 19,400. Approximately 2,900 *(GoCI, 2016)* live in rural areas, with the remainder living in the capital of Avarua on Rarotonga.

The approximate population distribution estimates for each of the 15 islands are as follows:

Northern Cook Islands	Population
Aitutaki	1,500
Mangaia	500
Atiu	450
Palmerston	60
Manuae	0
Rarotonga	10,500 (Capital)
Mitiaro	150
Mauke	300

Southern Cook Islands	Population
Manihiki	200
Nassau	70
Rakahanga	70
Penrhyn	200
Pukapuka	400
Suwarrow	0

Source: Country Digest, 2017

Solid waste management

Recycling in the Cook Islands is relatively advanced, with polyethylene terephthalate (PET) bottles and aluminium cans being recovered from household and commercial collections and usually exported to New Zealand. Due to the low market price for glass, however, bottles are collected and crushed at the waste management facility for use as landfill cover or as an aggregate in concrete mixes. Similarly, cardboard, previously exported, is now mostly used as mulching material applied in the agricultural sector.

E-waste, whitegoods, steel cans, scrap steel and nonferrous metals, used lead acid and lithium batteries, and solar panels are stockpiled and exported for recycling and recovery purposes by a private operator. Used engine oil is reused in-country and exported, while end-of-life tyres are reported to be reused in-country only.

The material flow chart below is based on an analysis of Cook Islands imports of the 15 material categories studied, averaged over a seven-year period to 2016, compared with exports of those recovered recyclable materials, averaged over a two-year period 2015-2016, presented as a percentage of the total of the 15 categories. *(Source: UN Comtrade, 2017)*

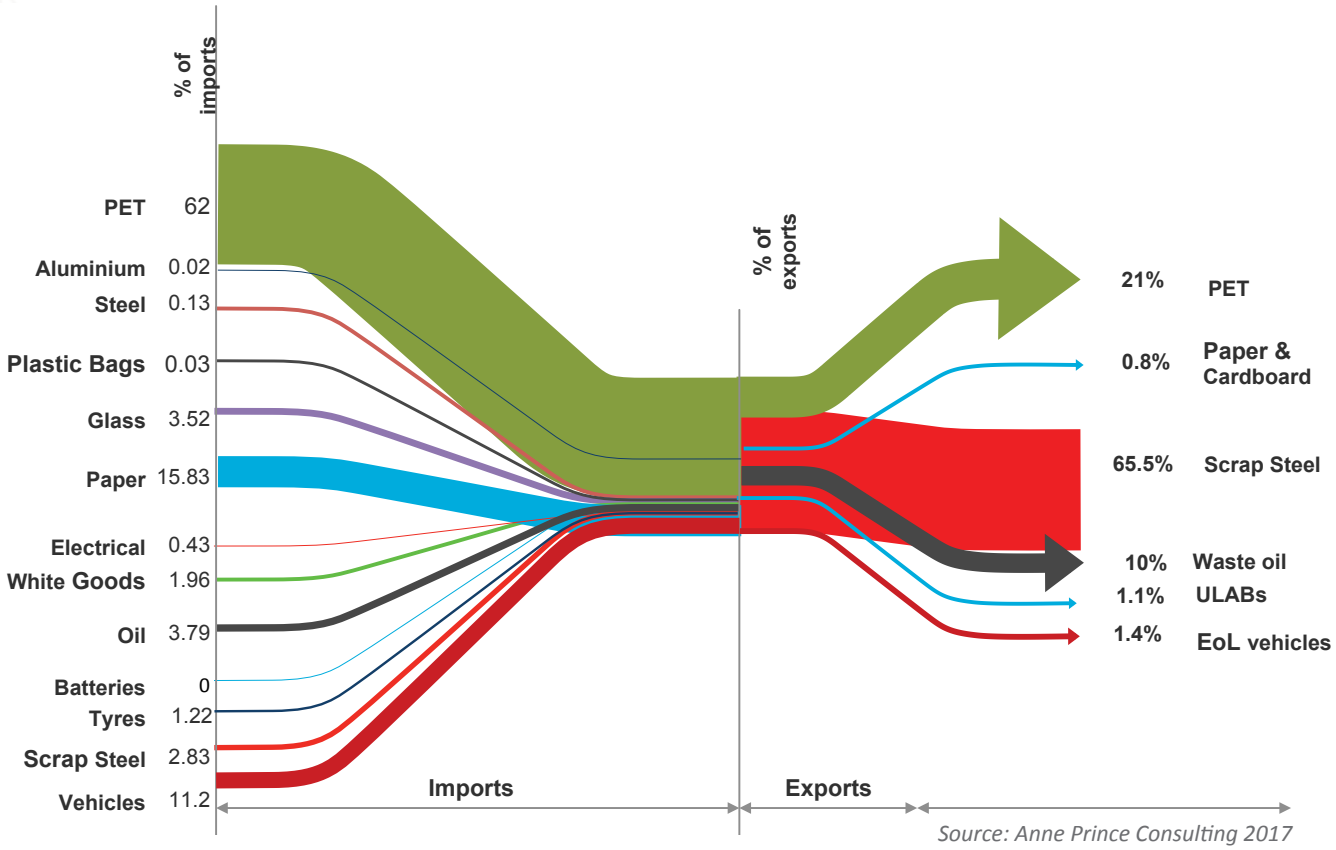
The analysis illustrates that imports of beverage containers of various material types, paper, cardboard and oils hold steady over the seven years. The number of motor vehicles of all types increased steadily during this period.

The Cook Islands exported more than 130 tonnes (t) of PET, 62t of cooking oil, 400t of scrap metal and approximately 9t of vehicles during 2015 and 2016.

This regional study coordinated by PRIF models the potential recovery of 15 materials types. A defined set of recovery rates was applied to the urban, rural, and outer island population distribution to calculate Cook Islands' potential recovery tonnage. The study compares various data to establish the context for the 15 waste materials.

Modelling of potential recovery of recyclable materials, presented in the table below, is based on an estimated average daily per capita municipal solid waste generation of 1.2kg *(World Bank, 2012)*. It also applies a range of location-specific estimated recovery rates that are based on a set of assumptions of existing or introduced incentive-based policies and programs, such as container-deposit schemes and import levies. The resulting ratios were used to estimate average annual tonnages that could be recovered for recycling. *(JICA, 2013; SPREP 2016; Mobile Muster, 2013; DOEE, 2017; Jambeck et al., 2015; MFAT, 2016; UNIDO/ICSHP, 2013).*

Material flow - Cook Islands



Source: Anne Prince Consulting 2017

**The percentage of imports and exports displayed relate only to the proportion of the 15 materials categories studied, not total imports/exports*

Cook Islands	
Recyclable Materials Forecast	**Estimated Metric Tonnes**
Polyethylene terephthalate (PET beverage containers)	60
Aluminium cans	118
Glass beverage containers	83
Steel cans	93
Plastic shopping bags	39
End-of-life (EOL) renewable energy equipment	-
Paper/cardboard	391
E-waste	2
Whitegoods	13
Used motor/cooking oil	118
Used lead acid batteries	21
Used lithium batteries	24
Scrap steel/nonferrous metals	140
EOL tyres	21
EOL vehicles	337
Total	**1,460**

Source: World Bank, 2012.

Future waste management

Future increases in material recovery are expected from the PacWaste (2014-17) programme, which is in the process of being implemented by SPREP for the improved management of e-waste. Activities under this programme include the establishment of an e-waste pilot project for the safe dismantling of e-waste, a community awareness campaign and assistance in developing a national e-waste strategy *(SPREP, 2017)*.

As the transition to renewable energy progresses, equipment such as solar panels and batteries will have a greater presence in the recoverable waste stream, as will household electrical items as a result of improved power access *(ADB, 2017)*. Over 90% of the country's electricity demand is on the islands of Rarotonga and Aitutaki. Ten of the 12 inhabited islands will have almost 100% renewable energy by mid-2017.

The renewable energy project relating to the Northern Group Islands completed eight photovoltaic-diesel hybrid systems on six islands. Four further systems will be installed in the outer islands of the Southern Group by mid-2017 *(GoNZ, 2016)*. The Renewable Energy Sector Project will install solar photovoltaic systems on five islands and three lithium battery storage systems. These projects are supported by the Asian Development Bank, European Union, Global Environment Facility, Green Climate Fund, New Zealand, United Arab Emirates, Japan, and the Government of the Cook Islands.

Plastic marine debris

Mismanaged plastic waste eventually enters the marine environment by way of inland rivers and waste water outfalls or is transported by wind and tide. Rigid and light-weight plastic material from products consumed or used on a daily basis become marine debris if not managed appropriately. An estimated 12% of the Cook Islands' waste stream consists of plastic components.

A recent study *(Jenna et al., 2015)* indicates that coastal communities within a 50km range of the seaboard in the Cook Islands generate approximately 3t of plastic waste each day. An estimated 1.1t is mismanaged on a daily basis, entering the marine environment through release from uncontained disposal sites or by direct littering. As a result, an estimated 416t of plastic waste became marine debris in the waters around the Cook Islands in 2010 which, if not addressed, is expected to rise to 784t by 2025.

Of the 3t of plastic generated each day, approximately 0.3t may derive from PET or high-density polyethylene (HDPE) bottles, eligible for recycling under a container deposit scheme (CDS). Based on an average reduction rate of 40% in mismanaged waste with a CDS in place, approximately 0.05t of PET and HDPE plastic could be recycled each day. This could increase to an 80% or above reduction rate, depending on access to recycling collection services and viable markets, among others. Nonetheless, a 40% reduction in mismanaged PET and HDPE would result in approximately 397t of plastic becoming marine debris each year.

The outcome of mismanaged plastic can be divided into three groups: plastic that remains on the surface of the sea as floating debris, plastic that sinks to the ocean floor and plastic that washes up on the beach. A CDS that recovers 40% of HDPE and PET plastic bottles in the Cook Islands may achieve the following reductions in marine debris each year:

- 3t in floating plastic
- 13t in sunken plastic
- 3t in beach plastic

Further benefits attributed to a CDS are a potential reduction in annual damage costs for the 74 local fishing vessels of the Cook Islands (approximately US$572. If beaches were cleaned up, it would save over US$4,667, of particularly relevance to the amenities of coastal communities and the tourism sector.

Infrastructure and services

Free weekly domestic waste and recycling collection services are provided to 100% (representing 74% of national population) of urban areas in Rarotonga.

Household waste and recycling collection services are delivered by a private operator under contract by the Ministry of Infrastructure Cook Islands. Household waste is placed in 60 litre bags and collected by a compactor vehicle. The weekly household recyclable service uses a trailer to collect PET, aluminium cans and glass bottles that are delivered to the Waste Management Facility for sorting and consolidation prior to export. Similarly, the private sector provides recycling services to commercial businesses, while hotels also transfer their own waste to the landfill.

The Rarotonga Waste Management Facility comprises the sanitary landfill (15-year capacity), constructed in 2006 with support from ADB, a transfer station and recycling centre. The Governments of Australia and New Zealand, with the private sector, have also supported improvements

at the site which employs eight operational staff. A building approximately 12 metres by six metres houses a baler to consolidate aluminium cans and PET bottles. Baled recyclables are loaded directly to 20' or 40' shipping containers for export and there are no further recycling storage facilities.

Glass bottles are also collected and are crushed for local use in concrete blocks, as road aggregate or as landfill cover. Cardboard is generally used for agricultural purposes and e-waste is collected and processed for export.

In addition to the facility in Rarotonga, the Cook Islands has 10 authorised open disposal sites and one other sanitary landfill - also constructed in 2006 with ADB assistance - with a life of 20 years. Recycle waste stations are also located on the outer islands. A small amount of recyclables is transferred to Rarotonga for export.

Community recycling and pickup stations provide services to householders in Rarotonga. Recycling waste stations with sorting areas are located on the outer islands; however these are generally uncovered facilities without storage. Rarotonga's Waste Management Facility currently receives a small amount of recyclables from the outer islands *(ADB, 2014)*.

Cook Islands Recycling Creations retails giftware from reprocessed packaging materials, providing a forum to promote community awareness with regard to the benefits of recycling. Cook Islands Trading Cooperation Ltd., a private operation, manages a drop-off centre for dry recyclables, including paper, cardboard and fluorescent light tubes. These are then exported to New Zealand. Furthermore, Cook Island General Transport is a private land/sea transport business that collects periodically white goods, e-waste, used lead acid and lithium batteries, end-of-life solar panels, PET, aluminium cans and scrap metal, also for export to New Zealand. Both companies have balers on their premises. *(Source: Cook Islands Pacific Regional Waste Strategy – Questionnaire, 2015).*

Logistics

The port of Avatiu at Avarua on the island of Rarotonga is the principal international port of the Cook Islands and is the transshipment port for cargo and passenger transfers to the outer islands. The port is operated by the Cook Island Ports Authority, as is the second port, Arutanga, located on the island of Aitutaki, 162km from Rarotonga.

The port terminal is approximately one hectare in size, and facilities include a main quay (260 metres long by around 8 metres deep) and a warehouse. There is neither a shore crane nor are there private stevedore services available.

The Port of Avatiu is serviced by the Polynesia Line that provides container shipments to New Zealand on a 21-day schedule. The estimated twenty-foot equivalent unit (TEU) shipping container rates, presented in the table below, are based on the cargo of nonhazardous goods, inclusive of un/loading and bunker adjustment factor (BAF). They do not account, however, for customs clearance, duties and quarantine inspection.

Cook Islands: Shipping Line		
Polynesia Line		
Destination	**Schedule**	**Est. USD per TEU**
New Zealand	21-day	3,150

AMSTEC Pty Ltd

Notes: USD = U.S. dollar; TEU = twenty-foot equivalent unit.

The Port of Avatiu is capable of handling 4,000 TEU per year. The port has a throughput of approximately 2,200 import, 300 export and the return of 1,900 empty containers each year which may potentially be made available for reverse logistic arrangements.

Cook Islands

The outer island harbours, in general, are able to cater for the inter-island freighters and passenger services that are privately operated. Taio Shipping Ltd. runs its ships to the islands of Penrhyn, Rakahanga and Manihiki in the Southern Group Islands every two months, as well as to the islands of Atiu, Mitiaro, Mauke and Mangaia in the Northern Group Islands every two and a half months. Barge services are also supplied by Cook Islands Towage Ltd.

Institutional framework

Data relating to the institutional framework of the Cook Islands have been gathered from the database of the Pacific Islands Legal Information Institute *(PacILII, 2017)*. ECOLEX is also an information service that relates to environmental law *(ECOLEX, 2017)*, from which various data also have also collected.

Governance responsibilities for solid waste management are spread over a number of agencies. Environment Act 2003, administered by the Ministry of Environment Services, establishes the National Environment Service and the Island Environment Authority. The former entity is responsible for environmental policy development, education and awareness. It also enforces regulations on illegal dumping, controls and monitors pollution, sets environmental standards at the Rarotonga Waste Management Facility and ensures the environmentally safe disposal of chemicals.

Regulations passed in 2008 control waste management practices on the outer islands of Atiu, Takutea and Mitiaro. Since 2012, while further regulation prohibits the importation of plastic and nonbiodegradable bags, it monitors the import of biodegradable bags.

Environment Act, Section 37, authorises the National Environment Service to prepare management plans for the islands. This comes at the request of the Island Environment Authority.

Public Health Act 2004 and Ministry of Health Act 2013 are administered by the Ministry of Health. The Ministry is responsible for policy development and the implementation of laws and programmes for public health and environmental protection, providing for the safe storage, collection, treatment, transport and disposal of solid and hazardous waste materials.

Prevention of Marine Pollution Act 1998, administered by the Ministry of Transport, prevents pollution and the dumping and transport of other waste in Cook Island waters by vessels. It gives effect to international conventions on marine pollution and protection.

As a result of the Cook Islands National Solid Waste Management Strategy 2013-2016, a waste management policy and legislative framework were introduced. The strategy recognises the need for a single solid waste management (SWM) entity, a dedicated fund solely for the management of solid waste, a national waste audit and an economic assessment of the costs associated with SWM. A "Zero Waste Cook Islands" goal, based on the 4R approach (Refuse, Reduce, Reuse and Recycle), is embedded in strategic policy. The polluter pays principle, as well as other precautionary, consultation, waste hierarchy and proximity principles, underpin the strategy and its objectives to improve the following:

- waste minimisation
- institutional framework
- the waste management infrastructure, including storage facilities for hazardous waste, recycling and solid waste
- financial mechanisms for cost recovery of collection and disposal fees, as well as an advance disposal fee levied on the import of selected goods and potential CDSs
- environmental education and awareness
- reliability of data collection, monitoring and analysis.

The initiatives of the strategy were expanded in the National Solid Waste Management Policy 2016-2026, linking them to those in the National Sustainable Development Plan 2016-2020 by way of Goal 3, "Promote sustainable practices and effectively manage solid and hazardous waste". The policy defines a number of options for financing recycling activities, such as:

- introduction of a container deposit scheme on aluminium and PET containers
- an advance disposal fee levied on selected imported items
- creation of a dedicated trust fund to cover the costs of SWM processing and exporting.
- A subsequent proposal intends to impose an advance disposal fee on vehicle imports to curb the issue of abandoned old cars on the island of Rarotonga by introducing a car bailer for scrap metal recycling.

The role of the Water, Waste and Sanitation Division of Infrastructure Cook Islands (ICI) is to oversee the waste management facility operations and waste collection services on Rarotonga. The agency advises the island governments responsible for waste management on outer islands.

Island Government Act 2012-13, administered by the Office of the Prime Minister, establishes the island governments (councils) and the Island Governments Association. Island governments are able to enact laws that conserve and sustain the relevant island environment, consistent with the provisions incorporated into Environment Act 2003. Other legislation includes the Reuse of Bottles Act 1988 that defines the ownership of bottles and provides for their reuse.

The Cook Islands is a party to various multilateral environmental agreements and conventions, listed in the following table.

Cook Islands	
Multilateral Environmental Agreements and Conventions	**Status**
Stockholm Convention on Persistent Organic Pollutants	Ratified
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	Ratified
1995 Waigani Convention	Ratified
Rotterdam Convention	Ratified
Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified
MARPOL 73/78: International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (Annex I, II, and IV)	Ratified
International Convention on Civil Liability for Oil Pollution Damage, 1969 (renewed 1992)	Ratified
International Convention on the Protocol of 1992 to Amend the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971	Ratified
Bunkers Convention 2001	Ratified
International Convention on the Control of Harmful Anti-fouling Systems in Ships (AFS Convention)	Ratified
Ballast Water Management Convention 2004	Ratified
Nairobi International Convention on the Removal of Wrecks 2007	Ratified
Noumea Convention	Ratified
Protocol on Dumping	Ratified

Source: SPREP. 2016.

PHOTO: ADB

Financial mechanisms

Currency: Cook Island dollar ($) and New Zealand dollar (NZ$).

Households are provided with waste collection services free of charge. ICI is allocated an annual budget of NZ$422,000 for the management of solid waste services on Rarotonga, which includes the operations of the waste management facility. The additional budget is drawn from landfill disposal fees of approximately NZ$67/t, paid by commercial and self-haul entry fees. Previously a NZ$5 departure tax was transferred to a special purpose environmental protection fund, with NZ$3.50 allocated to SWM. The fund has been abolished and departure tax revenues are considered consolidated revenue.

The Minister for ICI established a Waste Financing Committee in 2012 to investigate options for the long-term financing of SWM. The National Solid Waste Management Strategy identifies the potential for a container deposit scheme for aluminium and PET beverage containers, an advance disposal fee levied on selected imported items, and the creation of a dedicated trust fund to cover the costs of exporting and processing solid waste.

Island governments receive an annual stipend from the National Government. They also may levy property rates, fees and tariffs, as well as impose fines and penalties.

Conclusions

Recycling and on-island re-use systems are relatively advanced in the Cook Islands and public policy is designed to achieve sustainable waste and environmental management outcomes. National Solid Waste Management Policy 2016-2026 identifies CDS, advance disposal fees levied on specific imported items and the creation of an administrative fund for waste processing and export as key mechanisms to support sustainability.

A recent initiative discounts the cost of incinerating solid waste in the Cook Islands. (Tonkin and Taylor 2015). Furthermore, the need for increased management controls for plastic waste has been clearly identified. (Cook Islands National Solid Waste Management Strategy 2013-2016).

The Port of Avatiu does not have the capacity to handle increased cargo volume. Direct shipping services are limited.

Abbreviations

ADB	Asian Development Bank
AFS	Anti-fouling systems
BAF	Bunker adjustment factor
CDS	Container deposit scheme
DOEE	Department of Environment and Energy (Australia)
EOL	End of life
FY	Financial year
GoCI	Government of Cook Islands
HDPE	High-density polyethylene
ICI	Infrastructure Cook Islands
ICSHP	International Centre on Small Hydro Power
JICA	Japanese International Cooperation Agency
kg	kilogram
km	kilometre
km^2	square kilometre
MARPOL	International Convention for the Prevention of Pollution from Ships
MFAT	Ministry of Foreign Affairs and Trade (New Zealand)
PET	Polyethylene terephthalate
PRIF	Pacific Region Infrastructure Facility
SPREP	Secretariat of the Pacific Regional Environment Programme
SPTO	South Pacific Tourism Organisation
SWM	Solid waste management
t	tonne
TEU	Twenty-foot equivalent unit
UNIDO	United Nations Industrial Development Organisation
USD	United States dollar

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Federated States of Micronesia

Introduction

The increasing presence of plastic marine debris in the South Pacific Ocean is focusing attention on strengthening recycling policies and systems in the region. Unique challenges associated with shipping commodities of low value over long distances to recycling markets, however, reduce the economic viability to do so. This country profile includes the current technologies, material flow, logistics, public policies, institutional framework, financial mechanisms, and initiatives that are being designed or have been implemented to strengthen recycling systems in the Federated States of Micronesia (FSM).

FSM is located in the western Pacific Ocean and comprises over 600 islands, with a total land area of 701km^2 and a combined coastline of 6,112km. FSM forms part of the Micronesia region and is made up of four groups of island states:

- Yap - with four large islands, seven small islands, and 134 atolls;
- Chuuk - with seven major island groups;
- Pohnpei - the largest island of the Senjavin Islands; and
- Kosrae - a single, high island.

The national capital is Palikir on the island of Pohnpei. Its population is approximately 4,600.

Source: Google Maps.

Socioeconomic background

The total population of the FSM island group was 102,624 in 2010 *(GoFSM, 2010)*, spread across the four island states as follows:

Island of Yap	population, 11,376 -state capital is Colonia with a population of 3,126
Island of Chuuk	population, 48,651 - state capital is Weno (population 13, 856)
Island of Pohnpei	population, 35,981-state capital is Kolonia (population 6,000); and
Island of Kosrae	population, 6,616-state capital is Tofol (population 1,500).

The rural population in FSM is approximately 79,020, or 77% of the total *(Knoema, 2015)*. Visitors numbered 24,125 *(SPTO, 2017)* in 2016, which represented a decrease of 20% on the previous year.

FSM's gross domestic product (GDP) was US$1.13 billion, or US$3,500 per capita, in 2015 *(OEC, 2017)*. In that year there was a trade balance deficit of US$314 million, with exports at US$20.6 million (-17.8% annualized) and imports at $162 million (+15.8% since 2010).

The primary export market destinations in 2015 were the People's Republic of China, Japan, the Republic of Korea, Saudi Arabia, and Thailand. The main import origins in the same year were the People's Republic of China, Japan, the Republic of Korea, Russia, and the United States. *(OEC. 2017)*

The services sector, a major contributor to GDP, stood at 65%. Manufacturing, as a value adding activity, was responsible for only 0.45% of the country's economy *(GlobalEDGE, 2017)*, indicating that there are few production-based enterprises.

Solid waste management

A waste composition survey, conducted in 2011 as part of the first phase of the Promotion of Regional Initiative Solid Waste Management (J-PRISM I) program, found that household waste generation rates varied across the country. These are as follows:

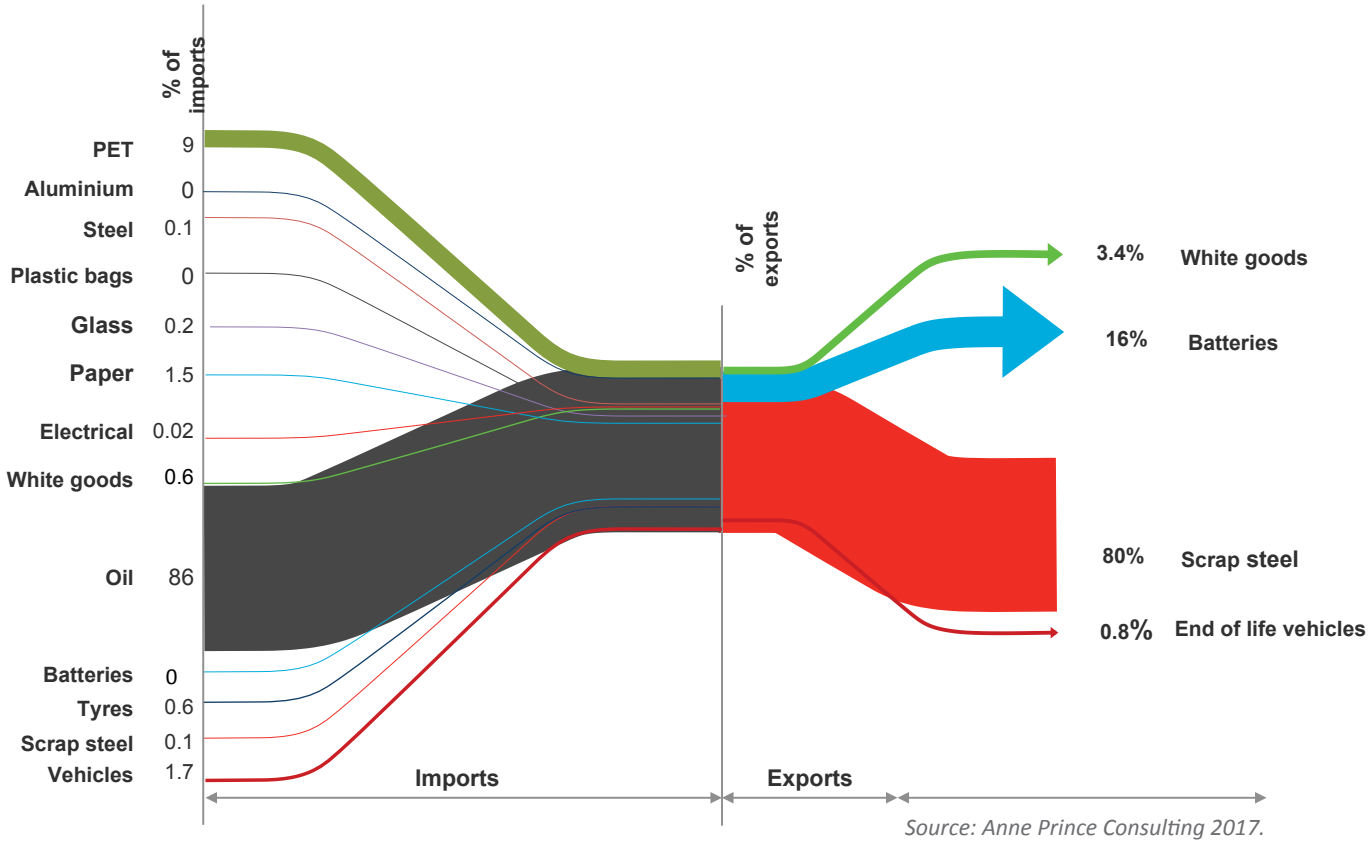
- Pohnpei: 0.1kg per day, comprising approximately 25% plastic and 25% metal,
- Yap: 0.5kg per day, comprising over 37% of plastic and 20% organic;
- Chuuk: 0.2kg per day, comprising over 33% organic and over 22% plastic;
- Kosrae: 0.1kg per day, comprising 26% organic and 20% plastic.

This regional study coordinated by PRIF models the potential recovery of 15 materials types. A defined set of recovery rates was applied to the urban, rural, and outer island population distribution to calculate FSM's potential recovery tonnage. The PRIF study compares various data to establish the context for the 15 waste materials.

The material flow chart below is based on an analysis of FSM's imports of the 15 material categories studied, averaged over a seven-year period to 2016, compared with exports of those recovered recyclable materials, averaged over a two-year period 2015-2016, presented as a percentage of the total of the 15 categories. *(UN Comtrade, 2017)*.

Polyethylene terephthalate (PET) beverage containers were imported at a steady rate, with imports of other beverage containers (e.g., aluminium and glass) having fallen sharply since 2013. As with other Pacific Island Countries, paper and cardboard imports have held reasonably steady, whereas imports of electronic and whitegoods have increased over time. Similar increased trends were observed for crude oil until 2012, having since decreased. Tyre and vehicle imports have been steady, with minor upward or downward trends.

Material flow - FSM



Source: Anne Prince Consulting 2017.

Note: The percentage of imports and exports displayed relate only to the proportion of the 15 materials categories studied, not total imports/exports

The only two exports of note for the FSM are lead-acid batteries and scrap metal. The remaining 13 materials have no substantial exports out of the FSM.

Modelling of potential recovery of recyclable materials, presented in the table below, is based on an estimated average daily per capita municipal solid waste generation of 2.1kg *(World Bank, 2012)*. It also applies a range of location-specific estimated recovery rates that are based on a set of assumptions of existing or introduced incentive-based policies and programs, such as container-deposit schemes and import levies. The resulting ratios were used to estimate average annual tonnages that could be recovered for recycling. *(JICA, 2013; SPREP 2016; Mobile Muster, 2013; DOEE, 2017; Jambeck et al., 2015; MFAT, 2016; UNIDO/ICSHP, 2013)*.

Federated States of Micronesia	
Forecast of Recyclable Materials	**Estimated Metric Tonnes**
Polyethylene terephthalate (PET) beverage containers)	69
Aluminium cans	124
Glass beverage containers	87
Steel cans	99
Plastic shopping bags	45
End-of-life (EOL) renewable energy equipment	-
Paper/cardboard	413
E-waste	3
Whitegoods	27
Used motor/cooking oil	626
Used lead-acid batteries	24
Used lithium batteries	35
Scrap steel/nonferrous metals	148
EOL tyres	24
EOL vehicles	380
Total	**2,104**

Future waste management

The second phase of the Promotion of Regional Initiative Solid Waste Management (J-PRISM II) project, implemented by the Japan International Cooperation Agency in early December 2016, supports capacity building in waste management. Target initiatives include improved governance and human resource development, which are expected to generate increased volumes of recoverable materials.

The European Union has a funding commitment of €12 million for renewable energy and energy-efficient programme initiatives, commencing in 2016 and continuing to 2020. Objectives include:

- increasing access to modern and sustainable energy services, with a focus on outer island populations;
- improving the overall efficiency of the energy sector; and
- increasing the share of renewable energy and decreasing dependence on imported petroleum.

FSM National Energy Policy aims to generate 30% of power from renewable sources, increasing end-use efficiency by 50% and achieving a 90% rate of rural household electrification by 2020. The State of Chuuk will install solar photovoltaic (PV) systems that include battery storage and solar-diesel hybrid systems. The State of Pohnpei will install solar and hydropower systems to reduce reliance on diesel power generation.

Through the installation of an integrated solar, wind and high-efficiency diesel power system, the State of Kosrae will increase its PV capacity.

These projects are funded by the Asian Development Bank, respective state governments, and other co-financing arrangements *(ADB, 2017)*. The United Arab Emirates-Pacific Partnership Fund also has supported the installation of a 600 kilowatt PV plant. Based on these projects, there is potential for an increased presence of household electrical items and end-of-life renewable energy in the waste stream.

Plastic marine debris

Mismanaged plastic waste eventually enters the marine environment by way of inland rivers and waste water outfalls or is transported by wind and tide. Rigid and light-weight plastic materials from products that are consumed or used on a daily basis become marine debris if not managed appropriately. An estimated 13% of the FSM's waste stream is comprised of plastic.

With a combined coastline of 6,112km, a recent study *(Jenna et al., 2015)* indicates a daily plastic waste generation of approximately 15.8 tonnes in coastal communities living within 50km of the seaboard in FSM. Approximately 13t of this are mismanaged daily and are predicted to enter the marine environment through release from uncontained disposal sites or by direct littering. An estimated 4,794t of plastic waste were released into the waters around the FSM in 2010, becoming marine debris. If not addressed, the amount is expected to rise to 10,699t by 2025.

Of the 13t of plastic generated each day, approximately 1.8t may comprise PET or high-density polyethylene (HDPE) plastic, eligible for recycling under a container deposit scheme (CDS). Based on an average reduction rate of 40% in mismanaged waste with a CDS in place, approximately 0.58t of PET and HDPE plastic could be recycled each day. This could increase to an 80% or above reduction rate, depending on access to recycling collection services and viable markets, among others. Nonetheless, a 40% reduction in mismanaged PET and HDPE would result in approximately 4,582t of plastic becoming marine debris each year.

The outcome of mismanaged plastic is split into three groups: plastic that remains on the surface of the sea as floating debris, plastic that sinks to the ocean floor, and plastic that washes up on the beach. A CDS that recovers 40% of HDPE and PET plastic bottles in the FSM may achieve the following reductions in marine debris each year:

- 32t in floating plastic
- 149t in sunken plastic
- 32t in beach plastics.

Further benefits attributed to a CDS are possible with a reduction in annual damage costs to PNG's 175 local fishing vessels of approximately US$1,359. If beaches were cleaned up, over US$53,800 would be saved, of particular relevance to the amenities of coastal communities and the tourism sector.

Infrastructure and services

Approximately 35% of the FSM's urban population (representing only 8% of national population) is provided with a weekly waste collection service. Fees for the services are levied in some areas up to US$5 a month.

FSM has 14 authorised open and three controlled dumps, respectively, while Pohnpei has two recycling collection stations. There are three private sector recycling companies that operate in Kosrae and Yap. Each exports glass bottles, aluminium cans, PET bottles, PET cooking oil containers, and e-waste, as well as ferrous and nonferrous metals and used lead-acid batteries.

Pohnpei has an aluminium beverage container recycling scheme that was revived in 2012, operated by the Pohnpei Environmental Protection Agency. Yap has a CDS, although it is uncertain how well this is performing *(ADB, 2014)*.

Logistics

The FSM has the following four international ports:

- Port of Lele, operated by Pohnpei Port Authority;
- Port of Colonia on the island of Yap, operated by the Tomil Harbour Authority;
- Port of Kosrae, operated by the Kosrae Port Authority; and
- Port of Chuuk, for which a Bill was presented to Parliament to create the Chuuk State Port Authority.

The terminal of the Port of Pohnpei is approximately three hectares. Facilities include a main quay (320 metres (m) long by approximately 12m deep) and a warehouse. There is no shore crane, private stevedore services, or quarantine incineration infrastructure available.

The Port of Pohnpei is serviced by the Kyowa Shipping Co. Ltd. Estimated twenty-foot equivalent unit (TEU) shipping container rates, presented in the table below, are based on the cargo of nonhazardous goods, inclusive of un/loading and a bunker adjustment factor. They do not account, however, for customs clearance, duties, and quarantine inspection.

Federated States of Micronesia: Shipping Line		
Kyowa Shipping Company		
Destination	Schedule	Est. USD per TEU
North Asia	14-day	4,210
Guam	21-day	1,110

Source: AMSTEC Pty Ltd

Notes: USD = U.S. dollar; TEU = twenty-foot equivalent unit.

The Port of Pohnpei is capable of handling 10,000 TEU per year. The port has a current throughput of approximately 3,200 import, 400 export and the return of 2,800 empty containers each year which may potentially be made available for reverse logistic arrangements. The port also loads and unloads approximately 500 transshipment containers each year.

The Port of Yap is capable of handling 8,000 TEU per year. The port has a current throughput of approximately 2,000 import, 100 export and the return of 1,900 empty containers each year which may potentially be made available for reverse logistic arrangements.

The four states of the FSM each has its own public domestic shipping fleet, and the national government operates one local ship to service the islands. The vessels are a mix of roll-on/roll-off container and passenger boats.

Institutional framework

Data relating to the institutional framework of the FSM have been gathered from the database of the Pacific Islands Legal Information Institute (PacILII, 2017). ECOLEX is also an information service that relates to environmental law (ECOLEX, 2017), from which various data also have been collected.

FSM has national overarching laws, policies, and strategic development plans that provide the framework for solid waste management (SWM) for the country. While the four states have enacting laws and utilities for the management of waste services and facilities, there appears to be an overlap in national and state responsibilities with regard to the construction of disposal facilities.

The FSM National Strategic Development Plan, Infrastructure Development Plan 2023, FSM Code of Law and its Constitution stipulate the legal and policy frameworks for SWM. Now expired, the FSM National Solid Waste Management Strategy for 2010-2014 was built on the polluter-pays principle, as well as that of precautionary, proximity, consultation, and waste hierarchy. The strategy identifies the need to establish financial mechanisms to support waste management systems. These include a CDS and a tax on vehicle imports to finance the collection of abandoned vehicles. The strategy also recognizes various key projects up to 2023 in terms of closing or rehabilitating landfills and developing new ones in each state.

The Division of Environment and Sustainable Development of the National Office of Environment and Emergency Management administers the Environment Protection Act. Based on this, it is responsible for policy development, legislation, environmental management, and protection. It also coordinates with state environmental protection agencies. Chapter 4, Title 19, of the FSM Code (Requirements for Vessels Environmental Quality Protection Act) addresses marine pollution prevention measures.

The Kosrae Island Resource Management Authority administers State Constitution, Article 2, as well as the following state codes that provide the legal and policy framework for waste management:

- Littering Law, Title 13, Section 506;
- Pollution Law, Title 13, Section 530; and
- Kosrae Recycling Program, Title 7, Chapter 22.

Solid waste disposal facilities are covered under the aegis of the Department of Transportation and Infrastructure, while the municipalities are responsible for waste collection services and operation of disposal sites. In the State of Chuuk, Chuuk State Law's Littering Law (191-33) is regulated by the Director of Public Safety. Its State Law's Public Law 02-94-01 and the Recycling Law (for aluminium cans) are administered by the state Environmental Protection Agency. These provide the legal and policy frameworks for waste management, while the Department of Transportation, Communication and Public Works Division of Chuuk Public Works provides waste services.

Article 7 of the Constitution, State Law No. 3L-26-92, the Environmental Protection Act and Solid Waste Regulation 3/30/95 come under Pohnpei's Environmental Protection Agency. These provide for the abatement of litter and the disposal of solid waste, as well as shipping container and motor vehicle waste disposal fees. The Environmental Quality Fund and the Litter Reward Fund, established by the agency, stipulate the legal basis for waste management, as does State Law 6L-66-06. Waste collection services and the operation of disposal sites are contracted to Pohnpei Waste Management Services.

In the State of Yap, Law No.4-4 (State Public Service Corporation), under Recycling Program Law 2008, allocates responsibility for waste collection and disposal. Recycling Program Regulations 2008 and Recycling Finance Law 2009 stipulate the legal and policy frameworks for waste management. They are administered by the State of Yap's Environmental Protection Agency. In the meantime, a Bill is being prepared to cease the importation of nonrecyclable plastic bags.

FSM is a party to various multilateral environmental agreements and conventions, listed below.

Federated States of Micronesia	
Multilateral Environmental agreements and Conventions	**Status**
Stockholm Convention on Persistent Organic Pollutants	Ratified
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	Ratified
1995 Waigani Convention	Ratified
Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified
Noumea Convention	Ratified
Protocol on Dumping	Ratified
Protocol on Combatting Pollution Emergencies	Ratified
Protocol on Oil Pollution Preparedness, Response and Cooperation	Signed
Protocol on Hazardous and Noxious Substances Pollution, Preparedness, Response and Cooperation	Signed

Source: SPREP. 2016.

Financial mechanisms

Currency: United States dollar (US$)

The financial system of the FSM relies on the intergovernmental transfer of funds through its Compact of Free Association with the United States. In Kosrae, approximately 80% of funds derive from U.S. aid support and 20% locally from import and export taxes.

SWM operations in the FSM mainly rely on funding as a result of the Compact of Free Association, together with CDSs in Kosrae and Yap, a soft drink tax in Chuuk, and private collection fees as described below. The 2009 Solid Waste Management Strategy has mechanisms to sustainably fund SWM, including a tax on imported vehicles to cover the cost of removing abandoned vehicles by 2013. It also recommends the introduction of an Infrastructure Maintenance Fund and a Waste Recycling Support Fund.

Systems for solid waste collection services, under the user pays principle, are in place in some municipalities in Kosrae. In Lelu, residents pay US$18 every six months, while in Tafunsak, they pay US$2 every two months.

Customers in Pohnpei, who use the services of a private operator, pay between US$40 and US$70 a month. The state government subsidises the company's operations with an annual amount of US$100,000 to collect the waste and manage the disposal facility.

The Kosrae Island Resource Management Authority manages the beverage container recycling program. A deposit fee of US$0.06 is levied on each imported aluminium, plastic, and glass beverage container. Consumers redeem US$0.05 per item with the remaining portion to cover handling charges.

A similar deposit programme for imported lead-acid batteries charges a fee of US$4 per battery. The levies collected are managed through a recycling fund that is used to finance the recycling program. In 2011, US$60,000 was recovered from recyclables, shipped to the People's Republic of China, the Republic of Korea, and Taipei, China.

Crushed glass is distributed locally for free and is used for paving projects. Kosrae has a scrap metal recycling programme that enables the sale of end-of-life cars and scrap to licensed dealers for export.

Conclusions

The legal and policy frameworks for waste and environmental management appear relatively robust in the FSM. Nevertheless, there is evidence of overlap in state and national responsibilities.

The primary ports of the State of Pohnpei and the State of Yap lack sufficient capacity to handle increased cargo volume. Direct shipping services are currently limited in terms of destination routes and schedule.

Abbreviations

ADB	Asian Development Bank
CDS	Container deposit scheme
DOEE	Department of Environment and Energy (Australia)
EOL	End of life
FSM	Federated States of Micronesia
FY	Financial year
GDP	Gross domestic product
GoFSM	Government of Federated States of Micronesia
HDPE	High-density polyethylene
JICA	Japan International Cooperation Agency
JPRISM	Promotion of Regional Initiative Sold Waste Management
kg	kilogram
km	kilometre
km^2	square kilometre
m	metre
MFAT	Ministry of Foreign Affairs and Trade (New Zealand)
OEC	Observatory of Economic Complexity
PET	Polyethylene terephthalate
PV	Photovoltaic
PRIF	Pacific Region Infrastructure Facility
SPREP	Secretariat of the Pacific Regional Environment Programme
SPTO	South Pacific Tourism Organisation
SWM	Solid waste management
t	tonne
TEU	Twenty-foot equivalent unit
UNIDO	United Nations Industrial Development Organisation

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Fiji

Introduction

The increasing presence of plastic marine debris in the South Pacific Ocean is focusing attention on strengthening recycling policies and systems in the region. Unique challenges associated with shipping commodities of low value over long distances to recycling markets, however, reduce the economic viability to do so. This country profile includes the current technologies, material flow, logistics, public policies, institutional framework, financial mechanisms, and initiatives that are being designed or have been implemented to strengthen recycling systems in Fiji.

Fiji is an archipelago of more than 332 islands and 500 islets, of which 110 are permanently inhabited. Located in the Melanesian region of the Pacific, the country has a land area of 18,333 square kilometres, with a combined coastline of 1,129 km. The two main islands are Vanua Levu and Viti Levu; the capital of Suva is located on the latter.

Source: Google Maps

Socioeconomic background

Fiji is a democratic republic with a complex administration of central, provincial, and local governments. Four electoral divisions represent 14 provinces, each with a council that is governed by the Fijian Affairs Board.

Each division consists of a combination of rural, city, and town councils. The Ministry for Local Government, Housing and Environment oversees 13 municipal councils that include two city councils and 11 town councils. The rural areas outside the municipal boundaries are governed by rural authorities.

The population of Fiji was estimated at 865,611 at the end of 2014 *(FBS, 2015)*. Approximately half of Fiji's population lives in the coastal towns and cities of the major islands. The two major islands of Viti Levu and Vanua Levu account for approximately 87% of the country's population, of which 75% live on Viti Levu's coastline, either in Suva, Nadi, or Lautoka. Fiji's rural population is 398,181, or approximately 46% of the total *(Knoema, 2015)*.

The table below sets out the Government of Fiji's structure and approximate population distribution.

