



SPREP
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Environment Programme



PacWastePlus
PACIFIC WASTE MANAGEMENT

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



Waste Audit Report

TIMOR-LESTE

October 2021



Supported by the Australian Government
through the Pacific Ocean Litter Project

The information and data gathered from these waste audits will be used by countries in the Pacific to support the development and monitoring of waste and resource recovery projects and recommend the infrastructure and policy interventions required. The regional dataset will also be used to identify and evaluate potential regional projects that would improve waste management in the region.

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Acknowledgment: SPREP, through the PacWastePlus programme engaged Total Waste Management Group PNG Limited to undertake a waste audit Timor-Leste. This report presents the findings of the waste audit undertaken for Timor-Leste. The methodology applied for this waste audit was as per the Waste Audit Methodology – a step-by-step manual to conduct comprehensive waste audits in SIDs, produced by the Pacific Regional Infrastructure Facility (PRIF). We acknowledge the services of the TWM Group for the compilation of this report in coordination and collaboration with the NAOS Services, Water and Sanitation Authority, ANAS-IP, Ministry of Public Works and the Sub-Consultant of TWM.

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

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GLOSSARY

ADB	Asian Development Bank
ANAS.IP	National Authority for Water and Sanitation – Ministry of Public Works; Water, Sanitation, Hygiene and Waste Management Division
EPS	Expanded polystyrene
EU	European Union
GNI	Gross National Income
HDI	Human Development Index (United Nations Development Program)
HDPE	High density polyethylene
HS Code	Harmonised Commodity Description and Coding System
JSA	Job Safety Analysis
LDPE	Low density polyethylene
LPB	Liquid paper board
MEA	Multilateral Environment Agreement
NAO	National Authorising Office, Ministry of Foreign Affairs and Cooperation
PacWastePlus	An EU funded Program implemented through SPREP that seeks to generate improved economic, social, health and environmental benefits for Pacific Island Countries.
PET	Polyethylene terephthalate
PICS	Pacific Island Countries
PP	Polypropylene
PPE	Personal Protective Equipment
PS	Polystyrene
PVC	Polyvinyl chloride
SMASA	Municipality Services for Water, Sanitation and Environment
SME	Small to medium enterprises
SPREP	Secretariat of the Pacific Regional Environment Programme
SWM	Solid Waste Management
TWM	TWM PNG Limited
UNEP	United Nations Environment Program

PacWastePlus Programme

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

About PacWastePlus

The impact of waste and pollution is taking its toll on the health of communities, degrading natural ecosystems, threatening food security, impeding resilience to climate change, and adversely impacting social and economic development of countries in the region. The PacWastePlus programme will generate improved economic, social, health, and environmental benefits by enhancing existing activities and building capacity and sustainability into waste management practices for all participating countries.

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

KEY OBJECTIVES

Outcomes & Key Result Areas

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

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

Key Result Areas

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

Learn more about the PacWastePlus programme by visiting



<https://pacwasteplus.org/>

Executive Summary

Timor-Leste is a member of the Pacific Island Development Forum and one of fifteen countries participating in the PacWaste Plus Program which is implemented by the Secretariat of the Pacific Regional Environment Programme (SPREP) and funded by the European Union Delegation of the Pacific.

The PacWaste Plus Programme is focused on improving waste management activities and the capacity of Governments, industry, and communities to manage wastes for the protection of human health and the environment. The program focuses on several priority wastes that include hazardous, recyclable, food packaging (inc. plastics), organic wastes, disaster, and bulky materials.

TWM PNG Limited (TWM) have been engaged by SPREP to undertake waste audits in Timor-Leste as part of the Pacific wide audit activity conducted by PacWaste Plus.

