

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 462,840km² 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.

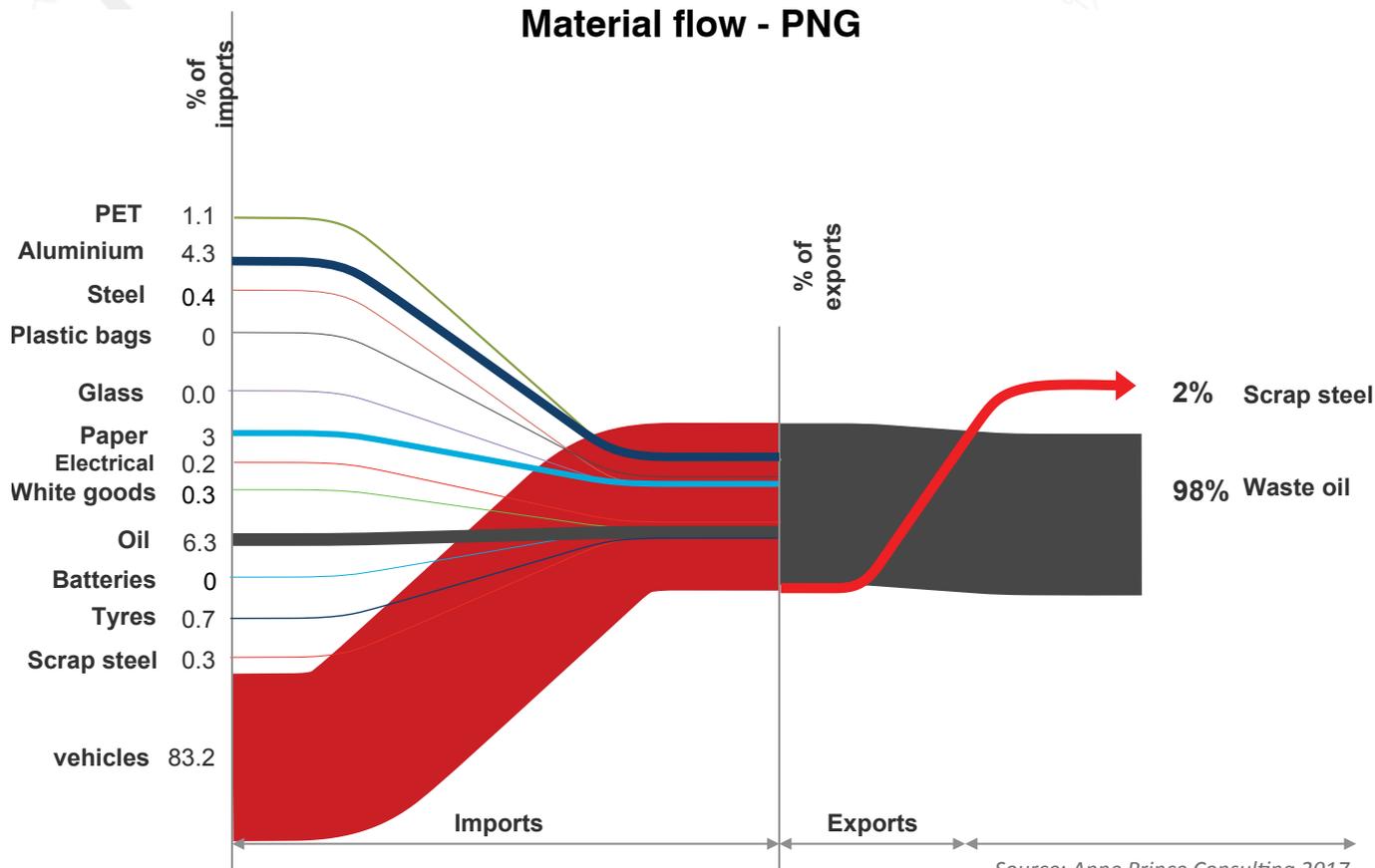
Solid waste management

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)

Material flow - PNG



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

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