Fiji Central Division, including Lami, Nausori, Nasinu Town Councils and Suva City Council		
Province	**Urban**	**Rural**
Naitasiri	146,079	27,593
Namosi		7,544
Rewa	90,535	12,720
Serua	7,023	12,379
Tailveu: 1 Rural Authority	19,593	42,172

Fiji Northern Division, including Savusavu Town Council and Labasa City Council		
Province	**Urban**	**Rural**
Bua		15,455
Cakaudrove	6,405	44,089
Macuata	26,678	39,317

Fiji Eastern Division, including Levuka Town Council		
Province	**Urban**	**Rural**
Kadavu: 1 Rural Authority		10,856
Lau		10,623
Lomaiviti: 1 Rural Authority; 1 Town Council	3,748	12,794

Fiji Western Division, including Lautoka City Council and Nadi, Ba, Tavua, Sigatoka and Rakiraki Town Councils		
Province	**Urban**	**Rural**
Ba	124,274	114,528
Nadroga-Navosa	9,608	48,629
Ra	4,372	26,162

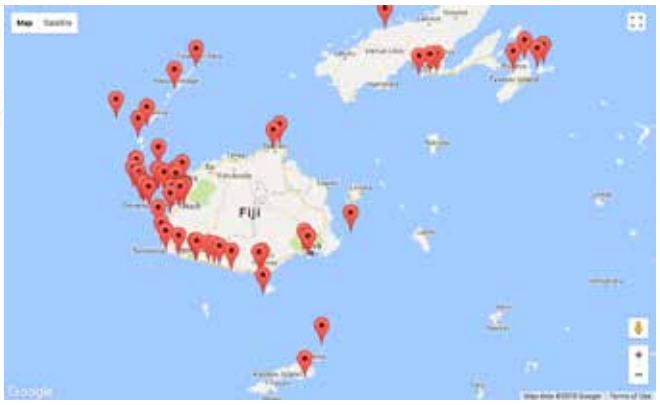
Outside Division		
Province	**Urban**	**Rural**
Rotuma Island 1 Rural Authority		1,814

Source: "Population and Labour Force Estimates of 2014". Statistical News, Release No. 99. Suva: Fiji Bureau of Statistics.

Tourists to Fiji were 754,835 in 2015 *(RTRC, November 2016)*, representing a 9% growth on the previous year and approximately 37% of gross domestic product (GDP) *(Colliers, 2014)*.

Vanua Levu has three resorts in Savusavu, while Viti Levu has 22 located along the Coral Coast, around Pacific Harbour, and in Suva, Nadi and on the remainder of the island. The country's 15 single resort islands include Toberua, Matangi, Vatulele, Kadavu, Mana, Matamanoa, Vomo, Bekana, Bounty, Viwa and Yasawa, as well as the islands named after the resorts of Royal Davui, Castaway, Treasure and Beachcomber,

Some of the outer islands have various resorts, including Taveuni (3), Tokoriki (2), Malolo (3), Malolo Lailai (3), Denarau (7).



Source: Map of Resort Locations in Fiji from Tourismfiji.com (2017), available at www.tourismfiji.com/fiji-map-resorts.html.

Fiji's GDP for 2015 was US$4.43 billion, at US$9,300 per capita *(OEC, 2017)*. The balance of trade in 2015 has a shortfall of US$1.39 billion, with exports at US$957 million (+0.8% annualised) and imports at US$2.35 billion (+5% since 2010).

The primary export market destinations in 2015 were Australia, the People's Republic of China, Japan, New Zealand, and the United States. The main import origins in the same year were Australia, the People's Republic of China, France, New Zealand, and Singapore. *(OEC, 2017)*.

The services sector is a major contributor to Fiji's GDP at 71%. Manufacturing as a value adding activity is responsible for 12.94% of the country's economy, the highest in the Pacific region *(GlobalEDGE, 2017)*.

Solid waste management

Waste composition studies, conducted in 2007, found a household waste generation rate of 0.403kg per day. This comprises nearly 60% organic waste, followed by approximately 12% plastic and over 11% paper.

The regional study coordinated by PRIF models the potential recovery of 15 materials types. A defined set of recovery rates was applied to the urban, rural, and outer island population distribution to calculate Fiji's potential recovery tonnage. The PRIF study compares various data to establish the context for the 15 waste materials.

The material flow chart below is based on an analysis of Fiji's imports of the 15 material categories studied, averaged over a seven-year period to 2016, compared with exports of those recovered recyclable materials, averaged over a two-year period 2015-2016, presented as a percentage of the total of the 15 categories. *(UN Comtrade, 2017)*.

The number of beverage containers imported into Fiji during the seven years either increased steadily or held steady, depending on the material type of the containers. Interestingly, the polymers of polyethylene terephthalate (PET) that are used for the on-shore manufacture of plastic bottles decreased progressively from 2009 to 2012, with an upward trend from 2012 to 2016. Plastic bag imports rose sharply from 2009 to 2012 and have since shown a variable, but downward, trend.

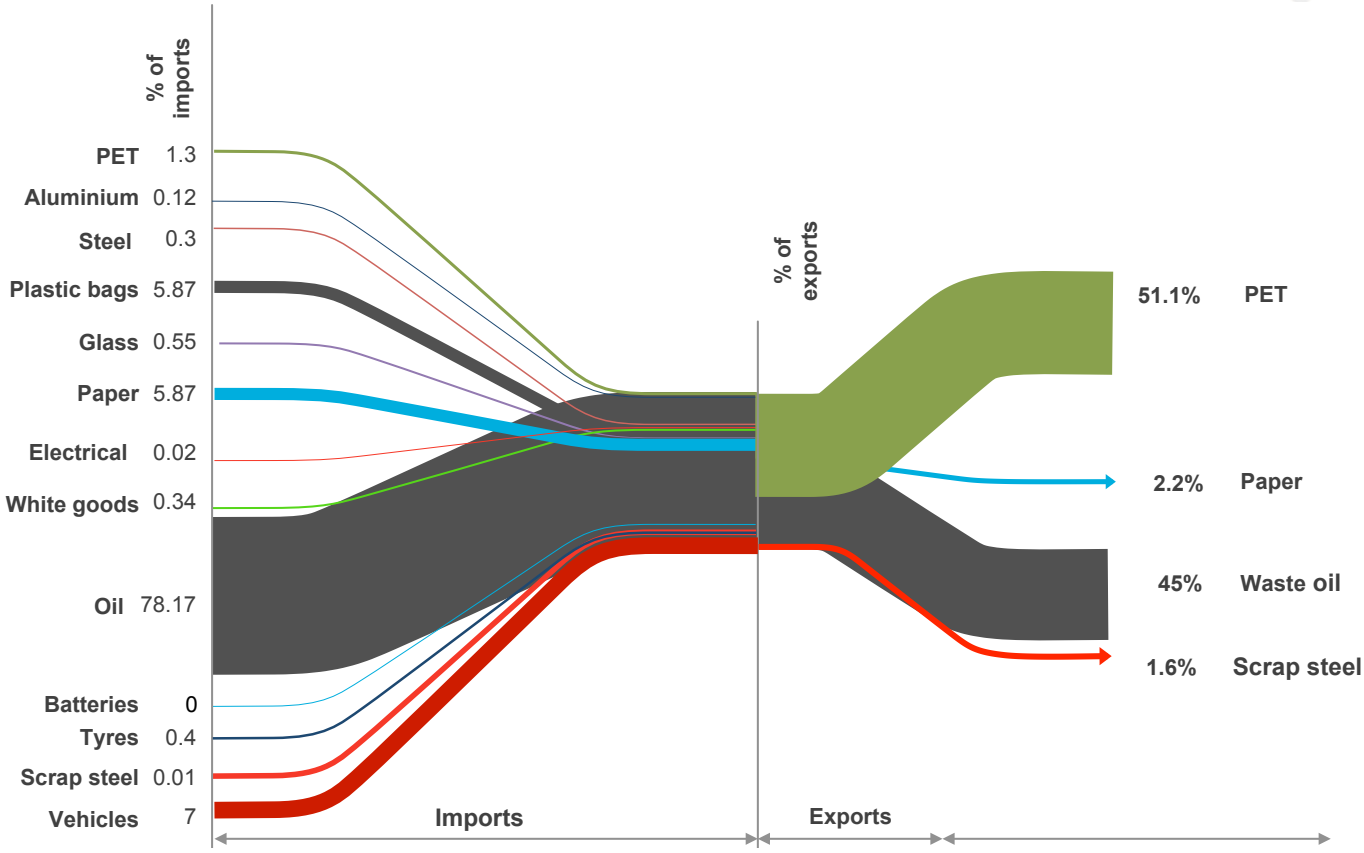
In 2003, the annual inflow of PET into Fiji was 44 million containers, comprising 1.7 million imported and 42 million PET bottles produced locally from imported pellets.

Import data indicates a major shift in policy or other trade-related factors in 2012 that impacted material use/import in Fiji. Paper, electronic items and whitegoods imports have held steady, as has that of petroleum oil. Motor vehicle imports rose sharply from 2009 to 2012.

Fiji is one of the largest exporters of the materials included in this report. In the two financial years, 2014/15 and 2015/16, Fiji exported more than 5,000 tonnes (t) of paper and cardboard and in excess of 116,000 t of PET beverage containers, on average. Scrap steel, tyres and end-of-life vehicles were other major exports.

Modelling of potential recovery of recyclable materials, presented in the table below, is based on an estimated average daily per capita municipal solid waste generation of 2.1kg *(World Bank, 2012)*. It also applies a range of location-specific estimated recovery rates that are based on a set of assumptions of existing or introduced incentive-based policies and programs, such as container-deposit schemes and import levies. The resulting ratios were used to estimate average annual tonnages that could be recovered for recycling. *(JICA, 2013; SPREP 2016; Mobile Muster, 2013; DOEE, 2017; Jambeck et al., 2015; MFAT, 2016; UNIDO/ICSHP, 2013)*.

Material flow - Fiji



Source: Anne Prince Consulting, July 2017

Note: The percentage of imports and exports displayed relate only to the proportion of the 15 materials categories studied, not total imports/exports

Fiji	
Recyclable Material	**Estimated Metric Tonnes**
Polyethylene terephthalate (PET) beverage containers	1,588
Aluminium cans	4,318
Glass beverage containers	3,048
Steel cans	3,429
Plastic shopping bags	1,029
End-of-life (EOL) renewable energy equipment	-
Paper/cardboard	14,351
E-waste	125
Whitegoods	640
Used motor/cooking oil	3,332
Used lead acid batteries	649
Used lithium batteries	929
Scrap steel/nonferrous metals	5,144
EOL tyres	647
EOL vehicles	9,454
Total	**48,683**

Future waste management

Significant importation of second-hand hybrid motor vehicles into Fiji in recent years is likely to result in a corresponding increase in nickel-metal hybrid batteries in the waste stream. The average age of the imported vehicles is around eight years, coinciding with a common battery-pack warranty period.

Future increases in material recovery are expected from the PacWaste (2014-17) programme, which is in the process of being implemented by the Secretariat of the Pacific Regional Environment Programme for the improved management of e-waste. Activities under this programme include the establishment of an e-waste pilot project for safe dismantling of e-waste, a community awareness campaign, and assistance in developing a national e-waste strategy *(SPREP, 2017)*.

The second phase of the Promotion of Regional Initiative Solid Waste Management (J-PRISM II) project, implemented by JICA in early December 2016, supports capacity building in waste management. Target initiatives include improved governance and human resource development, which is expected to generate increased volumes of recoverable materials.

The Government of Fiji has set a target of 90% renewable energy generation by 2030 and a 100% access to electricity by 2020. 65% Renewable energy electricity will be achieved on completion of current hydroelectricity projects that are supported by the Asian Development Bank, as well as the governments of the People's Republic of China, Japan and the United Arab Emirates. These initiatives are expected to result in an increased presence of household electrical items, computers, and communication equipment in the waste stream.

Plastic marine debris

Mismanaged plastic waste eventually enters the marine environment by way of inland rivers and waste water outfalls or is transported by wind and tide. Rigid and light-weight, plastic material from products that are consumed or used on a daily basis become marine debris if not managed appropriately.

An estimated 9% of Fiji's waste stream is made up of plastic. Evidence from a litter survey, conducted in 2007, shows that snack packs, followed by PET bottles and plastic bags, as predominant items *(GoF, 2007)*.

Fiji's islands have a combined coastline of 6,112km, and a recent study *(Jenna et al., 2015)* indicates a daily plastic waste generation of approximately 168.4t. An estimated 135t are mismanaged on a daily basis, entering the marine environment through the release from uncontained disposal sites or by direct littering. As indicative, an estimated 49,257t of plastic waste became marine debris in the waters around Fiji in 2010. If this is not addressed, the amount is expected to rise to 70,995t by 2025.

Of the 168.4t of plastic generated each day, approximately 18.6t may derive from PET or high-density polyethylene (HDPE) bottles eligible for recycling under a container deposit scheme (CDS). Based on an average reduction rate of 40% in mismanaged waste with a CDS in place, approximately 5.97t of PET and HDPE plastic could be recycled each day. This could increase to an 80% or above reduction rate, depending on access to recycling collection services and viable markets, among others. Nonetheless, a 40% reduction in mismanaged PET and HDPE would result in approximately 47,077t of plastic becoming marine debris each year.

The outcome of mismanaged plastic is split into three groups: plastic that remains on the surface of the sea as floating debris, plastic that sinks to the ocean floor, and plastic that washes up on the beach. A CDS that recovers 40% of HDPE and PET plastic bottles in the Fiji may achieve the following reductions in marine debris each year:

- 327t in floating plastic
- 1,526t in sunken plastic
- 327t in beach plastic

Further benefits attributed to a CDS are a potential reduction in annual damage costs for Fiji's 373 local fishing vessels (approximately US$2,901). If beaches were to be cleaned, over US$553,000 would be saved, of particular relevance to the amenities of coastal communities and the tourism sector.

Infrastructure and services

Information relating to the solid waste and recycling infrastructure and services in Fiji are sourced from *Solid Waste Management in the Pacific: Fiji Country Snapshot*. Manila: Asian Development Bank 2014. Other information is drawn from "Data Collection Survey on Reverse Logistics in the Pacific Islands". Final Report 2013. Japan International Cooperation Agency (JICA) and from the Fiji National Solid Waste Management Strategy 2011 – 2014.

The Naboro Landfill in Suva is the sole sanitary landfill in Fiji. Operated by private contractors, it was constructed in 2005 at a cost of over US$7 million with funding from the European Union. The landfill is owned by the Government of Fiji and comes under the responsibility of the Department of Environment *(ADB, 2014)*. The landfill has a remaining life span of approximately 60 years.

Four authorised, open disposal sites are located at Savusavu, Rakiraki, Tavua, and Ba, while three controlled disposal sites with restricted access are located at Lautoka, Sigatoka, and Vunato. With support from JICA, the Vunato site was upgraded to include composting operations, a weighbridge, a data collection system, heavy equipment for the placement and compaction of waste, and the development of a site operational plan. A dedicated and controlled disposal site for disaster waste is located within the Labasa Town Council area.

The first phase of the Promotion of Regional Initiative Solid Waste Management (J-PRISM I) project provided garbage compactor vehicles to Suva City Council, Nausori Town Council, Lami Town Council, and Rabi Island. The project also supplied a backhoe to the Sigatoka Town Council, as well as promoted recycling and offered solid waste management (SWM) training programmes.

Approximately US$540,000 was allocated in the 2014 national preliminary works budget to establish a waste transfer station able to receive waste from councils in the greater Suva area. The intention is for recoverable material to be segregated prior to final disposal at the Naboro Landfill.

Suva City Council provides residential solid waste and commercial collection services three and six times a week, respectively. Waste is placed in 60 litre bins and bags on the roadside curb or on raised platforms (i.e., to prevent dog access) for collection.

The Council operates its own waste vehicle fleet, with six compactors and two covered trucks. Private contractors are hired by the Council to collect green waste. Five private companies offer commercial and residential waste collection services, some directly contracted by the Council.

Fiji's remaining 12 councils are responsible for waste collection services in each municipality. In Labasa, for example, a waste collection service is provided to the entire city by a private company three times a week. This company also operates the city's landfill site where waste pickers collect recyclables and other materials of value.

A number of previous projects and pilot studies have established segregated recycling systems in Suva and Lautoka, although it is uncertain whether or not these

services remain in place. Fifteen recycling companies operate in Fiji, only one of which appears to operate on the island of Vanua Levu.

Scrap metal is transferred from Vanua Levu to the Port of Suva, using large trucks for roll-on/roll-off vessels. At least one recycling company has a shredder that processes the scrap metal for containerisation prior to export. Fifteen registered recycling companies export scrap metal, primarily to Australia, Indonesia, the Republic of Korea, and New Zealand. PET and paper are exported mainly to Australia and Hong Kong (China).

Progressive initiatives for waste minimisation are being undertaken on the resort island of Malolo Lailai, where the local supermarket charges for single-use plastic bags. It appears that recovered plastic and glass are shipped to the mainland from the island each week.

There is some in-country remanufacturing that takes place, with one company producing toilet paper from waste paper. Another entity produces new lead-acid batteries from used ones.

Logistics

The international ports of Fiji are operated by the Fiji Port Corporation Ltd. These are located in Suva and Latouka on the island of Viti Levu and Savusavu on the island of Vanua Levu. Two privately owned ports are located at Malau (Fiji Sugar Corporation) and Wairiki (Tropik Wood Industries Ltd.) *(Ports.com, 2017)*.

Fiji Islands

Source: Google Maps.

Suva is a busy trans-shipment port, not only for Fiji but also within the Pacific, with approximately 850 ships visiting annually. The terminal is approximately 3 hectares, with average standard facilities. These include a main quay of 492m long by approximately 12m deep and a warehouse. Shore cranes and private stevedore services are available.

Recent capital works have strengthened a large section (140m) of Kings Wharf, the main quay that previously had been useless for container operations, given a failing wharf structure. Heavy cranes and forklifts are now able to use this section.

Plans are in place to address congestion at the port terminal entry (north) and exit (south) gates, as well as light and on-site heavy vehicle movements. Adjacent road networks will be upgraded and an additional entry lane will be constructed to direct heavy vehicles away from the high-traffic town centre and market areas, so that they enter and exit the site at the northern gate. Remaining vehicles will use the entry/exit southern gate.

Suva has an annual handling capacity of 80,000 twenty-foot equivalent units (TEU) and manages a yearly throughput of approximately 34,210 import and 18,144 export containers, with 5,234 for transshipment. Approximately 16,066 containers return empty with a potential for significant backload.

The Port of Suva is serviced by multiple international shipping lines. Estimated TEU shipping container rates, presented below, are based on the cargo of non-hazardous goods, inclusive of un/loading and a bunker adjustment factor. They do not account, however, for customs clearance, duties, and quarantine inspection.

Fiji: Shipping Lines		
Swire Shipping; Neptune Pacific Line, Kyowa Shipping Co. Ltd.; Auspac Consortium; Polynesia Line; Matson Inc.; NZ-Fiji Consortium		
Destination	**Schedule**	**Est. USD per TEU**
Australia	14-day	2,050 to 4,600
Noumea	14-day	1,950 to 4,400
South East Asia	14-day	2,500 to 3,230
Papua New Guinea	14-day	Not provided
New Zealand	14-day	1,900 to 4,600
North Asia	21-day	2,400 to 5,050
United States, West Coast	30-day	Not provided

Source: AMSTEC Pty Ltd

Notes: USD = U.S. dollar; TEU = twenty-foot equivalent unit.

A 2015 review of the ports' waste reception facilities identifies essential improvements to reach the standards of the International Convention for the Prevention of Pollution from Ships (MARPOL), of which Fiji is a signatory *(SPREP, 2015)*.

The study recommends the development of a port waste management plan to address the operation of waste generated by ships and ports; managing waste data with regard to vessels; communicating MARPOL requirements and the availability of disposal services to shipping agents and crew; ensuring greater use of the Naboro Landfill for compliant waste; providing resources to enforce regulations and restrict port access to licensed waste handlers; appropriating on-shore storage and signage for quarantine waste and possible garbage; and offering a waste oil collection service to anchored ships. The Government of Fiji has expressed a commitment to achieve MARPOL compliance.

The Ministry of Infrastructure and Transport is responsible for policy and the regulatory and administrative functions of the Department of Government Shipping Services. It provides a number of cargo and passenger vessels that service the main and outer islands.

Fiji also has a number of privately owned inter-island shipping facilities. The Fiji Commerce Commission regulates fares and freight rates, based on the 2014 Control of Freight Rates and Passenger Fares Order.

The Fiji Searoad Service provides regular roll-on/roll-off passenger ferry services between the main islands of Viti Levu and Vanua Levu and the outer islands of Koro and Ovalau. This company's multi-modal service includes road transport around both main islands. Patterson Brothers Shipping provides regular ferry services on the Suva/Levuka/Suva and Suva/Natovi/Nabouwalu/Labasa routes on a daily basis.

Other ferry services include Goundar Shipping Ltd, which departs from Suva with a regular passenger and cargo service to Savusavu, Taveuni, Kadavu, Vunisea and Kavala, Koro, Gau, Lau, Vanuabalavu, Cicia, Rotuma, Yasayasa and Moala. South Sea Cruises concentrates on the resort islands of Malolo and Denarau three days a week, while Awsome Adventures services the islands of Malolo, Denarau, Nacula and Waya.

An indication of an inter-island domestic freight rate for a TEU between the Port of Labasa and the Port of Suva is approximately US$950. This includes the cost of road transport *(JICA, 2013)*.

Institutional framework

Data relating to the institutional framework of Fiji have been gathered from the database of the Pacific Islands Legal Information Institute *(PacILII, 2017)*. ECOLEX is also an information service that relates to environmental law *(ECOLEX, 2017)*, from which various data also have been collected.

The Department of Environment (DoE) is responsible for protecting the environment, while other agencies primarily focus on the health and welfare aspects of SWM. The DoE is the primary authority for implementation, monitoring, and enforcement of the following acts, regulations, and policies that relate to waste management.

Environmental Management Act 2005 established a waste management and pollution control unit in the DoE to administer Part 5 of the Act and develop management plans for the minimization of solid waste. It also provides guidelines for solid waste disposal infrastructure and the implementation of a national chemical management plan.

Fiji Environmental Management Regulations 2007 call for the development of environmental impact assessments to include potential environmental and resource management impacts of proposed activities. In addition, Environment Management (Waste Disposal and Recycling) (Amendment) Regulations 2011 control the discharge and disposal of solid, liquid, and hazardous waste. The regulations also prescribe permit conditions for waste transport, disposal, and recycling activities.

Support for recycling in the tourist sector is evident from the incorporation of waste minimisation principles in the waste disposal permit system. Tourist entities and hotels also must comply with specific permit conditions.

Environment Management Regulations 2011 Part 7 provides the legal framework for a container deposit legislation and refund system for beverage containers. This includes plastic, glass, and aluminium, as well as the administration of a revolving fund.

Environment Management (Waste Disposal and Recycling) (Container Deposit) Regulations 2011 call for the establishment of a nonprofit entity that is responsible for administering the container deposit system. Financial accounting and accountability for system entities will be key responsibilities of the entity. At the time of writing, these regulations have yet to come into force.

The Litter (Amendment) Decree prohibits littering, as well as its discharge from vehicles or in public places. The amendment decree also calls for the placement and maintenance of litter receptacles. Likewise, it appoints public officials (e.g., police officers, health inspectors, and land transport officials) as Litter Prevention Officers, enabling them to authorise immediately a community service in and around the offensive littering area and to impose spot fines. The decree redefines a waste receptacle and provides for the transfer of monies from paid fines to the governing public authority.

Previous surveys identified the need for a specific waste management/recycling act or regulation. The Environment and Climate Change Adaption Levy on Prescribed Services, Items and Income, 2017, amends the previous Environmental Levy Act 2015. The Amended Act established the Environment and Climate Adaption Fund and introduced a 10% import levy on non-biodegradable plastic shopping bags and a 10 cent per plastic bag levy payable by the person who is provided with a plastic bag from retail outlets. The Act is designed to reduce single-use plastic shopping bags by ensuring that manufactured or imported bags are biodegradable, with the name of the manufacturer or importer clearly visible. The amended Act was passed by Parliament in July 2017 and the introduction of a 10c per bag levy was in force by August 2017. While there has been no revision to Fiji's National Solid Waste Management Strategy 2010-2014 to date, the strategy does provide the framework for continual improvements.

The Ministry of Local Government, Housing and Environment administers the Local Government Act and empowers local governments to establish by-laws for the collection and disposal of waste. Continental Shelf Act 1970, Marine (Pollution Levy) Regulations 2014 and Maritime (Fiji Small Craft Code) Regulations 2014 provide protection for the marine environment.

The Ministry of Health monitors waste management under the Public Health Act (Cap 111), as do public sector health officials at the provincial level who report to the Ministry. This act allows local authorities to issue permits for waste transport, formulate by-laws for the collection and disposal of waste, prescribe fees for the removal of waste, and regulate waste disposal infrastructure.

Fijian Affairs Act (Cap 12) is administered by the Ministry of Fijian Affairs. This act ensures that councils at the provincial level monitor the management of solid waste, enact necessary by-laws, impose rates or fees for SWM, and restrict the fines that may be charged for breach of law.

The Biosecurity Authority of Fiji administers Biosecurity Promulgation 2008 which, in terms of waste management, provides border controls for imports and exports. Quarantine (Amendment) Decree 2010 and Plant Quarantine Act 1982 monitor and restrict the importation of plants, plant material, and plant cultures, among others. Permits are issued by the responsible minister.

Fiji is a party to the following multilateral environmental agreements and conventions. Fiji is not, however, a signatory to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal.

Fiji	
Multilateral Environmental Agreements and Conventions	**Status**
Stockholm Convention on Persistent Organic Pollutants	Ratified
1995 Waigani Convention	Ratified
Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified
International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (Intervention 1969)	Ratified
International Convention on Civil Liability for Oil Pollution Damage 1969 (renewed 1992)	Ratified
International Convention on the Protocol of 1992 to Amend the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971	Ratified
Noumea Convention:	Ratified
Protocol on Dumping	Ratified
Protocol on Combatting Pollution Emergencies Protocol	Ratified
Protocol on Oil Pollution Preparedness, Response and Cooperation	Signed
Protocol on Hazardous and Noxious Substances Pollution, Preparedness, Response and Cooperation	Signed

Source: SPREP. 2016.

Financial mechanisms

Currency: Fiji dollar (F$)

The DoE has a total annual waste management budget of US$230,000, including for solid waste, e-waste, and hazardous waste. The DoE has allocated US$1.2 million to the Naboro Landfill from external aid funding. Landfill disposal charges are based on weight and levied to all users (i.e., commercial and industrial) at approximately US$14/t for general and green wastes and US$25/t for special (regulated) waste. Landfill gate fees and household rates do not fully recover operating costs; thus, annual government subsidies of approximately US$650,000 are essential.

The Ministry of Health has a total annual waste and pollution management budget of US$50,000. City and town councils levy waste collection and disposal fees within the general household rate at approximately F$1.7 per household each week; however, in many instances, the rate charge usually goes unpaid. The Suva City Council, under Garbage Disposal By-Law 2009, levies households with an annual fee of approximately US$15 per bin to cover collection and disposal costs.

A joint partnership between Coca Cola-Amatil (Fiji) Ltd. and Fiji Water operates a stewardship programme, whereby 60kg sacks are provided for the collection of plastic bottles and aluminium cans. The returned recyclables are purchased by Coca Cola-Amatil for US$0.41/kg if the company collects, or US$0.54/kg if delivered to the factory. The recyclables are exported to New Zealand.

House-to-house beer bottle collections for locally produced beer are offered by private operators. The bottles are subsequently returned to the local brewery for reuse.

Lautoka City Council offers informal waste pickers of non-sanitary landfills an annual fee of approximately US$20. A private recycling company produces toilet paper from waste paper, purchasing the paper feedstock for approximately F$0.5/kg.

Conclusions

Fiji's commitment to financial mechanisms to support recycling is evident from its proposed container deposit legislation and refund system under the Environment Management (Waste Disposal and Recycling) (Container Deposit) Regulations 2011. National Solid Waste Management Strategy 2011-2014 identifies the importance of improving financing mechanisms such as a polluter-pays principle in value addition tax (i.e., nonessential basic items), an environment tax on specific imported goods, a fuel tax and a climate change levy on industrial energy usage.

Fiji has the strongest manufacturing base of all Pacific island countries featured in this study. This suggests that its utilities and services support increasing industry development in association with domestic recycling activities, enterprise, and relevant programmes. Fiji also has the highest export rate of recyclable material in the Pacific, with the potential to increase it and include material recovered from e-waste dismantling - an initiative yet to be established under the PacWaste programme.

The Port of Suva is a trans-shipment port that is located on a route that is cost-efficient and is serviced by multiple shipping companies that transfer to a large number of market destinations. While the port requires the capacity to increase the number of TEU's, it does provide significant opportunity for reverse logistics or the back-loading of exports.

The international destinations for the movement of hazardous wastes to recycling markets or treatment facilities are limited to countries that are a signatory to the Waigani Convention, as Fiji has not yet ratified the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal.

Abbreviations

ADB	Asian Development Bank
AMSTEC	Supply chain and transport consultancy firm
CDS	Container deposit scheme
DoE	Department of Environment (Fiji)
DOEE	Department of Environment and Energy (AUS)
ECOLEX	Environmental Law Database
EOL	End of life
GDP	Gross domestic product
HDPE	High-density polyethylene
ICSHP	International Centre on Small Hydro Power
J-PRISM	Promotion of Regional Initiative Solid Waste Management
JICA	Japan International Cooperation Agency
Kg	kilogram
Km	kilometre
km^2	square kilometre
m	metre
MARPOL	International Convention for the Prevention of Pollution from Ships
MFAT	New Zealand Ministry of Foreign Affairs and Trade
OEC	Observatory of Economic Complexity
PET	polyethylene terephthalate
PRIF	Pacific Region Infrastructure Facility
RTRC	Regional Tourism Resource Centre
SPREP	Secretariat of the Pacific Regional Environment Program
SWM	Solid waste management
T	tonne
TEU	Twenty-foot equivalent unit
UNIDO	United Nations Industrial Development Organisation

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Guam

Introduction

The increasing presence of plastic marine debris in the South Pacific Ocean is focusing attention on strengthening recycling policies and systems in the region. Unique challenges associated with shipping commodities of low value over long distances to recycling markets, however, reduce the economic viability to do so. This territory profile includes the current technologies, material flow, logistics, public policies, institutional framework, financial mechanisms, and initiatives that are being designed or have been implemented to strengthen recycling systems in Guam.

The island of Guam, located in the Western Pacific, is the southernmost island in the Mariana Island chain and is the largest island in the Micronesia region. Guam is a territory of the United States, covering a land area of 541km^2, with a coastline of 125.5km.

Hagåtña (or Agana), the territory's capital city, is located on the mid-west coast of the island. While it has the second smallest village population, it is one of the island's most advanced commercial districts.

Socioeconomic background

Guam's total population was estimated at 174,900 in 2013 *(SPREP, 2016)*. The rural population *(Knoeme, 2017)* was approximately 8,745, or 5% of the total, in 2015.

Guam is divided into 19 municipalities, referred to as villages. The approximate populations are provided in the table below.

Guam	
Municipality	**Population**
Agana Heights	3,808
Agat	4,917
Asan-Maina	2,137
Barrigada	8,875
Cahlan-Pago-Ordot	6,822
Dededo	44,943
Hagatna (Capital)	1,051
Inarajan	2,273
Mngilao	15,191
Merizo	1,850
Mongmong-Toto-Maite	6,825
Piti	1,454
Santa Rita	6,084
Sinajana	2,592
Talofofo	3,050
Tamuning	19,685
Umatac	782
Yigo	20,539
Yona	6,480

Source: US Census Bureau

Guam has a significant tourism sector. It represents over 50% of the economy and was in excess of 1.53 million in 2016.

Guam's gross domestic product in 2011 was US$25,420 per capita. In that year, Guam had a negative trade balance *(OEC, 2017)* of US$714 million, with exports at US$21.8 million (+7.7% annualised) and imports at US$735 million (+4.4% since 2010).

The primary export market destinations in 2015 were Australia, Hong Kong (China), the Republic of Korea, Palau, and Singapore. The main import origins in the same year were Hong Kong (China), Japan, the Republic of Korea, the Philippines, and the Republic of Singapore. Guam's key economic drivers are tourism and the military. *(OEC. 2017)*

Solid waste management

The Guam Zero Waste Plan estimates rates for municipal solid waste to be between 2kg and 2.39kg per capita per day. Non-municipal solid waste is estimated at between 1.27kg and 3.35kg per capita per day.

This regional study coordinated by PRIF models the potential recovery of 15 materials types. A defined set of recovery rates was applied to the urban, rural, and outer island population distribution to calculate Guam's potential recovery tonnage. The PRIF study compares various data to establish the context for the 15 waste materials.

The material flow chart below is based on an analysis of Guam's imports of the 15 material categories studied, averaged over a seven-year period to 2016, compared with exports of those recovered recyclable materials, averaged over a two-year period 2015-2016, presented as a percentage of the total of the 15 categories. *(UN Comtrade, 2017)*.

Import and export data were not specifically available for Guam within this study. It is likely this data is calculated within the data for U.S. imports, given that Guam is a territory.

Modelling of potential recovery of recyclable materials, presented in the table below, is based on an estimated average daily per capita municipal solid waste generation of 2.1kg *(World Bank, 2012)*. It also applies a range of location-specific estimated recovery rates that are based on a set of assumptions of existing or introduced incentive-based policies and programs, such as container-deposit schemes and import levies. The resulting ratios were used to estimate average annual tonnages that could be recovered for recycling. *(JICA, 2013; SPREP 2016; Mobile Muster, 2013; DOEE, 2017; Jambeck et al., 2015; MFAT, 2016; UNIDO/ICSHP, 2013)*.

Guam	
Recyclable Material Forecast	**Estimated Metric Tonnes**
Polyethylene terephthalate (PET) beverage containers	1,177
Aluminium cans	2,318
Glass beverage containers	1,637
Steel cans	1,841
Plastic shopping bags	763
End-of-life (EOL) renewable energy equipment	- -
Paper/cardboard	7,706
E-waste	75
Whitegoods	421
Used motor/cooking oil	1,052
Used lead-acid batteries	738
Used lithium batteries	216
Scrap steel/nonferrous metals	2,762
EOL tyres	735
EOL vehicles	10,788
Total	**32,229**

Future waste management

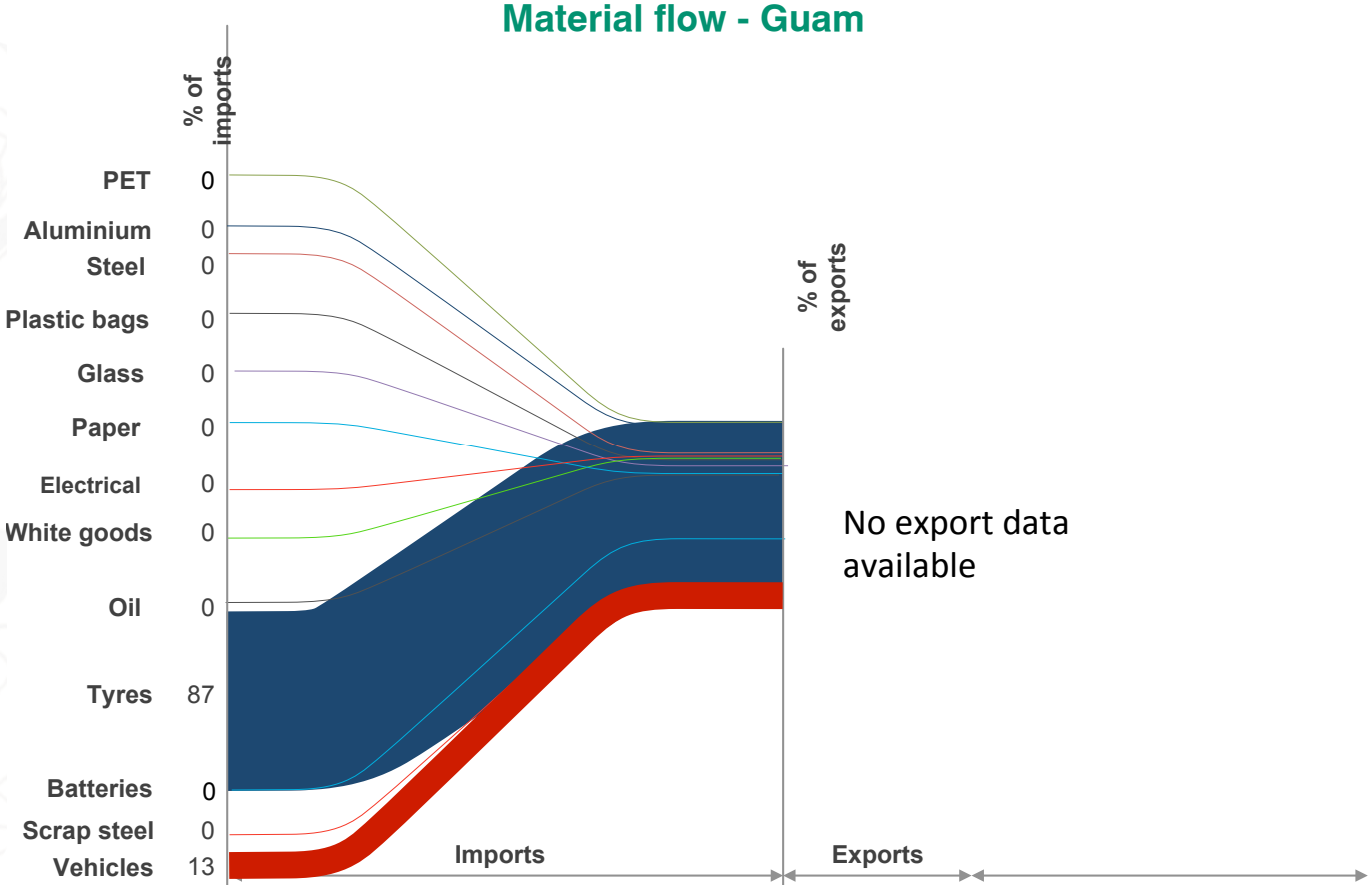
Guam's Zero Waste Plan 2013 outlines future initiatives that include the erection of a construction and demolition processing facility and the reprocessing of tyres, and glass for the paving of roadways. Extended producer programmes for e-waste and packaging material are expected to increase recycled materials *(GoG, 2013)*.

Plastic marine debris

Mismanaged plastic waste eventually enters the marine environment by way of inland rivers and waste water outfalls or is transported by wind and tide. Rigid and lightweight plastic material from products consumed or used on a daily basis become marine debris if not managed appropriately. An estimated 12% of Guam's waste stream is made up of plastic.

A recent study *(Jenna et al., 2015)* indicates that Guam generates approximately 47.9 tonnes (t) a day of plastic waste. An estimated 1.1t is predicted to enter the marine environment due to waste mismanagement and direct littering. As such, an estimated 393t of plastic waste is predicted to become marine debris in Guam waters in 2010. If not addressed, the amount is expected to rise to 574t by 2025.

Material flow - Guam



Source: Anne Prince Consulting 2017.

Note: The percentage of imports and exports displayed relate only to the proportion of the 15 materials categories studied, not total imports/exports

Of the 47.9t of plastic generated each day, approximately 5.3t may derive from polyethylene terephthalate (PET) or high-density polyethylene (HDPE) plastic bottles. These products are eligible for recycling under a container deposit scheme (CDS). Based on an average reduction rate of 40% in mismanaged waste with a CDS in place, approximately 0.05t of PET and HDPE plastic could be recycled each day. This could increase to an 80% or above reduction rate, depending on access to recycling collection services and viable markets, among others. Nonetheless, a 40% reduction in mismanaged PET and HDPE would result in approximately 375t of plastic becoming marine debris each year.

The outcome of mismanaged plastic is split into three groups: plastic that remains on the surface of the sea as floating debris, plastic that sinks to the ocean floor, and plastic that washes up on the beach. A CDS that recovers 40% of HDPE and PET plastic bottles in Guam may achieve the following reductions in marine debris each year:

- 3t in floating plastic
- 12t in sunken plastic
- 3t in beach plastic.

Further benefits attributed to a CDS are a potential reduction in annual damage costs for Guam's 191 local fishing vessels (approximately US$1,487). If beaches were to be cleaned up, over US$4,408 would be saved, of particular relevance to the amenities of coastal communities and the tourism sector.

Infrastructure and services

The Guam Solid Waste Authority (GSWA) is an autonomous public agency, responsible for providing solid waste management (SWM) services to 100% (16,000 households) of the population. This service takes place on a weekly bases and waste is collected from the curbside for recycling.

For those households that do not pay for curbside collection, there are three residential transfer stations in place for the recycle of cardboard, paper, aluminium and steel cans, and PET and HDPE plastic. The GSWA manages the operating contracts of the Layon Landfill and the hauler transfer station that receives only commercial waste. Disposal is banned for hazardous and liquid waste, construction and demolition debris, and recoverable materials. A household hazardous waste facility is located at the Harmon Residential Transfer Station. The GSWA also operates a material recovery facility where recyclables are consolidated and baled for export.

There are various recycling services managed by the private sector, under public/private partnerships, and by nonprofit organisations. These, together, achieve an estimated waste diversion rate of 17.85%. Recyclers collect and export scrap steel, whitegoods, e-waste, PET and HDPE plastic, cardboard, vehicle batteries, tyres, aluminium cans, and waste oils.

There is some on-island glass reprocessing which, once crushed, is used at the Layon Landfill as an alternative cover or as backfill for landfill roads and other civil works. Cardboard and paper are combined with green waste for composting. Gresco, Guam's environmental services company, accepts used oil from individuals and businesses for treatment and processing into a diesel-type product.

Logistics

Guam has one international seaport, operated by the Port Authority of Guam. It is located at Piti.

Apra Harbour

Source: Google Maps.

Port Apra terminal is approximately 15 hectares and is equipped with high-standard facilities. Included are a quay (591 metres long by 10 metres deep), a warehouse, shore cranes, and private stevedore services.

The Port of Apra is capable of handling 250,000 twenty-foot equivalent units (TEU) per year. The port has a current throughput of approximately 50,000 import, 2,000 export and the return of 22,950 empty containers each year which may potentially be made available for reverse logistic arrangements. The port also loads and unloads approximately 1,000 transshipment containers each year.

The Port of Apra is serviced by various international shipping lines. Estimated TEU shipping container rates, presented in the table below, are based on the cargo of nonhazardous goods, inclusive of un/loading and a bunker adjustment factor. They do not account for customs clearance, duties, and quarantine inspection.

Guam: Shipping Lines		
Swire Shipping; Guam Saipan Express (GSX); Kyowa Shipping Company; Matson Inc.		
Destination	**Schedule**	**Est. USD per TEU**
North Asia	14-day	3,260
New Zealand	21-day	4,250
South East Asia	14-day	TBA
West Coast USA	7-day	TBA

Source: AMSTEC Pty Ltd

Notes: USD = U.S. dollar; TEU = twenty-foot equivalent unit.

Institutional framework

Data relating to the institutional framework of Guam have been gathered from the database of the Pacific Islands Legal Information Institute *(PacILII, 2017)*. ECOLEX is also an information service that relates to environmental law *(ECOLEX, 2017)*, from which various data also have been collected.

The Solid Waste Management and Litter Control Act is administered by the Guam Environmental Protection Authority. The Act provides the legal framework for solid and hazardous waste and stipulates the development and implementation of SWM plans. The Act also regulates the management of hazardous waste and the issuance of permits for solid waste activities. It prohibits open dumping, littering, and burning of waste, and sets penalties for doing so. In addition, a Solid Waste Management Fund has been established to fund implementation of the Act.

Guam Solid Waste Disposal Regulations establish operating and permit requirements for landfill disposal operations. They also relate to the planning, permit, and operating requirements for the collection of solid waste, excluding hazardous waste.

Guam Beverage Container Recycling Act 2010 provides for a deposit fee of US$0.05, to be paid on the retail price of specific beverage containers (PET, HDPE, glass, and aluminium). Eighty percent of this fee is redeemed on delivery of empty containers at redemption centres.

The issuance of permits for the collection, storage, processing, purchasing, and resale of containers is set by Guam Beverage Container Regulations. The regulations, however, may be limited to only aluminium cans.

The GSWA was established under Public Law 31-20 and had been operating under the administration of a Receiver, appointed by the U.S. District Court of Guam. The Receiver oversaw the government's compliance with a Consent Decree, imposed in 2004, to prevent the discharge of contaminants from the Ordot Dump. Since then, however, an integrated waste management system has been put in place and the Ordot Dump has been closed. Rehabilitation of the site has taken place and construction of leachgate and gas capture systems has been completed.

Guam Zero Waste Plan 2013 is a comprehensive framework document that relates to various waste minimisation initiatives, to be phased over a 20-year period. Focus is placed on accelerating the circular economy by further encouraging the on-shore remanufacturing of recyclable material. The plan also sets out a range of administrative premises that include the improvement of GSWA resourcing and the strengthening of enforcement of litter control laws, green public procurement, 3R (reduce, reuse, recycle) building sustainability, and Zero Waste Plan funding.

The Zero Waste Plan has introduced a pay-as-you-throw system for households that opt to downsize from 96-gallon wheelie bins. Moreover, a single-use plastic bag ban will be put in place at retail and wholesale outlets.

As a Territory of the United States, Guam is a party to various multilateral environment agreements, listed in the table below.

Guam	
Multilateral Environmental Agreements and Conventions	**Status**
Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified
Minamata Convention on Mercury	Ratified
MARPOL 73/78: International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (Annexes I, II ,III, V, and VI)	Ratified
London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972	Ratified
International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (Intervention 1969):	Ratified
Protocol 1973	Ratified
International Convention on Oil Pollution Preparedness, Response and Co-operation 1990	Ratified
International Convention on the Control of Harmful Anti-fouling Systems in Ships (AFS Convention) 2001	Ratified
Noumea Convention	Ratified
Protocol on Dumping	Ratified
Protocol on Combatting Pollution Emergencies	Ratified

Source: SPREP. 2016.