The program sought to:

- Establish comprehensive data that would enable national policy interventions and contribute toward the objectives of the Cleaner Pacific 2025
- Determine the material composition of the domestic and commercial waste streams
- Establish potential areas for improvement in the country waste management system

The waste audit program introduces the *Waste Audit Methodology: A Common Approach, 2019, PRIF et al.* The methodology provides the tools to accurately measure change in waste generation and the corresponding efficacy and improvement in waste management systems. Audits will ideally be repeated on a regular basis throughout the Pacific, and it is therefore important the methodology is widely adopted in Timor-Leste.

For this project, due to continuing travel restrictions associated with managing COVID-19, the TWM audit team were unable to visit Timor-Leste and delivered the waste audit program remotely engaging a sub consultant based in Dili to coordinate project activities. The training and auditing resources prepared by TWM for the project were translated to Tetum for implementation in Timor-Leste.

Quantitative and qualitative waste auditing with a selection of households and businesses was undertaken in the Baucau and Covalima Districts in August and September 2021. This report provides a snapshot of waste audit generation and composition across the two waste streams for these locations. The study sampled and analysed household data from the urban, peri-urban, and rural areas which was further disaggregated by low, medium, and high-income groupings. The compilation of the data found an estimated average household waste generation rate of 0.44kg per capita per day which was found to be in line with findings from previous studies in Dili¹ and in other Pacific locations².

The study found the average household waste stream comprises approximately 52% organic materials; 24% paper and cardboard; 5% metals, less than 2% hazardous waste and 8.3% plastics of which approximately 1.7% are defined as single-use plastics. The household plastics were primarily made up of PET (48%), flexible/film plastics (28%) and lightweight supermarket bags (10%). The project found the composition for the business sector to be variable and largely in accordance with the business type.

¹ Preparing the Urban Services Improvement Sector Project, GHD, 2015

² PacWaste Plus Waste Audit Program, Papua New Guinea, TWM PNG Ltd, 2021

The highest recorded material for each of the business types studied by the project were organics at 48% for hotels, 50% for retail outlets and 76% for restaurant/food outlet waste streams; 58% plastics for the office sector and 53% paper and cardboard for the supermarket businesses. The large component of organics for retail outlets seems inconsistent with the business type.

Without formal collection services for waste management, the community resorts to burning, pit burial and disposal at informal and uncontained dump locations to manage wastes. The study noted Dili is equipped with community disposal sites throughout the city transferring wastes to the Tibar disposal site.

There is a strong awareness within the community of the risks to human health and the environment from poor waste management practices. There is also a significant expectation for Government to provide systems to manage waste. This study recommends comparison audits be conducted in the coming years using the adopted *Methodology, 2019* to determine changes in behaviours, material type, and the efficacy of waste management systems.

Background

The waste audit undertook representative sampling of the household and business waste streams in municipality Baucau and Covalima. The planning and implementation of the waste audit program was undertaken by TWM and the National Authorising Officer (NAO) services of the Ministry of Foreign Affairs and Cooperation.

The waste audit program received significant support from the NAO services, The National Authority for Water and Sanitation (ANAS.IP) and the Municipality Services for Water, Sanitation and Environment (SMASA).

The program included:

- Training of stakeholder counterparts in planning and delivery of waste audits in line with the adopted methodology: *Waste Audit Methodology: A Common Approach, 2019, PRIF et al* (herein referred to as the *PRIF Methodology, 2019*)
- Household waste sampling by physical audit and household interviews
- Business waste sampling by physical audit and business interviews
- Compilation of customs import and export data

TWM were requested to incorporate data from historical studies conducted outside of the PacWaste Plus program with the aim of presenting a national data statistic.

To this extent, the study received information/data from an audit conducted at the Tibar landfill site as part of the Dili Urban Services Improvement Sector Project Technical Assistance, GHD December 2015 which also referred to data from a previous Solid Waste Assessment and Characterisation Survey conducted as part of the Solid Waste Management Strategy Urban Investment Plan, 2014.

While initially planned as an in-country implementation, the waste audit project could not mobilise the TWM waste audit team to Timor-Leste due to COVID-19 travel and other restrictions.

