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

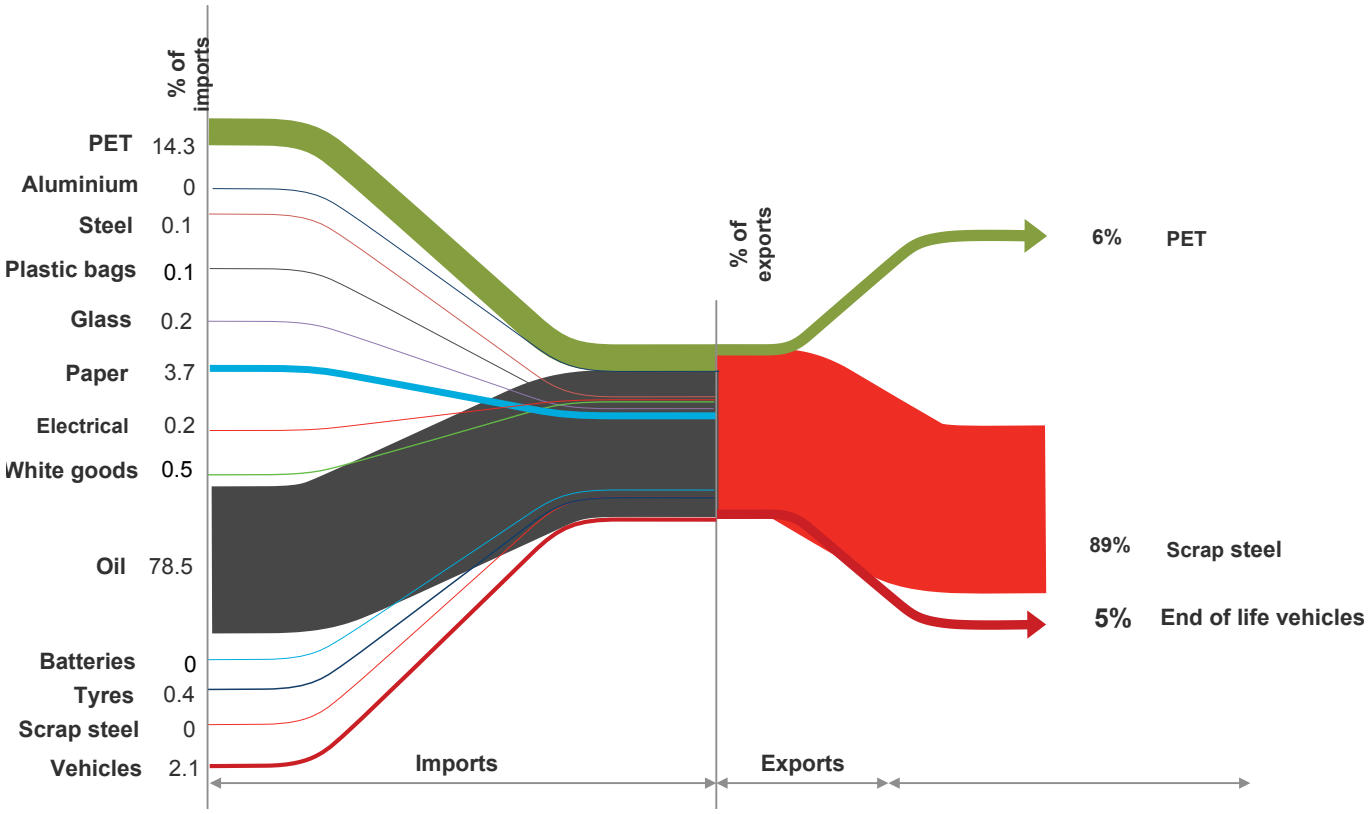
Source: 2015 Census of Population, Housing and Agriculture for the Republic of Palau. Volume 1. Office of Planning and Statistics, Bureau of Budget and Planning.

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.

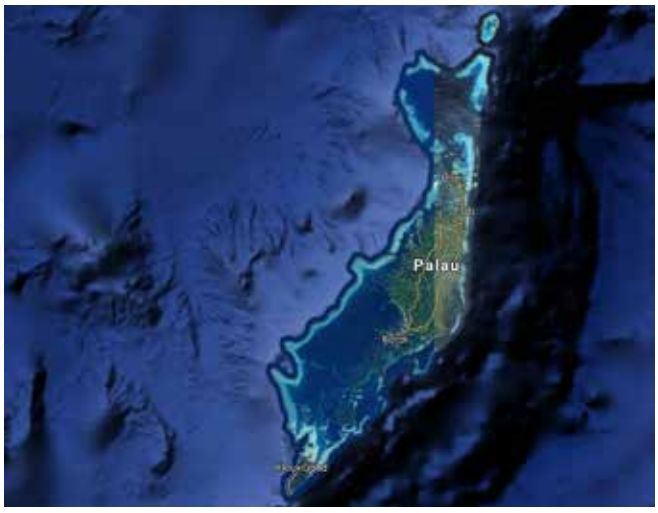
The State of Kayangel transports collected waste by boat to Koror's M-Dock Landfill, which is the country's largest disposal facility. Its location is in an area of shallow reef and mangrove wetland, which has provoked issues associated with leachate runoff that pollutes the surrounding marine environment.

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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Published in 2018 by Pacific Region Infrastructure Facility (PRIF),
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