Guam is neither a direct party to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal nor to the 1995 Waigani Convention. As a territory of the United States, however, it comes under the ratification of that party.

Financial mechanisms

Currency: United States dollar (US$)

The GSWA levies residential curbside collection service fees on a monthly basis. The weekly fee for a single bin is US$30; a dual bin, $45; and a garbage bag, US$4.

Transfer station fees are volume-based, from US$7.50 to US$22.50. An amount of US$7.50 is charged for sofas and mattresses, whereas cardboard and glass containers are free.

Guam's Recycling Revolving Fund lawstipulates a recycling fee of US$3-US$30 to be levied on annual motor vehicle registrations. Revenue is directed to the Recycling Industry Economic Stimulus programme, Guam's Zero Waste Plan, as well as towards grants for environmental education and awareness programmes.

The Deposit Beverage Container Fee is managed independent of other public funds. Eighty percent of the funds is reimbursed to redemption centres, with the remaining 20% applied to the administrative, audit, compliance, and recycling promotion activities of the programme.

Conclusions

Guam has a comprehensive SWM plan in place, with waste minimisation initiatives that will be phased over a 20-year period, to be funded by the Recycling Revolving Fund. The plan provides for economic development in the waste, recycling, and remanufacturing sectors.

Guam is one of two ports in the Pacific that has excellent facilities, with the capacity to handle increased cargo volume. It is currently a transshipment port that is located on mostly cost-effective routes between New Zealand, North America, and North Asia.

Abbreviations

3R	Reuse, reduce, recycle
AFS	Anti-fouling systems
CDS	Container disposal scheme
DOEE	Department of Environment and Energy (Australia)
FY	Financial year
GoG	Government of Guam
GSWA	Guam Solid Waste Authority
HDPE	High-density polyethylene
ICSHP	International Centre on Small Hydro Power
JICA	Japan International Cooperation Agency
kg	kilogram
km	kilometre
km^2	square kilometre
MARPOL	International Convention for the Prevention of Pollution from Ships
MFAT	Ministry of Foreign Affairs and Trade (New Zealand)
OEC	Observatory of Economic Complexity
PET	Polyethylene terephthalate
PRIF	Pacific Region Infrastructure Facility
SPREP	Secretariat of the Pacific Regional Environment Programme
SWM	Solid waste management
t	tonne
TEU	Twenty-foot equivalent unit
UNIDO	United Nations Industrial Development Organisation
USD	United States dollar

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Kiribati

Introduction

The increasing presence of plastic marine debris in the South Pacific Ocean is focusing attention on strengthening recycling policies and systems in the region. Unique challenges associated with shipping commodities of low value over long distances to recycling markets, however, reduce the economic viability to do so. This country profile indicates the current technologies, material flow, logistics, public policies, institutional framework, financial mechanisms, and initiatives that are being designed or have been implemented to strengthen recycling systems in Kiribati.

Kiribati is located in the Micronesia region of the central Pacific Ocean. The country's 33 coral atolls and islands are dispersed among the three groups that form Kiribati, which are the Gilbert, Line, and Phoenix islands. Covering a land area of 810km^2, the island groups are spread over approximately 3.5 million square kilometres in the Central Pacific Ocean. The nation's capital is South Tarawa, situated on the Gilbert Island group.

Kiribati's landscape is mostly a series of ring-shaped atolls with central lagoons, except for Banaba Island in the Gilbert Island group, which is a raised limestone island. With 1,140 kilometres of coastline, the majority of the atolls are approximately 6 metres (m) above sea level and surrounded by barrier reefs.

Source: Google Maps.

Socioeconomic background

Visitors to Kiribati are attracted by extensive water-based activities that include scuba diving and fishing. In 2016, 5,018 tourists visited Kiribati *(SPTO, 2017)*, representing a 15% increase on the previous year.

Kiribati has a tradition of strong leadership and culture, having remained relatively untouched because of its isolation. Approximately 60,500, or 55%, of the population live in rural, outer island locations. *(Knoema, 2015)*

Kiribati is a republic with two levels of government, central and local. The Ministry of Internal and Social Affairs oversees the three local urban councils (Teinainano (South Tarawa), Betio, and Kiritimati (Christmas Island)) and 23 island (rural) councils.

Approximately 50% of Kiribati's population of 110,136 *(GoK, 2015)* live on South Tarawa. The following table provides the approximate population distribution, based on the 2010 census across the districts (islands) of Kiribati.

Kiribati: Population Distribution

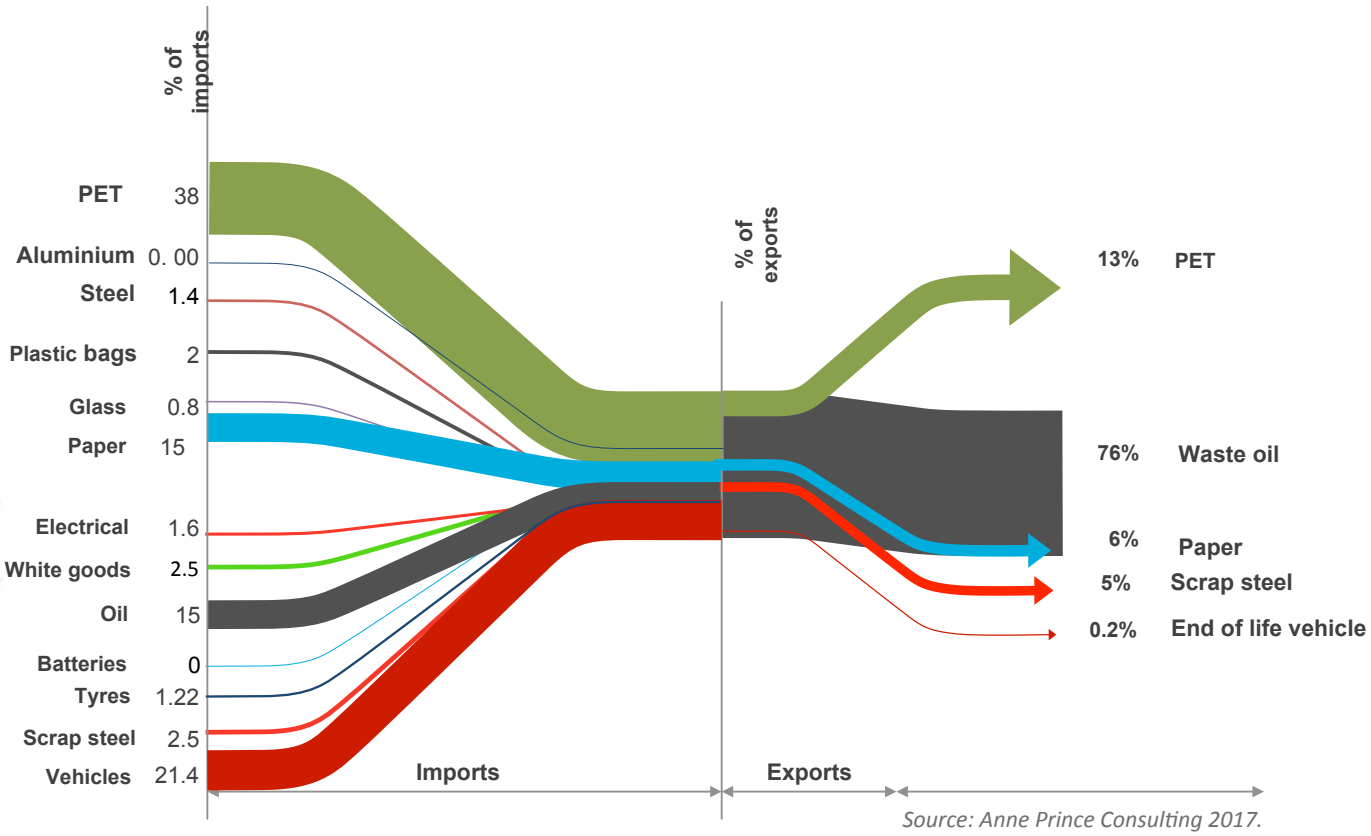
Island Group	Location	Population
Gilbert Island Group	Banaba	268
	Makin	1,990
	Butaritari	3,224
	Marakei	2,799
	Abaiang	5,568
	Nth. Tarawa	6,629
	Sth.Tarawa	56,388
	Maiana	1,982
	Abemama	3,262
	Kuria	1,046
	Aranuka	1,125
	Nonouti	2,743
	Nth. Tabiteuea	3,955
	Sth. Tabiteuea	1,306
	Beru	2,051
	Nikunau	1,789
	Onotoa	1,393
	Tamana	1,104
	Arorae	1,011
Northern Line Islands	Kiritimati	6,456
	Tabuearan	2,315
	Teraina	1,712
Phoenix Island Group	Kanton	20
Central Line Islands		No record
Southern Line Islands		No record

Source: GoK, 2015

Kiribati's gross domestic product in 2015 was US$160 million/US$1,990 per capita *(OEC, 2017)*. In the same year, there was a trade balance deficit of US$41.8 million, with exports at US$119 million (+36.6% annualised) and imports at US$161 million (+5.6% since 2010).

The primary export market destinations for 2015 were Australia, American Samoa, Colombia, New Zealand, and the United States. The main import origins included Australia, the People's Republic of China, the Fiji, Japan, and the Republic of Korea. Contributors to Kiribati's gross domestic product include the services and agriculture sectors, with manufacturing as a value adding activity, responsible for 4.82% of the country's economy *(GlobalEDGE, 2017)*

Material flow - Kiribati



Source: Anne Prince Consulting 2017.

Note: The percentage of imports and exports displayed relate only to the proportion of the 15 materials categories studied, not total imports/exports

Contributors to Kiribati's gross domestic product include the services and agriculture sectors, with manufacturing as a value adding activity, responsible for 4.82% of the country's economy *(GlobalEDGE, 2017)*.

Solid waste management

This regional study coordinated by PRIF models the potential recovery of 15 materials types. A defined set of recovery rates was applied to the urban, rural, and outer island population distribution to calculate Kiribati's potential recovery tonnage. The PRIF study compares various data to establish the context for the 15 waste materials.

The material flow chart below is based on an analysis of Kiribati's imports of the 15 material categories studied, averaged over a seven-year period to 2016, compared with exports of those recovered recyclable materials, averaged over a two-year period 2015-2016, presented as a percentage of the total of the 15 categories. *(UN Comtrade, 2017)*.

The import of plastic beverage containers increased steadily from 2009 to 2013 before reversing. Since then, however, there has been an increase in the import of pelletised polyethylene terephthalate (PET) for the on-shore production of PET bottles. Plastic bag imports also peaked in 2013, although have shown a downward trend since. Significant growth in the import of printing paper has been observed from 2009 to 2016, as has a decrease in the import of toilet paper or similar. Electronics and white goods are holding steady, while the number of cars being imported has increased.

Of the 15 materials considered for this study, Kiribati exported only paper, waste oil, and scrap metal in quantities of note in 2014-16. While the analysis did not detect a significant export of used lead-acid batteries, it is understood that it does, in fact, take place. This is based on the number of used lead-acid batteries that have been recovered through the Kaoki Mange! (Keep Kiribati Beautiful) recycling project.

Modelling of potential recovery of recyclable materials, presented in the table below, is based on an estimated average daily per capita municipal solid waste generation of 0.79kg *(World Bank, 2012)*. It also applies a range of location-specific estimated recovery rates that are based on a set of assumptions of existing or introduced incentive-based policies and programs, such as container-deposit schemes and import levies. The resulting ratios were used to estimate average annual tonnages that could be recovered for recycling. *(JICA, 2013; SPREP 2016; Mobile Muster, 2013; DOEE, 2017; Jambeck et al., 2015; MFAT, 2016; UNIDO/ICSHP, 2013).*

Kiribati	
Recyclable Material Forecast	**Estimated Metric Tonnes**
Polyethylene terephthalate (PET) beverage containers	122
Aluminium cans	219
Glass beverage containers	154
Steel cans	174
Plastic shopping bags	79
End-of-life (EOL) renewable energy equipment	-
Paper/cardboard	727
E-waste	3
Whitegoods	24
Used motor/cooking oil	563
Used lead-acid batteries	18
Lithium batteries	56
Scrap steel/nonferrous metals	261
EOL tyres	18
EOL vehicles	346
Total	**2,764**

Future waste management

Future increases in material recovery are expected as a result of the PacWaste (2014-17) programme, which is in the process of being implemented by the Secretariat of the Pacific Regional Environment Programme as a means for improving the management of e-waste. Activities under this programme include an e-waste pilot project for the safe dismantling of e-waste, shipping and logistical support, a community awareness campaign, and assistance in developing a national e-waste strategy *(SPREP. 2017)*.

Kiribati aims to achieve at least a 45% reduction in the generation of fossil-fuel energy by 2025. Ten percent renewable energy will be achieved at completion of various projects that include the installation of photovoltaic solar on Tarawa, a photovoltaic-diesel hybrid system on Kiritimati Island, and 1,700 household solar systems on outer islands. Approximately 65% of the population has access to electricity.

As the transition to renewable energy progresses, equipment such as solar panels and batteries will have a greater presence in the recoverable waste stream, as will household electrical items, computers, and communication equipment as a result of improved power access *(ADB, 2017)*. These projects have been supported by the Asian Development Bank, European Union, United Arab Emirates, World Bank and Japan.

Plastic marine debris

Mismanaged plastic waste eventually enters the marine environment by way of inland rivers and waste water outfalls or is transported by wind and tide. Rigid and light-weight, plastic material from products that are consumed or used on a daily basis become marine debris if not managed appropriately.

An estimated 13% of Kiribati's waste stream is comprised of plastic, and a recent study *(Jenna et al., 2015)* indicates a daily plastic waste generation of approximately 9.7 tonnes (t). An estimated 86% of this is mismanaged daily and is predicted to enter the marine environment. Approximately 8.1 t may enter the ocean, released from uncontained disposal sites, and 0.19 t will originate from littering (i.e., a total of 8.3 t). An estimated 3,045 t of plastic waste was released into the waters around Kiribati in 2010, becoming marine debris. If not addressed, the amount is expected to rise to 6,977 t by 2025.

Preliminary data modelling suggests that 80% of PET and high-density polyethylene (HDPE) plastic are eligible for recycling under a container deposit scheme (CDS), a potential of 300 t per annum. The remaining 2.7 t of non-CDS plastic and other plastic types (e.g., plastic bags/film and rigid containers) would continue to enter the marine environment

A CDS that recovers 40% of HDPE and PET plastic bottles in Kiribati may achieve the following reductions in marine debris each year:

- 20 t in floating plastic
- 94 t in sunken plastic
- 20 t in beach plastic.

Further benefits attributed to a CDS are a potential reduction in annual damage costs for Kiribati's 141 local fishing vessels (approximately US$1,098). If beaches were cleaned, over US$34,172.78 would be saved, of particular relevance to the amenities of coastal communities and the tourism sector.

Infrastructure and services

Kiribati operates the Kaoki Mange! project, launched in February 2005, including a container deposit/advance disposal scheme for aluminium cans, PET bottles, and lead-acid batteries. Early reports indicate 89% recovery of these commodities, which have now largely been excluded from the general waste stream. Given the success of this project, the authorities are considering extending it to include vehicles.

Current private recycling efforts located in Betio show good recovery, in general, from the CDS, with one shipping container of aluminium cans and other nonferrous materials exported to Australia every four weeks. Another container of PET bottles and lead-acid batteries is exported to Hong Kong (China) every seven weeks. This private recycler, under contract with the Ministry of Environment, Lands and Agricultural Development, also manages the CDS collection and container refund centres in Kiribati.

Community recycling drop-off facilities are located at Bonriki, Bikenibeu, Teaoraereke, and Bairiki (main island only). Residents bring eligible containers to the centres to receive a redemption, based on volume. The receptacles are standard-size steel cages capable of housing 500 containers. Rural councils, in contrast, tend to struggle to provide basic infrastructure and services in contrast to Kiribati's urban centres, where this is mostly provided by the central government.

Recyclables collected at the community drop-off facilities are transferred for further processing to the Kaoki Mange Waste Recycling Facility that is located adjacent to the Materials Recovery Facility on the main road to Betio Port. A 10 m by 8 m hanger facility provides cover for the bailer and the processing of recyclables, later to be containerised prior to transfer to the port. Collection and community centre recycling services are restricted to the main island only.

Residents from the outer islands enter the main island through Betio Port. This way, they are able to deposit their bulk bags of CDS recyclables at the recycle centres.

Residents on Kiritimati Island may participate in the CDS through their local council, which collects and pays them the deposit on the containers. The materials are then transferred to Betio or sent direct to market and the local council receives the income from the contractor of the Kaoki Mange facility.

The Materials Recovery Facility receives and stockpiles whitegoods, e-waste, scrap metal, and end-of-life vehicles for export. These are then collected (uncompacted) by international recyclers in a barge for direct transfer to market. Vehicle tyres currently are stockpiled, cardboard and paper is reused, and lithium batteries landfilled.

Council waste services use tractors and trailers to collect household waste in 167 litre drums or rice bags that are located on roadsides. These services, which are meant to operate on a weekly basis, are somewhat unreliable.

A private contractor also offers a weekly collection service to accessible households, using waste compactor vehicles. This service collects the pre-purchased green bags under the Green Bag Programme, a user-pay system whereby special green garbage bags are purchased at A$0.20 per bag.

The Tarawa Urban Council (TUC) operates landfills at Nanikai and Bikenibeu, while Betio Town Council (BTC) operates the Betio landfill. Some compacting is undertaken at Betio and Nanikai, although at the time of writing, it is understood that the landfill leachate pumps are inoperative at the Nanikai and Bikenibeu facilities.

Logistics

Kiribati has three international seaports, operated by the Kiribati Ports Authority. They are located at Banaba, Betior, and Kiritimati. Betio is the primary port of arrival, as well as a container terminal. Other domestic ports include English Harbour and Fanning Island.

Inter-island services from Betio Port are frequent to islands that are closer to the mainland. These are operated by the Kiribati Shipping Services Ltd., a wholly-owned government shipping company established in 2008. The fleet includes a roll-on/roll-off vessel with the capacity to carry 35 cars and 315 passengers, as well as a container vessel with a 60 twenty-foot equivalent unit (TEU) capacity and two cranes.

The Tarawa Port terminal is approximately 2 hectares. Facilities include a main quay that is 200 m long by approximately 9 m deep and a warehouse. There are neither shore cranes, private stevedore services, nor quarantine incineration facilities on site.

The Port of Tarawa is capable of handling 4,000 TEU per year. The port has a current throughput of approximately 2,500 import, 200 export and the return of 2,300 empty containers each year which may potentially be made available for reverse logistic arrangements.

Tarawa Port is serviced by multiple international shipping lines. Estimated TEU shipping container rates, presented below, are based on the cargo of nonhazardous goods, inclusive of un/loading and a bunker adjustment factor. They do not account, however, for customs clearance, duties, and quarantine inspection.

Kiribati: Shipping Lines

Auspac Consortium; Kyowa Shipping Co. Ltd.; Polynesia Line

Destination	Schedule	Est. USD per TEU
Australia	21-day	2,100 to 4,600
Fiji	21-day	2,450 to 3,342
North Asia	21-day 30-day	2,600 to 4,530

Source: AMSTEC Pty Ltd

Notes: USD = U.S. dollar; TEU = twenty-foot equivalent unit.

Institutional framework

Data relating to the institutional framework of Kiribati have been gathered from the database of the Pacific Islands Legal Information Institute *(PacILII, 2017)*. ECOLEX is also an information service that relates to environmental law *(ECOLEX, 2017)*, from which various data also have been collected.

The Environment and Conservation Division of the Ministry of Environment, Lands and Agriculture Development administers Environment Act 1999 (amended in 2007) and Environmental Regulations 2001. While the Act authorises the local councils to manage waste, the Division plans and implements National Solid Waste Management Strategy 2007. Together with the Secretariat of the Pacific Regional Environment Programme, the latter prepared the 2012 Kiribati Integrated Environment Policy. In addition, Special Fund (Waste Materials Recovery) Act 2004 regulates the container deposit scheme and is administered by the Ministry of Finance.

Other legislations that impact the management of waste include the Public Health Act Ordinance and Local Government Act 1984 (amended 2006). These allocate control of waste collection and disposal services to the local councils, authorizing them to issue by-laws with regard to waste management fees *(ADB, 2014)*.

In the Gilbert Island Group, TUC is responsible for Tanea town in the east of Bairiki. BTC is responsible for Betio Islet, which is linked to Bairiki by a causeway. Settlements and commercial premises outside of these areas must manage their own waste, which may be composted, although there are reports of waste being disposed at sea, on the beach, buried, or burned.

Maritime Act 2017 was passed by Parliament in April/May 2017. It addresses issues that relate to internal and marine waters, toxic and hazardous substances, marine conservation, and social impact.

Kiribati is a party to various multilateral environmental agreements and conventions, listed below.

Kiribati	
Multilateral and Environmental Agreements and Conventions	Status
Stockholm Convention on Persistent Organic Pollutants	Ratified
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	Ratified
1995 Waigani Convention	Ratified
Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified
MARPOL 73/78: International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (Annexes I, II, III, IV, V, and VI)	Ratified
London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972	Ratified
International Convention on Civil Liability for Oil Pollution Damage 1969 (renewed 1992)	Ratified
International Convention on the Protocol of 1992 to Amend the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971	Ratified
International Convention on Civil Liability for Bunker Oil Pollution Damage (BUNKER) 2001	Ratified
Control of Harmful Anti-fouling Systems in Ships (AFS Convention) 2001	Ratified
International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) 2004	Ratified

Source: SPREP. 2016.

Financial mechanisms

Currency: Kiribati dollar (K$); Australian dollar (A$)

Under the CDS, a deposit of A$0.05 is levied on beverage containers and A$5 on lead-acid batteries at the point of import. These fees are collected by Kiribati Customs and deposited into a special fund, established under the Special Fund (Waste Materials Recovery) Act. Consumers are then able to redeem A$0.04 in return for the containers that are meant for recycling and the remaining A$0.01 covers handling fees. In the case of lead-acid batteries, the full AU$5 levied on importation is redeemed on return.

Service charges are levied by councils for household waste collection at A$29 per annum and at A$650 per annum for commercial premises. It is reported, however, that only around 25% of the levies are recovered from billed properties.

The Green Bag programme is a user-pay system. The purchase price of garbage bags is A$0.20 per bag, and the revenue helps to cover the cost of collection services. It is anticipated that future increases of the green bag price will fund fully the collection services.

Annual budgets are prepared annually, with the central government providing funding to local authorities for waste management. BTC annual revenue is at a surplus of A$120,000, with expenses at approximately A$90,000. With regard to the TUC, its expenses are greater, at an approximate annual rate of A$210,000, with budget revenue at only A$190,000.

The landfill infrastructure is largely supported by donor funding as there are no disposal fees applied.

The most recent national solid waste management strategy indicates the potential expansion of the import tax system to include glass bottles, steel cans, and vehicles.

Conclusions

Kiribati successfully established the Kaoki Mange! (Keep Kiribati Beautiful) project with a recovery achievement of approximately 89% in recyclable materials. A green bag project was also implemented with a user-pay approach to increase access to sustainable waste collection services.

It is evident that Kiribati has the capacity to extend resource recovery systems outside of Tarawa, based on the success of these financial mechanisms and on the availability of its inter-island shipping services.

Tarawa Port lacks the capacity to handle increased cargo volume, and current shipping services are limited in terms of destination routes and schedules. There is, nevertheless, ample capacity for backload freight for the export of recyclables.

Abbreviations

ADB	Asian Development Bank
AFS	Anti-fouling systems
BTC	Betio Town Council
BWM	Ballast water and sediments
CDS	Container deposit scheme
DOEE	Department of Environment and Energy (Australia)
EOL	End of life
FY	Financial year
GoK	Government of Kiribati
HDPE	high-density polyethylene
ICSHP	International Centre on Small Hydro Power
JICA	Japan International Cooperation Agency
kg	kilogram
km	kilometre
km^2	square kilometre
m	metre
MARPOL	International Convention for the Prevention of Pollution from Ships
MFAT	Ministry of Foreign Affairs and Trade (New Zealand)
OEC	Observatory of Economic Complexity
PET	Polyethylene terephthalate
PRIF	Pacific Region Infrastructure Facility
RTRC	Regional Tourism Resource Centre
SPREP	Secretariat of the Pacific Regional Environment Programme
t	tonne
TEU	Twenty-foot equivalent unit
TUC	Tarawa Urban Council
UNIDO	United Nations Industrial Development Organisation
USD	United States dollar

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New Caledonia

Introduction

The increasing presence of plastic marine debris in the South Pacific Ocean is focusing attention on strengthening recycling policies and systems in the region. Unique challenges associated with shipping commodities of low value over long distances to recycling markets, however, reduce the economic viability to do so. This Territory profile includes the current technologies, material flow, logistics, public policies, institutional framework, financial mechanisms, and initiatives that are being designed or have been implemented to strengthen recycling systems in New Caledonia.

New Caledonia consists of a main island, Grande Terre, and various smaller islands that include the Loyalty Islands, Chesterfield Islands, Isle of Pines, Belep archipelago, and a number of remote islets. It is situated in the Melanesia region of the southwest Pacific, covering 18,576km^2, with a combined coastline of 2,254km.

New Caledonia is relatively mountainous and is surrounded by coastal plains. Coral reefs almost entirely encircle the main island. Noumea, the capital, is located on the peninsula of the main island.

Socioeconomic background

New Caledonia is a French territory that is governed by a Territorial Congress, a legislative body represented by members from three provincial assemblies. These are Northern Province, Southern Province, and the Loyalty Islands.

New Caledonia's population in 2014 was approximately 269,000. This included a rural population of approximately 77,700 or 30%. The population distribution across the largest cities of the three provinces is as follows *(GoNC, 2014)*:

South Province	Population
Noumea, capital	99,926
Le Mont-Dore	27,.155
Dumbéa	31,812
Païta	20,616

Loyalty Islands	Population
Lifou Island, capital	9,275
Mare Island	5,648
Ouvea Island	3,374

North Province	Population
Kone, capital	7,340
Poindimie	4,868
Houailou	4,240

Source: GoNC. 2014.

Prior to the end of World War II, the country's economy was largely based on the nickel mining industry. With the collapse of nickel prices in the 1970s, however, greater emphasis was set on developing a vibrant tourism sector. Nonetheless, the nickel industry remains primarily responsible for New Caledonia being one of the largest economies in the South Pacific. Visitors to New Caledonia in 2016 numbered 115,676, an increase of 1.4% compared to the previous year *(SPTO, 2017)*.

New Caledonia's gross domestic product in 2011 was US$36,405 per capita *(SPREP, 2016)*. In 2015, it had a trade balance deficit of US$1.42 billion, with exports at US$1.48 billion (+0.8% annualised) and imports at $2.91 billion (-0.4% since 2010).

The primary export market destinations for 2015 were Australia, the Republic of China, Japan, the Republic of Korea and various other Asian countries. The main import origins for the same year were Australia, the People's Republic of China, France, the Republic of Korea and the Republic of Singapore. *(OEC, 2017).*

Solid waste management

The regional study coordinated by PRIF models the potential recovery of 15 materials types. A defined set of recovery rates was applied to the urban, rural, and outer island population distribution to calculate New Caledonia's potential recovery tonnage. The PRIF study compares various data to establish the context for the 15 waste materials.

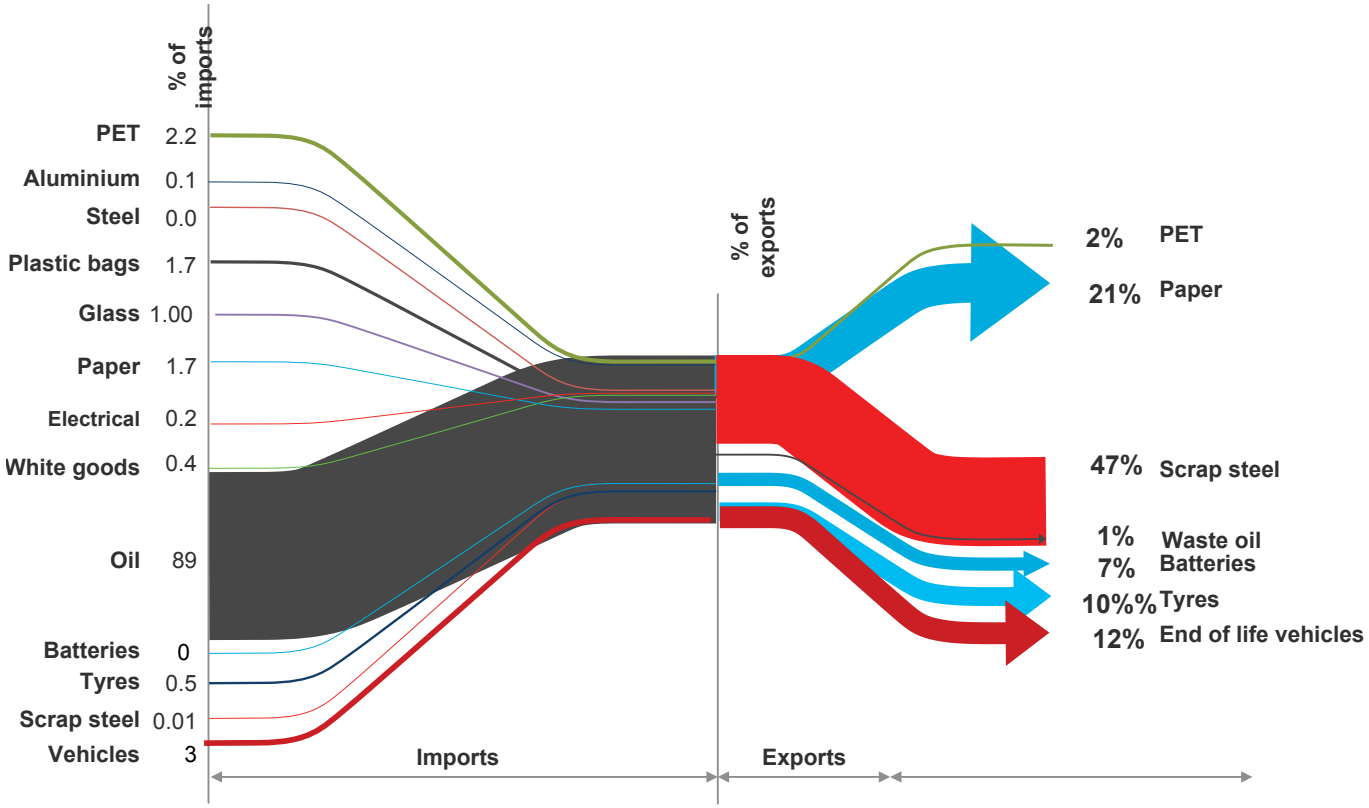
The material flow chart below is based on an analysis of New Caledonia's imports of the 15 material categories studied, averaged over a seven-year period to 2016, compared with exports of those recovered recyclable materials, averaged over a two-year period 2015-2016, presented as a percentage of the total of the 15 categories. *(UN Comtrade, 2017).*

New Caledonia imports large quantities of beverage containers, which have held steady over the course of the seven-year period under study. While similar trends were observed for plastic bags and paper, there was an increase in the number of whitegoods and the volume of crude oils. Import of general purpose vehicles has continued at the same pace, with specialised vehicles (e.g., large vans and tractors) showing a downward trend over the same period.

Export data was available for 13 of the 15 materials imported into New Caledonia. Data indicate that an average of 2,000 tonnes (t) of paper and cardboard, 4,000t of scrap steel, and 1,000t of vehicles were exported in 2014-16.

Modelling of potential recovery of recyclable materials, presented in the table below, is based on an estimated average daily per capita municipal solid waste generation of 2.1kg *(World Bank, 2012)*. It also applies a range of location-specific estimated recovery rates that are based on a set of assumptions of existing or introduced incentive-based policies and programs, such as container-deposit schemes and import levies. The resulting ratios were used to estimate average annual tonnages that could be recovered for recycling. *(JICA, 2013; SPREP 2016; Mobile Muster, 2013; DOEE, 2017; Jambeck et al., 2015; MFAT, 2016; UNIDO/ICSHP, 2013).*

Material flow - New Caledonia



Source: Anne Prince Consulting, July 2017

Note: The percentage of imports and exports displayed relate only to the proportion of the 15 materials categories studied, not total imports/exports

New Caledonia	
Recyclable Materials Forecast	**Estimated Metric Tonnes**
Polyethylene terephthalate (PET) beverage containers	822
Aluminium cans	1,620
Glass beverage containers	1,143
Steel cans	1,286
Plastic shopping bags	533
End-of-life (EOL) renewable energy equipment	--
Paper/cardboard	5,383
E--waste	31
Whitegoods	176
Used motor/cooking oil	997
Used lead-acid batteries	180
Lithium batteries	254
Scrap steel/non-ferrous	1,929
EOL tyres	179
EOL vehicles	4,507
Total	**19,040**

Future waste management

New Caledonia aims to reduce the use of diesel by encouraging the implementation of reliable renewable energy resources. Over 95% of the population has access to electricity. One hydropower plant and three off-grid hybrid systems are being developed, representing 19% in renewable energy once completed *(MFAT, 2016)*. These initiatives are expected to increase the presence of end-of-life renewable energy equipment in the waste stream.

Plastics marine debris

Mismanaged plastic waste eventually enters the marine environment by way of inland rivers and waste water outfalls or is transported by wind and tide. Rigid and light-weight plastic from products that are daily consumed or used become marine debris if not managed appropriately. An estimated 12% of New Caledonia's waste stream consists of plastic.

A recent study *(Jenna et al., 2015)* indicates that 64.7t of plastic waste is generated on a daily basis among communities that live within 50km of the coastline. An estimated 2% (or 1.3t) are mismanaged daily and are predicted to enter the marine environment through littering. Approximately 472t of plastic waste were released in New Caledonia's waters in 2010. If not addressed, the amount is expected to rise to 702t per year by 2025.

Of the 64.7t of plastic waste generated each day, approximately 80% may comprise polyethylene terephthalate (PET) and high-density polyethylene (HDPE) plastic that is eligible for recovery under a container deposit scheme (CDS) at the rate of approximately 42 t/year. The balance of over 430t of non-eligible plastic (e.g., plastic bags/film and rigid containers), however, will continue to enter the marine environment. A CDS that recovers 40% of HDPE and PET bottles in New Caledonia may achieve the following reductions in marine debris each year:

- 3t in floating plastic
- 15t in sunken plastic
- 3t in beach plastic.

Further benefits attributed to a CDS are possible with a reduction in annual damage cost to New Caledonia's 218 local fishing vessels (approximately US$3,389). If beaches were cleaned up, over US$10,606 would be saved, of particular relevance to the amenities of coastal communities and the tourism sector.

A scheme, known as Clean Island, is available for free for those citizens who pinpoint illegal dumping areas. As a result, several hundred illegal disposal sites have been tagged, from which key sites have been earmarked for rehabilitation. Implementation, however, has been slow in Northern Province and Southern Province. In any event, new waste management facilities have been developed, and the municipalities now are responsible for the monitoring and management of the facilities, with the exception of the Loyalty Islands, given limited capacity at the municipal level.

Other projects relating to the management of pollution include the following:

- Ocean Protection Initiative, developed by the Surfrider Foundation, aims to encourage an awareness of marine issues by integrating grassroots campaigns to promote responsible behaviour.
- Observatory of the Environment to monitor terrestrial and aquatic environments and to maintain a database on the state of New Caledonia's environment.

SOS Mangrove project to identify and restore degraded mangroves. A series of events under the banner of Clean Up the World, conducted between 2009 and 2014, identified the key types of waste as plastic bottles, ferrous metals, aluminium cans, glass, used cell phones, used batteries, end-of-life vehicles, inert waste, effluent discharge, and wastewater *(SPREP, 2016)*.

Infrastructure and services

A number of well--established recycling initiatives is provided by SIGN, the Inter-Council's association of Greater Noumea, responsible for providing waste services. In most council areas, household collection services are limited to waste materials. Voluntary waste drop-off bins for segregated recyclable materials are available at waste facilities and at specific roadside locations throughout Noumea.

SAEML Mont-Dore Environnement is a public/private partnership in the city of Mont-Dore, with 72.7% equity. Nine of the partners are private investors. The firm provides household waste and recycling services in Mont-Dore only, with a commercial waste collection service twice a week in Grande Noumea and twice per month basis.

SAEML Mont-Dore Environnement operates a fully equipped material recovery facility, constructed in 2014, with undercover storage for incoming and baled materials, shipping container loading areas, an elevated, enclosed sorting station, and a weighbridge. The site operates front-end loaders and a forklift, and processes materials collected from households and businesses, as well as from public drop-off receptacles in the city and across Grand Noumea. These ultimately are exported to Australia.

A partnership between Mont-Dore and Maroochydore in Queensland, Australia,organises the export of recyclable items (e.g., paper/cardboard, plastic, and aluminium cans). SAEML Mont-Dore Environnement also provides educational activities relating to the development of renewable energy sources in Mont-Dore.

There are various private sector recycling businesses in New Caledonia, one of which was established in 2005 to recycle ferrous and nonferrous packaging material. It processes approximately 3,000t for export to Australia and New Zealand or to supply the local market. Since 2007, another firm has been buying, collecting, and cleaning nonferrous materials (e.g., copper, aluminium, brass, lead, inox and zinc) for export. Another has recycled plastic bottles since 2013, purchasing materials that have been cleaned for shredding and export to Australia.

In the Loyalty Islands, a public/private partnership focuses on renewable energy, having installed a generator of 300 units of apparent power (kVA), powered by coconut oil as a biofuel. In Southern Province, a computer reprocessing initiative provides retraining for people for re-entry into the workforce.

End-of-life vehicles of over 3.5t are not recycled. Recovery of tyres is limited to those less than 1.2 metres in diameter.

Logistics

New Caledonia's six seaports are located on the main island of Grande Terre. The principal international port and container terminal is in Noumea and, together with the port of Poro, is operated by the Port Autonome de Nouvelle-Calédonie. The ports of Kouaoua, Thio, and Nepoui are operated by the private sector firm, Societe Métallurgique Le Nickel.

The terminal at the Port of Noumea is approximately 27 hectares with facilities of high standard, including a main quay (750 metres long by 9.4-10 metres deep) and a warehouse. While there are no shore cranes, private stevedore services are available.

The Port of Noumea has an annual handling capacity of 180,000 twenty-foot equivalent units (TEU), and manages a yearly throughput of 110,000 TEU containers, comprising 55,500 import, 2,000 export, and 5,000 transshipment containers. The remaining 53,000 containers return empty and provide potential backload.

The Port of Noumea is serviced by various international shipping lines. Estimated TEU shipping container rates, presented below, are based on the cargo of non-hazardous goods, inclusive of un/loading and a bunker adjustment factor, although they do not account for customs clearance, duties, and quarantine inspection.

New Caledonia: Shipping Lines		
Swire Shipping; Kyowa Shipping Co. Ltd.; AUSPAC Consortium; Polynesia Line		
Destination	**Schedule**	**Est. USD per TEU**
Australia	14-day	1,900 to 4,600
SE Asia	14-day	2,500 to 3,330
Fiji	14-day 21-day	1,950 to 3,000
New Zealand	14-day 21-day	1,900 to 4,600
North Asia	14-day	2,400 to 3,600

AMSTEC Pty Ltd

Notes: USD = U.S. dollar; TEU = twenty-foot equivalent unit.

Inter-island shipping services are provided by a ferry service twice a week between Noumea and Isle of Pines, and Lifou and Mare.

The country is a major cruise line and pleasure craft destination. A 2015 review of the port waste reception facilities identified a number of essential improvements for the port to achieve the standards of the International Convention for the Prevention of Pollution from Ships (MARPOL), of which New Caledonia is a signatory *(SPREP, 2015)*.

This study recommends incorporating ship waste into the waste management systems of the provinces, providing daily waste services to ships at port, and including batteries and oil waste under the Trecodec Initiative as an extended producer responsibility (EPR). Further recommendations include the collection and management of data on ship waste; communicating MARPOL requirements and the contact information of disposal services among shipping agents and crew; and taking into account the refining of used oil waste and an extension to the sewerage system so that it is able to accept cruise ship wastewater *(PacILII, 2017; ECOLEX, 2017)*.

Institutional framework

New Caledonia has a complex waste management and pollution control framework, involving five levels of intervention. The Government of France is responsible for hazardous and radioactive waste and for providing technical and financial support to improve waste management. Furthermore, the environmental guardianship principles expressed in the French Environment Chart and Environment Code are incorporated into the Environment Code, adopted by the Northern Province and Southern Province of New Caledonia.

Part 4 of the Environment Code provides a regulatory framework for environmental protection and waste management. The Government of New Caledonia is responsible for healthcare waste and the safe management of waste materials such as asbestos and polychlorinated biphenyls (PCB). The Government of New Caledonia imposed an import tax on 27 March 2003, to support activities relating to waste and pollution management. Each of the three provinces is responsible, within their context, for developing their own policies and strategies.

The polluter-pays principle is embedded in the Environment Code for Northern Province and Southern Province, and it requires producers to establish waste management plans. This is supported by an EPR regulatory mechanism, known as chains. The mechanism would require producers to collect and treat used oils, end-of-life vehicles, lead-acid batteries, cell phones, and tyres.

The Loyalty Islands adopted Resolution No. 2007-60/API on August 30, 2007, relating to the elimination of used lead-acid batteries and waste oil. An objective of the EPR scheme is to increase private sector opportunities to recycle such materials, thus enabling firms to minimise their environmental impact. To date, there are two schemes in place on the outer islands.

Additional regulations relating to electrical and electronic waste were implemented in Southern Province in 2014. Agenda 21 was adopted by the City of Noumea Municipal Council in 2013, setting five-year targets. One such target is a 7% reduction in household waste by 2018 *(SPREP, 2016)*.

Trecodoc, a stewardship initiative, was created by producers in 2008 as a collective response to EPR regulations to oversee the waste management plans for each of the 15 material types of waste that are the focus of this study. A network of voluntary drop-off receptacles has been developed in each of the provinces.

Used oils, cell phones, lead-acid and other batteries are collected in all provinces. The gathering of e-waste is limited to Southern Province and Northern Province. The collection of radioactive legacy was funded by an anti-pollution tax before becoming a self-sustaining EPR.

In urban Noumea, Grande Noumea is the only waste treatment authority. The four urban municipalities of Noumea, Le Mont-Dore, Dumbea, and Paita responsible for waste collection services in their respective area. These, in a number of cases, are implemented with a joint municipal approach under the inter-council authority SIGN.

New Caledonia is a party to various multilateral environmental agreements and conventions through France as the signatory. These are listed in the table below.

New Caledonia	
Multilateral Environmental Agreements and Conventions	**Status**
Stockholm Convention on Persistent Organic Pollutants	Ratified
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	Ratified
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	Ratified
Montreal Protocol	Ratified
MARPOL 73/78: International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (Annex I, II, III, IV, V, and VI)	Ratified
1997 Amendment (Annex VI)	Ratified
London Convention on the Prevention of Marine Pollution by the Dumping of Wastes and Other Matter 1972	Ratified
1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (London Protcol)	Ratified
Intervention on the High Seas in Cases of Oil Pollution Casualties (Intervention 1969)	Ratified
Protocol 1973	Ratified
International Convention on Civil Liability for Oil Pollution Damage 1969 (renewed 1992)	Ratified
Protocol 1976	
International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971	
Protocol 1976	Ratified
Protocol of 1992	Ratified
Protocol 2003	Ratified
International Convention on Oil Pollution Preparedness, Response and Co-operation Convention 1990	Ratified
Convention on Hazardous and Noxious Substances by Sea, 2000	Ratified
International Convention on Civil Liability for Bunker Oil Pollution Damage (BUNKER)	Ratified
International Convention on the Control of Harmful Anti-fouling Systems in Ships (AFS Convention) 2001	Ratified
International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) 2004	Ratified
Hong Kong Convention	Ratified
Noumea Convention:	Ratified
Protocol on Dumping	Ratified
Emergency Protocol	Ratified

Source: SPREP. 2016.

Financial mechanisms

Currency: franc (CFPF)

The implementation of user fees for waste management is increasing across New Caledonia and is funding the newly regulated dumpsites and waste drop-off facilities. User fees have been increased to take into account new facilities, with households levied on a quarterly basis. Fees are settled electronically or in person at town halls.

EPR schemes are funded by an eco-tax on the sale of materials included in the programmes, paid by the consumer. Revenue is collected by Trecodec partners and returned to the central administration to cover waste management costs.

An anti-pollution import tax is applied to lubricant oils, tyres, rubber inner tubes, food packaging, aluminium cans, bottle caps, cell phones, batteries, and e-waste. The tax is collected at Customs and recovered by the Treasury. Taxes are distributed to a fund that is allocated to the management of waste and pollution, established under Resolution No. 365 in 2003 that draws financial resources from the private and public sectors.

The fund is managed by a committee comprising the president of the local government, as well as congressional and provincial presidents, with the Department of Industry, Mines and Energy acting as Committee Secretariat. The fund is used to help finance such projects as contaminated site rehabilitation and the construction of disposal facilities. Applications are submitted to the provinces prior to approval by the committee *(SPREP, 2016)*.