A sub consultant was subsequently engaged in country to:

- undertake intensive familiarisation in the *PRIF Methodology, 2019*
- translate all training and audit documentation
- deliver training to ANAS.IP staff in Dili and to SMASA staff in each of the audit locations
- supervise audits in Baucau and Covalima
- coordinate with the National Authority for Water and Sanitation and the Municipality Services for Water, Sanitation and Environment throughout the audit program
- manage procurement and logistics arrangements for the training and the audit activities

The report has incorporated information, where applicable from previous studies and has attempted to provide a national perspective on waste generation, waste stream composition and waste management systems in Timor-Leste.

Project Stakeholders and Communications

Preparations for the audit study were coordinated between the National Focal Point, National Authorising Officer (NAO) services of the Ministry of Foreign Affairs and Cooperation, the SPREP PacWaste Plus Programme Manager and Technical Waste Project Officer, the TWM Project Manager and Project Coordinator. The final plan was approved by the NAO and SPREP who also both assisted to source previous reports and data for the project.

Due to language barriers, the sub-consultant led consultations during the study with the National government departments and administrations of the district audit locations, industry stakeholders and community members.

Approval for the INAS.IP and the SMASA staff to participate in the audit activities was provided through the coordination efforts of the NAO services. Similarly, customs data was also sourced through NAO request to the Customs Authority.

TWM appreciate the advice, assistance, and willingness to participate in the study which was provided by all stakeholders. The combined support has assisted TWM's completion of the project deliverables and this report.

Country Profile

Timor-Leste has sustained an increasing annual population growth over the past five decades, almost doubling during that period and is now currently home to over 1.3 million people in 2020. Population distribution is around 31% living in urban areas and 69% in rural. 37% of the population are 14yrs or under and only 4.5% of the population are aged 65 or over (Koema, 2021).

Tetun or Tetum is the most widely used language in Timor-Leste followed by Bahasa, Portuguese and then English. (T-L Census 2015). Referred to as Tetum throughout this report.



Timor-Leste comprises the eastern half of the island of Timor; the Atauro Island north of Dili, Jaco Island on the eastern most end of the island and Oecussi, an enclave on the north-western side of the island within Indonesia. Timor-Leste has four levels of government administration:

- National
- District and capital city municipality
- Sub district or Administration
- Village

The Head of State is the President of the Republic of Timor-Leste. The national government is the executive body of state and is led by the Head of Government, the Prime Minister supported by two Vice Prime Ministers. The national government currently comprises twenty ministries.

The country is divided into 13 districts/municipalities, as per **Table 1**. Each district/municipality has a capital city and is divided by sub districts/administrations which are further divided by village administrative divisions (Suku). The Villages can comprise one or many hamlets (Government of Timor-Leste website).

Table 1: Timor-Leste Population Distribution (2015)

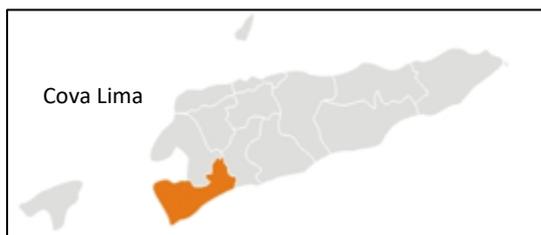
Timor-Leste Population Distribution 2015 Census				
Capital City Municipality	Sub District Administrations	Population	# Households	# Persons In Household
Aileu	Alieu Vila, Laulara, Lequidoe, Remexio	48,837	7,598	6.42
Ainaro	Ainaro, Hato-Udo, Hato-Builico, Maubisse	63,136	10,600	5.94
Baucau	Baquia, Baucau, Laga, Quelicai, Vemasse, Venilale	123,203	22,976	5.34
Bobonaro	Atabae, Balibo, Bobonaro, Cailaco, Lolotoe, Maliana	97,762	17,635	5.51
Covalima	Fatululic, Faumean, Fohorem, Maucatar, Suai, Tilomar, Zumalai	65,301	12,564	5.19
Dili	Atauro, Cristo Rei, Dom Aleixo, Metinaro, Nain Feto, Vera Cruz	277,279	42,485	6.49
Ermera	Atsabe, Ermera, Hatulia, Letefoho, Railaco	125,702	20,670	6.06
Lautem	Iliomar, Lautem, Lospalos, Luro, Tutuala	65,240	12,050	5.41
Liquica	Bazartete, Liquica, Maubara	71,297	11,884	6.03
Manatuto	Barique, Lacro, Laclubar, Laleia, Manatuto, Soibada	46,619	7,467	6.24
Manufahi	Alas, Fatuberlio, Same, Turiscari	53,691	9,023	5.95
Sar of Oecusse	Nitibe, Oesilo, Pante Macassar, Passabe	68,913	14,345	4.79
Viqueque	Lacluta, Ossu, Uato-Lari, Uatucarbau, Viqueque	76,033	15,297	4.97