Conclusions

User-pays and EPR schemes, as well as recycling systems are well established in Noumea. They have the potential to build on in-country recycling and the remanufacture of recovered materials. The Government of New Caledonia is investigating alternative treatment options, such as energy from waste.

There appears to be significant private sector involvement in waste management and recycling through the Trecodec EPR initiative and SAEML Mont-Dore Environnement. So too are supermarkets making efforts to reduce single-use plastic bags by selling solid plastic, reusable bags.

Noumea is one of two ports in the Pacific considered to have an excellent standard of facilities. Since it is not managing the 180,000 TEU/year that it is designed for, the port has the capacity to handle increased cargo movements, given that it is located on a cost-effective shipping route.

Abbreviations

CDS	Container deposit scheme
CFPF	French colonies of the Pacific franc
DOEE	Department of Environment and Energy (Australia)
EOL	End of life
EPR	Extended producer responsibility
GoNC	Government of New Caledonia
ICSHP	International Centre on Small Hydro Power
kg	kilogram
km	kilometre
km^2	square kilmetres
kVA	Kilo volt amps
MARPOL	International Convention for the Prevention of Pollution from Ships
MFAT	Ministry of Foreign Affairs and Trade (New Zealand)
PCB	Polychlorinated biphenyls
PET	Polyethylene terephthalate
PRIF	Pacific Region Infrastructure Facility
SAEML	New Caledonian scrap company
SE	South east
SIGN	Syndicat intercommunal du Grand Nouméa (SIGN)
SPREP	Secretariat of the Pacific Regional Environment Program
SPTO	South Pacific Tourism Organisation
t	Tonne
TEU	twenty-foot equivalents
UNIDO	United Nations Industrial Development Organisation
USD	United States dollar

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Palau

Introduction

The increasing presence of plastic marine debris in the South Pacific Ocean is focusing attention on strengthening recycling policies and systems in the region. Unique challenges associated with shipping commodities of low value over long distances to recycling markets, however, reduce the economic viability to do so. This country profile indicates the current technologies, material flow, logistics, public policies, institutional framework, financial mechanisms and initiatives that are being designed or have been implemented to strengthen recycling systems in Palau.

Palau is the most western island group of the Caroline Islands, located in the Micronesia region of the Western Pacific Ocean. The archipelago of over 500 islands covers an area of 488 km^2, with a combined coastline of 1,519km. Palau consists of two main islands, Babeldaob and Koror. The former is the largest island of Palau, comprising 10 of the country's 16 states, and is connected to Koror by way of a bridge.

Ngerulmud, is located 20km northeast of Koror and is the nation's capital. Kayangel is a coral atoll lying 45km north of Babeldaob. The islands of Peleliu and Angaur lie approximately 50km to the south of Koror Island. The two smallest islands, Sonsorol and Hatohobei, are between 560km and 640km southwest of Koror. Hundreds of small, uninhabited rock islands lie between Peleliu and Koror Islands.

Socioeconomic background

The terrain in Palau varies from the mountainous main island of Babeldaob to the low coral islands, mainly surrounded by large reefs. Approximately 75% of Palau is covered in native forest and mangroves.

Tourists are drawn to Palau's eco-tourism activities because of its pristine natural environment. Tourists to Palau numbered 161,961 in 2015 *(RTRC, 2015)*, representing a 15% increase over the previous year.

Littering, illegal dumping, and the burning of waste is uncommon in the Koror area. There is, however, further need for improvement in the management of solid waste to ensure continued economic growth, particularly with respect to the tourist sector.

Palau became independent in 1994 when it entered into a Compact of Free Association (COFA) with the Government of the United States. Under this, it receives guaranteed financial assistance over a 15-year period.

Palau's gross domestic product in 2015 *(OEC, 2017)* was US$287 million or US$15,300 per capita, with tourism accounting for approximately 50%. In the same year, there was a trade balance deficit of US$144 million, with exports at US$18.5 million (+8.1% annualised) and imports at US$163 million (+1.7% since 2010).

The primary export market destinations for 2015 were Guam, India, Japan, Turkey and the United States. The main import origins for the same year were the Peoples Republic of China, Japan and Singapore, among other Asian countries, as well as the United States. *(OEC, 2017).*

Contributions to gross domestic product are dominated by the services sector. Manufacturing accounts for approximately 1% of the country's economy *(GlobalEDGE, 2017).*

Palau's population in 2015 was 17,661 *(GoP, 2015)*, including approximately 2,300, or 13%, living in rural locations *(Knoema, 2015).* Palau has a central government and 16 states with their own legislature. The approximate population distribution across the 16 states of Palau is provided in the table below.

Palau: Population Distribution by State

State	Capital	Population
Kayangel	Kayangel	54
Ngarchelong	Mengellang	316
Ngaraard	Ulimang	413
Ngiwal	Ngerkeai	282
Melekeok	Melekeok	277
Ngchesar	Ngersuul	291
Airai	Ngetkib	2,455
Aimeliik	Mongami	334
Ngatpang	Ngereklmadel	282
Ngardmau	Urdmang	185
Ngaremlengui	Imeong	350
Angaur	Ngaramasch	119
Peleliu	Kloulklubed	484
Koror	Koror	11,444
Sonsorol	Dongosaru	40
Hatohobei	Hatohobei	25

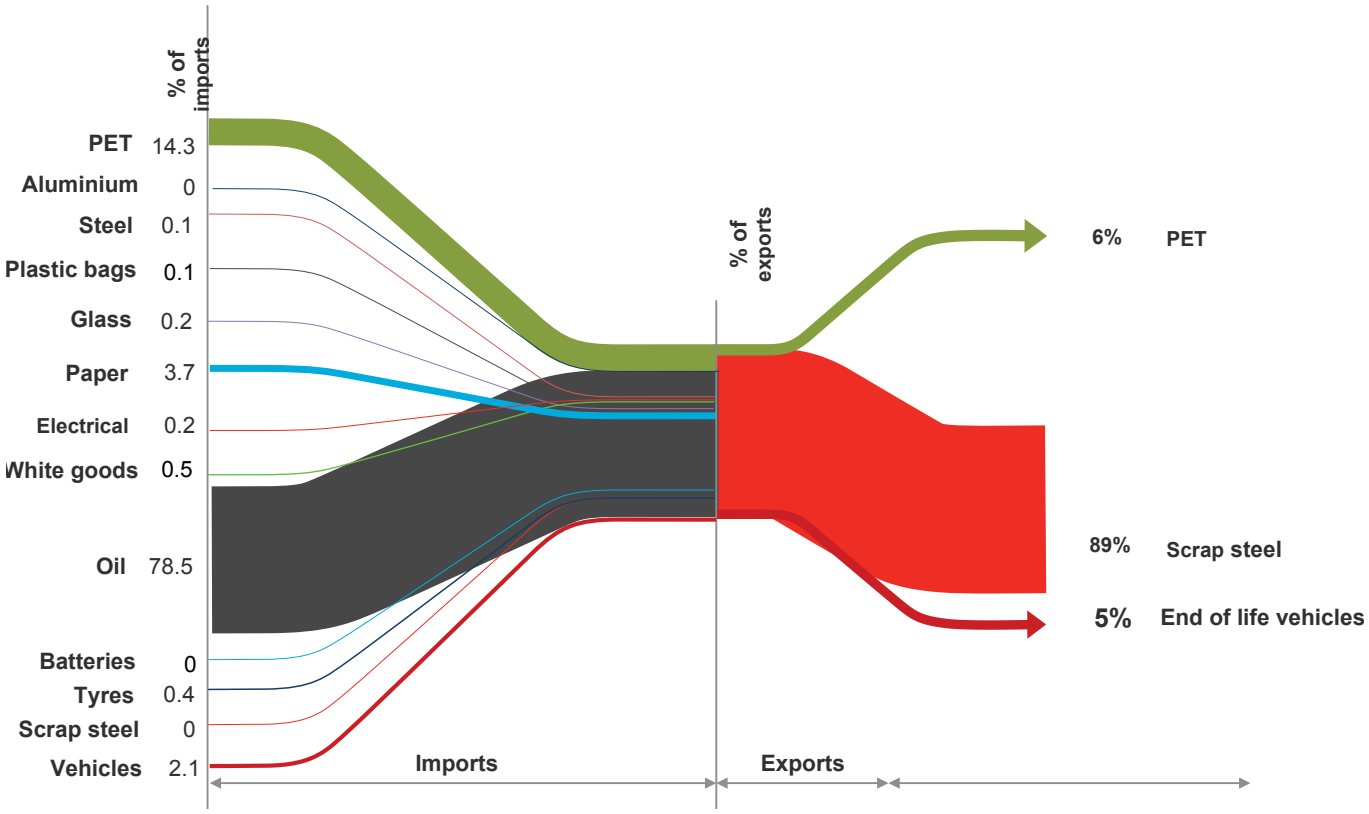
Source: 2015 Census of Population, Housing and Agriculture for the Republic of Palau. Volume 1. Office of Planning and Statistics, Bureau of Budget and Planning.

Solid waste management

The regional study coordinated by PRIF models the potential recovery of 15 materials types. A defined set of recovery rates was applied to the urban, rural, and outer island population distribution to calculate Palau's potential recovery tonnage. The PRIF study compares various data to establish the context for the 15 waste materials.

The material flow chart below is based on an analysis of Palau's imports of the 15 material categories studied, averaged over a seven-year period to 2016, compared with exports of those recovered recyclable materials, averaged over a two-year period 2015-2016, presented as a percentage of the total of the 15 categories. *(UN Comtrade, 2017)*

Material flow - Palau



Source: Anne Prince Consulting, July 2017

Note: The percentage of imports and exports displayed relate only to the proportion of the 15 materials categories studied, not total imports/exports

Taking into account reliable data since 2012, the import of beverage containers, plastic bags, paper, cardboards and whitegoods is relatively steady. Oil imports, both vegetable and crude, show a downward trend, however. Imports of special-purpose motor vehicles, similar to those designed to carry more than 10 people, grew in the last seven years.

Of the 15 materials examined, only polyethylene terephthalate (PET), scrap metal, and end-of-life vehicles were exported in any significant amount. Interestingly, no waste oil export figures are available for Palau, in contrast to other Pacific nations.

Modelling of potential recovery of recyclable materials, presented in the table below, is based on an estimated average daily per capita municipal solid waste generation of 1.2kg *(World Bank, 2012)*. It also applies a range of location-specific estimated recovery rates that are based on a set of assumptions of existing or introduced incentive-based policies and programs, such as container-deposit schemes and import levies. The resulting ratios were used to estimate average annual tonnages that could be recovered for recycling. *(JICA, 2013; SPREP 2016; Mobile Muster, 2013; DOEE, 2017; Jambeck et al., 2015; MFAT, 2016; UNIDO/ICSHP, 2013)*.

Palau	
Recyclable Materials Forecast	**Estimated Metric Tonnes**
Polyethylene terephthalate (PET) beverage containers	58
Aluminium cans	114
Glass beverage containers	81
Steel cans	91
Plastic shopping bags	38
End-of-life (EOL) renewable energy equipment	-
Paper/cardboard	380
E-waste	2
Whitegoods	12
Used motor/cooking oil	99
Used lead-acid batteries	18
Lithium batteries	28
Scrap steel/non-ferrous metals	136
EOL tyres	18
EOL vehicles	307
Total	**1,382**

Palau's Solid Waste Management Office estimates approximately 11 million aluminium cans are imported into Palau each year. The Koror state government set up its own Solid Waste Management Office in 2004.

Future waste management

Future increases in material recovery are expected as a result of the PacWaste (2014–17) programme, which is in the process of implementation by SPREP for improved management of e-waste. Activities under this programme include the establishment of an e-waste reception and processing centre, a project for the safe dismantling and export of e-waste, and a community awareness campaign *(SPREP, 2017)*.

Palau aims for 45% renewable electricity generation and a 35% improvement in energy efficiency by 2025. The European Union has committed €1 million to Palau in support of energy efficiency, transmission, and consumption programme initiatives, to commence in 2016 over a period of four years to 2020.

An ongoing project for the installation of photovoltaic solar systems is anticipated to generate 2.3% renewable energy. The project is funded by the Government of Japan. Approximately 98% of the population has access to electricity, giving an indication that household electrical items are present in the waste stream.

The second phase of the Promotion of Regional Initiative Solid Waste Management (J-PRISM II) project, implemented by the Japan International Cooperation Agency in December 2016, supports capacity building in waste management. Target initiatives include improved governance and human resource development, which are expected to generate increased volumes of recoverable materials.

Plastic marine debris

Mismanaged plastic waste eventually enters the marine environment by way of inland rivers and waste water outfalls or is transported by wind and tides. Rigid and light-weight, plastic material from products that are consumed or used on a daily basis become marine debris if not managed appropriately. An estimated 12% of Palau's waste stream consists of plastic.

The Palau islands have a combined coastline of 1,519km, and a recent study *(Jenna et al., 2015)* indicates a daily plastic waste generation of approximately 3.4 tonnes (t). An estimated 2t are mismanaged daily, entering the marine environment through the release from uncontained disposal sites or by direct littering. As a result, an estimated 716t of plastic waste became marine debris in the waters around Palau in 2010. If this is not addressed, the amount is expected to rise to 1,350t per year by 2025.

Of the 3.4t of plastic generated each day, approximately 0.372t may derive from PET or high-density polyethylene (HDPE) plastic bottles, eligible for recycling under a container deposit scheme (CDS). Based on an average reduction rate of 40% in mismanaged waste with a CDS in place, approximately 0.09t of PET and HDPE plastic could be recycling each day. This could increase to an 80% or above reduction rate, depending on access to recycling collection services and viable markets, among others. Nonetheless, a 40% reduction in mismanaged PET and HDPE would result in approximately 685t of plastic becoming marine debris each year.

The outcome of mismanaged plastic can be divided into three groups: plastic that remains on the surface of the sea as floating debris, plastic that sinks to the ocean floor, and plastic that washes up on beaches. A CDS that recovers 40% of HDPE and PET plastic bottles in Palau may achieve the following reductions in marine debris each year:

- 5t in floating plastic
- 22t in sunken plastic
- 5t in beach plastic.

Further benefits attributed to a CDS are a potential reduction in annual damage costs for Palau's 77 local fishing vessels (approximately US$601). If the beaches were cleaned up, over US$8,040 would be saved, of particular relevance to the amenities of coastal communities and the tourism sector.

Infrastructure and services

Information relating to the solid waste and recycling infrastructure and services in Palau are sourced from *Solid Waste Management in the Pacific: Palau Country Snapshot*. 2014 Asian Development Bank, Manila. Other information is drawn from the Regional Resource Circulation and Recycling Network Project Survey Return, Government of Palau, 2017.

Koror State Government installed 25 waste segregation stations through a pilot programme in 2007 so that residents and institutions, such as schools, are able to separate waste materials into different bins at the stations. Non-recyclable and non-biodegradable waste is separated as residual for landfill, while paper, aluminium cans, PET bottles, metal, glass and compostable materials are placed in separate bins. Given the success of the program, the number of recycling stations will be increased to a point where waste, in future, will be only collected from the recycling stations rather than from households.

The CDS that was established in 2011 successfully recycles glass, plastic, and metal beverage containers achieving an 80% recovery rate. The Koror Redemption Centre, also constructed in 2011, receives redeemable containers from businesses and residents. Cash disbursements are paid for smaller amounts (<3,000) and cheques are issued for larger amounts (>10,000). The Redemption Centre is equipped with balers which prepare recyclable materials for sale to the private sector who export to international markets.

The redemption centre is also focused on closed loop activities including shredding and composting of organics, cardboard and paper with the potential for biogas technology currently under investigation. Glass containers are crushed and hand blown into new containers and bottles. The glass blowing furnace is fueled by oils derived from pyrolysis of plastics.

The recent licensing of a private sector redemption centre has the potential to compete for product with the State owned facility.

Urban areas in Koror currently are provided with waste collection services on a weekly basis, with the Ngatpang and Ngchesar rural areas of the main island serviced bi-weekly and monthly, respectively. Other rural areas of the main island operate under a self-haul arrangement, as do the outer island communities.

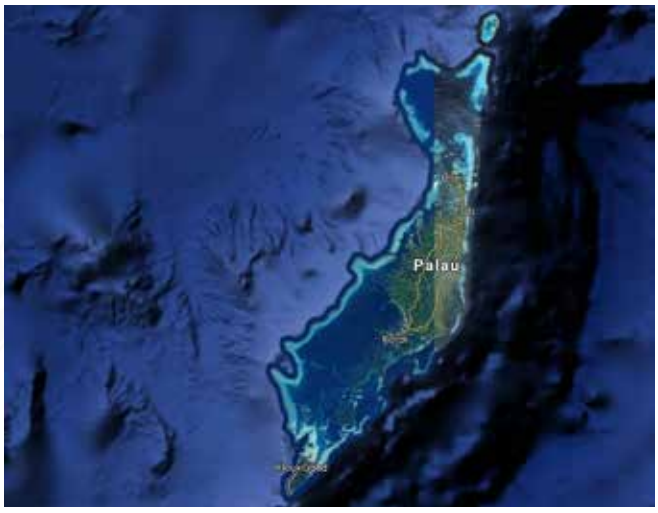
The State of Kayangel transports collected waste by boat to Koror's M-Dock Landfill, which is the country's largest disposal facility. Its location is in an area of shallow reef and mangrove wetland, which has provoked issues associated with leachate runoff that pollutes the surrounding marine environment.

JICA's 2006/07 J-PRISM program installed semi-aerobic landfill technology to the M-Dock facility. By 2012, the landfill reached its capacity and has since been extended on a temporary basis until a new sanitary landfill is constructed on Babeldaob. Each of the remaining 15 states has at least one landfill. Only Ngaraad and Ngatpang, however, are compliant with basic landfill management standards.

Logistics

Palau has one international seaport and one container terminal. These are located at Koror and operated by the Malakai Port Authority.

Palau



Source: Google Maps.

Koror Port terminal is approximately 1.5 hectares in size. Facilities comprise a main quay that is 300 metres long by 8 metres deep and a warehouse. There are no shore cranes, although private stevedore services are available.

The Port of Koror is capable of handling 8,000 twenty-foot equivalent units (TEU) per year. The port has a current throughput of approximately 2,800 import, 200 export and the return of 2,600 empty containers each year which may potentially be made available for reverse logistic arrangements.

Koror Port is serviced by Kyowa Shipping Co. Ltd.. Estimated TEU shipping container rates, presented below, are based on the cargo of nonhazardous goods, inclusive of un/loading and a bunker adjustment factor. They do not account for customs clearance, duties, and quarantine inspection.

Palau: Shipping Lines		
Kyowa Shipping Co. Ltd.		
Destination	**Schedule**	**Est. USD per TEU**
North Asia	21-day	3,860

Source: AMSTEC Pty Ltd

Notes: USD = U.S. dollar; TEU = twenty-foot equivalent unit.

Palau Shipping Co. Inc. is a privately owned entity that has operated under a number of partnerships over the years. It services the State of Yap in the Federated States of Micronesia and the Republic of the Marshall Islands, in addition to Palau.

Institutional framework

Data relating to the institutional framework of Palau have been gathered from the database of the Pacific Islands Legal Information Institute *(PacILII, 2017)*. ECOLEX is also an information service that relates to environmental law *(ECOLEX, 2017)*, from which various data also have been collected.

The Government of Palau consists of executive, legislative (bicameral), and judicial branches. Each of the 16 states has its own governor and state legislature.

Traditional leadership councils operate under national and state laws. They have jurisdiction over traditional cultural law that is not specifically regulated by state and national laws.

Waste management is the responsibility of each state government. In Koror, however, it is the Bureau of Public Works, under the national government, that is responsible for managing the Koror M-Dock Landfill. The Ministry of Public Infrastructure, Industries and Commerce, through the Bureau of Public Works, is responsible for infrastructure planning and public awareness relating to the issue of solid waste.

The Environmental Quality Protection Act 1981 established the Environmental Quality Protection Board, a semi-autonomous public agency responsible for enforcing solid waste management practices, as well as the Marine and Freshwater Quality Regulations 1996.

Based on the solid waste regulations, the Environmental Quality Protection Board regulates the collection, disposal, and storage of waste and issues licenses to establish, modify, or operate waste disposal facilities.

Recycling Act 2006 (Nos. 7-24) initiated the CDS and Recycling Fund for the recycling of PET, HDPE, and metal beverage containers (i.e., beer, spirits, wine, tea, coffee, soda, noncarbonated water, nonalcoholic drinks, and plain water).

The Beverage Container Recycling Regulations came into effect in 2011, under which the Ministry of Public Infrastructure, Industries and Commerce and the Ministry of Finance oversee CDS operations. The Division of Environmental Health is responsible for maintaining public health and safety in relation to issues arising from solid waste. Biosecurity Act 2014 ensures the management of imports into Palau.

Palau's 2008 National Solid Waste Management Plan, supported by JICA, provides the national framework for the management of solid waste. The proposed Bill (No. 5-96-3) aims to ban the import of single-use disposable plastic items, such as cups, plates, and other containers, as well as flatware. It fails, however, to include plastic packaging.

The rapidly growing number of tourist visitors to Palau (over 160,000 in 2015) has led the Government to adopt the Palau Responsible Tourism Policy Framework, 2017-2021. The policy targets the development of high value, low impact consumer segments to protect the natural environment and to ensure a profitable and sustainable tourism sector. Improved recycling systems for tourism operations and public place bin infrastructure is likely to be a key focus moving forward.

The Acts that control marine pollution in Palau are the Environment Quality Protection Act and the Open Ship Registry Act. In addition, Palau is a party to the following multilateral environmental agreements and conventions.

Palau	
Multilateral Environmental Agreements and Conventions	**Status**
Stockholm Convention on Persistent Organic Pollutants	Ratified
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	Ratified
1995 Waigani Convention	Signed
Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified
Minimata Convention on Mercury	Signed
MARPOL 73/78: International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (Annexes I, II, III, IV, V, and VI)	Ratified
International Convention on Civil Liability for Oil Pollution Damage 1969 (renewed 1992)	Ratified
International Convention on the Protocol of 1992 to Amend the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971	Ratified
International Convention on Oil Pollution Preparedness, Response and Co-operation 1990	Ratified
Protocol on Preparedness, Response and Co-operation to pollution Incidents by Hazardous and Noxious Substances (OPRC/HNS) 2000	Ratified
International Convention on Civil Liability for Bunker Oil Pollution Damage (BUNKER) 2001	Ratified
Control of Harmful Anti-fouling Systems in Ships (AFS Convention) 2001	Ratified
International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) 2004	Ratified
Nairobi International Convention on the Removal of Wrecks 2007	Ratified

Source: SPREP. 2016.

Financial mechanisms

Currency: United States dollar (US$)

The financial system of Palau relies on COFA with the Government of the United States. The COFA Trust Fund of approximately US$150 million contributes to Palau's government an annual amount of approximately US$60 million. This, in turn, helps to fund Palau's waste management.

Palau intends to become self-sufficient and reduce its reliance on COFA funding in preparation for expiry of the agreement in 2024. As such, it is essential that Palau implement a user-pay system to support solid waste management efforts.

The beverage container recycling program, begun in 2011, imposes a fee of A$0.10 for each imported beverage container, of which A$0.05 is returned to the customer as redemption. The national Government receives A$0.025, as does Koror State Government, to cover administrative costs. There is an import tax in place, and the recycling programme is financed through a dedicated recycling fund that is now sustainable.

At present, there is no user-fee system in Palau and all collection and disposal services are provided for free. National Solid Waste Management Plan 2008, however, aims to introduce a user-pay system and a gate fee at the M-dock Landfill. An advance disposal fee by way of an import tax on each vehicle and electrical appliance that enters Palau also will be introduced.

Approximately 80% of Palau's funding derives from U.S. aid and 20% from import and export taxes. The country's solid waste management system is currently supported by these funds.

Conclusions

Palau's CDS achievements to date are impressive. This suggests that producer responsibility schemes may also be well supported.

Palau has previously participated in the Pacific Island Regional Recycling Initiative which was established under the Micronesian Chief Executive Summit in 2005. While limited progress has been achieved to date, a recycling subcommittee continues under the Micronesian Island Forum.

While Koror Port is relatively small, it has reasonable standard infrastructure and a potential for reverse logistic cargo movements. The port is not considered a cost-efficient shipping route and services are provided by only one company to North Asia. It is understood that freight movements to alternative destinations would require trans-shipment.

Abbreviations

AFS	Anti-fouling systems
AMSTEC	Supply chain and transport economics consultancy firm
BWM	Ballast water and sediments
CDS	container deposit scheme
COFA	Compact of Free Association
DOEE	Department of Environment and Energy (Australia)
EOL	End of life
FY	Financial year
GoP	Government of Palau
HDPE	high-density polyethylene
HNS	Hazardous and Noxious Substances
ICSHP	International Centre on Small Hydro Power
J-PRISM	Regional Initiative Solid Waste Management
JICA	Japan International Cooperation Agency
kg	kilogram
km	kilometre
km^2	square kilometre
MARPOL	International Convention on the Prevention of Pollution from Ships
MFAT	Ministry of Foreign Affairs and Trade (New Zealand)
OEC	Observatory of Economic Complexity
OPRC	Protocol on Preparedness, Response and Co-operation to Pollution Incidents
PET	polyethylene terephthalate
PRIF	Pacific Region Infrastructure Facility
RTRC	Regional Tourism Resource Centre
SPREP	Secretariat of Pacific Regional Environment Program
t	tonne
TEU	twenty-foot equivalent unit
UNIDO	United Nations Industrial Development Organisation

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Papua New Guinea

Introduction

The increasing presence of plastic marine debris in the South Pacific Ocean is focusing attention on strengthening recycling policies and systems in the region. Unique challenges associated with shipping commodities of low value over long distances to recycling markets, however, reduce the economic viability to do so. This country profile includes the current technologies, material flow, logistics, public policies, institutional framework, financial mechanisms and initiatives that are being designed or have been implemented to strengthen recycling systems in Papua New Guinea (PNG).

PNG and its 600 off-shore islands have a land area of approximately 462,840km^2 with a combined coastline of 5,152 km. Located in the Melanesian region of the Southwestern Pacific Ocean, the country's capital is Port Moresby.

PNG's diverse natural environment includes mountain ranges, lowland rainforests, wetlands and coastal plains. The rugged interiors of the main and outer islands are largely inaccessible by road or navigable river. The marine environment is equally as diverse, with an ecosystem that includes coral reefs, mangrove forests, and coastal wetlands.

Source: Google Maps.

Socioeconomic background

Tourist visits to PNG were at 198,685 in 2015, representing a 3.8% growth on the previous year. PNG is fast becoming the largest short-stay accommodation provider in the South Pacific, with tourism representing 2.5% of its gross domestic product (GDP) (SPHTR, 2014).

Based on PNG's 2000 Census and 2011 Census, its population increased by 2 million over the decade, reaching 7.2 million *(GoPNG, 2011)*. Nearly 40% of the population lives in traditional social groups that are reliant on subsistence farming. A large proportion, approximately 6,254,000, or 87%, live in rural areas *(Knoema, 2015)*.

PNG has three levels of government - central, provincial, and local. There are 31 urban and 317 rural local governments. The table below provides an approximate regional distribution of the provincial populations.

Papua New Guinea: Regional and Provincial Population Distribution

Region	Provinces	Population (million)
Southern Region	Central; Gulf; Milne Bay; Oro (Northern); Western (Fly); National Capital District	1.44
Highlands Region	Simbu (Chimbu); Eastern Highlands; Enga; Southern Highlands; Western Highlands; Hela; Jiwaka	2.8
Islands Region	East New Britain; Manus; New Ireland; Autonomous Government of Bougainville; West New Britain	1.08
Momase Region	East Sepik; Madang; Morobe; Sandaun (West Sepik)	1.87

Source: GoPNG, 2011

PNG's GDP for 2015 was US$3,500 per capita *(OEC, 2017)*. In the same year, it had a trade balance of US$4.52 billion, with exports at US$9.1 billion (+8.1% annualised) and imports at US$4.54 billion (+1.7% since 2010).

The primary export market destinations for 2015 were Australia, the People's Republic of China, Germany and Japan, as well as other countries in Asia. The main import origins for the same year were Australia, the People's Republic of China, the Republic of Korea, Malaysia and the Republic of Singapore.

Since much of the population relies on subsistence farming, the oil and gas industry is a major contributor to GDP. Manufacturing contributes 6% to the country's economy *(GlobalEDGE, 2017)*. This may indicate that infrastructure and utilities are sufficient to support PNG's production-based enterprises.

PNG contributes to the bulk of exports in the Melanesian region. Almost all these exports are destined for large, industrial markets.

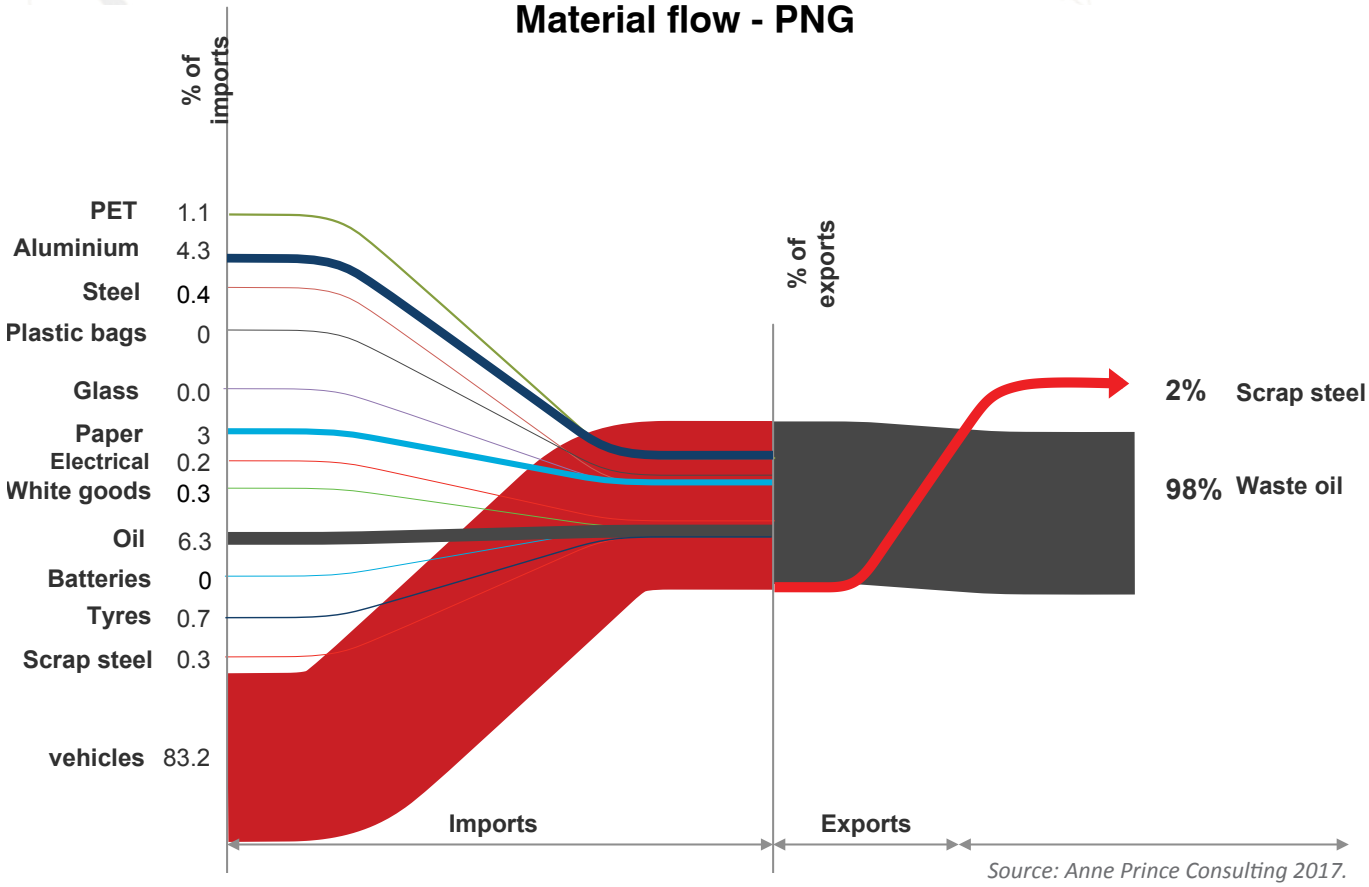
Solid waste management

A waste composition survey was conducted by the National Capital District Commission (NCDC) of Port Moresby in 2011. Based on the distribution of primary material groups, it was found that the urban household waste generation rate was 0.36kg per day, comprising over 30% organic waste and over 18.5% plastic waste. *Source: NCDC 2011*

The regional study coordinated by PRIF models the potential recovery of 15 materials types. A defined set of recovery rates was applied to the urban, rural, and outer island population distribution to calculate PNG's potential recovery tonnage. The PRIF study compares various data to establish the context for the 15 waste materials.

The material flow chart below is based on an analysis of PNG's imports of the 15 material categories studied, averaged over a seven-year period to 2016, compared with exports of those recovered recyclable materials, averaged over a two-year period 2015-2016, presented as a percentage of the total of the 15 categories. *(UN Comtrade, 2017)*

Papua New Guinea



Source: Anne Prince Consulting 2017.

Note: The percentage of imports and exports displayed relate only to the proportion of the 15 materials categories studied, not total imports/exports

Imports of beverage containers made of all types of material peaked in 2011. Bottles for water, flavoured water and fruit juice have dropped considerably while some (e.g., polymers of ethylene in pellet form, used to make plastic bags), have remained steady. The import of malt beer has remained stable over the years, while aluminium containers have shown a rapid decrease since 2011. Paper and cardboard products have remained steady, overall, with the increase in some paper rolls being offset by a decrease in certain sizes. Data for e-waste is available only for 2011 and 2012, while for renewable energy equipment, data is not available.

PNG exports large quantities of used motor oil, scrap steel, and small quantities of polyethylene terephthalate (PET) bottles, indicating that a large proportion of imported materials remains on shore.

Modelling of potential recovery of recyclable materials, presented in the table below, is based on an estimated average daily per capita municipal solid waste generation of 2.1kg *(World Bank, 2012)*. It also applies a range of location-specific estimated recovery rates that are based on a set of assumptions of existing or introduced incentive-based policies and programs, such as container-deposit schemes and import levies. The resulting ratios were used to estimate average annual tonnages that could be recovered for recycling. *(JICA, 2013; SPREP 2016; Mobile Muster, 2013; DOEE, 2017; Jambeck et al., 2015; MFAT, 2016; UNIDO/ICSHP, 2013)*.

Papua New Guinea	
Recyclable Material Forecast	**Estimated Metric Tonnes**
Polyethylene terephthalate (PET) beverage containers	1,484
Aluminium cans	2,666
Glass beverage containers	1,882
Steel cans	2,117
Plastic shopping bags	961
End-of-life (EOL) renewable energy equipment	11
Paper/cardboard	8,859
E-waste	65
Whitegoods	365
Used motor/cooking oil	23,760
Used lead-acid batteries	320
Lithium batteries	2,855
Scrap steel/nonferrous metals	3,175
EOL tyres	319
EOL vehicles	9,360
Total	**58,199**

Future waste management

Future increases in material recovery are expected as a result of the PacWaste (2014-17) program, which is in the process of being implemented by the Secretariat of the Pacific Regional Environment Programme (SPREP) for improved management of e-waste. The program includes assistance in developing a national e-waste strategy *(SPREP, 2017)*.

The second phase of the Promotion of Regional Initiative Solid Waste Management (J-PRISM II) project, implemented by JICA in December 2016, supports capacity building in waste management. Target initiatives include improved governance and human resource development, which is expected to generate increased volumes of recoverable materials.

PNG's national energy strategy relies on the construction of hydropower schemes to increase household access to electricity from the current rate of 12% to 70% by 2030. Fifty percent renewable electricity generation is expected to be achieved on completion of projects supported by the governments of Australia and New Zealand, as well as by the Asian Development Bank, JICA, and World Bank. The result will reflect an increased presence of household electrical items, computers, and communication equipment in the future waste stream.

Plastic marine debris

Mismanaged plastic waste eventually enters the marine environment by way of inland rivers and waste water outfalls or is transported by wind and tide. Rigid and lightweight, plastic material from products that are consumed or used on a daily basis become marine debris if not managed appropriately. An estimated 13% of PNG's waste stream consists of plastic.

PNG has a combined coastline of 5,152 km, and a recent study *(Jenna et al., 2015)* indicates a daily plastic waste generation of approximately 282 tonnes (t). An estimated 246t are mismanaged daily, entering the marine environment through release from uncontained disposal sites or by littering. As a result, an estimated 89,835t of plastic waste became marine debris in the waters around PNG in 2010. If not addressed, the amount is expected to rise to 242,328t by 2025. Of the 282t of plastic generated each day, approximately 31t may be PET or high-density polyethylene (HDPE) plastic, eligible for recycling under a container deposit scheme (CDS).

Based on an average reduction rate of 40% in mismanaged waste with a CDS in place, approximately 10.89t of PET and HDPE plastic would be recycled each day. This could increase to an 80% or above reduction rate, depending on access to recycling collection services and viable markets, among others. Nonetheless, a 40% reduction in mismanaged PET and HDPE would result in approximately 85,859t of plastic becoming marine debris each year.

The outcome of mismanaged plastic is split into three primary groups: plastic that remains on the surface of the sea as floating debris, plastic that sinks to the ocean floor and plastic that washes up on beaches. A CDS that recovers 40% of HDPE and PET plastic bottles in PNG may achieve the following reductions in marine debris each year:

- 596t in floating plastic
- 2,784t in sunken plastic
- 596t in beach plastic.

Further benefits attributed to a CDS are a potential reduction in annual damage costs for PNG's 605 local fishing vessels (approximately US$4,700). If beaches were cleaned up, over US$1 million would be saved, of particular relevance to the amenities of coastal communities and the tourism sector.

Infrastructure and services

PNG has over 21 unregulated disposal sites and two controlled sites located in Lae and Port Moresby. The Baruni site in Port Moresby was the focus of infrastructure and environmental monitoring initiatives during J-PRISM I. This project also aims to improve collection services, solid waste management (SWM) planning, data and contract management, and capacity building. The Reduce, Reuse and Recycle (3R HEART) community awareness and SWM training programmes were implemented by JICA between 2011 and 2016.

NCDC contracts to the private sector the delivery of SWM, including the Baruni Dump operation, where informal waste pickers recover materials of value. JICA proposes, within its J-PRISM II project, to build a covered area as a material recovery facility.

The majority of the 63 settlements in Port Moresby are not serviced for solid waste collection. The waste is collected by 36 private contractors under contract to the NCDC, including 11 contractors for household waste, with 8 for the settlements; 11 for public markets and other public spaces; and 3 for schools. Solid waste from medical institutions, commercial facilities and sanitation and wastewater are collected by a single company.

Lae City Council is responsible for providing a waste collection service, which usually benefits the higher-income areas of the city. The council uses private contractors to operate Lae's Second Seven disposal site.

The government does not provide formal recycling services other than two recyclers that collect and export ferrous and nonferrous waste, used lead-acid batteries and e-waste material to destinations in Asia, including the People's Republic of China, Indonesia, India, Japan, the Republic of Korea and Myanmar. Materials are collected from the mainland and outer islands and transported to the larger metal recycle operations in Port Moresby, Lae and Tabubil. A smaller firm operates from a temporary building for the baling and storage of aluminium cans and products, as well as copper prior to export.

A local registered company, certified by the International Organization for Standardization, provides hazardous waste management and recycling services to commercial and industrial clients throughout PNG. Waste oils are refined and recycled in Port Moresby, while plastic bottles and e-waste are exported to Asian and Australian markets. The company has also partnered with an Australian-based company to receive and recover mercury-containing waste, including fluorescent lighting. The company operates its own fleet of vehicles and has a substantial storage and processing facility located at Badili.

Logistics

The international ports located at Lae and Port Moresby account for approximately 70% of all cargo volume in and out of PNG. The main trading routes are Guam to PNG, Solomon Islands to PNG, and PNG to Fiji *(Searates.com, 2017; Ports.com, 2017)*.

Ships visiting Port Moresby are able to access waste services through licensed service providers. There is little transparency, however, regarding how shipboard waste is managed other than access by those to the Baruni Dump which incurs fees to NCDC. While Port Morseby receives oily water and bilge waste, quarantine waste, sewerage, garbage from domestic ships and fishing gear, it is not able to receive recyclables, ozone depleting substances, chemical tankers or exhaust gas cleaning system residue, which the country has banned. A 2015 review of the port's waste reception facilities identifies improvements to reach the standards of the International Convention for the Prevention of Pollution from Ships (MARPOL), of which PNG is a signatory *(SPREP, 2015)*.

The review recommended greater collaboration between agencies to plan for the reception and management of ship waste, as well as liaison between the National Agriculture Quarantine and Inspection Authority and NCDC to develop a waste tracking system. In addition, strategies are essential to estimate the future demand of visiting ships and to communicate regulated waste disposal services for quarantine waste. It is also recommended that a barge service to ships at anchor be considered to reduce illegal dumping.

The outer islands of PNG are serviced by private shipping companies, such as R&A Marine Services Ltd., a PNG company that provides Inter-island passenger and cargo services. It connects the Provinces of New Britain, West Britain, New Ireland, Central, Gulf, Morobe, Mandang, and Oro to the rest of PNG.

PNG has four international shipping ports and container terminals. These are located at Port Moresby, Lae, Rabaul and Mandang, as shown on the chart below.

Source: Google Maps.

(A) Vanimo; (B) Ataipe; (C) Wewak; (D) Daru; (E) Kumul Marine Terminal; (F) Madang International; (G) Lae International; (H) Napa Napa / Port Moresby International; (I) Lorengau; (J) Oro Bay; (K) Kimbe; (L) Alotau; (M) Samarai; (N) Bialla; (O) Kavieng; (P) Rabaul International; (Q) Luise Harbour; (R) Buka; (S) Kieta.

Port Moresby terminal will be approximately 14 hectares when construction work is completed. The port is equipped with facilities that include a main quay, 250 metres (m) long by 12m deep. There are neither shore cranes nor a quarantine incineration infrastructure. However, private stevedore services are available.

The Port of Port Moresby is capable of handling 100,000 twenty-foot equivalent units (TEU) per year. The port has a current throughput of approximately 24,000 import, 7,000 export and the return of 19,000 empty containers each year which may potentially be made available for reverse logistic arrangements. The port also loads and unloads approximately 1,000 trans-shipment containers each year.

The Port of Lae is capable of handling 230,000 twenty-foot equivalent units (TEU) per year. The port has a current throughput of approximately 65,000 import, 21,450 export and the return of 43,550 empty containers each year which may potentially be made available for reverse logistic arrangements. The port also loads and unloads approximately 7,800 trans-shipment containers each year.

The Port of Port Moresby is serviced by multiple shipping lines. Estimated TEU shipping container rates, presented below, are based on the cargo of nonhazardous goods, inclusive of un/loading and a bunker adjustment factor. They do not account for customs clearance, duties, and quarantine inspection.

Port Moresby, Papua New Guinea: Shipping Lines

Swire Shipping; Australian National Line; Kyowa Shipping Co. Ltd.

Destination	Schedule	Est. USD per TEU
North Asia	30-day	2,400 to 2,600
Australia	7-day 14-day	2,200 to 3,700
New Zealand	21-day	2,600 to 3,700
South East Asia	21-day 30-day	2,600 to 3,000

Source: AMSTEC Pty Ltd

Notes: USD = U.S. dollar;

TEU = twenty-foot equivalent unit.

The Port of Lae has been designated as a new Tidal Basin Wharf. The terminal is approximately 18 hectares and is equipped with a main quay that is 250m by 14m deep, as well as a warehouse. While there is neither a shore crane nor quarantine incineration infrastructure, there are private stevedore services.

Lae has an annual handling capacity of 230,000 TEU. Throughput is 130,000, comprising 65,000 import, 21,450 export, and 7,800 transshipment containers each year. The remaining 43,550 containers return empty and provide reverse logistic potential.

The Port of Lae is serviced by multiple shipping lines. Estimated TEU rates (see table below) are based on those that apply for Port Moresby.

Port Lae, Papua New Guinea: Shipping Lines		
Swire Shipping; Australian National Line; Kyowa Shipping Co. Ltd.		
Destination	**Schedule**	**Est. USD per TEU**
North Asia	30-day	2,400 to 2,600
Australia	7-day 14-day	2,200 to 3,700
New Zealand	21-day	2,600 to 3,000
Southeast Asia	21-day	2,600 to 3,000

Source: AMSTEC Pty Ltd
Notes: USD = U.S. dollar;
TEU = twenty-foot equivalent unit.

Institutional framework

Data relating to the institutional framework of PNG have been gathered from the database of the Pacific Islands Legal Information Institute *(PacILII, 2017)*. ECOLEX is also an information service that relates to environmental law *(ECOLEX, 2017)*, from which various data also have been collected.

Responsibilities for waste and environmental management exist within a range of acts and regulations, although no single point of control exists to regulate planning and operation. The government has identified the need for policies and strategies to rectify this and to effectively implement its commitments under the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, 1995 Waigani Convention, and Stockholm Convention on Persistent Organic Pollutants.

Environment Act 2000 is the principal legislation for environmental protection, providing for constitutional requirements and regulating the environmental impacts of development activities and the management of national water resources. It is implemented through multiple environment regulations under the Department of Environment and Conservation through the Conservation and Environment Protection Authority. The Act empowers provincial and local governments to develop environmental legislation, policies, and by-laws for waste management. The Act also requires the development of national policies and a national SWM strategy with associated regulations.

PNG has identified a need for national policy and strategic planning for waste management, since this area currently is governed under broader environment management legislation. It is anticipated that this will come about as part of a JICA technical cooperation project and that the strategy will incorporate various financial mechanisms.

Environment (Control of Biodegradable Plastic Shopping Bags) Regulation 2010 controls the manufacture and importation of biodegradable plastic bags through the issuance of an environment permit. Bags are required to be labelled and must meet the standards of the Department of Environment and Conservation.

Public Health Act (Amalgamated) (Amendment) 1974 and the Public Health (Sanitation and General) Regulation are administered by the Department of Health. They relate to practices of scavenging and waste disposal, as well as fines for illegal dumping.

Organic Law on Provincial and Local-Level Governments 1995 and Local-Level Governments Administration Act 1997 empower local governments to formulate waste management policies, legislation, and by-laws. National Capital District Commission Act 2001 provides for public welfare protection in relation to waste and environmental management.

Dumping of Waste at Sea Act 1979 gives effect to the 1972 International Convention on the Prevention of Marine Pollution by the Dumping of Wastes and Other Matter. It also relates to the issuance of permits to vessels to do so, and penalties for noncompliance.

Prevention of Pollution of the Sea Act 1979 and Prevention of Pollution at Sea Regulation 1980 relate to oil and other substances. They also give effect to a number of relevant international conventions.

Environmental Contaminants Act 1978 and Environmental Contamination (Pesticides) Regulations 1988 relate to the prevention, abatement, and control of environmental contamination, setting out the export permit process for hazardous waste and giving effect to constitutional requirements. The Customs Prohibited Exports Regulations restrict the export of specific hazardous materials. Quarantine Act 1953 and Quarantine Regulations 1956 provide biosecurity measures for the prevention of disease and the pests that affect humans, animals, and plants in terms of international trade.

PNG is a party to the following multilateral environmental agreements and conventions:

Papua New Guinea	
Multilateral Environmental Agreements and Conventions	**Status**
Stockholm Convention on Persistent Organic Pollutants	Ratified
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	Ratified
1995 Waigani Convention	Ratified
Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified
MARPOL 73/78: International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (Annexes I, II, III, IV, and V)	Ratified
London Convention on the Prevention of Marine Pollution by the Dumping of Wastes and Other Matter 1972	Ratified
Intervention on the High Seas in Cases of Oil Pollution Casualties (Intervention 1969	Ratified
International Convention on Civil Liability for Oil Pollution Damage 1969 (renewed 1992)	Ratified
International Convention on the Protocol of 1992 to Amend the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971	Ratified
Noumea Convention:	Ratified
Protocol on Dumping	Ratified
Protocol on Combatting Pollution Emergencies	Ratified

Source: SPREP. 2016.

Financial mechanisms

Currency: PNG Kina (K)

In this report, the approx. currency rate used is US$1=K3.17

PNG's local government is responsible solely for the supply of waste management services, although environmental management is shared between the local and central governments. Since waste management services are not funded through the national government, local governments may levy a variety of local taxes and charges, which account for a large share of revenue. Only a limited amount of revenue, however, is actually collected from households. Unfunded expenses are thus reflected in the standard of infrastructure and collection systems, with many communities lacking efficient and regular collection services.

The NCDC in Port Moresby, in 2012, allocated an annual budget of over K10 million (US$3.15m) earmarked for solid waste operations and services. The funds originated from revenue sources, such as land taxes, license fees, and solid waste service fees levied to residents of titled properties at K33.00 (US$10.38) per month and paid quarterly for an 80 litre waste bin. Only around 50% of the levies are collected, however, and the large population living in settlements in the city that does not have access to collection services pays no levy.

Tipping fees are applied at the Baruni Dump, at approximately K52.00 (US$18) per truckload. In PNG's second largest city, the Lae City Council waste management budget for 2012 was K$0.5 million (US$157,000). Similar to the NCDC, the revenue derives from license fees, land tax, and waste management charges of K36.00 per month to high-income residential areas. The council recovers approximately 80%.

At the national level, import duties are applied, under customs legislation, to second-hand vehicles, ranging between 60% and 110% of value. It appears, however, that this revenue is not allocated as an advance disposal fee.

Conclusions

PNG has identified the need for a national waste management policy with strategic planning. At present, such decisions are governed by environment management legislation.

The international ports of Port Moresby and Lae have an additional cargo handling capacity and they are located on cost-efficient shipping routes. The Port of Lae is the bigger transshipment port, predominantly servicing the oil and gas sectors and having the greater container throughput of the two ports. Port Moresby is in the process of significant port improvement and is slightly better serviced on the Southeast Asia route.

Port Moresby has the largest residential population of the two cities and, therefore, is able to generate a greater level of recycling volume. The city also has a more significant manufacturing base than does Lae.

Abbreviations

3R	Reduce, reuse, recycle
ADB	Asian Development Bank
CDS	Container deposit scheme
DOEE	Department of Environment and Energy (Australia)
FY	Financial year
GDP	Gross domestic product
GoPNG	Government of Papua New Guinea
HDPE	High-density polyethylene
ICSHP	International Centre on Small Hydro Power
J-PRISM	Promotion of Regional Initiative Solid Waste Management
JICA	Japan International Cooperation Agency
Kg	kilogram
km	kilometre
km^2	square kilometre
m	metre
MARPOL	International Convention for the Prevention of Pollution from Ships
MFAT	Ministry of Foreign Affairs and Trade (New Zealand)
NCDC	National Capital District Commission
OEC	Observatory of Economic Complexity
PET	Polyethylene terephthalate
PNG	Papua New Guinea
PRIF	Pacific Region Infrastructure Facility
SPHTR	South Pacific Hotel and Tourism Report
SPREP	Secretariat of the Pacific Regional Environment Programme
SWM	Solid waste management
t	tonne
TEU	Twenty-foot equivalent unit
UNIDO	United Nations Industrial Development Organisation

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Republic of the Marshall Islands

Introduction

The increasing presence of plastic marine debris in the South Pacific Ocean is focusing attention on strengthening recycling policies and systems in the region. Unique challenges associated with shipping commodities of low value over long distances to recycling markets, however, reduce the economic viability to do so. This country profile includes the current technologies, material flow, logistics, public policies, institutional framework, financial mechanisms, and initiatives that are being designed or have been implemented to strengthen recycling systems in the Republic of the Marshall Islands (RMI).

With a land area of 1,812km^2 and a combined coastline measuring 370km, RMI is located in the central Pacific Ocean in the Micronesia region. RMI consists of 29 atolls and 5 islands that are divided into the Ratak (Sunrise) Island Chain and Ralik (Sunset) Island Chain.

RMI is one of four coral atoll nations in the world, and it has a landscape with saltwater lagoons, surrounded by white beaches and small lush islands. The capital city, Majuro, is situated on Majuro Atoll, the country's most developed and urban atoll. There is evidence that Majuro has the highest per capita waste generation in the Pacific.

Socioeconomic background

Ecotourism activities, such as scuba diving and canoeing, are significant attractions. The number of visitors in 2016 reached 9,831, which represented a 56% growth from the previous year *(SPTO, 2017)*, and 2015 experienced a 29% increase over 2014.

RMI became independent in 1986, yet remains a signatory to the Compact of Free Association with the Government of the United States. Thus, it benefits from financial assistance over a 15-year period.

RMI's gross domestic product in 2015 was US$179 million/US$3,910 per capita *(OEC, 2017)*. It had a trade balance deficit of US$14 billion, with exports at US$491 million (+3.2% annualized) and imports at US$14.5 billion (+8.5% since 2010).

The primary export market destinations for 2015 were the People's Republic of China, Cyprus, Greece, the Republic of Korea and Poland. The main import origins for the same year were the People's Republic of China, Germany, Japan, the Republic of Korea and Romania. *(OEC, 2017)*.

Contributions to gross domestic product are largely derived from the services sector. The manufacturing sector contributes approximately 1.8% to the country's economy *(GlobalEDGE, 2017)*.

The population was 53,158 in 2011 *(GoRMI, 2011)*, distributed across the country's atolls and islands of the two Island Chains (table below). Approximately 14,352, or 27%, live in rural areas, with the remainder living in either Majuro or Kwajalein.

Chain	Islands and Atolls	Population
Ralik	Ailinglaplap Atoll	1,729
	Ebon Atoll	706
	Enewetak	664
	Jabat Island	84
	Jaluit Atoll	1,788
	Kili	548
	Kwajalein Atoll	11,408
	Lae Atoll	347
	Lib Island	155
	Likiep Atoll	401
	Namdrik Atoll	508
	Namu Atoll	780
	Rongelap Atoll	79
	Ujae Atoll	364
	Wotho Atoll	97
Ratak	Ailuk Toll	339
	Arno Atoll	1,794
	Aur Atoll	499
	Majuro Atoll (Capital)	27,797
	Maloelap Atoll	682
	Mejit Island	348
	Mili Atoll	738
	Utirik Atoll	435
	Wotje Atoll	859

Source: GoRMI, 2011

Solid waste management

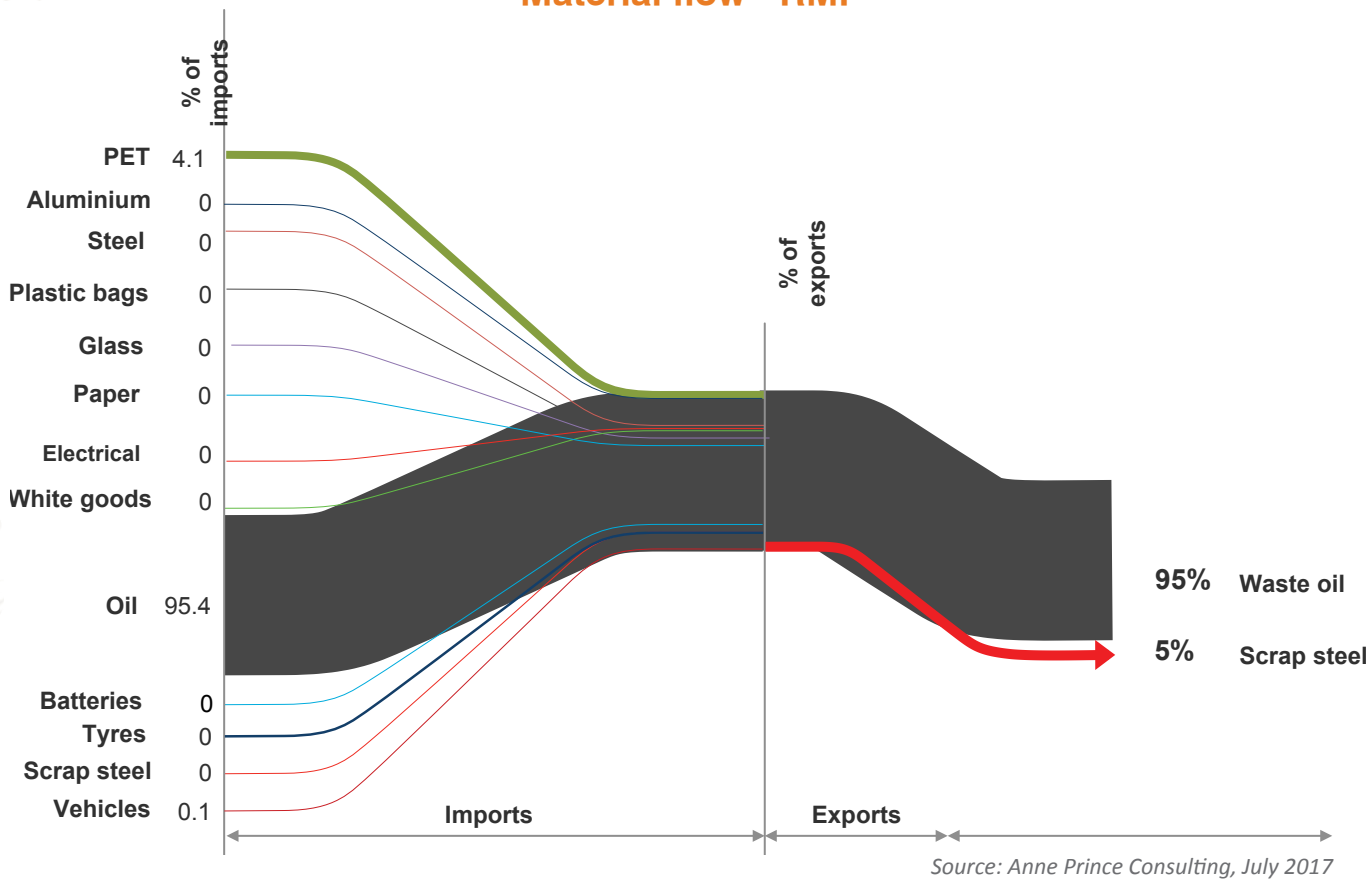
A study of the characteristics of waste was conducted in Majuro in 2014 as part of the first phase of the Promotion of Regional Initiative Solid Waste Management project, J-PRISM I, supported by the Japan International Cooperation Agency (JICA). It found, based on household sample survey data, household waste generation to be 1.1 kg per day. Organic waste represented 42.7%, followed by 16% plastic in the overall waste stream.

The regional study coordinated by PRIF models the potential recovery of 15 materials types. A defined set of recovery rates was applied to the urban, rural, and outer island population distribution to calculate RMI's potential recovery tonnage. The PRIF study compares various data to establish the context for the 15 waste materials.

The material flow chart below is based on an analysis of RMI's imports of the 15 material categories studied, averaged over a seven-year period to 2016, compared with exports of those recovered recyclable materials, averaged over a two-year period 2015-2016, presented as a percentage of the total of the 15 categories. *(UN Comtrade, 2017)*.

There is no evidence of a particular trend in the import of beverage containers, except for high-strength alcohol (>80%), peaking in 2012 and subsequently demonstrating

Material flow - RMI



Source: Anne Prince Consulting, July 2017

Note: The percentage of imports and exports displayed relate only to the proportion of the 15 materials categories studied, not total imports/exports

a strong downward trend. Plastic bag imports also peaked in 2012 and have dropped considerably since then. Paper and cardboard mostly held steady, while electronic goods are increasingly imported. Most oil imports are continuing at the same rate, except for palm oil, which peaked in 2010 and since, has experienced a sharp decline. RMI exported more than 22,000 tonnes (t) of oil, 1,100t of scrap metal, and an average of 16t of vehicles in the period 2014-16.

Modelling of potential recovery of recyclable materials, presented in the table below, is based on an estimated average daily per capita municipal solid waste generation of 1.2kg *(World Bank, 2012)*. It also applies a range of location-specific estimated recovery rates that are based on a set of assumptions of existing or introduced incentive-based policies and programs, such as container-deposit schemes and import levies. The resulting ratios were used to estimate average annual tonnages that could be recovered for recycling. *(JICA, 2013; SPREP 2016; Mobile Muster, 2013; DOEE, 2017; Jambeck et al., 2015; MFAT, 2016; UNIDO/ICSHP, 2013)*.

Republic of the Marshall Islands	
Recyclable Materials Forecast	**Estimated Metric Tonnes**
Polyethylene terephthalate (PET) beverage containers	229
Aluminium cans	322
Glass beverage containers	228
Steel cans	256
Plastic shopping bags	148
End-of-life (EOL) renewable energy equipment	1
Paper/cardboard	1,072
E-waste	3
Whitegoods	23
Used motor/cooking oil	307
Used lead-acid batteries	19
Lithium batteries	23
Scrap steel/non-ferrous metals	384
EOL tyres	19
EOL vehicles	330
Total (metric tonnes)	**3,364**

Source: World Bank, 2012.

Future waste management

RMI's National Energy Policy and Energy Action Plan aims for 20% renewable energy by 2020 to reduce its current reliance on diesel power generation. Proposed projects, funded by the Asian Development Bank, the Government of RMI, and other co-financing mechanisms include infrastructure and system improvements to increase power from solar photovoltaic and other renewable energy sources *(ADB, 2017; MFAT, 2016)*. As a result, an increase is expected in end-of-life equipment entering the waste stream (e.g., household electrical items, computers, and communication equipment).

The PacWaste (2014-17) programme, implemented by the SPREP and funded by the European Union, aims to deliver various initiatives to improve the management of e-waste and used lead-acid batteries. Activities include establishing a lead-acid battery collection system and creating an e-waste community awareness campaign *(SPREP, 2017)*. An increase in the recovery of plastics, nonferrous metals, and other materials associated with the dismantling of electrical equipment is expected as a result of these initiatives.

The second phase of the Promotion of Regional Initiative Solid Waste Management (J-PRISM II) project, implemented by JICA in early December 2016, supports capacity building in waste management. Target initiatives include improved governance and human resource development, which are expected to increase the volume of recoverable materials.

Plastic marine debris

Mismanaged waste plastic eventually enters the marine environment by way of inland rivers and waste-water outfalls or is transported by wind and tide. Rigid and lightweight, plastic materials from products that are consumed or used on a daily basis become marine debris if not managed appropriately. An estimated 16% of RMI's waste stream consists of plastic.

RMI has a combined coastline of 370km and a recent study *(Jenna et al., 2015)* indicates a daily plastic waste generation of approximately 11.1 t. An estimated 8.7t are mismanaged daily, entering the marine environment through release from uncontained disposal sites or by littering. As a result, an estimated 3,187t of waste plastic became marine debris in the waters around RMI in 2010. If not addressed, the amount is expected to rise to 5,717t by 2025. Of the 11.1t of plastic generated each day, approximately 1.2t may be PET or high-density polyethylene (HDPE) plastic, eligible for recycling under a container deposit scheme (CDS).

Based on an average reduction rate of 40% in mismanaged waste with a CDS in place, approximately 0.39t of PET and HDPE plastic could be recycled each day. This would increase to an 80% or above reduction rate, depending on access to recycling collection services and viable markets, among others. Nonetheless, a 40% reduction in mismanaged PET and HDPE would result in approximately 3,046t of plastic becoming marine debris each year.

The outcome of mismanaged plastic can be divided into three groups: plastic that remains on the surface or subsurface of the sea as floating debris, plastic that sinks to the ocean floor, and plastic that washes up on beaches. A CDS that recovers 40% of HDPE and PET plastic bottles in RMI may achieve the following reductions in marine debris each year:

- 21t in floating plastic
- 99t in sunken plastic
- 21t in beach plastic.

Further benefits attributed to a CDS are a potential reduction in annual damage costs for RMI's 114 local fishing vessels (approximately US$890). If beaches were cleaned up, over US$35,773 would be saved, of particular relevance to the amenities of coastal communities and the tourism sector.

Infrastructure and services

The Majuro Atoll Waste Company (MAWC) provides waste collection services to approximately 75% of households on the island. A development project in 2010 provided households with 360 litre bins. Commercial services are also provided, although a number of households and businesses transfer their own waste to the landfill for disposal *(ADB, 2014)*. A recent presentation at the Seventh Regional 3R Forum in Asia and the Pacific reported RMI has increased its solid waste management workforce from 12 in 2007 to 42 in 2016, as well as increased its focus on resource recovery.

The Majuro Atoll local government has a collection centre with a baler, where recovered materials are prepared for export. Aluminium, copper and used acid-lead batteries are transferred to international recycling markets - paper is processed into briquettes, green waste is now composted, and tyres are shredded on the island. These improvements have been largely driven by the need to reduce pressure on the Jable-Batkan disposal site, which is already at capacity. To prolong the life of the site, a seawall has been constructed as a temporary measure to prevent flooding.

Alternatives are extremely difficult to identify in a low-lying atoll environment, and a 2010 feasibility study funded by the Asian Development Bank, found that while a waste-to-energy facility was technically feasible, the power generated would be more expensive than is the current diesel powered system. Nonetheless, a private sector proposal for a waste-to-energy generator is understood to be under consideration and is dependent on land to be provided by the government.

The atoll waste management pilot programme, one of the four focus areas of the SPREP PacWaste project, introduced the Iokwe Bag collection system on Majura Atoll. A pre-disposal fee is charged on the sale of garbage bags to contribute to the expansion of household waste collections across the atoll.

In addition, MAWC has established a scrap steel material recovery facility that employs the use of compactors and plasma arc technology for metal recovery. A CDS for aluminium cans and PET bottles will be implemented in 2018, although MAWC has reportedly had some difficulty identifying international recycling markets *(GoRMI, 2017)*.

The outer islands, as well as RMI's tourism/accommodation facilities, do not recycle and do not have storage facilities. There are neither household recycling collection services nor community recycling centres, storage buildings, or balers to process recyclable materials.

Logistics

RMI Port Authority operates two international seaports. These have the capacity to handle international container services at Kwajalein and the Port of Majuro, the latter being the primary entry port.

Shipping Vessel Maintenance Fund Act 2011 was established as a special revenue fund under the supervision of the Ministry of Finance for maintenance, dry docking, surveying, and provision of safety equipment for shipping vessels managed by the Marshall Islands Shipping Corporation. The entity operates five vessels to transfer people and freight between the outer islands. The United States Army operates passenger ferry services to and from Kawajalein Island more or less 10 times a day over a six-day week schedule. These services are free of charge to the public.

Republic of the Marshall Islands

Source: Google Maps.
(A) Wake Island (B) Kwajalein (C) Majuro.

The Port of Majuro terminal is approximately 2.2 hectares, and is equipped with a main quay, 304 metres by approximately 12 metres deep, and a warehouse. There is no shore crane quarantine incineration infrastructure and no private stevedore services are available.

The Port of Majuro is capable of handling 20,000 twenty-foot equivalent units (TEU) per year. The port has a current throughput of approximately 4,181 import, 250 export and the return of 3,931 empty containers each year which may potentially be made available for reverse logistic arrangements. The port also loads and unloads approximately 1,400 transshipment containers each year.

The Port of Majuro is serviced by multiple international shipping lines. Estimated TEU rates, presented below, are based on the cargo of nonhazardous goods, inclusive of un/loading and a bunker adjustment factor. They do not account for customs clearance, duties, and quarantine inspection.

Republic of the Marshall Islands		
Swire Shipping; Kyowa Shipping Co. Ltd.; Polynesia Line		
Destination	**Schedule**	**Est. USD per TEU**
Australia	21-day	2,100 to 3,700
North Asia	21-day	2,600 to 3,560
Guam	21-day	TBD
Fiji	21-day	2,450 to 4,400

Source: AMSTEC Pty Ltd
Notes: USD = U.S. dollar;
TEU = twenty-foot equivalent unit.

Institutional framework

Data relating to the institutional framework of RMI have been gathered from the database of the Pacific Islands Legal Information Institute *(PacILII, 2017)*. ECOLEX is also an information service that relates to environmental law *(ECOLEX, 2017)*, from which various data also have been collected.

RMI's Environmental Protection Agency (EPA) is responsible for the administration of Environment Protection Act 1984 and Solid Waste Management Regulations 1989, which provide the legal and policy framework for waste management. Within this framework, the EPA regulates and monitors standards for the design, construction, operation, and management of solid waste storage, collection, and disposal facilities.

The EPA also administers Environmental Impact Assessment Regulations 1994, which provide for the implementation of Part 5 of National Environment Protection Act 1984, as well as Coastal Conservation Act 1988. It establishes standard procedures for the preparation and evaluation of environmental impact assessments for proposed public and private sector developments. The Ministry of Health, through the Public Health, Safety and Welfare Act 1966, is responsible for ensuring waste management activities do not present a risk to public health.

The Majuro Atoll Waste Company, a quasi- corporate entity owned jointly by the national and local Majuro Atoll governments, manages solid waste, recycling collection, and landfill operations. The Ministry of Public Works is responsible for managing the MAWC contract, overseen by a board representative each from the central government, local government, Marshall Islands Chamber of Commerce, Marshall Islands Visitors Authority, and Marshall Islands Conservation Society. This arrangement centralises the management of waste under a single authority. A national solid waste management committee was established in 2006 to develop a relevant strategic plan, which has yet to be achieved.

Local governments have a number of ordinances in place to protect marine resources and the marine environment. Included are the Civil Liability for Oil Pollution Damage Act 2012, Marine Water Quality Regulations 1991, and National Environment Protection (Amendment) Act 2006.

Recently legislated Bill 28 prohibits the importation, manufacture, sale, and distribution of Styrofoam™ and plastic cups and plates, as well as plastic shopping bags. The legislation is to be phased in and subsequently complemented with the implementation of a CDS. In addition, Import Duties (Amendment) Act 2015 waives import duties on renewable energy vehicles.

Except for the 1995 Waigani Convention, RMI is a party to various multilateral environmental agreements and conventions. These are listed in the table below.

Republic of the Marshall Islands	
Multilateral Environmental Agreements and Conventions	**Status**
Stockholm Convention on Persistent Organic Pollutants	Ratified
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	Ratified
Rotterdam Convention	Ratified
Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified
MARPOL (73/78: International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 Annexes I, II, III, IV, V, and VI)	Ratified
London Convention on the Prevention of Marine Pollution by the Dumping of Wastes and Other Matter 1972	Ratified
Intervention on the High Seas in Cases of Oil Pollution Casualties (Intervention 1969)	Ratified
1973 Protocol Relating to Intervention on the High Seas in Cases of Pollution by Substances Other than Oil	Ratified
International Convention on Civil Liability for Oil Pollution Damage 1969 (renewed 1992)	Ratified
International Convention on the Protocol of 1976 to Amend the International Fund for Compensation for Oil Pollution Damage, 1971	Ratified
International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC)	Ratified
International Convention on Civil Liability for Bunker Oil Pollution Damage (BUNKER) 2001	Ratified
International Convention on the Control of Harmful Anti-fouling Systems in Ships (AFS Convention) 2001	Ratified
International Convention for the Control and Management of Ships Ballast Water and Sediments (BWM) 2004	Ratified
Nairobi International Convention on the Removal of Wrecks 2007	Ratified
Noumea Convention:	Ratified
Protocol on Dumping	Ratified
Protocol on Combatting Pollution Emergencies	Ratified
Protocol on Oil Pollution Preparedness, Response and Cooperation	Signed
Protocol on Hazardous and Noxious Substances Pollution, Preparedness, Response and Cooperation	Signed

Source: SPREP. 2016.

Financial mechanisms

Currency: United States dollar US$

While commercial premises are charged for waste management services in RMI, there are currently no user fees for household collection systems. The SPREP PacWaste programme enabled the introduction of a user-pays principle for a specially designed garbage bag, referred to as the Iokwe Bag. The money collected is earmarked for the expansion of household waste collection services across the entire Majuro Atoll. MAWC receives revenue from the export of recyclables, including aluminium cans, used lead-acid batteries, and nonferrous metals to international markets, as well as from the sale of compost and paper fuel briquettes.

A further initiative under the PacWaste programme is the introduction of a used lead-acid battery buy-back scheme, whereby the community is able to take old batteries for a redemption fee by weight. This is expected to draw additional revenue.

RMI receives financial assistance through The Compact Trust Fund for the People of the Republic of the Marshall Islands under the Compact of Free Association with the Government of the United States. Through this mechanism, MAWC receives US$325,000 a year for solid waste operations, with potential for future, periodic grants for new plants and equipment. Further financing initiatives include the previously mentioned CDS in 2018.

Despite the revenue MAWC receives from commercial waste collection services and the sale of recyclable materials, it still lacks the funds to support the efficient collection of waste and disposal services. In an effort to cover the shortfall, a 'green fee' of US$20 is levied as a departure tax.

The European Union has allocated €8 million to the RMI for renewable energy and energy efficiency initiatives *(EU, 2014)*. This may increase the level of end-of-life renewable energy equipment in the waste stream.

Conclusions

It appears that interest in the pre-paid Iokwe Bag has been minimal to date, given the lack of community awareness. In response, MAWC intends to revise its target area and users of the bag.

RMI is in a relatively isolated location within the Micronesia region. Its primary international port in Majuro is small and, while located on a reasonably cost-efficient shipping route, it has limited infrastructure. It is able, however, to handle increased cargo volume.

Abbreviations

3R	Reduce, reuse, recycle
ADB	Asian Development Bank
AFS	Anti-fouling systems
BWM	Ballast water and sediments
CDS	Container deposit scheme
DOEE	Department of Environment and Energy (Australia)
EPA	Environmental Protection Agency
EU	European Union
FY	Financial year
GoRMI	Government of Republic of Marshall Islands
HDPE	High-density polyethylene
ICSHP	International Centre on Small Hydro Power
J-PRISM	Promotion of Regional Initiative Solid Waste Management
JICA	Japan International Cooperation Agency
kg	kilogram
km	kilometre
km^2	square kilometre
MARPOL	International Convention for the Prevention of Pollution from Ships
MAWC	Majuro Atoll Waste Company
MFAT	Ministry of Foreign Affairs and Trade (New Zealand)
OPRC	International Convention on Oil Pollution Preparedness, Response and Cooperation
PET	Polyethylene terephthalate
PRIF	Pacific Region Infrastructure Facility
RMI	Republic of the Marshall Islands
RTRC	Regional Tourism Resource Centre
SPREP	Secretariat of the Pacific Regional Environment Programme
t	tonne
TEU	Twenty-foot equivalent unit
UNIDO	United Nations Industrial Development Organisation
USD	United States dollar

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Samoa

Introduction

The increasing presence of plastic marine debris in the South Pacific Ocean is focusing attention on strengthening recycling policies and systems in the region. Unique challenges associated with shipping commodities of low value over long distances to recycling markets, however, reduce the economic viability to do so. This country profile includes the current technologies, material flow, logistics, public policies, institutional framework, financial mechanisms, and initiatives that are being designed or have been implemented to strengthen recycling systems in Samoa.

Samoa comprises an archipelago of islands covering an area of 3,000 square kms with a combined coastline of 403 km. It is situated in the central South Pacific region, forming part of Polynesia. There are 10 islands, six of which are uninhabited. The majority of the population lives on Upolu Island, where the centre of government and the country's capital of Apia are located. The Samoan Islands are generally rocky, with volcanic soil from which lush vegetation grows. The islands are ringed by coral reefs and shallow lagoons.

Socioeconomic background

The country offers low-impact tourism activities such as cycling, scuba diving, fishing, and surfing. Visitors numbers (139,043 in 2015), increased 5.6% over the previous year *(SPTO, 2015)*, and 9.4% in FY2016. Tourist accommodation, such as resorts, hotels, and beach *fales*, contribute to the volume of waste on the islands.

Samoa has two levels of government. The central government is a modern, state system, while the village local administrations are based on traditional structures. The latter is an expansive system that comprises 286 traditional and 56 nontraditional village councils.

Samoa's gross domestic product (GDP) in 2015 was US$5,930 per capita *(OEC, 2017)*. It had a trade balance deficit of US$356 million in the same year, with exports at US$83 million (-1.2% annualised) and imports at US$439 million (+1.2% since 2010).

The primary export market destinations for 2015 were Australia, American Samoa, Colombia, New Zealand and the United States. The main import origins for the same year were Australia, the People's Republic of China, New Zealand, Singapore and the United States. *(OEC 2017)*.

Samoa's economy increased by 6.6% in FY2016, driven by a 41% increase in fisheries, as a result of a newly established local fishing operation. With recent increases in visitor numbers, hotels and restaurants grew by 36.9%. Transport also grew by 21.9% *(ADB 2017)*.

Building construction, food manufacturing, and beverages increased substantially. As such, contributions to GDP were led by the services sector. Manufacturing contributed approximately 7.7% to the economy, indicating the level of value addition of the industry, and the consequent support of the utilities sector *(GlobalEDGE, 2017)*.

Samoa's total population was 192,196 in 2016 *(GoS, 2016)*. A rural population of approximately 80%, or 153,756, was predominantly living in villages on the coastal fringes of the islands *(Knoema, 2015)*. The approximate population distribution shown in the table below is based on Samoa's 2016 Census.

Samoa		
Island	**Urban**	**Rural**
Upolu	Apia 35,454	111,730
Savai'i		43,819
Manono		1,118
Apolima		75
Fanuatapu, Namu'a, Nu'utele, Nu'ulua and Nu'usafee	Non populated	

Source: Village Directory 2016: Census 2016 Preliminary Count. Samoa Bureau of Statistics.

Solid waste management

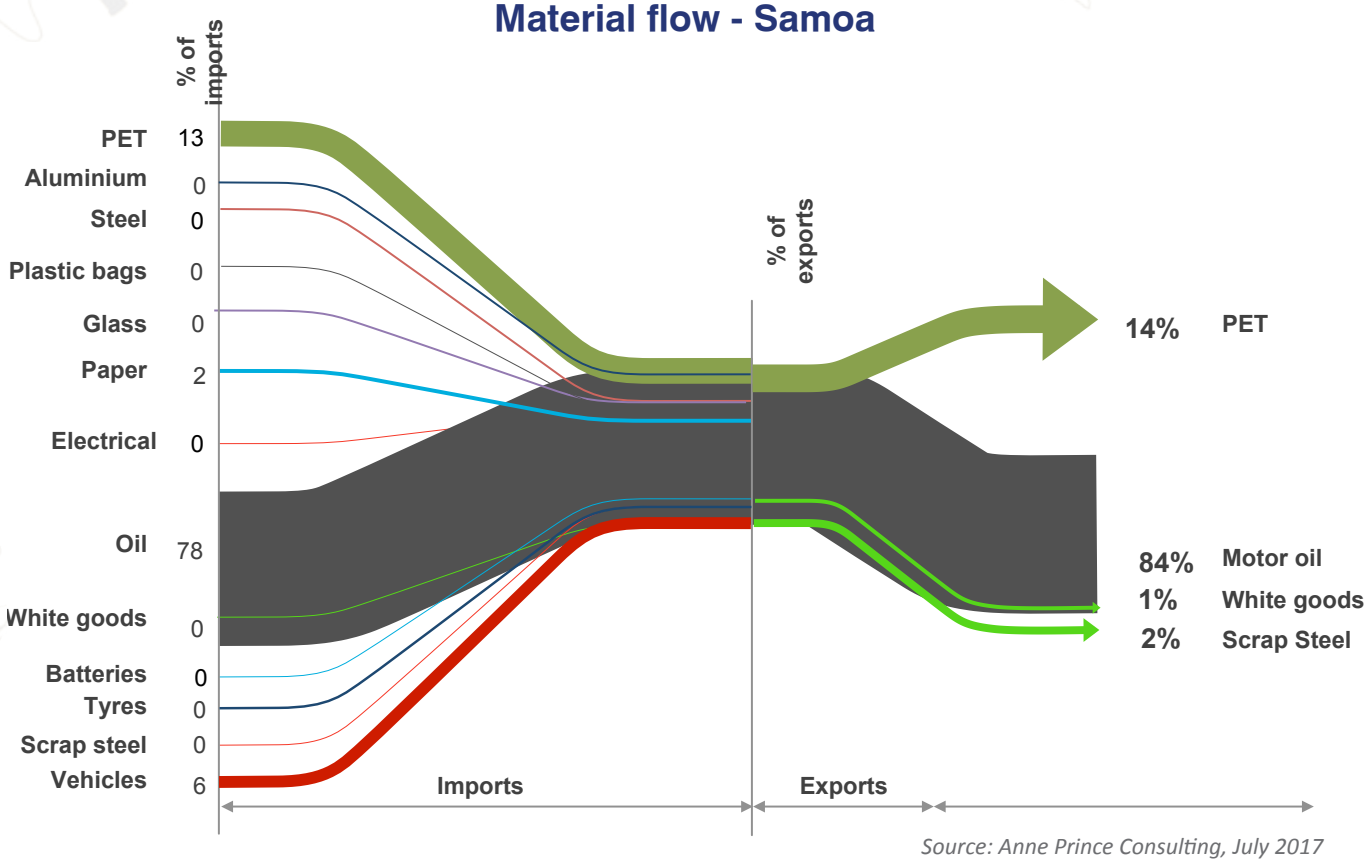
A study of waste characteristics, undertaken by the Ministry of Natural Resources and Environment and reported in JICA's Data Collection Survey on Reverse Logistics in the Pacific Islands, January 2013, indicated a daily waste generation rate of 0.38 kg per person. This comprised 42% organic waste and over 13% plastic waste.

The regional study coordinated by PRIF models the potential recovery of 15 materials types. A defined set of recovery rates was applied to the urban, rural, and outer island population distribution to calculate Samoa's potential recovery tonnage. The PRIF study compares various data to establish the context for the 15 waste materials.

The material flow chart below is based on an analysis of Samoa's imports of the 15 material categories studied, averaged over a seven-year period to 2016, compared with exports of those recovered recyclable materials, averaged over a two-year period 2015-2016, presented as a percentage of the total of the 15 categories. *(UN Comtrade, 2017)*.

Beverage containers made of plastic and aluminium are imported at a steady rate, while there was an increase in the number of glass ampules used for making glass bottles. Samoa has experienced a large uptake of renewable energy equipment in recent years, including heat pumps, air conditioners, vehicles, and whitegoods. Paper and cardboard imports remain stable. As in most other Pacific island countries, large volumes of petroleum and cooking oil were imported over the seven years under consideration. Furthermore, market intelligence indicates that Samoa may be receiving waste beverage containers from other Pacific island countries.

Material flow - Samoa



Source: Anne Prince Consulting, July 2017

Note: The percentage of imports and exports displayed relate only to the proportion of the 15 materials categories studied, not total imports/exports

Samoa exports a wide variety of the materials listed. Furthermore, it is one of the few Pacific island countries to have exported a substantial volume of whitegoods in the last two years. In addition, an average of more than 2,600 tonnes (t) of polyethylene terephthalate (PET), 16,000 t of motor oil and cooking oil, and a large amount of scrap steel and end-of-life vehicles were exported. While not yet quantified, it does appear that Samoa also exported used lead-acid batteries on a regular basis.

Modelling of potential recovery of recyclable materials, presented in the table below, is based on an estimated average daily per capita municipal solid waste generation of 0.79kg *(World Bank, 2012)*. It also applies a range of location-specific estimated recovery rates that are based on a set of assumptions of existing or introduced incentive-based policies and programs, such as container-deposit schemes and import levies. The resulting ratios were used to estimate average annual tonnages that could be recovered for recycling. *(JICA, 2013; SPREP 2016; Mobile Muster, 2013; DOEE, 2017; Jambeck et al., 2015; MFAT, 2016; UNIDO/ICSHP, 2013)*.

Samoa	
Recyclable Materials Forecast	**Estrimated Metric Tonnes**
Polyethylene terephthalate (PET) beverage containers	94
Aluminium cans	170
Glass beverage containers	120
Steel cans	135
Plastic shopping bags	61
End-of-life (EOL) renewable energy equipment	-
Paper/cardboard	564
E-waste	28
Whitegoods	141
Used motor/cooking oil	983
Used lead acid batteries	78
Lithium batteries	158
Scrap steel/nonferrous metals	202
EOL tyres	78
EOL vehicles	2,085
Total	**4,897**

Future waste management

Future increases in recovered materials are expected as a result of the PacWaste (2014-17) programme, implemented by SPREP. The programme aims to improve the management of e-waste, with activities that include the establishment of a pilot project for the safe dismantling and export of e-waste and the creation of a community awareness campaign *(SPREP, 2017)*.

The second phase of the Promotion of Regional Initiative Solid Waste Management (J-PRISM II) project, implemented by JICA in early December 2016, supports capacity building in waste management. Target initiatives include improved governance and human resource development, expected to generate increased volumes of recoverable materials.

The Government of Samoa is targeting 100% renewable energy by 2025. Some solar power generation is in place, and wind turbines are installed on the island of Upolu. Work on the first hydropower scheme is underway on the island of Savaii.

The Renewable Energy Development and Power Sector Rehabilitation Project will increase access to renewable energy generation and improve existing power infrastructure. This project is funded by the Asian Development Bank, European Union, Government of New Zealand and Government of Samoa, as well as the Multi-Donor Clean Energy Fund *(ADB, 2017)*. While 95% of the population has access to electricity, the expansion of renewable energy systems may yet result in an increased presence of end-of-life renewable energy equipment in the waste stream. Coca Cola South Pacific has announced that over the past couple of years, there has been a significant rise in the presence of PET in the waste stream, possibly as a result of a surge in local water production and the establishment of over 30 bottling plants in Samoa within the same period. Local and imported cans (Chinese Traders, Brandes Shasta, and Coolma) also dominate market share.

Plastic marine debris

Mismanaged plastic waste eventually enters the marine environment by way of inland rivers and waste water outfalls or is transported by wind and tide. Rigid and lightweight plastic materials from products that are consumed or used on a daily basis become marine debris if not managed appropriately. An estimated 13% of Samoa's waste stream is comprised of plastic.

The Samoan islands have a combined coastline of 403kms and a recent study *(Jenna et al., 2015)* indicates that approximately 17.1t of plastic waste is generated each day. An estimated 14t is mismanaged daily and are predicted to enter the marine environment through release from uncontained disposal sites or by direct littering. An estimated 5,122 t of plastic waste was released in the waters around Samoa in 2010. If not addressed, the amount is expected to rise to 10,989 t by 2025.

Of the 17.1 t of plastic generated each day, approximately 1.9 t may comprise polyethylene terephthalate (PET) or high-density polyethylene (HDPE) plastic, eligible for recycling under a container deposit scheme (CDS). Based on an average reduction rate of 40% in mismanaged waste with a CDS in place, approximately 0.62 t of PET and HDPE plastic could be recycled each day. This could increase to an 80% or above reduction rate, depending on access to recycling collection services and viable markets, among others. Nonetheless, a 40% reduction in mismanaged PET and HDPE would result in approximately 4,895 t of plastic becoming marine debris each year.

The outcome of mismanaged plastic can be divided into three groups: plastic that remains on the surface of the sea as floating debris, plastic that sinks to the ocean floor, and plastic that washes up on beaches. A CDS that recovers 40% of HDPE and PET bottles in Samoa may achieve the following reductions in marine debris each year:

- 34 t in floating plastic
- 159 t in sunken plastic
- 34 t in beach plastic.

Further benefits attributed to a CDS are possible with a reduction in annual damage costs to Samoa's 181 local fishing vessels (approximately US$1,400). If beaches are cleaned up, over US$57,486 would be saved, of particular relevance to the amenities of coastal communities and the tourism sector.

Infrastructure and services

Information relating to the solid waste and recycling infrastructure and services in Samoa is sourced from *Solid Waste Management in the Pacific: Samoa Country Snapshot*. *(ADB 2014)*. Other information has been drawn from "Data Collection Survey on Reverse Logistics in the Pacific Islands". Final Report 2013. Japan International Cooperation Agency (JICA), Tokyo.

A significant level of support has been provided to Samoa to improve its waste management under the first phase of the JICA (J-PRISM I) project. A number of improvements were achieved between 2011 and 2015, including recycling promotion through the Reduce, Reuse and Recycle (3R HEART) community awareness programme; strengthening of landfill operations; and development of a landfill operation training programme.

There are three recycling operations on the main island of Upolu which source steel and nonferrous scrap from abandoned vehicles and the local landfill *(JICA, 2013; ADB, 2014)*. Together, these export approximately 12 x 20 foot shipping containers a month to Australia, the Republic of Korea, and New Zealand. Whitegoods, PET bottles, paper and cans are baled and exported to Indonesia and New Zealand. Used lead-acid batteries are sent to Fiji, India, New Zealand, and Singapore.

Household solid waste is usually collected twice a week and, in some cases, on a daily basis in urban areas. Services are provided to 100% of the population, although this excludes the collection of separate dry recyclables. Waste compactor vehicles are operated by five private companies under government contract and managed by the waste management section of the Ministry of Natural Resources and Environment (MNRE).

Contractors also service commercial and institutional organisations, transferring waste materials to the Tafa'igata Sanitary Landfill, operated by the government and located approximately 10 kms west of Apia. JICA and SPREP have been extensively involved over the long term in the development and operation of the Tafa'igata landfill and the solid waste collection system.

Bulky waste is collected by private sector firms once every three months, free of charge. The waste, including whitegoods, vehicles and furniture, among others, is transported to the landfill, where it is placed in a designated area facing the landfill entrance for community reuse. The island of Savaii also has a semi-aerobic landfill structure, developed with the cooperation of JICA.

Logistics

The islands of Samoa are well serviced by the Samoa Shipping Corporation, a state-owned entity under the Ministry of Works, Transport and Infrastructure, which provides shipping, slipway, and port management services. It also transfers hazardous goods.

The corporation operates a fleet of seven ships, including three roll-on/roll-off passenger vessels; two cargo and landing vessels; one cargo and one passenger ferry. Regular domestic, inter-island, and international services depart from Apia. Various cargo, courier, vehicle and passenger services operate daily between the islands of Upolu (Mulifanua) and Savai'i (Salelologa). The international route between Apia and Pago Pago in American Samoa is serviced on a weekly basis.

Domestic freight charges are estimated to be approximately US$300 per twenty-foot equivalent (TEU) between Manifanua and Salelologa. A loaded, heavy vehicle is charged at US$1/t *(JICA, 2013)*.

The port of Apia is the only international and commercial container port in Samoa, with approximately 204 ships visiting annually. The port handles Samoa's foreign trade cargo of mostly imports, as well as cruise ships.

Samoa

Source: Google Maps.

- Apia

The terminal at the Port of Apia is approximately three hectares and is equipped with a main quay, 166 metres by approximately 12 metres deep, and a warehouse. The construction of an extended berth is currently underway. There is no shore crane, although there are private stevedore services.

The Port of Apia is capable of handling 35,000 twenty-foot equivalent units (TEU) per year. The port has a current throughput of approximately 12,800 import, 1,500 export and the return of 11,300 empty containers each year which may potentially be made available for reverse logistic arrangements. The port also loads and unloads approximately 500 trans-shipment containers each year.

The port of Apia is serviced by multiple international shipping lines. Estimated TEU shipping container rates, presented below, are based on the cargo of nonhazardous goods, inclusive of un/loading and a bunker adjustment factor. They do not account for customs clearance, duties, and quarantine inspection.

Samoa: Shipping Lines

Swire Shipping; ASUPAC Consortium, including SOUTHPAC Service; Kyowa Shipping Co. Ltd.; Polynesia Line

Destination	Schedule	Est. USD per TEU
North Asia	30-day	2,400 to 3,600
Australia	16-day	2,650 to 4,600
Fiji	21-day	2,500 to 4,400
New Zealand	14-day	2,682 to 4,600
Southeast Asia	14-day	2,500 to 4,400
United States, West Coast	14-day	TBD

Source: AMSTEC Pty Ltd
Notes: USD = U.S. dollar;
TEU = twenty-foot equivalent unit.

The port of Apia receives sewerage and waste from domestic ships only. The port does not accept oil tankers, oily water/bilge water, ozone depleting substances, or exhaust gas cleaning system residues. Recyclables from international ships are subject to quarantine, and small amounts of quarantine waste are incinerated on site, with larger quantities sent to the landfill for deep burial.

A 2015 review of the port's waste reception facilities considered them of a satisfactory standard, as are those relating to quarantine waste *(SPREP, 2015)*. Nevertheless, improvements are called for to upgrade the port in line with the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), of which Samoa is a signatory, as well as to ensure that the disposal of ship waste meets environmental standards. Recommended improvements from the review include the planning of the disposal of general and hazardous waste from ships within national waste strategies and management systems; extending sewerage infrastructure to the port; communicating waste service information to visiting ships; considering options for servicing anchored ships; and entering into regional arrangements for exhaust gas cleaning system residues and ozone depleting substances.

Institutional framework

Data relating to the institutional framework of Samoa have been gathered from the database of the Pacific Islands Legal Information Institute *(PacILII, 2017)*. ECOLEX is also an information service that relates to environmental law *(ECOLEX, 2017)*, from which various data also have been collected.

The waste management section of the MNRE administers the Waste Management Act 2010. It also monitors and enforces the planning and management of solid waste services, including Samoa's six collection contracts. The Act covers the collection, management, disposal, and recycling of solid waste. It also provides for the registration and licensing of waste operators; issuance of dumping and incineration

permits; establishment of environmental standards; and ensures community involvement in waste management. This Act also provides for the issuance of permits to vessels in relation to the dumping or incineration of waste at sea and the application of penalties due to noncompliance with the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1972) and its London Protocol 1996, as well as the 1995 Waigani Convention.

Planning and Urban Management Act 2004 relates to urban planning and development. It guides the sustainable management of urban areas and environmental impact assessments. A National Waste Management Policy was developed in 2001. It does not appear to have been revised.

The National Chemical Management Strategy 2007-2017 provides a framework for sustainable management of all chemicals. It includes the activities of procurement, transportation, storage, distribution, use, and disposal.

Plastic Bag Prohibition Regulation 2006 considers plastic products as 'environment pollutants', as defined in Land Surveys and Environment Act 1989. The regulation establishes minimum biodegradability standards, rules, and licensing for the importation of plastic products. These are defined as plastic bags, plastic film sheets, and the pellets that are used in their manufacture.

The Ministry of Health is responsible for Health Ordinance 1959 and Board of Health (Rubbish) Regulations that relate to the operation of the National Health Service. The Ministry of Women, Community and Social Development, the Samoa Umbrella for Non-Government Organisations Inc., (which represents 300 villages), and various international donor agencies play a key role in the institutional and community management of solid waste. While the former is responsible for waste management and the environment at the local government level, the latter two are responsible at the central and local levels.

Marine Pollution Prevention Act 2008 falls under the MNRE and relates to the prevention of pollution to the marine environment, as well as to response to incidents of marine pollution discharged from vessels. It ensures adherence to marine pollution conventions.

Quarantine Biosecurity Act 2005 relates to 'regulated articles'. These are soil, garbage, litter, fodder, animals, animal products, plant, and plant materials, among others.

Water Resources Management Act 2008 is led by the MNRE. It relates to the management, conservation, and use of water resources, including coastal waters where freshwater accumulates or discharges and is mixed with seawater.

In 2015, Cabinet approved the prohibition of end-of-life (waste) tyre imports due to public health concerns. Such concerns include the potential effects of these materials in the waste stream.

Samoa is a party to various multilateral environmental agreements and conventions. These are listed in the table below.

Samoa	
Multilateral Agreements and Conventions	**Status**
Stockholm Convention on Persistent Organic Pollutants	Ratified
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	Ratified
1995 Waigani Convention	Ratified
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	Ratified
Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified
Minimata Convention	Signed
MARPOL 73/78: International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (Annexes I, II, III, IV, V, and VI)	Ratified
International Convention on Civil Liability for Oil Pollution Damage 1969 (renewed 1992)	Ratified
International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage 1992 (FUND92)	Ratified
International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC)	Ratified
Hazardous and Noxious Substances by Sea Convention (HNS Convention 1996)	Ratified
International Convention on Civil Liability for Bunker Oil Pollution Damage (BUNKER) 2001	Ratified
Noumea Convention:	Ratified
Protocol on Dumping	Ratified
Protocol on Combatting Pollution Emergencies	Ratified
Protocol on Oil Pollution Preparedness, Response and Cooperation	Signed
Protocol on Hazardous and Noxious Substances Pollution, Preparedness, Response and Cooperation	Signed

SPREP. 2016.

Financial mechanisms

Currency: Samoan tala (ST)

The MNRE solid waste budget for 2012 was ST 2,281 million (US$0.97million), which funds landfill operations, maintenance work, and cleaning of public areas. Households are not charged for collection or disposal services. Private collection companies charge for commercial and institutional collection services and are, in turn, pay a tipping fee on entry to the Tafaigata Landfill. This provides the government with additional revenue. It appears that waste pickers at the Tafaigata Landfill recover and sell aluminium cans to recycling companies for US$0.90/kg.

The government at the central level makes transfer payments to village councils for capital development as necessary. Village councils have the power to levy taxes in line with village usage to support community activities, although there is no legal provision to enforce this.

Samoa Breweries Ltd. operates a redemption scheme for the return of glass bottles through its distributors. The distributers pay 20 cents per 750 ml bottle.

Conclusions

Specific waste management legislation was introduced in Samoa in 2010, with regulations to address plastic environment pollution in 2006. Samoa's National Waste Management Policy, however, has not been updated since 2001.

No fees are charged for household collections. As a result, financial mechanisms can be considered to support improved waste management systems.

A number of recyclers and recyclable waste generators in Apia have recently formed the Samoa Waste Management Recycling Association Inc. The Association is undertaking strategic planning and seeks to work closely with the national government to progress improvements to solid waste management systems in Samoa.

Samoa has an extensive inter-island shipping service and a relatively strong private sector recycling industry. This indicates that there is potential to further support the deposit schemes and extend producer responsibility schemes.

Construction work to extend the berths at the Port of Apia is currently underway. The port, which is on a rather efficient shipping route, has the capacity to handle increased cargo volumes.

Abbreviations

ADB	Asian Development Bank
CDS	container deposit scheme
EOL	End of life
ECOLEX	Environmental Law Database
FY	Financial year
GDP	Gross domestic product
HDPE	high-density polyethylene
J-PRISM	Promotion of Regional Initiative Solid Waste Management
JICA	Japan International Cooperation Agency
km(s)	kilometre(s)
MARPOL	International Convention for the Prevention of Pollution from Ships
MFAT	New Zealand Ministry of Foreign Affairs and Trade
ml	millilitre
MNRE	Ministry of Natural Resources and Environment
OEC	Observatory of Economic Complexity
PET	polyethylene terephthalate
PRIF	Pacific Region Infrastructure Facility
SPREP	Secretariat of the Pacific Regional Environment Programme
SPTO	South Pacific Tourism Organisation
t	tonne
TEU	twenty-foot equivalent unit
UNIDO	United Nations Industrial Development Organization
ICSHP	International Centre on Small Hydro Power

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Solomon Islands

Introduction

The increasing presence of plastic marine debris in the South Pacific Ocean is focusing attention on strengthening recycling policies and systems in the region. Unique challenges associated with shipping commodities of low value over long distances to recycling markets, however, reduce the economic viability to do so. This country profile includes the current technologies, material flow, logistics, public policies, institutional framework, financial mechanisms, and initiatives that are being designed or have been implemented to strengthen recycling systems in Solomon Islands.

Solomon Islands is a group of six major islands and 900 small islands, stretching across 28,400km^2, with a combined coastline of 5,313km. The country is geographically placed east of Papua New Guinea and northwest of Vanuatu in the Melanesia region of the Pacific Ocean. The main islands are Guadalcanal - the largest of the Choiseul group of three islands - Santa Isabel, Malaita, New Georgia, and Makira (or San Cristobal). The capital, Honiara, is located on Guadalcanal Island.

Socioeconomic background

Solomon Islands consists of a group of mountainous islands and low-lying coral atolls. Ecotourism activities, such as scuba diving, continue to grow, despite increasing concern for the natural marine environment and the demise of the coral reefs. Furthermore, the lack of infrastructure and transport services presents development challenges in this sector. With tourism a significant industry in Solomon Islands, visitors numbered 21,623 in 2015 *(RTRC, 2015)*, representing a 7.7% increase over the previous year.

Approximately 16% of the population is powered by the electricity grid. The state-owned power utility is almost entirely dependent on diesel generators to supply power to Honiara. The Province of Malaita receives only 2% of the power generation capacity, and many rural areas now use small PV panels. Power supply, in general, remains unreliable and costly, although the government is targeting an increase in renewable energy to 50% by 2020. The Asian Development Bank (ADB), together with other development partners, is funding the Tina River Hydro Development Project. It also has implemented the Solar Power Development Project to support transition to hydroelectric power.

The country's gross domestic product in 2015 *(OEC, 2017)* was US$1.13 billion or US$2,200 per capita. Its trade balance was US$210 million, with exports at US$648 million (+10.8% annualised) and imports at US$438 million (+4.8% since 2010).

The primary export market destinations for 2015 were the People's Republic of China, India, Italy and the United Kingdom. The main import origins for the same year were Australia, the People's Republic of China, Malaysia, New Zealand and Singapore. *(OEC, 2017).*

Many Solomon Islanders engage in subsistence agriculture. The major contributors to gross domestic product in 2017 were agriculture at 39% and the service sector at 55%. Manufacturing, as a value adding sector, is relatively small, standing at 3.76% and indicating limited capacity to support process-based enterprises *(GlobalEDGE, 2017).*

The population of Solomon Islands in 2016 was estimated at 639,418 *(GoSI, 2017)*, distributed over 10 provinces, as shown in the table below. Approximately 78%, or 498,746, live in rural areas *(Knoema, 2015)*, the majority as subsistence farmers. The largest urban population is in the rapidly growing capital of Honiara. An estimated 35% of Honiara's population lives in informal settlements surrounding the capital city.

Solomon Islands		
Province	**Population**	**Urban Centre**
Choiseul	33,370	Taro
Western	92,319	Munda and Noro
Isabel	32,434	Buala
Central	30,837	Tulagi
Rennel	3,823	
Guadalcanal	133,790	
Honiara City	82,485	
Malaita	155,457	Auki
Makira	50,625	Kirakira
Temotu	24,278	Lata

Source: Solomon Islands National Statistics Office, Project Population by Province 2010-2025

A significant level of support has been provided to improve waste management under the first of two phases of the Promotion of Regional Initiative Solid Waste Management project (J-PRISM I), funded by the Japan International Cooperation Agency (JICA). Various core planning and infrastructure improvements were achieved during FY2014/15.

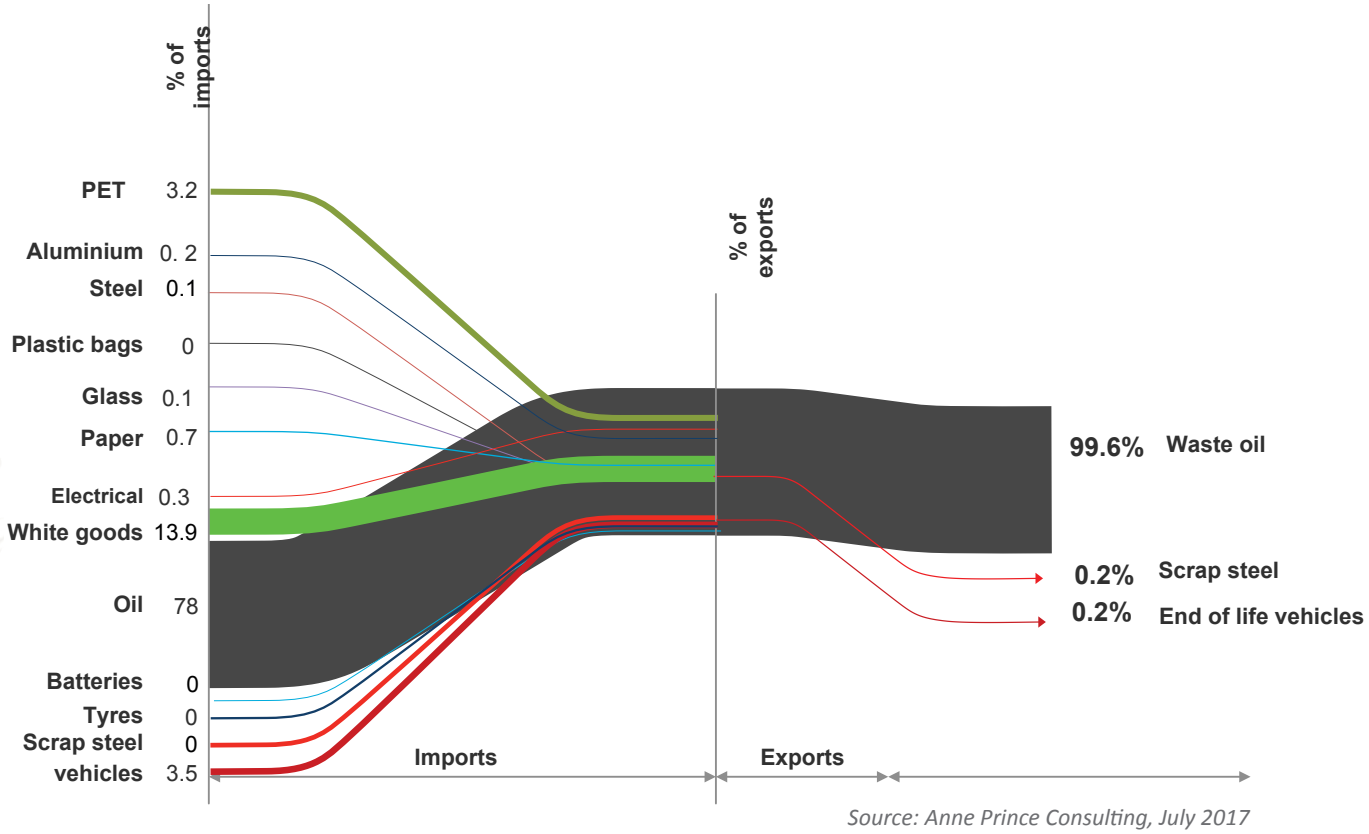
Solid waste management

A 2011 study on the characteristics of waste, supported J-PRISM I, demonstrated that the household waste generation rate in Honiara and Gizo is 0.9 kg per day.

The regional study coordinated by PRIF models the potential recovery of 15 materials types. A defined set of recovery rates was applied to the urban, rural, and outer island population distribution to calculate Solomon Islands potential recovery tonnage. The PRIF study compares various data to establish the context for the 15 waste materials.

The material flow chart below is based on an analysis of Solomon Islands imports of the 15 material categories studied, averaged over a seven-year period to 2016, compared with exports of those recovered recyclable materials, averaged over a two-year period 2015-2016, presented as a percentage of the total of the 15 categories. *(UN Comtrade, 2017).*

Material flow - Solomon Islands



Source: Anne Prince Consulting, July 2017

Note: The percentage of imports and exports displayed relate only to the proportion of the 15 materials categories studied, not total imports/exports

Importation of polyethylene terephthalate (PET) beverage containers for fruit juice and flavoured drinks steadily increased from 2009 to 2016. A similar trend is taking place in terms of other beverage containers. There is also a steady rise in paper products coming into the country over the course of 2009 to 2016. The number of televisions and other electronic items are holding steady, while a large amount of crude oil is imported each year, although this appears to have peaked in 2011. A large number of vehicles were imported in 2010 after nearly five years of low volume. This, however, picked up again in 2015 and 2016.

Three major items exported were used motor and cooking oils and vehicles, following the general trend of other Pacific island countries. Otherwise, very little or no export was noted relating to beverage containers, plastic bags, e-waste, paper, and cardboard.

Modelling of potential recovery of recyclable materials, presented in the table below, is based on an estimated average daily per capita municipal solid waste generation of 0.79kg *(World Bank, 2012)*. It also applies a range of location-specific estimated recovery rates that are based on a set of assumptions of existing or introduced incentive-based policies and programs, such as container-deposit schemes and import levies. The resulting ratios were used to estimate average annual tonnages that could be recovered for recycling. *(JICA, 2013; SPREP 2016; Mobile Muster, 2013; DOEE, 2017; Jambeck et al., 2015; MFAT, 2016; UNIDO/ICSHP, 2013)*.

Solomon Islands	
Recyclable Materials Forecast	**Metric Tonnes**
Polyethylene terephthalate (PET) beverage containers	111
Aluminium cans	200
Glass beverage containers	141
Steel cans	159
Plastic shopping bags	72
End-of-life (EOL) renewable energy equipment	-
Paper/cardboard	666
E-waste	15
Whitegoods	139
Used motor/cooking oil	1,055
Used lead-acid batteries	33
Lithium batteries	197
Scrap steel/non-ferrous metals	239
EOL tyres	33
EOL vehicles	1,973
Total	**5,033**

Future waste management

Future increases in recovered materials are expected as a result of the PacWaste (2014-17) programme, implemented by SPREP. The programme aims to improve the management of e-waste and used lead-acid batteries. Activities include the establishment of a used lead-acid battery and mobile phone collection system, as well as support in developing a national e-waste strategy *(SPREP, 2017)*.

The second phase of the Promotion of Regional Initiative Solid Waste Management (JPRISM II) project, implemented by JICA in early December 2016, will support capacity building in waste management. Target initiatives include improved governance and human resource development, which are expected to increase the volume of recoverable materials.

Currently, around 23% of the population of Solomon Islands has access to electricity, largely powered by diesel, while the contribution of renewables such as hydro and solar is targeted to increase to 20% of electricity generation by 2020. Projects funded by ADB, World Bank's International Development Association and various Climate Investment Funds, the private sector and the Governments of UAE, Australia and Solomon Islands aim to install five solar-diesel hybrid and battery storage systems and various hydropower-diesel hybrid systems to meet 65% demand *(ADB, 2017)*. Other ongoing projects include upgrades to diesel power stations, hydro systems, and solar power and battery storage systems.

The transfer to renewable energy systems and increasing household access to electricity is anticipated to generate more household electrical items. As a result, there will be more end-of-life renewable energy equipment in the waste stream in the future.

Plastic marine debris

Mismanaged plastic waste eventually enters the marine environment by way of inland rivers and waste water outfalls or is transported by wind and tide. Rigid and light-weight plastic from products that are consumed or used daily become marine debris if not managed appropriately. An estimated 13% of Solomon Islands waste stream consists of plastic.

Solomon Islands has a combined coastline of 5,313km, and a recent study *(Jenna et al., 2015)* indicates a daily plastic waste generation of approximately 63.2 tonnes (t). An estimated 55.8t are mismanaged daily and are predicted to enter the marine environment through release from uncontained disposal sites or by direct littering. An estimated 20,394t of plastic waste was released in the waters around Solomon Islands in 2010. If not addressed, the amount is expected to rise to 176,589 t by 2025.

Of the 63.2t of plastic generated each day, approximately 7t may comprise PET or high-density polyethylene (HDPE) plastic, eligible for recycling under a container deposit scheme (CDS).

Based on an average reduction rate of 40% in mismanaged waste with a CDS in place, approximately 2.47t of PET and HDPE plastic could be recycled each day. This could increase to an 80% or above reduction rate, depending on access to recycling collection services and viable markets, among others. Nonetheless, a 40% reduction in mismanaged PET and HDPE would result in approximately 19,491t of plastic becoming marine debris each year.

The outcome of mismanaged plastic can be divided into three groups: plastic that remains on the surface of the sea as floating debris, plastic that sinks to the ocean floor, and plastic that washes up on beaches. A CDS that recovers 40% of HDPE and PET plastic bottles in Solomon Islands may achieve the following reductions in marine debris each year:

- 135 t in floating plastic
- 632 t in sunken plastic
- 135 t in beach plastic.

Further benefits attributed to a CDS are possible with a reduction in annual damage costs to the 318 local fishing vessels of Solomon Islands (approximately US$2,472). If beaches were cleaned up, over US$229,000 would be saved, of particular relevance to the amenities of coastal communities and the tourism sector.

Infrastructure and services

Information relating to the solid waste and recycling infrastructure and services is sourced from *Solid Waste Management in the Pacific: Solomon Islands Country Snapshot*. 2014 Asian Development Bank, Manila. Information has also been drawn from the Regional Resource Circulation and Recycling Network Project Survey Return, Government of Solomon Islands.

Most provinces have some form of waste collection system in place, coordinated by the respective provincial departments under the Environmental Health Division. Approximately 60% of households in Honiara and 12% of the rest of the population have access to collection services. Plans to improve waste management in the provinces include a waste management strategy for Choiseul Province and a waste management action plan for Taro Island.

In Honiara, the collection of household waste is delivered by contractors employed by the city council. The city is divided into residential zones and contractors generally use 3t open trucks for collection. Collection, however, is often unreliable and waste is often left uncollected on the street for long periods of time. A collection service generally is not provided in the settlement areas around Honiara and, more often than not, waste is dumped into drains, eventually washing into streams, rivers, and the ocean during rainy periods. There are no household recycling collection services.

There are currently no sanitary landfills and the largest disposal site is the Ranadi landfill in Honiara, which is located on flat, reclaimed land. Adjacent to mangrove wetlands, the site receives residential, commercial, and industrial waste, collected by Honiara City Council. There is no waste segregation at the landfill, although waste pickers recover scrap metals and other materials of value. The site has a warehouse and baler to compress and store PET plastic.

A 2015 J-PRISM I initiative by JICA undertook rehabilitation work at the Ranadi Landfill and Gizo Dump to set up waste cells and leachate management systems in line with the semi aerobic Fukuoka method of technology. A training centre and perimeter fence at Ranadi were also erected, with upgrade work supported by those trained, as well as guided by operating manuals developed for on-site use. This initiative also included waste characterisation surveys and time and motion studies in Honiara and Gizo to inform the improvement of waste collection services.

There is one recycling firm in Gizo Western Province that purchases aluminium cans from residents. These are shipped to a recycler in Honiara for export. A PacWaste pilot project collects used lead-acid batteries from household solar systems in the provinces of Malaita, Santa Isabel, and Choiseul in the outer islands. These also are transported to Honiara and exported.

Honiara is the main recycling hub, where five recycling companies provide services in marked collection vehicles at which people return their aluminium cans for a redemption fee. The batteries are transported to the Solomon Island Power Warehouse for payment. While aluminium cans and ferrous and nonferrous metals are exported, a PET bottle collection project in Honiara has met challenges in accessing the international recycling market. The project is now under the responsibility of the Honiara City Council.

Reuse initiatives for a range of other materials exist across the island nation. For instance, cardboard is collected and used by a local firm to package coral for export. Used engine oil from the Solomon Power Station is salvaged and used as chainsaw oil or sold as vehicle oil on the local market; vehicle tyres are used by residents in their gardens; PET bottles are reused for lemonade drinks and arts and crafts to sell at markets; and some PET bottles are used as containers for growing vegetables.

Similarly, office paper is useful for early childhood teachers; magazines and coloured paper are made into beads for jewelry and sold at local markets; and newspaper is used for cooking. Nevertheless, the reuse of such materials is small in scale, with most becoming litter or discarded for transport to landfills.

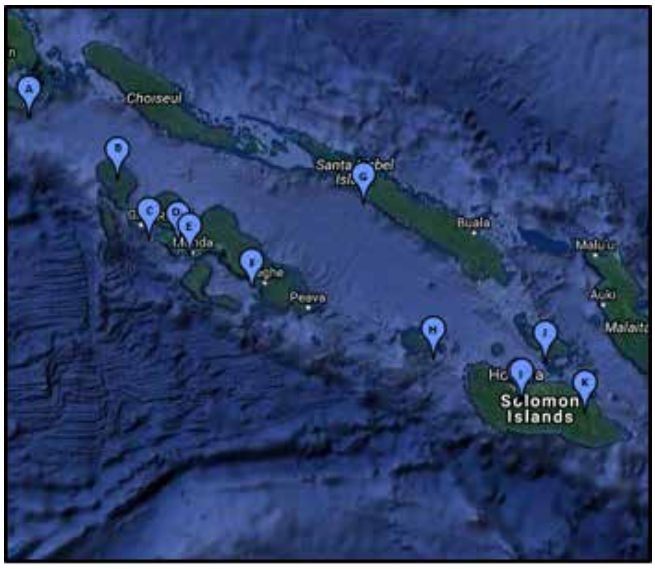
Solomon Breweries Ltd. operates a bottle reuse scheme whereby glass bottles are redeemed by retail distributors at SI$0.50 a bottle. Some tourist accommodations similarly recycle bottles and aluminium cans, ultimately for export.

While a number of recyclers in Solomon Islands use shipping containers to store materials, there are two that have warehouse facilities-one perhaps with a baler. Other than a shipping container for the storage of aluminium cans in Gizo, there are no storage facilities on other outer islands.

Logistics

Solomon Islands has four international ports that are operated by the Solomon Islands Port Authority. These are located in Honiara on the island of Guadalcanal, Noro on Kohinggo Island (or Arundel Island in the New Georgia island group), Viru Harbour in the New Georgia island group, and Yandina on Pavuvu Island in the Russell Islands.

Solomon Islands: Shipping Ports



Source: Google Maps.

(A) Shortland Harbour; (B) Malloco Bay; (C) Gizo; (D) Ringi Cove; (E) Noro; (F) Viru Harbour; (G) Allardyce Harbour; (H) Yandina; (I) Honiara; (J) Tulagi; (K) Aola Bay; (L) Pakera Point.

Silentworld is a freight forwarding service for the outer islands, with landing craft tankers that are able to roll on and roll off cargo at sites where there is limited port infrastructure. The barges are equipped with forklifts and cargo facilities, and service the towns of Malaita, Choiseul, Gizo, Munda, and Buin on a monthly basis.

The ADB Domestic Maritime Support (Sector) Project aims to provide access to remote outer island communities. It intends to establish eight shipping services between major centres of Solomon Islands and the islands listed below *(ADB, 2013)*:

- outer islands of Temotu Province (operational);
- Ontong Java in the outlying region of Malaita Province (operational, although not economically sustainable);
- Sikaiana atoll in the outlying region of Malaita Province (not economically viable);
- Shortland Islands in Western Province;
- Rennell and Bellona Province (not economically viable);
- Makira Island (east of Guadalcanal) (operational);
- Weather Coast in the Guadalcanal Province; and
- Ulawa in Makira-Ulawa Province (operational).

Under the ADB project, 12 wharves and 3 landing ramps have been built, and most provincial centres-including Honiara-have jetty facilities. Kirakira, the main centre in Makira Ulawa Province, is the exception.

The Port of Honiara terminal is approximately four hectares with a main quay, 150 metres long by 12 metres deep, and a warehouse. Absent are a shore crane, a quarantine incineration facility, and private stevedore services.

The Port of Honiara is capable of handling 40,000 twenty-foot equivalent units (TEU) per year. The port has a current throughput of approximately 13,000 import, 1,800 export and the return of 11,200 empty containers each year which may potentially be made available for reverse logistic arrangements. The port also loads and unloads approximately 1,000 trans-shipment containers each year.

The Port of Honiara is serviced by multiple international shipping lines. Estimated TEU shipping container rates, presented below, are based on the cargo of nonhazardous goods, inclusive of un/loading and a bunker adjustment factor. They do not account for customs clearance, duties, and quarantine inspection.

Solomon Islands: Shipping Lines

Swire Shipping; AUSPAC Consortium, including SOUTHPAC Service; Kyowa Shipping Co. Ltd.; NYK Line; Polynesia Line

Destination	Schedule	Est. USD per TEU
Australia	21-day	2,200 to 4,600
Papua New Guinea	21-day	TBA
Fiji	14-day	2,920 to 3,300

Source: AMSTEC Pty Ltd
Notes: USD = U.S. dollar;
TEU = twenty-foot equivalent unit.

Solomon Islands: Island Port Facilities

Location/Island	Province	Port Facilities
Nu'usi and Siota Islands		Wharf and landing ramp
Mbunikalo on Choiseul Island	Choiseul	Wharf and landing ramp
Katurasele		Wharf
Manikaraku		Wharf
Ringgi on Kolombangara Island (New Georgia Islands)	Western	Wharf
Keru on Keru Island, (New Georgia Islands)	Western	Wharf
Ngasini on Vangunu Island		Wharf
Susubona on Santa Isabel Island	Isabel	Wharf
Lambulambu on Vella Lavella Island	Western	Wharf
Vuranggo Point on Choiseul Island	Choiseul	Wharf
Lengana	Western	Wharf
Uhu Island	Malaita	Landing ramp

Institutional framework

Data relating to the institutional framework of Solomon Islands have been gathered from the database of the Pacific Islands Legal Information Institute *(PacILII, 2017)*. ECOLEX is also an information service that relates to environmental law *(ECOLEX, 2017)*, from which various data also have been collected.

Solomon Islands nine provincial governments were established under the Provincial Government Act 1997, allowing them to issue ordinances and policies and provide services to rural areas. These include waste collection and disposal services and shipping facilities.

Honiara City, the tenth province and only council, was established under Honiara City Act 1999. It assigns the City Council the responsibility for waste collection and disposal, street cleaning, and environmental health control. Honiara Refuse Disposal By-Law 1994 directs Honiara City Council to plan and implement solid waste management (SWM) systems, and Honiara Litter By-Law 1994 prohibits littering in public places. The Council also shares responsibility for environmental conservation and other public schemes (e.g., medical, roads) with the remaining nine provincial governments. While Local Government Act 1996 decrees that the Minister for Home Affairs establish local councils, they are yet to be so.

Since the Western Provincial Government (Gizo) is at the forefront in terms of tourism in the Solomon Islands, it is in the process of preparing protocols to ban plastic bags. These are considered now to be at an epidemic proportion.

Environmental Health Act 1980 is administered by the Environmental Health Division of the Ministry of Health and Medical Services, responsible for developing and implementing health policies in relation to solid waste. The Act prohibits the creation of health nuisances from solid waste, including the breeding of mosquitoes from refuse; dumping of refuse in urban watercourses, on beaches, and foreshores. It oversees the activities of waste service authorities, ensuring they maintain hygiene and prevent such nuisances.

The Ministry of Environment, Climate Change, Disaster Management and Meteorology administers Environment Act 1998 through its Environment and Conservation Division. The Act provides for the protection and conservation of the environment by regulating the discharge of pollutants to air, water, and land; the transport, collection, treatment, storage, and disposal of waste; and the promotion of economically viable recycling, reuse, and recovery. This legislation also gives effect to the regional and multilateral agreements and conventions listed in the table below.

Environment Regulation 2008 guides the environmental impact assessments of proposed developments and pollution control relating to the discharge of waste. The regulations were amended in 2014 to introduce sewerage and effluent discharge fees. Environment Act 1998 and this Regulation were reviewed in 2016, although further review of Section 5 (Control of Pollution) is yet to be undertaken.

The Act and Solid Waste Management Strategy 2009–2014 provide the legal and policy framework for improving SWM. Progress, however, has been slow due to a lack of financial resources, institutional capacity, and the political will to promote SWM as a priority issue, particularly in Honiara. Pollution control and the protection of human health from unregulated dumping are the responsibility of the Environmental Health Division and the Environment and Conservation Division. The fact that there are two bodies involved may be reason for the delay of much-needed improvements.

The Solomon Islands Integrated Waste Management and Pollution Control Strategy 2016-2025 has been drafted, although endorsement by cabinet is yet outstanding. National Solid Waste Management Strategy 2009 identifies the need for national policy and legislation for waste management and pollution control, as well as for sustainable financing mechanisms.

Maritime Safety Administration Act 2009 and Shipping (Marine Pollution) Regulations 2011 give effect to international conventions and relate to pollution caused by vessels. Merchant Shipping (Oil Pollution) Order 1975 and the Continental Shelf Act 2006 do likewise. Biosecurity Act 2013 provides for measures in relation to the import and export of plant and animals, and it ensures quarantine control over recyclable materials.

Solomon Islands is a party to various multilateral environmental agreements and conventions, except for the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. These are listed in the table below.

Solomon Islands	
MEA's and Conventions	**Status**
Stockholm Convention on Persistent Organic Pollutants	Ratified
1995 Waigani Convention	Ratified
Montreal Protocol	Ratified
MARPOL 73/78: International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (Annexes I, II, III, IV, and V)	Ratified
London Convention on the Prevention of Marine Pollution by the Dumping of Wastes and Other Matter 1972	Ratified
International Convention on Civil Liability for Oil Pollution Damage 1969 (renewed 1992)	Ratified
Noumea Convention:	Ratified
Protocol on Dumping	Ratified
Protocol on Combatting Pollution Emergencies	Ratified

SPREP. 2016

Financial mechanisms

Currency: Solomon Islands dollar (SI$)

Honiara City Council has no specific budget for SWM, although it does receive from the government at the national level special and unconditional grants for key services. These amounted to approximately US$1.7 million in 2011. The grants accounted for approximately 30% of total council revenue, with US$29,000 having been allocated in 2012 for contractors of waste collection.

There are no user-pays fees for waste collection or disposal services in Honiara. A property tax, based on land and building values, is applied, although only approximately 25% is collected.

Honiara City Council provides user-pays waste collection services to market vendors and commercial businesses at a rate of US$3.70 per drum (US$3 for each additional drum). The collection fee for larger, 2 cubic metre, bins is US$185 and for 3 cubic metre bins, approximately US$300. Collection of uncontained ground waste is charged at US$88. These fees offset the cost of residential collection services. The low collection rate of property tax and the large number of informal settlements that do not pay council fees are key issues that need addressing in terms of SWM improvement in Honiara.

The nine provincial governments also receive funding from the national government for operational and capital development. Financial support is provided by the Provincial Capacity Development Fund, Rural Development Program, Rural Advancement Micro-Projects Program, and Rural Constituency Livelihood Fund.

Approximately 66% of the provincial budget is allocated to operations, administration and wage expenditures. The remainder applies to capital development projects.

Conclusions

While National Integrated Waste Management and Pollution Control Strategy 2016-2025 awaits government endorsement, its predecessor, National Solid Waste Management Strategy 2009, identifies the need for specific legislative regulations for various financial mechanisms. These include user-pays/polluter-pays schemes and a CDS. Such mechanisms will support the longer-term sustainability of waste management systems in the Solomon Islands.

Increased efforts to provide regular shipping services to the outer islands of Solomon Islands should be made. These will enable communities to participate in a CDS, as well as potential future extended producer responsibility (EPR) strategies.

Solomon Islands has not ratified the Basel Convention, therefore movements of hazardous waste to recycling markets or treatment facilities is limited to destinations within the Waigani Convention region.

While the port of Honiara is located on a reasonably cost-efficient and regularly serviced route, it also has the capacity to handle increased cargo volume. Its port infrastructure, however, is relatively standard and requires upgrading.

Abbreviations

ADB	Asian Development Bank
CDS	container deposit scheme
DOEE	Department of Environment and Energy (Australia)
EOL	End of life
FY	Financial Year
GoSI	Government of Solomon Islands
HDPE	high-density polyethylene
HNS	Hazardous and noxious substances
ICSHP	International Centre on Small Hydro Power
J-PRISM	Promotion of Regional Initiative Solid Waste Management
JICA	Japan International Cooperation Agency
kg	kilogram
km	kilometre
km^2	square kilometres
MARPOL	International Convention on the Prevention of Pollution from Ships
MEA	Multilateral environmental agreement
MFAT	Ministry of Foreign Affairs and Trade (New Zealand)
OEC	Observatory of Economic Complexity
PET	polyethylene terephthalate
PV	Photovoltaic
PRIF	Pacific Region Infrastructure Facility
RTRC	Regional Tourism Resource Centre
SPREP	Secretariat of the Pacific Regional Environment Programme
SWM	Solid waste management
T	tonne
TEU	twenty-foot equivalent unit
UAE	United Arab Emirates
UNIDO	United Nations Industrial Development Organization

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Timor-Leste

Introduction

The increasing presence of plastic marine debris in the South Pacific Ocean is focusing attention on strengthening recycling policies and systems in the region. Unique challenges associated with shipping commodities of low value over long distances to recycling markets, however, reduce the economic viability to do so. This country profile includes the current technologies, material flow, logistics, public policies, institutional framework, financial mechanisms, and initiatives that are being designed or have been implemented to strengthen recycling systems in Timor-Leste.

Timor-Leste is part of the Southeast Asia region, occupying approximately half of the eastern side of the island of Timor. It is the smallest and most eastern island of the Malay Archpelago and includes the enclave of Oecussi-Ambeno on the western (Indonesian) part of the island, as well as the islands of Atauro and Jaco.

Timor-Leste stretches over 15,000km^2 with a combined coastline of 2,538km. The capital, Dili, is located on the country's mid-north coast.

Source: Google Maps.
(A) Dili

Socioeconomic background

Timor-Leste has an extremely rugged landscape with a mountainous backdrop that rises to over 2,000 metres in altitude. Steep slopes dominate most of the country, other than a narrow plain around the coast. Slopes of 40 degrees or more make road construction and agriculture extremely difficult. Subsistence farming and coffee production are predominant.

Timor-Leste's gross domestic product in 2015 *(OEC, 2017)* was US$1.44 billion/US$2,400 per capita. It had a trade balance deficit of US$3.47 million, with exports at US$306 million (+35.5% annualised) and imports at US$310 million (-18.7% since 2010). Contributions to gross domestic product largely came from the petroleum sector. Manufacturing, as a value adding sector, inputs approximately 1% to the country's economy *(GlobalEDGE, 2017)*.

The primary export market destinations for 2015 were Canada, Japan, Singapore, Thailand and the United States. The main import origins for the same year were Australia, the People's Republic of China, Malaysia, the Republic of Singapore and Thailand. *(OEC, 2017)*.

Timor-Leste had a population in 2010 of 1,066,409 *(GoTL, 2010)*. An estimated 316,086, or 30%, of the population lives in urban areas, with 70% in rural areas. The approximate population distribution across districts is presented in the table below.

Timor-Leste	
District	**Population**
Ainaro	58,147
Aileu	43,664
Baucau (including city of Baucau)	110,160
Bobonaro	91,199
Cova Lima	59,045
Dili (including city of Dili)	228,559
Ermera	116,937
Liquiça	63,171
Lautem	59,776
Manufahi	48,614
Manatuto (including city of Manatuto)	41,709
Oecusse	63,514
Viqueque	69,476

Source: GoTL, 2010

Tourist visitors to Timor-Leste numbered 71,680 in 2016 (SPTO, 2017), which represented a 17.4% increase over the previous year.

Solid waste management

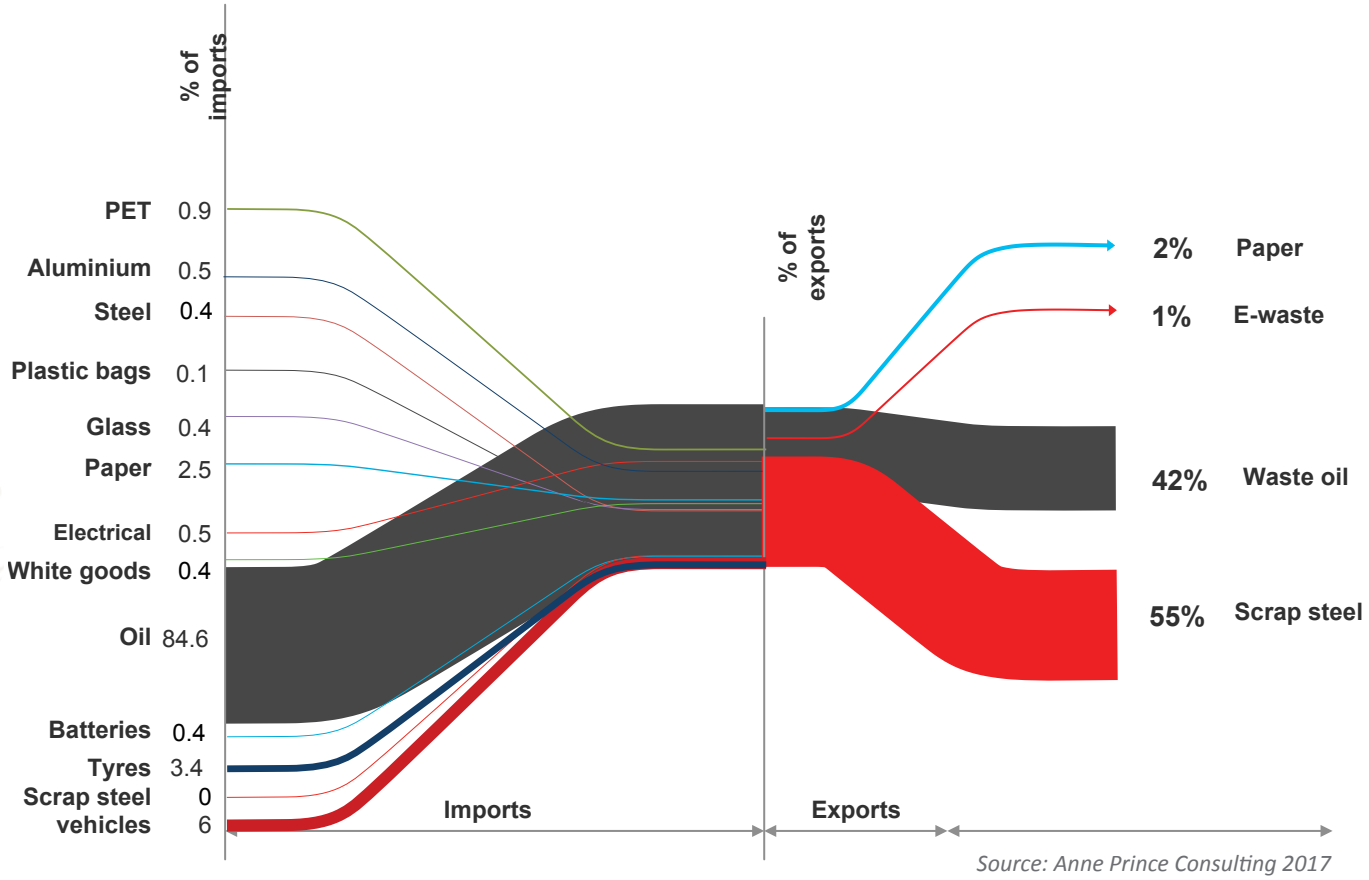
The regional study coordinated by PRIF models the potential recovery of 15 materials types. A defined set of recovery rates was applied to the urban, rural, and outer island population distribution to calculate Timor-Leste's potential recovery tonnage. The PRIF study compares various data to establish the context for the 15 waste materials.

The material flow chart below is based on an analysis of Timor-Leste's imports of the 15 material categories studied, averaged over a seven-year period to 2016, compared with exports of those recovered recyclable materials, averaged over a two-year period 2015-2016, presented as a percentage of the total of the 15 categories. *(UN Comtrade, 2017).*

Import data from 2013 onwards shows that paper and cardboard imports have held steady, as has been the case in most countries. The import of vegetable oil has increased over time, as has particular vehicles (e.g., those that carry more than 10 passengers).

Other than paper and cardboard, Timor-Leste exported cooking oil and scrap steel in substantial amounts over the course of 2014-16. This indicates that most beverage containers remain on the island and should be recycled.

Material flow - Timor-Leste



Source: Anne Prince Consulting 2017

Note: The percentage of imports and exports displayed relate only to the proportion of the 15 materials categories studied, not total imports/exports

Modelling of potential recovery of recyclable materials, presented in the table below, is based on an estimated average daily per capita municipal solid waste generation of 0.79kg *(World Bank, 2012)*. It also applies a range of location-specific estimated recovery rates that are based on a set of assumptions of existing or introduced incentive-based policies and programs, such as container-deposit schemes and import levies. The resulting ratios were used to estimate average annual tonnages that could be recovered for recycling. *(JICA, 2013; SPREP 2016; Mobile Muster, 2013; DOEE, 2017; Jambeck et al., 2015; MFAT, 2016; UNIDO/ICSHP, 2013).*

Timor-Leste	
Recyclable Material Forecast	**Estimated Metric Tonnes**
Polyethylene terephthalate (PET) beverage containers	279
Aluminium cans	501
Glass beverage containers	354
Steel cans	398
Plastic shopping bags	181
End-of-life (EOL) renewable energy equipment	-
Paper/cardboard	1,665
E-waste	53
Whitegoods	269
Used motor/cooking oil	1,584
Used lead-acid batteries	61
Lithium batteries	348
Scrap steel/nonferrous metals	597
EOL tyres	61
EOL vehicles	3,967
Total	**10,318**

Timor-Leste's National Waste Management and Pollution Control Strategy indicates that the generation of waste oil is estimated at 247,500 litres per annum. India receives 125,000 litres (51%) of this.

Future waste management

Future increases in recovered materials are expected to result from the PacWaste (2014-17) programme, implemented by the Secretariat of the Pacific Regional Environment Programme. The programme aims to improve the management of e-waste and develop a national e-waste strategy *(SPREP, 2017)*.

Between 2003 and 2014, electrification rates increased from 22% to 71% *(ADB, 2017)*, providing sufficient capacity to connect all households and meet peak demand. Approximately 60% of the power generated, however, is not billed to the consumer. The Electricity Strengthening and Sustainability Program, supported by the Asian Development Bank and the Government of Timor-Leste, aims to improve transmission and distribution infrastructure and metering services to achieve financial sustainability (ADB, 2017). Increased access to electricity, however, may give rise to greater levels of household electrical items in the waste stream.

Plastic marine debris

Mismanaged plastic waste eventually enters the marine environment by way of inland rivers and waste-water outfalls or is transported by wind and tide. Rigid and lightweight plastic from products that are consumed or used on a daily basis become marine debris if not managed appropriately. An estimated 13% of Timor-Leste's waste stream is made up of plastic.

Timor-Leste has a coastline of 2,538km, and a recent study *(Jenna et al., 2015)* indicates a daily plastic waste generation of approximately 68.4 tonnes (t). An estimated 56.6t are mismanaged daily and are predicted to enter the marine environment through release from uncontained disposal sites or by direct littering. Approximately 20,690t of plastic waste were released in the waters around Timor-Leste in 2010. If not addressed, the amount is expected to rise to 64,205t by 2025.

Of the 68.4t of plastic waste generated each day, approximately 7.5t may comprise polyethylene terephthalate (PET) or high-density polyethylene (HDPE) plastic that is eligible for recycling under a container deposit scheme (CDS). Based on an average reduction rate of 40% in mismanaged waste with a CDS in place, approximately 2.51t of PET and HDPE plastic could be recycled each day. This could increase to an 80% or above reduction rate, depending on access to recycling collection services and viable markets, among others. Nonetheless, a 40% reduction in mismanaged PET and HDPE would still result in approximately 19,774t of plastic becoming marine debris each year.

The outcome of mismanaged plastic can be divided into three primary groups: plastic that remains on the surface of the sea as floating debris, plastic that sinks to the ocean floor, and plastic that washes up on beaches. A CDS that recovers 40% of HDPE and PET bottles in Timor-Leste may achieve the following reductions in marine debris each year:

- 137t in floating plastic
- 641t in sunken plastic
- 137t in beach plastic.

Further benefits attributed to a CDS are possible with a reduction in annual damage costs for Timor-Leste's 328 local fishing vessels (approximately US$2,557). If beaches were cleaned up, over US$232,224 would be saved, of particular relevance to the amenities of coastal communities and the tourism sector.

Infrastructure and services

Villages around Dili have access to municipal solid roadside containers or skip bins that are placed on public sites and in neighbourhoods for the disposal of solid waste. Waste is manually emptied by collectors and transferred to waste collection vehicles.

An aging and poorly maintained fleet of hook lifts, compactors, open trucks, and three-wheel vehicles suggest that services are irregular, often resulting in waste left on footpaths and roads. A large fleet of private vehicles (around 40) on contract to the Municipality provides a collection service, transferring waste to Tibar Dump.

Other private waste collection companies account for approximately 10% of the waste that enters Tibar Dump. They provide drums for waste storage on street curbs, which are then emptied for a fee. Tibar Dump, with its two bulldozers, is located approximately 25km from Dili and is managed by the Dili District administration, which employs around 20 people.

Dili has various recycling companies, two of which reprocess plastic bottles that are shredded and bailed for export (there is no evidence of whether or not this occurs on a regular basis). The price of each kg of PET bottles is US$0.30. A third company is seeking to remanufacture plastic within Timor-Leste, and has recently received the necessary moulding equipment to produce plastic chairs.

Yet another firm collects and exports scrap metal and aluminium to the People's Republic of China. Steel, whitegoods, e-waste, and aluminium cans are purchased from a network of individuals, using trolleys for collection and transport. This business also sees to the disassembly of e-waste items and used lead-acid batteries for export. There are, however, some safety and environmental concerns to this effort.

It appears that there are two startup businesses that intend to buy and export steel, thus competing for market share. The recycling companies have warehouse, shredding, and baling facilities.

Various micro-enterprises remanufacture some of the waste materials. Paper is recycled to produce envelopes, of which approximately 3,000-4,000 per annum are exported to Australia. Manufactured notebooks and book marks are sold locally. One entity is partnering with Engineers Without Borders and the Embassy of the United States to examine the potential of an automated production line.

Other remanufactured products include arts and crafts that are made from shredded office paper and sold through various retail outlets in Timor-Leste. One micro-business plans to expand and install a second paper shredder.

Compost is created from green waste, used by a few producers to make briquettes from such materials as the husks of coffee, rice, and coconut, as well as bamboo waste. Used engine oil and vehicle tyres are recycled by another two firms.

Logistics

Timor-Leste has one international seaport and a container terminal. These are operated by the Port Authority of Timor-Leste, located in Dili.

The terminal at the Port of Dili is approximately three hectares and has a main quay, 280 metres long by 5-9 metres deep, and a warehouse. There is neither a shore crane nor quarantine incineration facility, although private stevedore services are available. A new port is being constructed to handle a larger capacity.

The Port of Dili is capable of handling 70,000 twenty-foot equivalent units (TEU) per year. The port has a current throughput of approximately 18,000 import, 1,000 export and the return of 16,850 empty containers each year, which may potentially be made available for reverse logistic arrangements. The port also loads and unloads approximately 50 trans-shipment containers each year.

The Port of Dili is serviced by two international shipping lines (table below). A privately owned domestic shipping service operates weekly to Atauro Island and twice weekly to the Oecusse region.

Estimated TEU shipping container rates, presented below, are based on the cargo of nonhazardous goods, inclusive of un/loading and a bunker adjustment factor. They do not account for customs clearance, duties, and quarantine inspection.

Timor-Leste: Shipping Lines

Swire Shipping; AUSPAC Consortium, including SOUTHPAC; KYOWA-NYK; Polynesia Line

Destination	Schedule	Est. USD per TEU
Australia (Darwin only)	21-day	TBA
Southeast Asia	21-day	TBA

Source: AMSTEC Pty Ltd
Notes: USD = U.S. dollar;
TEU = twenty-foot equivalent unit.

Institutional framework

Timor-Leste's Strategic Development Plan 2011-2030 (GoTL) sets a pathway to improve the management of waste and the environment. While yet to be implemented, Decree Law 3/2016 and Decree Law 2/2017 stipulate the legal framework for the Urban Solid Waste Management system for the Municipality of Dili and other municipalities and territories. Decree Law number 2/2017 prescribes the location and type of waste containment and broadly schedules collection in urban and rural areas. It also stipulates which municipalities may contract services and which are to provide services. The Decree also limits collection to 1,100 litres, with prior requests to be made with waste collectors for bins exceeding this volume. The Decree will not come into force until solid waste services are in place, likely to be in 2018.

The National Directorate of Basic Sanitation Services, under the Ministry of Public Works, is responsible for planning and policymaking. It also accounts for National Sanitation Policy 2012 that outlines the roles and responsibilities of relevant agencies and sets standards and guidelines. The policy specifies a five-year strategy, with corresponding investment plans to support policy implementation and the reduction, reuse, and recycle of solid waste.

The National Directorate for Climate Change, under the Ministry of Industry, Commerce and Environment, is responsible for the policy and laws that relate to environmental management and pollution control. Environmental Licensing Decree Law 5/2011 provides for environmental impact assessments, management plans, and licensing for proposed developments.

Ministerial Diploma 04/2008/MAEOT establishes the structure and operation of district administrations. It also assigns waste collection responsibilities to the municipalities and territories under the National Directorate for Local Administration.

The National Directorate of Community Health Services is responsible for protecting public health in terms of solid waste. Hygiene and Public Order Decree Law 33/2008 prohibits the dumping of waste on public sites and on the roadside, imposing fines of between US$5 and US$500.

Decree Law number 21/2003 provides quarantine and sanitary control of imported and exported goods. These include, in particular, live plants and animals, animal or vegetable products, merchandise, and organisms.

Timor-Leste is a party to a couple of multilateral environmental agreements and conventions. These are listed in the table below.

Timor-Leste	
Multilateral Agreements and Conventions	**Status**
Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified
Kyoto Protocol	Ratified

While Timor-Leste is not a signatory to the 1995 Waigani Convention, it is a Special Observer to the Pacific Islands Forum. Timor-Leste is not a signatory to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. Australia will set in place provisions that relate to the import of hazardous waste from Timor-Leste, included in "Hazardous Waste (Regulation of Exports and Imports) (Imports from East Timor) Regulations 2003" of the Government of Australia *(GoA, 2003)*.

Financial mechanisms

Currency: United States dollar (US$)

The new Urban Solid Waste Management Decree imposes a levy on the use of electricity at a rate of US$0.01 per kilowatt/hour for domestic and US$0.02 per kilowatt/hour for nondomestic users. It is unclear whether the charge will be ring-fenced to cover the cost of providing domestic and nondomestic solid waste and recycling services, including the collection, transport and disposal, as well as the management and maintenance of landfills.

The Ministry of Finance is responsible for preparing the annual operating budget for each municipality. Revenue from the electricity levy for the collection of solid waste is centralised and then redistributed to each municipality. Additional revenue is raised from fines that are imposed for littering and the burning of solid waste (US$115) and for the misuse of garbage bins (US$50). The Penalty for destroying garbage bins is US$115 and for the illegal removal of a bin, US$75.

Conclusions

The Government of Timor-Leste recently passed waste management legislation. It is in the process of examining various financial mechanisms to support ongoing improvements of solid waste management and increased access to services.

Timor-Leste's national strategic plan identifies the need to upgrade and expand its waste management system. It promotes the development of infrastructure for composting and the recycling of plastic, paper and glass.

The island nation is on a somewhat cost-efficient shipping route, limited to destinations in Australia and Southeast Asia. With a new port under construction, however, TEU handling capacity should increase shipping services significantly.

Abbreviations

ADB	Asian Development Bank
CDS	Container deposit scheme
DOEE	Department of Environment and Energy (Australia)
EOL	End of life
GoA	Government of Australia
GoTL	Government of Timor-Leste
HDPE	High-density polyethylene
ICSHP	International Centre on Small Hydro Power
kg	kilogram
km	kilometre
km^2	square kilometre
MAEOT	Ministry of State Administration and Territorial Planning (Timor-Leste)
OEC	Observatory of Economic Complexity
PET	Polyethylene terephthalate
PRIF	Pacific Region Infrastructure Facility
RTRC	Regional Tourism Resource Centre
SPREP	Secretariat of the Pacific Regional Environment Programme
T	tonne
TEU	Twenty-foot equivalent unit
UNIDO	United Nations Industrial Development Organisation
USD	United States dollar

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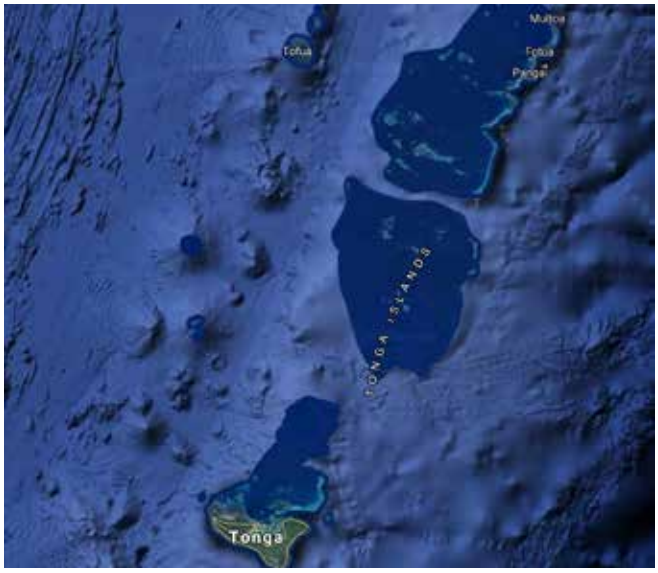
Tonga

Introduction

The increasing presence of plastic marine debris in the South Pacific Ocean is focusing attention on strengthening recycling policies and systems in the region. Unique challenges associated with shipping commodities of low value over long distances to recycling markets, however, reduce the economic viability to do so. This country profile includes the current technologies, material flow, logistics, public policies, institutional framework, financial mechanisms, and initiatives that are being designed or have been implemented to strengthen recycling systems in Tonga.

Tonga is in the Polynesia region of the Central Pacific Ocean, covering 749km^2 and with a coastline of 419km. It has more than 170 islands, of which 45 are inhabited. Nuku'afola, the capital, is located on the main island of Tongatapu.

There are four main island groups, including Tongatapu, Ha'apai, Vava'u, and Niuas, running somewhat north to south in two parallel chains. The western island chain is volcanic, with islands rising to 1,033 metres in altitude (e.g., Kao) and the eastern chain is encircled by coral reefs.



Source: Google Maps.

Socioeconomic background

Tourists to Tonga in 2015 numbered 53,752 representing an increase of 6.6% over the previous year *(SPTO, 2015)*, and contributing only 15% to the country's gross domestic product. A small number of hotels have been built on the main island of Tongatapu, and cruise ships regularly visit the northern island of Vava'u.

Tonga's gross domestic product in 2015 was US$435 million/ US$5,530 per capita *(OEC, 2017)*. It had a trade balance deficit of US$155 million, with exports at US$11.5 million (-4.6% annualised) and imports at US$167 million (-3.1% since 2010).

The primary export market destinations for 2015 were Australia, Japan, the Republic of Korea, New Zealand and the United States. The main import origins for the same year were Australia, the People's Republic of China, Fiji and New Zealand *(OEC, 2017)*. The services sector is a major contributor to Tonga's economy, at 61%. Manufacturing, a value addition input, contributed 7% *(GlobalEDGE, 2017)*.

Tonga's population was 103,252 in 2011, most of whom live on the island of Tongatapu, with more or less 76% (or 78,471) on the outer islands *(GoT, 2011)*. The approximate population distribution across the districts and Islands of Tonga is shown in the table below.

Tonga		
District: Tongatapu	**Total**	**75,416**
Kolofo'ou	18,957	
Kolomotu'a	17,088	
Vaini	12,949	
Tatakamotonga	7,233	
Lapaha	7,380	
Nukunuku	7,733	
Kilovai	4,076	
District: Vava'u	**Total**	**13,833**
Neiafu	5,774	
Pangaimotu	1,325	
Hahake	1,197	
Leimatua	2,436	
Hihifo	2,105	
Motu	985	
District: Ha'apai	**Total**	**6,616**
Pangai	2,410	
Foa	1,359	
Lulunga	1,055	
Mu'omu'a	609	
Ha'ano	511	
'Uiha	672	
District 'Eua	**Total**	**5,016**
'Eua Motu'a	5,774	
'Eua Fo'ou	1,325	
District: Ongo Niua	**Total**	**1,282**
Niuatoputapu	759	
Niuafo'ou	523	

Solid waste management

A 2008 survey on the characteristics of waste found the daily per capita waste generation rate to be 0.47kg. A 2012 study of Vava'u rated the daily household generation at 0.5kg per day, made up of over 51% organic waste and 13.4% plastic waste.

The regional study coordinated by PRIF models the potential recovery of 15 materials types. A defined set of recovery rates was applied to the urban, rural, and outer island population distribution to calculate Tonga's potential recovery tonnage. The PRIF study compares various data to establish the context for the 15 waste materials.

The material flow chart below is based on an analysis of Tonga's imports of the 15 material categories studied, averaged over a seven-year period to 2016, compared with exports of those recovered recyclable materials, averaged over a two-year period 2015-2016, presented as a percentage of the total of the 15 categories. *(UN Comtrade, 2017).*

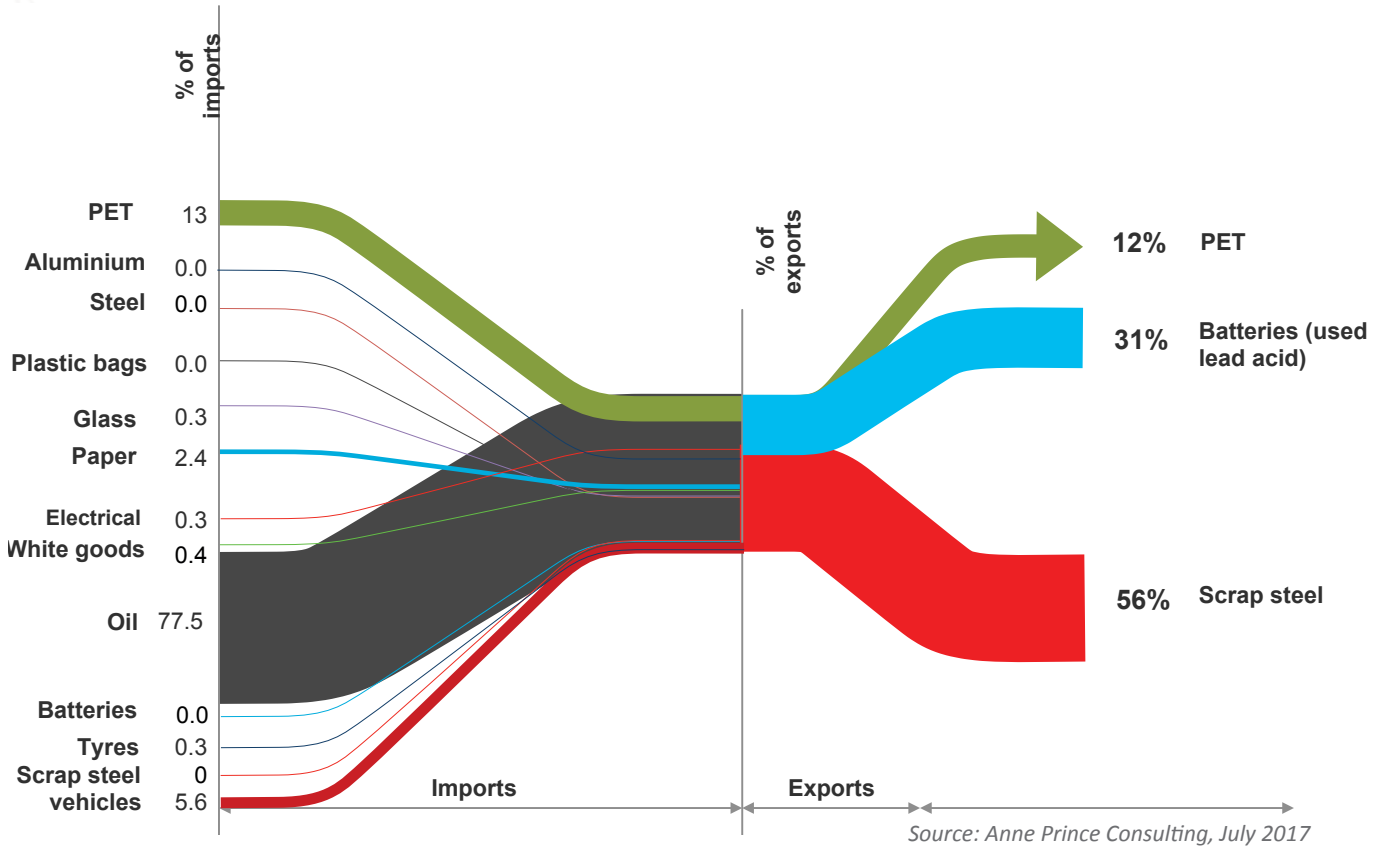
The number of imported polyethylene terephthalate (PET) beverage containers remained relatively steady until 2014, when it began to decrease, except for the pellet form of PET, which increased sharply. This indicates that a large number of PET bottles are being manufactured in Tonga.

Importation of aluminium cans remains low, and there is evidence that the entry of glass beverage containers is decreasing. Paper product imports are cyclical, remaining within the same margin. While electronic and whitegoods demonstrate a mostly steady trend, palm oil and refined petroleum oil imports have risen sharply in the last couple of years. Tonga is increasingly importing renewable energy equipment, as reflected in the last couple of years.

Tonga's exports reflect a similar pattern to a majority of Pacific Island Countries. Its major exports are PET containers, scrap steel, and used lead-acid batteries.

Modelling of potential recovery of recyclable materials, presented in the table below, is based on an estimated average daily per capita municipal solid waste generation of 3.71kg *(World Bank, 2012). It* also applies a range of location-specific estimated recovery rates that are based on a set of assumptions of existing or introduced incentive-based policies and programs, such as container-deposit schemes and import levies. The resulting ratios were used to estimate average annual tonnages that could be recovered for recycling. *(JICA, 2013; SPREP 2016; Mobile Muster, 2013; DOEE, 2017; Jambeck et al., 2015; MFAT, 2016; UNIDO/ICSHP, 2013).*

Material flow - Tonga



Source: Anne Prince Consulting, July 2017

Note: The percentage of imports and exports displayed relate only to the proportion of the 15 materials categories studied, not total imports/exports

Tonga	
Recyclable Materials Forecast	**Estrimated Metric Tonnes**
Polyethylene terephthalate (PET) beverage containers	138
Aluminium cans	583
Glass beverage containers	412
Steel cans	463
Plastic shopping bags	89
End-of-life (EOL) renewable energy equipment	2
Paper/cardboard	1,939
E-waste	13
Whitegoods	73
Used motor/cooking oil	579
Used lead-acid batteries	104
Lithium batteries	103
Scrap steel/nonferrous metals	695
EOL tyres	104
EOL vehicles	1,872
Total	**7,169**

Tonga receives significant assistance for the development of waste management policies and the improvement of waste management collection services and landfill infrastructure. Much of this originates from Australia's Department of Foreign Affairs and Trade, Japan International Cooperation Agency (Phase 1 of the Promotion of Regional Initiative Solid Waste Management project (J-PRISM I)), and Asian Development Bank (Nuku'alofa Urban Development Sector Project).

Future waste management

Future increases in recovered materials are expected to result from the PacWaste (2014-17) programme, implemented by the Secretariat of the Pacific Regional Environment Programme. The programme aims to improve e-waste management by establishing a nongovernment organisation to receive and process e-waste, implementing a pilot project for the safe dismantling and export of e-waste, and creating a public awareness campaign *(SPREP, 2017)*.

The second phase of the Promotion of Regional Initiative Solid Waste Management (J-PRISM II) project, implemented in early December 2016, supports capacity building in waste management. Target initiatives include improved governance and human resource development, which are expected to generate increased volumes of recoverable materials.

The Government of Tonga is targeting a 50% reduction in fossil fuel imports for power generation, with 100% access to electricity by 2020. To date, 89% of the population has access to power, and 13% is expected to draw from renewable energy sources by 2018.

The Outer Island Renewable Energy Project, supported by the Asian Development Bank, DANIDA (Danish International Development Agency), and European Union, as well as the Government of Australia and Government of Tonga, provides for the construction of solar photovoltaic power plants on the eight outer islands of Ha'apai, 'Eua, Uiha, Nomuka, Ha'ano, Ha'afeva, Niuatoputapu, and Niuafo'ou *(ADB, 2017; MFAT, 2016)*. Increasing reliable power distribution will likely result in rising levels of end-of-life renewable energy equipment, household electrical appliances, computers, and communication items in the waste stream.

Plastic marine debris

Mismanaged plastic waste eventually enters the marine environment by way of inland rivers and waste water outfalls or is transported by wind and tide. Rigid and light-weight plastic materials from products that are daily consumed or used become marine debris if not managed appropriately. An estimated 6% of Tonga's waste stream is made up of plastic.

The islands of Tonga have a combined coastline of 419 kilometres, and a recent study *(Jenna et al., 2015)* indicates a daily plastic waste generation of approximately 22.7 tonnes (t). An estimated 18.1t are mismanaged daily and are predicted to enter the marine environment through release from uncontained disposal sites or by direct littering. Approximately 6,624t of plastic waste were released in Tongan waters in 2010. If not addressed, the amount is expected to rise to 10,272t by 2025.

Of the 22.7t of plastics generated each day, approximately 2.5t may comprise PET or high-density polyethylene (HDPE) plastic that is eligible for recovery under a container disposal scheme (CDS). Based on an average reduction rate of 40% in mismanaged waste with a CDS in place, approximately 0.80t of PET and HDPE plastic could be recycled each day. This could increase to an 80% or above reduction rate, depending on access to recycling collection services and viable markets, among others. Nonetheless, a 40% reduction in mismanaged PET and HDPE would result in approximately 6,331t of plastic becoming marine debris each year.

The outcome of mismanaged plastic can be divided into three groups: plastic that remains on the surface of the sea as floating debris, plastic that sinks to the ocean floor, and plastic that washes up on beaches. A CDS that recovers 40% of HDPE and PET bottles in Tonga may achieve the following reductions in marine debris each year:

- 44t in floating plastic
- 205t in sunken plastic
- 44t in beach plastic.

Further benefits attributed to a CDS are possible with a reduction in annual damage costs to Tonga's 146 local fishing vessels (approximately US$1,139). If beaches were cleaned up, over US$74,348 would be saved, of particular relevance to the amenities of coastal communities and the tourism sector.

Infrastructure and services

Tongatapu Island is serviced by a single integrated solid waste management system, managed by Waste Authority Ltd. (WAL). WAL provides a collection service to approximately 65% of urban households in Nuku'alofa and 25% of the rural areas on the island of Tongatapu. The low percentage reflects the inoperability of WAL's three compactor vehicles from time to time, with the need for private collectors to step in. Furthermore, burning and illegal dumping appear to be a persistent issue. The private sector provides waste collection to the commercial sector, delivering the waste to the Tapuhia Landfill, established as part of the Tongan Solid Waste Management Project and operated by WAL.

Approximately 170 community recycle cages are spread across most villages and throughout Nuku'alofa. Householders deposit their recyclables in cages that are cleared by a private recycling company. Refunds are made to a local community organisation. Neither WAL nor the private sector appears to offer household recycle collection services.

E-waste Tonga, a nonprofit organisation, was established in Nuku'alofa in 2010. Together with the outer islands of Ha'apai and Vava'u, it has created an e-waste recycling programme, apparently charging one company T$0.10 Tongan pa'anga per kg.

While five companies have been issued recycle licenses, only one of them operates in Ha'apai and Vava'u. It collects ferrous and nonferrous metal scrap, plastic bottles, paper and cardboard, used lead-acid batteries, e-waste, and used oil for export. The company has one full-size and two half-size vehicle crushers, a baler for cardboard/paper, and another for plastic. In 2013, the company exported approximately 1,470t of steel, 9.5t of copper, and 15.5t of aluminium to New Zealand. A total of 54,000 litres of used oils were exported to India, while 50.4t of used lead-acid batteries were sent to the Republic of Korea and New Zealand.

Logistics

Tonga has three international seaports and one domestic, operated by Ports Authority Tonga. These are the following:

- Port of Neiafu in the District of Vava'u;
- Port of Nuku'alofa, a container terminal in the District of Tongatapu;
- Port of Pangai in the Ha'apai Group
- Port of Eua Island (domestic).

The terminal at the Port of Nuku'alofa is approximately 3 hectares and includes a main quay, 110 metres long by 11 metres deep, and a warehouse. There is neither a shore crane nor are there private stevedore services available.

The Port of Nuku'alofa is capable of handling 20,000 TEU per year. The port has a current throughput of approximately 8,000 import, 1,000 export and the return of 7,000 empty containers each year which may potentially be made available for reverse logistic arrangements. The port also loads and unloads approximately 1,000 trans-shipment containers each year.

The Port of Nuku'alofa is on a cost-effective route, regularly serviced by various international shipping lines. Estimated TEU shipping container rates, presented below, are based on the cargo of nonhazardous goods, inclusive of un/loading and a bunker adjustment factor, although they do not account for customs clearance, duties, and quarantine inspection.

Tonga: Shipping Lines

AUSPAC Consortium, including SOUTHPAC; Kyowa Shipping Co. Ltd.

Destination	Schedule	Est. USD per TEU
Australia	16-day	2,650 to 4,600
Fiji	21-day	2,500 to 4,400
North Asia	14-day	2,400 to 3,600
New Zealand	7-day	2,682 to 4,600

Source: AMSTEC Pty Ltd
Notes: USD = U.S. dollar;
TEU = twenty-foot equivalent unit.

Friendly Island Shipping Agency is a public sector entity that provides weekly passenger and cargo services, using a roll-on/roll-off vessel between Nuku'alofa and the islands of Nomuka, Ha'afeva, Pangai, and Vava'u. It also has a bimonthly run to Niuas. The freight rate for a 20 foot shipping container is approximately US$546 between Nuku'alofa and Vava'u.

A second shipping company, Tonga Exports Shipping Agency Ltd., operates a cargo ship that provides inter-island services. It has the potential to offer services across the region.

Institutional framework

Data relating to the institutional framework of Tonga have been gathered from the database of the Pacific Islands Legal Information Institute *(PacILII, 2017)*. ECOLEX is also an information service that relates to environmental law *(ECOLEX, 2017)*, from which various data also have been collected.

The Kingdom of Tonga is a constitutional monarchy with two levels of government. The local government, however, has no formal structure, requiring only an election of 23 district officers and 155 town officers every three years.

Legislative provisions for local government are held in Fonos Act 1988 and District and Town Officers Act 1988. The Ministry of Internal Affairs oversees the work of the district, and town officers are empowered to organise a *fono*, or public meeting, to discuss local matters of priority. They may be requested to organise a grand *fono* at which public officials may preside.

The Ministry of Health is responsible for waste management on the outer islands until such time as service areas are declared. WAL, as previously mentioned, manages the solid waste management system on Tongatapu Island.

Waste Management Act 2005 provides legislation for the development of the waste management sector with wide ranging powers and responsibilities for WAL. The Act establishes waste management service areas and relates to waste collection and disposal services; contracting arrangements; fees to be levied and collected; preparation of operating plans and reports; development of codes of practice; community awareness raising; and monitoring of public health and environmental impacts.

Waste Management (Plastic Levy) Regulations 2013 impose a 10% levy on the import of certain plastic bags, empowering authorised officers to ensure that correct payments are made. WAL is the collection authority.

Public Health Act 1992 regulates the collection of waste and waste containers, as well as the disposal of solid and hazardous waste. It also prohibits the import of toxic and hazardous waste and ensures that recyclers are issued licenses. The provisions of the Act also extend to ships. Amendment 2005 designates service areas under Waste Management Act 2005.

Biosafety Act 2009 establishes the national Biosafety Advisory Committee, giving effect to the Cartagena Protocol on Biosafety to the Convention on Biological Diversity. It also regulates the transboundary movement of materials and goods that may contain living organisms.

Marine Pollution Prevention Act 2002 provides for the response to marine pollution from ships and land-based sources; places restrictions on the dumping and incineration of waste at sea; and gives effect to international marine pollution conventions. Environment Management Act 2010 establishes Tonga's Ministry of Environmental and Climate Change, its functions, and its powers. These include the (i) monitoring of environmental impacts; (ii) regulation or prohibition of pollution to air, water, or land, as well as dumping of litter and rubbish, and movement or disposal of hazardous waste and chemicals; and (iii) protection of coastal areas.

Environment Management (Litter and Waste Control) Regulations 2016 define the activities and offences that relate to waste pollution. These include the dumping of waste and hazardous waste, waste that causes pollution, and the burning of litter and waste. Provisions for landfill improvements are prioritised in Tonga's National Infrastructure and Investment Plan 2013-2023.

Tonga is a party to various multilateral environmental agreements and conventions. These are included in the table below.

Tonga	
Multilateral Environmental Agreements and Conventions	**Status**
Stockholm Convention on Persistent Organic Pollutants	Ratified
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	Ratified
1995 Waigani Convention	Ratified
Rotterdam Convention	Ratified
Montreal Protocol	Ratified
MARPOL 73/78: International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (Annexes I, II, III, IV, V, and VI)	Ratified
London Convention on the Prevention of Marine Pollution by the Dumping of Wastes and Other Matter 1972	Ratified
1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (London Protocol)	Ratified
Intervention on the High Seas in Cases of Oil Pollution Casualties (Intervention 1969):	Ratified
Protocol 1973	Ratified
International Convention on Civil Liability for Oil Pollution Damage 1969 (renewed 1992)	Ratified
Protocol of 1992 to Amend The International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971	Ratified
International Convention on Oil Pollution Preparedness, Response and Co-operation Convention 1990	Ratified
Convention on Hazardous and Noxious Substances by Sea 1996	Ratified
International Convention on Civil Liability for Bunker Oil Pollution Damage (BUNKER) 2001	Ratified
International Convention on the Control of Harmful Anti-fouling Systems in Ships (AFS Convention) 2001	Ratified
International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) 2004	Ratified
Nairobi International Convention on the Removal of Wrecks 2007	Ratified

SPREP. 2016.

Financial mechanisms

Currency: Tongan pa'anga (T$)

A household levy of T$10 a month and commercial levies, ranging from T$17 to T$128 a month, are charged for waste management collection services. Fees are also charged at the landfill, with revenue paid directly to WAL.

A private sector waste collection company charges between T$100 and T$300 for regular collection services from commercial customers. Newly adopted littering regulations came into effect in April 2017, imposing fines of between T$20 and T$2,000 per infringement.

Conclusions

Tonga has improved significantly its waste management sector, as well as has achieved the relocation of its disposal infrastructure and the enactment of its Waste Management Act 2005. Initiatives are supported by a number of development projects.

Relatively robust user-pays mechanisms are in place, particularly since waste management fees are included in Tonga Water Board bills. Rural areas may, in future, be charged solid waste management tariffs in their electricity bills. Nonetheless, a budget shortfall appears to continue, with costs insufficient to cover the provision of services and maintenance of infrastructure.

Tonga lacks a solid waste management and pollution control policy or strategic plan. If such were in place, a CDS could be implemented.

The Port of Nuku'alofa is a relatively small port with a capacity of 20,000 TEU per annum. It has insufficient capacity to handle increased cargo volume, although wharf infrastructure and handling equipment are considered to be of a reasonable standard. The port has reverse logistic or backload export potential and is considered to be on a reasonably cost-efficient route.

Abbreviations

ADB	Asian Development Bank
AFS	Anti-fouling systems
BWM	Ballast Water and Sediments
CDS	Container disposal scheme
DANIDA	Danish International Development Agency
DOEE	Department of Environment and Energy (Australia)
EOL	End of life
GoT	Government of Tonga
HDPE	High-density polyethylene
ICSHP	International Centre on Small Hydro Power
J-PRISM	Promotion of Regional Initiative Solid Waste Management
kg	kilogram
km	kilometre
km^2	square kilometre
MARPOL	International Convention for the Prevention of Pollution from Ships
MFAT	Ministry of Foreign Affairs and Trade (New Zealand)
OEC	Observatory of Economic Complexity
PET	Polyethylene terephthalate
PRIF	Pacific Region Infrastructure Facility
SPREP	Secretariat of the Pacific Regional Environment Programme
SPTO	South Pacific Tourism Organisation
t	tonne
TEU	Twenty-foot equivalent unit
UNIDO	United Nations Industrial Development Organisation
WAL	Waste Authority Ltd.

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Tuvalu

Introduction

The increasing presence of plastic marine debris in the South Pacific Ocean is focusing attention on strengthening recycling policies and systems in the region. Unique challenges associated with shipping commodities of low value over long distances to recycling markets, however, reduce the economic viability to do so. This country profile includes the current technologies, material flow, logistics, public policies, institutional framework, financial mechanisms, and initiatives that are being designed or have been implemented to strengthen recycling systems in Tuvalu.

Tuvalu, with 26km^2 of land area and 24km of coastline, lies in the Polynesia region of the Western Pacific Ocean, midway between Hawaii and Australia. With its capital Funafuti, it comprises nine islands, of which three are reef islands and six are low-lying atolls.

Socioeconomic background

Tuvalu is the fourth smallest nation in the world and one of the most remote. Considered timeless and steeped in traditional customs, the not-yet-commercialised, peaceful location and spectacular marine environment attract increasing numbers of visitors. The number of tourists in 2016 (2,465) reflected a 5.2% increase over the previous year *(SPTO, 2017)*.

Tuvalu's atolls are extremely vulnerable to the impacts of climate change, threatening the country's security and survival. Potable water and arable land are limited. The Government of Tuvalu, in 2015, established the Tuvalu Survival Fund to finance the response to the impacts of climate change. The government also aims to promote a 100% transition to renewable energy sources by 2020 to replace the diesel-powered electricity generation systems on eight islands.

Tuvalu's gross domestic product in 2015 was US$32.7 million/US$3,930 per capita *(OEC, 2017)*. Its trade balance deficit stood at US$19.2 million, with exports at US$37.4 million (+20.6% annualised) and imports atUS$56.5 million (-3.2% since 2010).

Tuvalu's main export market destinations in 2015 were Australia, the People's Republic of China, the Republic of Korea, Japan, and Thailand. The main import origins in the same year were Australia, the People's Republic of China, Fiji, Japan, and New Zealand.

Tuvalu has a central government and eight *Kaupules* (island councils) that bring together the traditional responsibilities of the assembly of elders for each island. *Kaupules* also assemble with the elected council to deliver land and lagoon transport services, provide assistance in mechanical and joinery activities, and maintain roads, public facilities, and beach ramps.

The population in 2011 was estimated at 11,206, mostly in the only urban area, the capital Funafuti, which is located on the island of the same name *(GoT, 2017)*. The remaining 41% (or 4,594) of residents live in rural areas on the outer islands (Knoema, 2015). The approximate population distribution across the electoral districts (islands) of Tuvalu is shown below.

Tuvalu	
Island	**Population**
Nanumea	544
Niutao	606
Nanumaga	481
Nui	542
Vaitupu	1,555
Nukufetau	536
Funafuti, including the capital of Funafuti	6,025
Nukulaelae	324
Niulakita	27

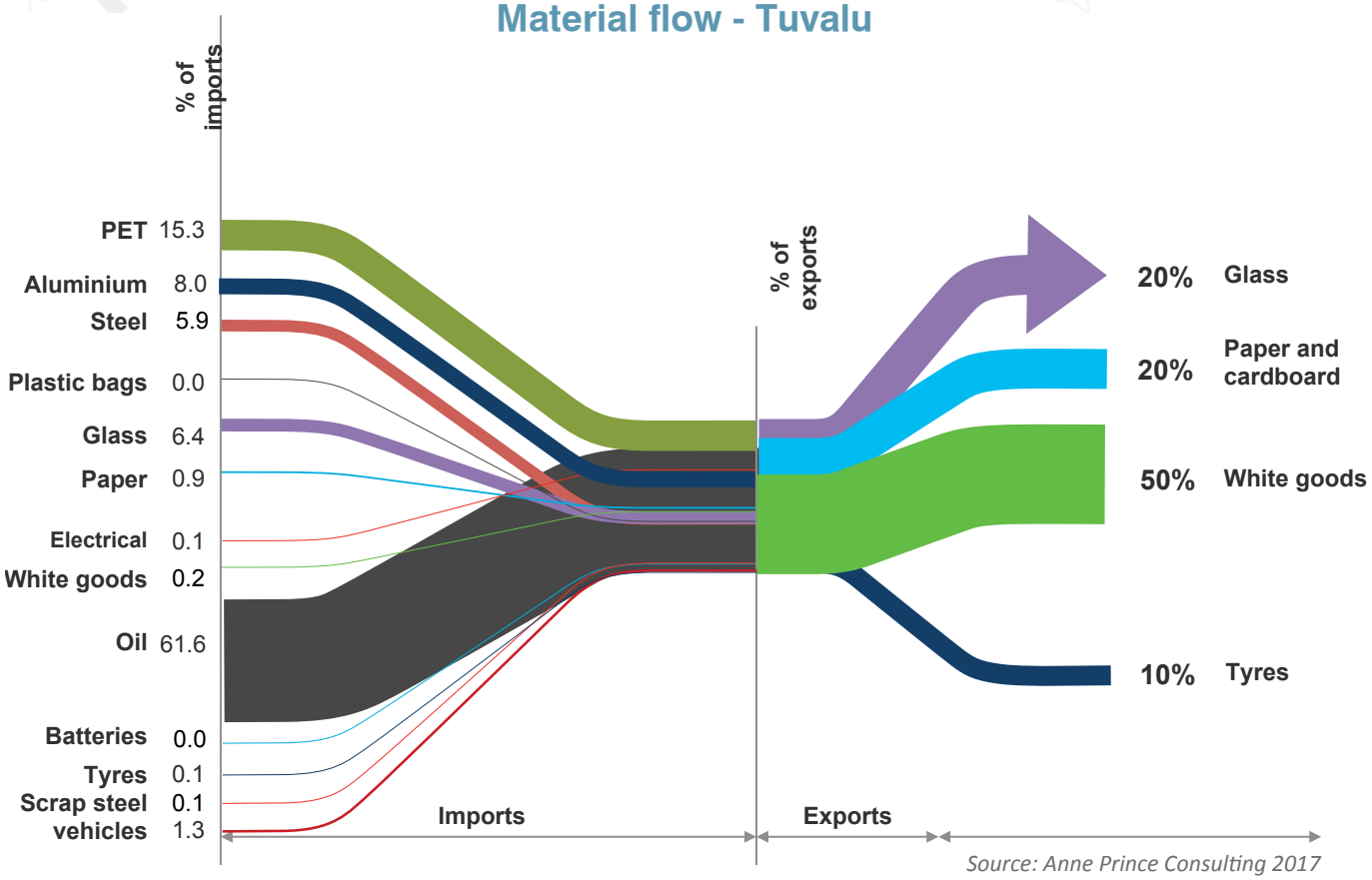
Solid waste management

A waste composition survey, conducted in 2017, found that daily municipal waste was 0.42kg per person, comprising an estimated 60% organic, 15% nappies, 5% paper, 7% plastics, and the remaining 13% comprising metals, glass, textiles and other materials. According to a World Bank study, daily per capita waste generation is estimated at 1.2kg *(World Bank, 2012)*.

The material flow chart below is based on an analysis of Tuvalu's imports of the 15 material categories studied, averaged over a seven-year period to 2016, compared with exports of those recovered recyclable materials, averaged over a two-year period 2015-2016, presented as a percentage of the total of the 15 categories. *(UN Comtrade, 2017)*.

The number of imported polyethylene terephthalate (PET) bottles for fruit juices and fermented drinks increased, while there was a sharp drop in those for water. Plastic bags entering the country decreased and paper and cardboard held steady. Palm oil imports continue to rise as do crude oil and motor vehicles.

Material flow - Tuvalu



Source: Anne Prince Consulting 2017

Note: The percentage of imports and exports displayed relate only to the proportion of the 15 materials categories studied, not total imports/exports

Evidence in 2014-16 data indicates that there were only two major exports from Tuvalu: white goods and tyres. This indicates that there is substantial waste material of the type reflected in this profile, a solution for which is essential.

Modelling of potential recovery of recyclable materials, presented in the table below, is based on an estimated average daily per capita municipal solid waste generation of 0.79kg *(World Bank, 2012)*. It also applies a range of location-specific estimated recovery rates that are based on a set of assumptions of existing or introduced incentive-based policies and programs, such as container-deposit schemes and import levies. The resulting ratios were used to estimate average annual tonnages that could be recovered for recycling. *(JICA, 2013; SPREP 2016; Mobile Muster, 2013; DOEE, 2017; Jambeck et al., 2015; MFAT, 2016; UNIDO/ICSHP, 2013)*.

Tuvalu	
Recyclable Materials Forecast	**Estimated Metric Tonnes**
Polyethylene terephthalate (PET) beverage containers	25
Aluminium cans	49
Glass beverage containers	35
Steel cans	39
Plastic shopping bags	16
End-of-life (EOL) renewable energy equipment	0.20
Paper/cardboard	163
E-waste	0.54
White goods	5
Used motor/cooking oil	63
Used lead-acid batteries	4
Lithium batteries	7
Scrap steel/nonferrous metals	59
EOL tyres	4
EOL vehicles	72
Total	**542**

Tuvalu has received support from Japan International Cooperation Agency under the first phase of its Promotion of Regional Initiative Solid Waste Management project. The project aims to build capacity and improve solid waste management, including provide training in the operation of landfills.

Tuvalu also received support from the EU and SPREP in developing the Tuvalu Integrated Waste Policy and Action Plan 2017-2026 which includes strategic actions and targets for 3R and Return operations.

Future waste management

Future increases in recovered materials are expected to result from the PacWaste (2013-18) program, implemented by the Secretariat of the Pacific Regional Environment Programme. The PacWaste Project assisted Tuvalu on medical waste through providing medium waste incinerator and co-financed with DWM to conduct baseline survey and CBA for Green Waste.

Resource recovery programs are expected to be enhanced also through the EU funded PacWaste Plus (2018-2022), which will be implemented by SPREP and Sustainable Waste Program in Tuvalu (2018-2022).

Since 2007, various donor-funded projects have seen to the installation or improvement of renewable energy systems. Under its Energy Sector Development Project, the World Bank partnered with the European Union (EU), Government of New Zealand, and Government of the United Arab Emirates (UAE-Pacific Partnership Fund) to support the installation of systems for solar and wind-powered electricity, as well as battery storage in Funafuti and PV-diesel hybrids systems on eight outer islands *(ADB, 2017; MFAT, 2016)*.

Approximately 98% of Tuvalu's population has access to electricity. As such, it is expected that there will be an increase in household electrical items and end-of-life renewable energy equipment in the country's waste stream. To help address this, the Pacific Region Infrastructure Facility has provided technical support for the Tuvalu Infrastructure Strategy and Investment Plan. This aims to create initiatives to improve solid waste management on the outer islands and support the construction of landfills.

Plastic marine debris

Mismanaged plastic waste eventually enters the marine environment by way of inland rivers and waste water outfalls or is transported by wind and tide. Rigid and light-weight plastic materials from products that are daily consumed or used become marine debris if not managed appropriately. An estimated 12% of Tuvalu's waste stream is made up of plastic.

The islands of Tuvalu have a combined coastline of 24km, and a recent study *(Jenna et al., 2015)* indicates a daily plastic waste generation of approximately 1.7 tonnes (t). Of this, an estimated 1.3t is mismanaged, entering the marine environment through release from uncontained disposal sites or by direct littering. An estimated 457t of plastic waste were released in the waters around Tuvalu in 2010, forming marine debris. If not addressed, the amount is expected to rise to 861t by 2025.

Of the 1.7t of plastics generated each day, approximately 0.18t may comprise PET or high-density polyethylene (HDPE) plastic that is eligible for recovery under a container deposit scheme (CDS). Based on an average reduction rate of 40% in mismanaged waste with a CDS in place, approximately 0.06t of PET and HDPE plastic could be recycled each day. This could increase to an 80% or above reduction rate, depending on access to recycling collection services and viable markets, among others. Nonetheless, a 40% reduction in mismanaged PET and HDPE would result in approximately 437t of plastic becoming marine debris each year.

The outcome of mismanaged plastic can be divided into three primary groups: plastic that remains on the surface of the sea as floating debris, plastic that sinks to the ocean floor, and plastic that washes up on beaches. A CDS that recovers 40% of HDPE and PET bottles in Tuvalu may achieve the following reductions in marine debris each year:

- 3t floating plastic
- 14t in sunken plastic
- 3t in beach plastic.

Further benefits attributed to a CDS are possible with a reduction in annual damage costs to Tuvalu's 57 local fishing vessels (approximately US$440). If beaches were cleaned up, over US$5,128 would be saved, of particular relevance to the amenities of coastal communities and the tourism sector.

Infrastructure and services

In Funafuti, household waste is stored in 120 litre and 80 litre waste bins for weekly collection. This service is provided to around 100% of residences by the Funafuti *Kaupule*, which operates two flat-tray collection vehicles.

The Water, Waste and Sanitation Project, funded by the EU and completed in 2013, achieved an upgrade in waste services. Nevertheless, collections often are interrupted due to mechanical issues and ad hoc service arrangements that result in waste either not being gathered over long periods or being illegally dumped or burned.

The same programme supported the purchase of new trailers with waste cages for the collection of recyclables. It is understood that these have been distributed to the *Kaupules* of the outer islands.

Tuvalu's Department of Waste Management maintains large communal waste bins in public locations in Funafuti. A small recycling service is provided by the local recycler. The collection of green waste and conversion to compostable materials is undertaken in Funafuti and there are potential opportunities for improvement and expansion to the Vaitupu island.

While in the past waste was often disposed of in "borrow pits" around Funafuti, which have been excavated during World War II to build the airport runway, this practice has stopped thanks to the rehabilitation of the borrow pits completed in 2016 by the Government of Tuvalu with support from New Zealand.

While the capacity of the main disposal site in Funafuti is depleted, an EU-funded rehabilitation programme is underway to extend the life of the facility beyond 2025. Competing pressure from economic and social

redevelopment plans make it a significant challenge to identify an alternative site, as is the case on the outer islands where disposal facilities are rudimentary. A new waste transfer station and a recycling centre, funded by the Government of Tuvalu, are in the process of construction on the island of Funafuti, expected to open by end of April 2018.

The Taipei (China) Technical Mission operates a greenwaste shredder at its composting facility, which sells the compost to farmers and householders as fertilizer. A small private sector operator in Funafuti recovers ferrous and nonferrous metals from the disposal site for export to Australia and New Zealand.

Previously, aluminium cans had been recycled under a programme supported by a nongovernment organisation. Subsequent to having exported 70t a year of the material to New Zealand, the programme was disbanded due to the organisation's lack of financial viability.

A further EU project (2018-2022) focuses on efforts to increase the recycling capacity of the private sector. So far, a baler to prepare aluminium and steel cans for export has been purchased

Logistics

Tuvalu has one international seaport and container terminal at Funafuti. This is operated by the Department of Marine and Port Services under the Ministry of Communication and Transport.

The terminal at the Port of Funafuti is approximately one hectare and has a main quay that is 80 metres long and a warehouse. There is neither a shore crane nor are there private stevedore services available.

The Port of Funafuti is capable of handling 1,000 TEU per year. The port has a current through put of approximately 1,000 import, 100 export and the return of 900 empty containers each year which may potentially be made available for reverse logistic arrangements.

This port is not on a cost-effective route and is only serviced by the Pacific Direct Line. Estimated TEU shipping container rates, presented below, are based on the cargo of nonhazardous goods, inclusive of un/loading and a bunker adjustment factor. They do not account for customs clearance, duties, and quarantine inspection.

Tuvalu: Shipping Lines		
AUSPAC Consortium; Kyowa Shipping Co. Ltd.; Polynesia Line		
Destination	**Schedule**	**Est. USD per TEU**
Fiji	21-day	3,200

Source: AMSTEC Pty Ltd

Notes: USD = U.S. dollar; TEU = twenty-foot equivalent unit.

Through its shipping agent, Trade Pacific Shipping Agency Ltd., the Government of Tuvalu operates an inter-island shipping service, consisting of two passenger/cargo ships and an ocean going barge. With the recent addition of a new ship, the current two-month schedule for inter-island transport is expected to expand to increase service. The ships also move cargo and passengers between Fiji and Tuvalu. The estimated rate for a 20 foot shipping container between Funafuti and the outer island of Nanumea is US$1,600 *(JICA, 2013)*.

The Tuvalu Infrastructure Strategic Investment Plan (PRIF 2017) aims to upgrade container storage and handling facilities at the Port of Funafuti. The Asian Development Bank will assist in the construction of harbours on four outer islands to accommodate small working boats to load and unload cargo from inter-island vessels.

Institutional framework

Data relating to the institutional framework of Tuvalu have been gathered from the database of the Pacific Islands Legal Information Institute *(PacILII, 2017)*. ECOLEX is also an information service that relates to environmental law *(ECOLEX, 2017)*, from which various data also have been collected.

The Ministry of Home Affairs and Rural Development is responsible for local government and the administration of *Falekaupule* (Local Government) Act 1997. The Act places responsibility to councils for waste collection services and ensures public places are free of rubbish.

The Ministry for Home Affairs administers the Environment Protection (Waste Reform) Amendment Act 2017 through the Department of Waste Management of Tuvalu. The latter regulates and monitors the compliance of waste collection and disposal systems across Tuvalu, develops national waste strategies, and provides public awareness programs and technical guidance to waste management operators.

Department of Waste Management of Tuvalu ensured the implementation of Integrated Solid Waste Plan 2005-2010. It also has developed Tuvalu National Waste Policy and Action Plan 2017-2026 and has recently completed a Performance Review of the country's Integrated Waste Action Plan for 2017-2026.

The Ministry of Foreign Affairs, Trade, Tourism, Environment and Labour administers Environment Protection Act 2008. Environment Protection (Environment Impact Assessment) Regulations 2014 established the Environmental Assessment Task Force and the procedures for preparing environmental impact assessment reports for all developments.

Environment Protection (Litter and Waste Control) Regulations 2013 prohibits the burning and disposal of waste in or near water sources, beaches and foreshores, mangroves, and directly into the sea. This regulation also bans the disposal of white goods and e-waste in landfills, as well as regulates the transport, storage, and disposal of prescribed waste. Funafuti *Kaupule under the direction of the Department of Waste Management,* has a Garbage Disposal By-Law, prohibiting the dumping of garbage beyond designated disposal sites.

Marine Pollution Act 2008 prohibits the discharge from ships of oils, garbage, and sewerage into the sea; empowers the harbour master to provide reception facilities for these materials at port; and gives effect to a number of international conventions for the prevention of marine pollution. Merchant Shipping Oil Pollution Order 1975 also controls marine pollution.

The Tuvalu Infrastructure Strategy and Investment Plan (PRIF 2017) prioritises the consolidation of Funafuti and outer island landfills; collects import tariffs to fund solid waste management activities; and creates initiatives to facilitate private sector recycling and reuse activities. Included among the goals of National Strategy for Sustainable Development 2016-2020 (titled *Te Kakeega III*) are the upgrading of waste management infrastructure and operations, particularly on the outer islands, and the development of a national waste management policy. *TeKakeega III* also aims to improve sea transport between the eight outer islands for the movement of cargo and passengers.

While Tuvalu is not a signatory to the Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal, it is a party to various other multilateral environmental agreements and conventions, listed in the table below.

Tuvalu	
Multilateral Agreements and Conventions	**Status**
Stockholm Convention on Persistent Organic Pollutants	Ratified
1995 Waigani Convention	Ratified
Montreal Protocol	Ratified
MARPOL 73/78: International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (Annex I/II, III, IV, V, and VI)	Ratified
International Convention on Civil Liability for Oil Pollution Damage 1969 (renewed 1992)	Ratified
International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (FUND), 1971	Ratified
International Convention on the Protocol of 1992 to Amend The International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971	Ratified
International Convention on Civil Liability for Bunker Oil Pollution Damage (BUNKER) 2001	Ratified
International Convention on the Control of Harmful Anti-fouling Systems in Ships (AFS Convention) 2001	Ratified
International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM)2004	Ratified
Nairobi International Convention on the Removal of Wrecks 2007	Ratified

SPREP. 2016.

Financial mechanisms

Currency: Tuvaluan dollar; Australian dollar (A$)

The Funafuti *Kaupule* levies an annual household fee of approximately A$40 and a commercial fee that ranges between A$110 and A$140 for waste collection services. These charges, however, fall short of covering costs. Tipping fees are not charged for waste that enters the dumpsite.

Funds are transferred to island councils from the national government on an annual basis. Of the total annual grant, 63% is conditional and 37% is non-conditional. The Government of Tuvalu allocated in 2016 around A$900 000 to support Department of Waste Management programs including operations. Funding, however, continues to be insufficient and consideration now is placed on the introduction of a waste management levy on imported goods. It is proposed that a green fund be created from airport departure taxes to raise the necessary reserves to enhance Tuvalu's waste management practices.

Conclusions

Waste management in Tuvalu is governed by environmental laws. A long-term policy to 2026 is being developed, as is an implementation plan to 2021. The current waste collection coverage for Funafuti (Main Island) is 100% but 80% for all outer islands.

Recent additions to inter-island shipping services and the planned renovation of harbours on the outer islands should support a country-wide CDS. It should also be conducive to an extended producer responsibility scheme in the future.

The Port of Funafuti is small and has standard infrastructure. It lacks the capacity to handle increased cargo volume. There is a forthcoming project to boost container storage capacity and handling facilities.

Abbreviations

ADB	Asian Development Bank
AFS	Anti-fouling systems
BWM	Ballast water and sediments
CDS	Container deposit scheme
DOEE	Department of Environment and Energy (Australia)
EOL	End of life
EU	European Union
HDPE	High-density polyethylene
ICSHP	International Centre on Small Hydro Power
JICA	Japanese International Cooperation Agency
kg	kilogram
km	kilometer
km^2	square kilometres
MARPOL	International Convention for the Prevention of Pollution from Ships
MFAT	Ministry of Foreign Affairs and Trade (New Zealand)
PET	Polyethylene terephthalate
PV	Photovoltaic
PRIF	Pacific Region Infrastructure Facility
SPREP	Secretariat of the Pacific Regional Environment Program
t	tonne
TEU	Twenty-foot equivalent unit
UAE	United Arab Emirates
UNIDO	United Nations Industrial Development Organisation
USD	United States dollar

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Vanuatu

Introduction

The increasing presence of plastic marine debris in the South Pacific Ocean is focusing attention on strengthening recycling policies and systems in the region. Unique challenges associated with shipping commodities of low value over long distances to recycling markets, however, reduce the economic viability to do so. This country profile includes the current technologies, material flow, logistics, public policies, institutional framework, financial mechanisms, and initiatives that are being designed or have been implemented to strengthen recycling systems in Vanuatu.

Vanuatu is a Y-shape string of islands that runs in a northwest-to-southeast direction in the Melanesia region of the Pacific Ocean. Over 80 islands total a land area of 12,2812km^2, with a combined coastline of 2,530km. The largest cities are the capital, Port Vila (Island of Efate), and Luganville (Espiritu Santo, the largest island).

Source: Google Maps.

Socioeconomic background

A mountainous volcanic archipelago made up of high plateaus, rolling hills, and narrow coastal plains, Vanuatu maintains strong cultural traditions, while tourism has experienced strong growth. With the transition by urban communities to consumer economics, solid and liquid wastes are on the rise, increasing the risks of marine pollution and human health and safety.

Contributions to the waste stream are increasing in line with growing urban populations and rising international visitor numbers which reached 95,117 in 2016. *(SPTO, 2017)*. In the 10 years leading to 2014, cruise ship arrivals increased 15%, reflecting 230 cruise ships carrying more than 2,000 passengers, each calling into the ports of Port Vila, Luganville, Mystery Island, Pentecost, Champagne Bay, and Wala. The ships dispose of waste material in Port Vila.

Vanuatu's gross domestic product in 2015 was US$742 million/US$2,990 per capita *(OEC, 2017)*. It had a trade balance deficit of US$194 million, with exports at US$133 million (-23.6% annualised) and imports at US$328 million (-19.1% since 2010).

The primary export market destinations for 2015 were the People's Republic of China, Japan, New Caledonia, Thailand and Turkey. The main import origins for the same year were Australia, the People's Republic of China, Fiji, Japan and New Zealand. *(OEC, 2017)*.

Vanuatu's economy is based primarily on small-scale agriculture, although the manufacturing sector contributes 3.71% to the economy *(GlobalEDGE, 2017)*. Tourism represented nearly 65% of gross domestic product in 2014

Vanuatu's population in 2015 was approximately 277,500, with a growth rate of 2.4% *(ADB, 2016)*. Approximately 205,350, or 74%, live in rural areas *(Knoema, 2015)* across the islands, grouped into six provinces, according to Vanuatu's 2009 Census. These provinces, including the main towns and islands, are indicated in the table below.

Vanuatu	
Torba Province Islands	**Population**
Hiw	269
Tegua	58
Lo	198
Ureparapara	437
Motalava	1,399
Vanua Lava	2,539
Mota	666
Gaua	2,471
Merig	12

Sanma Province Islands	**Population**
Espiritu Santo, including the city of Luganville	38,303
Tutuba	609
Mavea	196
Aore	405
Araki	140
Malo	4,191

Penama Province Islands	**Population**
Ambae	10,146
Maewo	3,556
Pentecost	16,224

Malampa Province Islands	**Population**
Malekula	22,617
Ambrym	7,110
Paama	1,542

Shefa Province islands	Population
Epi	5,066
Tongoa	2,273
Emae	732
Tongariki	267
Makira	106
Mataso	74
Efate including Port Vila	64,327
Emau	602

Tafea Province Islands	Population
Erromango	1,917
Tanna	2,8734
Aniwa	341
Futuna	481
Aneityum	901

Source: Vanuatu National Statistics Office, 2009 National Population and Housing Census, Analytical Report, Volume

Solid waste management

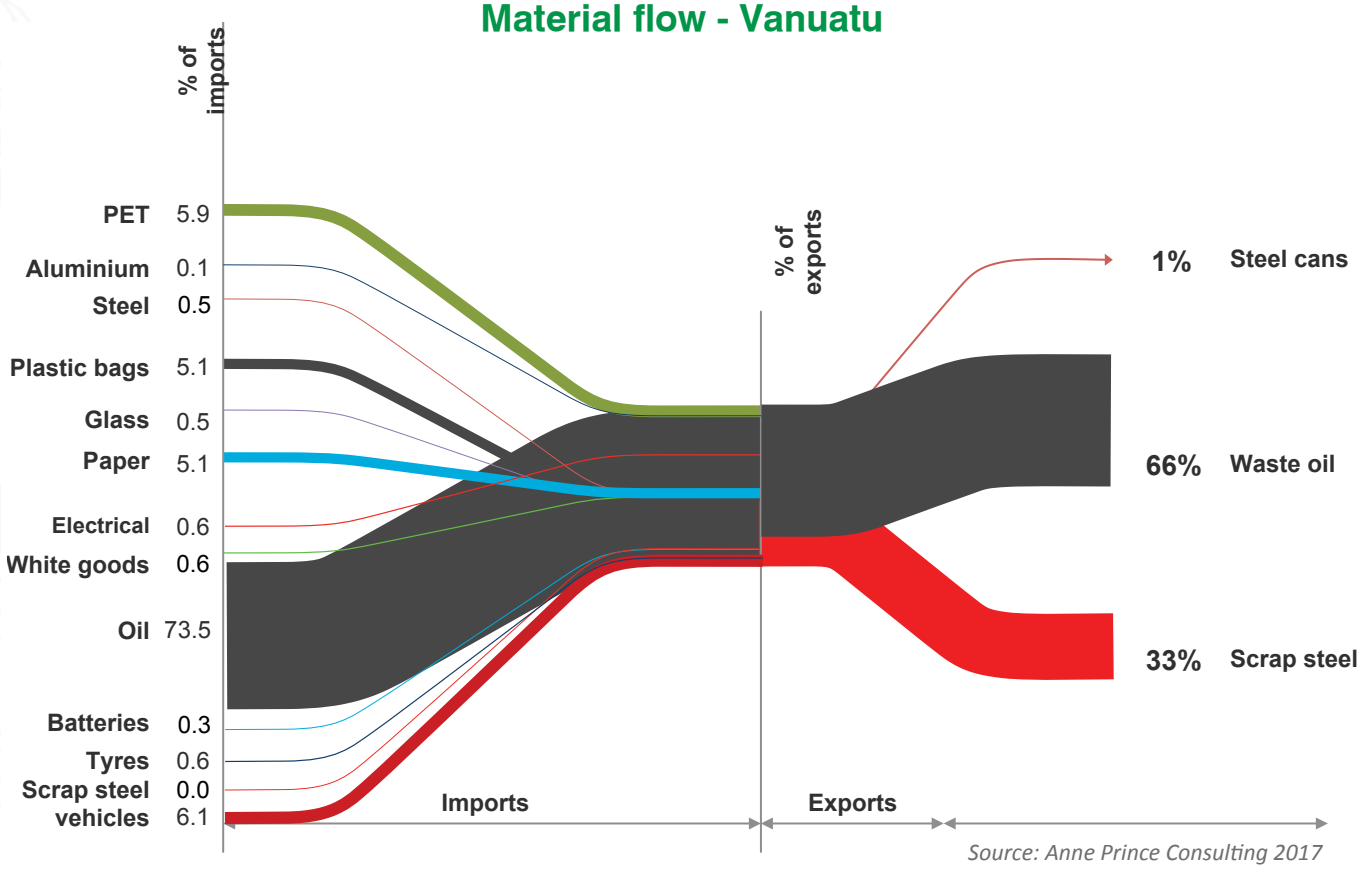
Undertaken by the Japan International Cooperation Agency (JICA) in 2011, an audit of daily household waste in Port Vila shows a rate of 0.427kg. A further study in 2014 established an average household daily waste generation in Luganville of 6.8kg. *(Luganville Municipal Council).*

Both studies show that the majority of waste is organic, followed by plastic. Yet another study, taking into account Tafea Province, established a per capita waste generation rate of approximately 0.5kg a day on islands with populations of less than 5,000, and 0.8kg a day on islands of more than 5,000 *(Tafea Provincial Government Council and Lenakel Town Municipal Council, 2017).*

This regional study coordinated by PRIF models the potential recovery of 15 materials types. A defined set of recovery rates was applied to the urban, rural, and outer island population distribution to calculate Vanuatu's potential recovery tonnage. The PRIF study compares various data to establish the context for the 15 waste materials.

The material flow chart below is based on an analysis of Vanuatu's imports of the 15 material categories studied, averaged over a seven-year period to 2016, compared with exports of those recovered recyclable materials, averaged over a two-year period 2015-2016, presented as a percentage of the total of the 15 categories. *(UN Comtrade, 2017).*

Material flow - Vanuatu



Source: Anne Prince Consulting 2017

Note: The percentage of imports and exports displayed relate only to the proportion of the 15 materials categories studied, not total imports/exports

Import data indicates that beverage container imports increased steadily from 2009 to 2011, dropping sharply from 2012 onwards. Similar trends were observed in electronics and whitegoods, whereas paper and cardboard imports have held steady over time. Palm oil, vegetable oil, and petroleum imports have increased steadily. It is notable that imports of large, 10-passenger vehicles also has increased at a steady pace.

While recyclable material exports from Vanuatu, overall, are relatively insignificant, these mainly comprise used motor and cooking oils, as well as scrap steel. Few exports of beverage containers, e-waste, and paper and cardboard were recorded, other than 12 tonnes (t) in 2015.

Modelling of potential recovery of recyclable materials, presented in the table below, is based on an estimated average daily per capita municipal solid waste generation of 3.28kg *(World Bank, 2012)*. It also applies a range of location-specific estimated recovery rates that are based on a set of assumptions of existing or introduced incentive-based policies and programs, such as container-deposit schemes and import levies. The resulting ratios were used to estimate average annual tonnages that could be recovered for recycling. *(JICA, 2013; SPREP 2016; Mobile Muster, 2013; DOEE, 2017; Jambeck et al., 2015; MFAT, 2016; UNIDO/ICSHP, 2013).*

Vanuatu	
Recyclable Material Forecast	**Estimated Metric Tonnes**
Polyethylene terephthalate (PET) beverage containers	301
Aluminium cans	818
Glass beverage containers	577
Steel cans	649
Plastic shopping bags	195
End-of-life (EOL) renewable energy equipment	3
Paper/cardboard	2,718
E-waste	12
Whitegoods	112
Used motor/cooking oil	839
Used lead-acid batteries	47
Lithium batteries	143
Scrap steel/ nonferrous metals	974
EOL tyres	47
EOL vehicles	1,581
Total	**9,016**

Future waste management

Future increases in recovered materials are expected to result from the PacWaste (2014-17) program, implemented by Secretariat of the Pacific Regional Environment Programme (SPREP). Its objectives are to improve the management of e-waste by establishing a pilot project for the safe dismantling and export of e-waste and creating a public awareness campaign *(SPREP. 2017)*.

The second phase of the Promotion of Regional Initiative Solid Waste Management (J-PRISM II) project, implemented by JICA in early December 2016, supports capacity building in waste management. Target initiatives include improved governance and human resource development, focusing on Port Vila, Luganville, and Lenakel.

Restoration of Ecosystem Services and Adaption to Climate Change is a regional program of the Pacific Community which, jointly with Vanuatu's Shefa Province, is funded primarily by the French Development Agency and the Global Environment Facility, as well as the tourism sector. It aims to develop waste services and recycling systems in the north of Efate, including the resorts along that coast. Initiatives include the return of packaging waste, such as aluminium cans, from the more remote areas, in particular offshore islands. The program also will support recycling bins and the development of return logistics, using private supply vehicles to transfer the waste to the recycler in Port Vila.

Only 33% of the population, mostly in urban Port Vila, Luganville and Lenakel, has access to electricity. Rural areas have a much lower rate of supply. Vanuatu's National Energy Roadmap 2016-2030 targets 65% renewable energy by 2020. This may have been revised, however, to account for 100% renewable electricity generation and 100% access by 2030 *(MFAT, 2016)*.

Phase 1 of the Vanuatu Rural Electrification Program supported by the World Bank, Government of New Zealand and others, will ensure the electrification of 17,500 off-grid households and provide initiatives that include geothermal energy and hydropower. The Energy Access Project of the Asian Development Bank and the Government of Vanuatu will increase electrification rates on the islands of Malekula and Espiritu Santo with hydropower *(ADB, 2017)*. The rise in power distribution is expected, in turn, to increase the presence of electrical household goods in Vanuatu's waste stream.

Plastic marine debris

Mismanaged plastic waste eventually enters the marine environment by way of inland rivers and waste water outfalls or is transported by wind and tide. Rigid and lightweight plastic from products that are consumed daily or used become marine debris if not managed appropriately. An estimated 9% of Vanuatu's waste stream consists of plastic.

The islands of Vanuatu have a combined coastline of 2,530km, and a recent study *(Jenna et al., 2015)* indicates a daily plastic waste generation of approximately 74t. An estimated 61.5t is mismanaged daily and predicted to enter the marine environment through release from uncontained disposal sites or by direct littering. An estimated 22,470t were released in the waters around Vanuatu in 2010. If not addressed, the amount is expected to rise to 38,000t by 2025.

Of the 74t of plastic generated each day, approximately 8.1t may comprise polyethylene terephthalate (PET) or high-density polyethylene (HDPE) plastic that is eligible for recovery under a container deposit scheme (CDS). Based on an average reduction rate of 40% in mismanaged waste with a CDS in place, approximately 2.73t of PET and HDPE plastic could be recycled on a daily basis. This could increase to an 80% or above reduction rate, depending on access to recycling collection services and viable markets, among others. Nonetheless, a 40% reduction in mismanaged PET and HDPE would result in approximately 21,483t of plastics becoming marine debris each year.

The outcome of mismanaged plastic can be divided into three primary groups: plastic that remains on the surface of the sea as floating debris, plastic that sinks to the ocean floor, and plastic that washes up on beaches. A CDS that recovers 40% of HDPE and PET bottles in Vanuatu may achieve the following reductions in marine debris each year:

- 149t in floating plastic
- 696t in sunken plastic
- 149t in beach plastic.

Further benefits attributed to a CDS are possible with a reduction in annual damage costs to Vanuatu's 215 local fishing vessels (approximately US$1,677). If beaches were cleaned up, over US$252,294 would be saved, of particular relevance to the amenities of coastal communities and the tourism sector.

Infrastructure and services

Information relating to the solid waste and recycling infrastructure and services in Vanuatu are sourced from 2014. Solid Waste Management in the Pacific: Vanuatu Country Snapshot. Manila: Asian Development Bank. Other information has been drawn from the 2013, "Data Collection Survey on Reverse Logistics in the Pacific Islands". Final Report, Japan International Cooperation Agency and Vanuatu's National Waste Management and Pollution Control Strategy and Investment Plan 2016–2020.

The use of canned food, single-use plastic bags, and plastic bottles is standard on the outer islands, much of which now has become marine debris. In addition, the materials cause significant disposal issues for local communities. As a result, waste is commonly burned and plastic is frequently used as a means to light fires.

Exported recyclables (see table below) are collected on the island of Efate by a recycling firm, while cartridges are collected in Espiritu Santo and exported to New Zealand for recycling. The management processes of the 15 materials within the scope of this profile are reflected in the following table.

Vanuatu: Management Processes	
Export	Steel and aluminium cans, paper, used engine oil, e-waste, scrap steel, and nonferrous
Reused	Cardboard, used engine oil, polyethylene terephthalate and glass bottles
Non-recycled	Used cooking oil, whitegoods, vehicle tyres, solar panels, used lead acid-batteries, and lithium batteries

Source: Regional Resource Circulation and Recycling Network Project Survey, Department of Environment and Conservation Protection, June 2017

A 2013 study *(JICA, 2013)* found evidence that the scrap metal and aluminium exports to the Republic of Korea attracted a market rate of US$500/t and US$12,000/t, respectively. Scrap exports to Abu Dhabi, Fiji, India, New Zealand, and Vietnam sold from US$300/t to US$400/t. Cardboard and office goods to these locations sold for US$200/t and US$400/t, respectively.

Previously, five recycling companies exported approximately 11,740t (587 twenty-foot equivalent units, TEU) of scrap metal per annum, mainly to the Republic of Korea and New Zealand. Recycling activities have been seriously impacted, however, as a result of the Government of Vanuatu's decision to apply an export levy of 15% on scrap metal and other recyclable materials that are classified as second-hand goods. Three of the five companies, therefore, were forced to close down and the remaining two companies have reduced operations by 50%.

A significant level of support has been provided by JICA's J-PRISM I project for upgrading waste management processes, under which achievements include core planning and infrastructure improvements between 2011 and 2015. These have promoted the practice of recycling, ensured efficient operating capacity at the disposal site and developed a landfill training programme.

The Secretariat of the Pacific Regional Environment Programme (SPREP) is partnering with a local recycler, under its PacWaste program, to pilot the processing and export of e-waste. It also facilitates export of used lead-acid batteries to the Republic of Korea for recycling.

In terms of waste as a result of natural disasters, an example can be drawn from the Tropical Cyclone Pam waste management project. Under the Waste Management and Livelihoods Recovery Initiative of the United Nations Development Programme, the project sought to reuse the debris resulting from the event.

Vanuatu's Azure Pure Water recently launched the Give-me-5 recycling solution, offering a Vt$0.05 rebate on clean bottles returned to the factory. Azure Pure Water has partnered with a local recycler and the packaging supplier, VISY of Australia, to export bales of plastic for recycling. The company expects to send its first container following the December 2017 Vanuatu Pacific Games.

Vanuatu's Department of Environment Protection and Conservation (DEPC), in collaboration with Wan Smol Bag Theatre - a local nongovernment organization - Port Vila Municipality, and JICA, has partnered with RecycleCorp Vanuatu to manage a cash-for-aluminium-can return programme. Through this campaign, three Port Vila communities deposit empty cans in bags placed at a post office. RecycleCorp pays Vt40/kg for the cans, the revenue of which is allocated to the three communities.

Other than the aluminium can return programme on the island of Efate, there are no household collection services or community recycling centres in place. A storage facility and baler exists within a local company that pays collectors between Vt10/kg and Vt200/kg for nonferrous material, exporting it to the Asian market. The firm also collects electronic waste for free. There is no evidence of the recycle of paper and cardboard or of plastic and construction waste. Vanuatu Brewing and Vanuatu Beverage Ltd. have a CDS for glass bottles at the point of sale. The deposit is refunded on return of the bottle.

Municipal solid waste is managed by the councils of Port Vila, Luganville, and Lenakel. Port Vila's service offers a collection two to three times a week with compactor/tipper vehicles that dispose the waste in Port Vila's Bouffa Landfill, which applies the semi-aerobic method. JICA's J-PRISM I project has provided waste disposal equipment to the Bouffa Landfill.

Luganville collects waste one day a week, transporting it to a controlled disposal site. The provinces, including the outer islands, use small pick-up vehicles that deliver the waste to open-pit disposal sites. Rural areas do not have waste collection services.

A prepaid bag system has been established in Port Vila whereby 100kg or 70kg yellow bags cost Vt100 (Vt1,500 a roll) or Vt80 (Vt850 a roll), respectively. Luganville has a similar system, whereby 15kg red bags are prepaid at Vt80, Vt70, or Vt60 each, depending on the per roll price. Both municipalities offer commercial collection services for a fee, based on volume.

Quarantine waste in Port Vila and Luganville is managed by the Vanuatu Department of Biosecurity. While existing incinerators are meant to process the materials, the waste usually is treated by open fires at landfills, given the cost of fuel necessary for incineration.

Since services are generally unreliable and inefficient, and the practice of burning waste is constant, efforts are being made to boost the use of a GPS tracking system, along with real-time motion planning methods.

Logistics

Vanuatu has two international ports - in Port Vila and Luganville. These are operated by the respective port authorities.

Vanuatu

Source: Google Maps.

Port of Santo terminal is approximately three hectares and has a main quay, 360 metres long by 14 metres deep, and a warehouse. It does not have a shore crane, although private stevedore services are available. A new port is under construction to replace it.

The Port of Santo is capable of handling 8,000 TEU per year. The port has a current throughput of approximately 2,800 import, 300 export and the return of 2,500 empty containers each year which may potentially be made available for reverse logistic arrangements.

This port is located on a route that is cost effective and is regularly serviced by various international shipping lines. Estimated TEU shipping container rates, presented below, are based on the cargo of nonhazardous goods, inclusive of un/loading and a bunker adjustment factor, although they do not account for customs clearance, duties, and quarantine inspection.

Port of Santo, Vanuatu: Shipping Lines		
Swire Shipping; Kyowa Shipping Co. Ltd.; Polynesia Line		
Destination	**Schedule**	**Est. USD per TEU**
North Asia	30-day	2,400 to 3,650
Australia	14-day	2,100 to 3,650
Fiji	21-day	2,450 to 3,200
New Zealand	21-day	2,400 to 4,600
Noumea	21-day	1,950 to 3,200

Source: AMSTEC Pty Ltd
Notes: USD = U.S. dollar;
TEU = twenty-foot equivalent unit.

The Port of Port Vila is capable of handling 50,000 TEU per year. The port has a current throughput of approximately 8,000 import, 1,400 export and the return of 6,200 empty containers each year which may potentially be made available for reverse logistic arrangements. The port also loads and unloads approximately 400 trans-shipment containers each year.

Port Vila is also located on a cost effective and well-serviced shipping route. Data presented in the table below are similar to those that relate to the Port of Santo in terms of characteristics.

Port Vila, Vanuatu: Shipping Lines		
Swire Shipping; Kyowa Shipping Co. Ltd.; Polynesia Line		
Destination	**Schedule**	**Est. USD per TEU**
North Asia	14-day	2,400 to 3,650
Australia	14-day 16-day	2,100 to 3,650
Fiji	14-day 21-day	2,450 to 3,200
New Zealand	21-day	2,400 to 4,600
Noumea	21-day	1,950 to 3,200

Source: AMSTEC Pty Ltd
Notes: USD = U.S. dollar;
TEU = twenty-foot equivalent unit.

Both international ports offer services that include warehouse storage, water supply, electricity, and hinterland road links. A few outer islands have wharves and jetties for domestic cargo ship loading/offloading and for passenger ship dis/embarkation. Where this is not the case, coastal anchorages and landing barges are offered.

Frequent ferry services are provided to the central provinces, although this is not the case with the southern and northern islands, which experience irregular services. Tafea Province and Torba Province attract higher cargo freight rates and passenger fares.

Vanuatu's domestic fleet of vessels plies between the outer islands and Port Vila and Luganville. Services to all islands, however, are unreliable. A 2013 study found that local, registered vessels include:

- 10 cargo and passenger landing crafts
- 54 cargo and passenger flare hull vessels
- 175 miscellaneous vessels, used for coastal cargo and passenger transportation.

The Inter-Island Shipping Support Project, supported by the Asian Development Bank and the Government of New Zealand, intends to boost the movement of domestic freight. A new inter-island shipping terminal at Port Vila will be built; new jetties at Lolowai, Loitong, and Port Sandwich will be added; and the wharves of Litzlitz, Lenakel, and Simonsen will be rehabilitated. The project also will subsidise a number of voyages at a designated frequency on otherwise commercially uneconomical routes. The outcome of this project significantly will enhance the logistics for the domestic movement of recovered waste materials to specific locations.

Institutional framework

Data relating to the institutional framework of Vanuatu have been gathered from the database of the Pacific Islands Legal Information Institute *(PacILII, 2017)*. ECOLEX is also an information service that relates to environmental law *(ECOLEX, 2017)*, from which various data also have been collected.

The Government of Vanuatu implements regulations and strategies that relate to the management of waste, control of pollution, issuance of permits, and monitoring of waste management operations. It also implements the international conventions and treaties to which it is a signatory.

The DEPC, under the Ministry for Climate Change Adaption, Meteorology, Geo-Hazards, Environment, Energy and Disaster Management, is the lead agency for waste management and pollution control. It develops regulations and strategies, as well as supervises Vanuatu's Environmental Protection and Conservation Act.

The DEPC is also responsible for coordinating the implementation of Vanuatu's National Waste Management and Pollution Control Strategy and Investment Plan 2016–2020 (NWMPCSIP). This strategy aligns with the SPREP Cleaner Pacific 2025: Pacific Regional Waste and Pollution Management Strategy, and it aims to enhance mechanisms for policy and legislation; financing systems; capacity development; minimization of waste; integration of waste management; and coordination of national public awareness. The strategy's objectives are to develop incentive schemes under the Waste Management Act (e.g., CDS and/or polluter-pays mechanisms) and to encourage public/private partnership investment opportunities, supported also by the Vanuatu Infrastructure Strategic Investment Plan 2015-2024.

On 30 July 2017 the Vanuatu Government announced its intention to ban single use plastic bags and bottles. Regulations are being drafted under the Waste Management Act to formally introduce the bans as of 1 January 2018. It is understood the regulations will provide for a phased approach to introducing a range of polymer types under the ban.

Various long-range policies, legislations, strategies, and multilateral agreements that address issues relating to the management of waste and the control of pollution include the following:

- National Sustainable Development Plan 2016-2030
- National Environment Policy and Implementation Plan 2016-2030
- National Biodiversity Strategy and Action Plan
- Vanuatu Climate Change and Disaster Risk Reduction Policy 2016-2030.

Pollution Control Act No. 10 (2013) and Waste Management Act No. 24 (2014) designate the role of waste management operators to the municipal, provincial, and national levels. They also establish the penalties for noncompliance.

Environmental Protection and Conservation Act, 2002 (Cap 283) is administered by the Ministry of Lands and Natural Resources through the DEPC. The Act provides

for conservation and the sustainable development and management of the environment. It identifies community conservation areas and oversees environmental impact assessments and bioprospecting. Environmental Impact Assessment Regulations 2012 provide an environmental impact assessment framework for project developments.

The Department of Energy's Environmental Code of Practice (Used Battery Disposal) for [the] Rural Electrification Project of June 2014 relates to the management of used lead-acid and nickel-cadmium batteries. It stipulates that vendors of photovoltaic solar systems are to adhere to the appropriate collection and disposal of such end-of-life batteries. The Department of Environment are to construct storage facilities for end of life batteries in the outer provinces.

Maritime Authority Act (Amendments) 2002, 2003, and 2004; Maritime (Conventions) Act 2006; and Pollution Control Act 2013 provide for the control of marine pollution. Public Health Act 1994, administered by the Ministry of Health, relates to the placement of bins in public places and the prevention of littering.

The Department of Tourism created a tourism accreditation framework in 2014 for the endorsement of the Vanuatu Tourism Operators Minimum Standards for a business license. The standards prevent negative impacts on land and marine environments and the burning of plastic, as well as encourage the appropriate disposal of waste.

Provincial governments are responsible for waste collection, transport, and disposal. Sanma Province has developed such a plan and Penama is in the process of doing so. Similarly, Tafea Province and Lenakel Town Municipal Council have incorporated Rubbish Collection By-Law (2014).

Municipal councils are responsible for the management, collection, and transport of solid waste, as well as the operation of landfill sites within their jurisdictions. They prepare annual waste management plans, policies, and by-laws to support national waste management strategies. The municipal councils of Port Vila, Luganville, and Lenakel have waste management plans that identify a range of waste reduction initiatives, including the recycling of aluminium cans, metal, plastic bags, and cardboard.

Luganville Municipal Council has developed Waste Management By-Law 2013 that regulates curbside collection services from individual properties and establishes community waste collection sites for areas that lack service. It also stipulates waste management fees and enforces compliance.

The Restoration of Ecosystem Services and Adaption to Climate Change project focuses on the creation of village waste committees, modelled on the Nguna-Pele Marine Protected Area Network (Vanuatu). The network promotes sound waste practices, organises the transfer of recyclable materials to Port Vila, and monitors progress in reducing littering and burning.

While Vanuatu is not a signatory to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, the NWMPCSIP outlines the case for ratifying this, as well as the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, and the Minimata Convention on Mercury. Vanuatu is, nevertheless, a party to the following multilateral environmental agreements and conventions.

Vanuatu	
Multilateral Agreements and Conventions	**Status**
Stockholm Convention on Persistent Organic Pollutants	Ratified
1995 Waigani Convention	Ratified
Montreal Protocol	Ratified
MARPOL 73/78: International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (Annexes I, II, III, IV, V, and VI)	Ratified
London Convention on the Prevention of Marine Pollution by the Dumping of Wastes and Other Matter 1972	Ratified
1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (London Protocol)	Ratified
Intervention on the High Seas in Cases of Oil Pollution Casualties (Intervention 1969):	Ratified
Protocol 1973	Ratified
Protocol to the International Convention on Civil Liability for Oil Pollution Damage of 29 November 1969 (1976)	Ratified
International Convention on Civil Liability for Oil Pollution Damage 1969 (renewed 1992)	Ratified
International Convention on the Protocol of 1976 to Amend the International Fund for Compensation for Oil Pollution Damage, 1971	Ratified
Protocol of 1992 to Amend The International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971	Ratified
International Convention on Oil Pollution Preparedness, Response and Co-operation Convention 1990	Ratified
Protocol on Preparedness, Response and Co-operation to pollution Incidents by Hazardous and Noxious Substances, 2000 (OPRC/HNS) 2000	Ratified
International Convention on Civil Liability for Bunker Oil Pollution Damage (BUNKER) 2001	Ratified
International Convention on the Control of Harmful Anti-fouling Systems in Ships (AFS Convention) 2001	Ratified
Small Island Developing States Accelerated Modalities of Action (Samoa Pathway)	Ratified

Source: SPREP. 2016.

Financial mechanisms

Currency: Vanuatu vatu (Vt).

The NWMPCSIP incorporates a strategy towards the sustainable financing of waste management and pollution control from internal sources. It also aims to create revenue streams, such as a CDS. The Government of Vanuatu does not finance waste management systems; therefore, local governments are required to draw revenue from landfill disposal fees (Vt7,000/t), prepaid waste collection fees, and property taxes. Collection of these fees, however, is generally poor, affecting services.

In Luganville, fees charged at the disposal site range from Vt80/bag to Vt1,800/flat bed and Vt50,000/cruise ship. There is no disposal fee for containers approved by the municipal council. Commercial property levies are imposed on a quarterly basis, ranging from Vt13,000 for a small commercial business to Vt78,000 for a large firm.

In some cases, municipal and provincial councils include a waste management fee on the property, as is the case in Port Vila where the fee is approximately Vt13,000/year per property. The overall budget for waste management in Port Vila in 2009 was approximately Vt49,095,500, with an allocation of 68% for collection services and 32% for disposal costs.

Conclusions

Vanuatu has implemented long-term policies and strategies for the environment, pollution control, and waste management. Limited human resource capacity and lack of access to government funding, however, are challenges that continue to hamper attempts to govern waste management.

Improved domestic shipping services and infrastructure, as a result of the Inter-Island Shipping Support Project, will offer significant opportunities to recover recyclable materials from the outer islands. Communities also will be able to participate in future CDSs and extended producer responsibility schemes.

Vanuatu has not ratified the Basel Convention, therefore movements of hazardous waste to recycling markets or treatment facilities is limited to destinations within the Waigani Convention region.

Port Vila's port is an important cruise ship destination and once improvements are complete, it will be able to handle 50,000 TEU each year. The port will require, however, an upgrade to its quarantine waste infrastructure and waste disposal services for ships. Port Vila is neither a trans-shipment port nor is it located on a cost-effective shipping route.

Given the insufficient resources for waste management and Vanuatu's inherent reliance on support from international donors and development partners, it is essential that appropriate financial mechanisms to support the recycling industry are put in place. Furthermore, it is necessary to provide recycling facilities to towns and provinces.

Abbreviations

AMSTEC	Supply chain and transport economics consulting firm
CDS	container deposit scheme
DEPC	Department of Environmental Protection and Conservation (Vanuatu)
DOEE	Department of Environment and Energy (Australia)
EOL	End of life
GPS	Global Positioning System
HDPE	high-density polyethylene
HNS	Hazardous and noxious substances
ICSHP	International Centre on Small Hydro Power
J-PRISM	Promotion of Regional Initiative Solid Waste Management
JICA	Japan International Cooperation Agency
kg	kilogram
km	kilometre
km^2	square kilometre
MFAT	Ministry of Foreign Affairs and Trade (New Zealand)
NWMPCSIP	National Waste Management and Pollution Control Strategy and Investment Plan 2016–2020
OEC	Observatory of Economic Complexity
OPRC	International Convention on Oil Pollution Preparedness, Response and Cooperation
PET	polyethylene terephthalate
PRIF	Pacific Region Infrastructure Facility
RTRC	Regional Tourism Resource Centre
SPREP	Secretariat of the Pacific Regional Environment Programme
t	tonne
TEU	twenty-foot equivalent unit
UNIDO	United Nations Industrial Development Organization

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