Reference: Statistics Timor-Leste, <https://www.statistics.gov.tl/category/publications/census-publications/2015-census-publications/volume-2-population-distribution-by-administrative/>

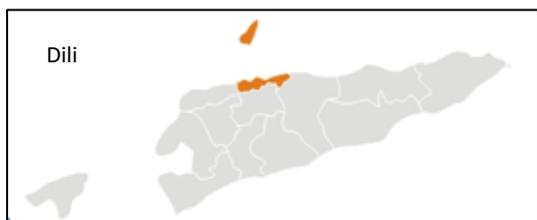
The information drawn from audits conducted throughout urban, peri-urban, and rural locations in two districts have been included in this report. The section below provides a high-level overview of these locations.



The District of Baucau is located on the eastern end of the island of Timor and approximately 122km from Dili. It is the second largest city and is a tourism centre for Timor-Leste and has the country's biggest international airport.



Covalima is located approximately 136km southwest of Dili in the western part of the country, bordering Indonesia. Covalima while located in a coastal area is also located close to Darwin, Australia and is industry focused. The area is being developed with new and improved infrastructure (e.g., roads etc) designed to function as a supply base for the growing Oil and Gas industry.



Dili, the national capital of Timor-Leste is located on the north coast of the island and is the smallest sized district at 372m². Dili has the country's only formal landfill, Tibar. At the commencement of the project a series of audits were recommended for Dili, where the only formal landfill is located. The locations for the audit were subsequently changed to include Baucau, Emera, and Covalima.

The audit in Ermera, selected as a landlocked district, was unable to be undertaken due to a COVID-19 lockdown, with the district of Aileu (a location with similar characteristics) selected as a replacement. Once again, renewed COVID-19 related travel restrictions and lock-down in Dili meant that the third audit could not be conducted as part of the project.

Socio Economic 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.

The country has a population of over 1.3 million people of which around 31% live in urban townships/cities with the remainder residing in rural areas where subsistence farming is common.

The economy is dominated by two broad sectors, agriculture and oil reserve extraction which accounts for most of the export earnings and GDP.

Timor-Leste top exports in 2017 were crude petroleum, followed by coffee, used clothing and agricultural products including locust beans, sugar beet, cane, and seaweed. Top imports were refined petroleum followed by rice, cars, and cement (OEC, 2020).

Its GDP as of 2017 was US\$2.9B and US\$7,210 per capita. The country's trade balance for that year was -US\$543M with exports at US\$108M and imports at US\$651M (OEC 2021). The World Bank forecast an economic contraction of ~7% in 2020 with recovery in 2021 likely to be slow with a forecast GDP growth of 3.1%.

The impact risks from COVID-19 are considerable as the economy is very reliant on the oil and gas sector and therefore vulnerable to market shocks.

The United Nations Development Program (UNDP) monitors the human development index (HDI) annually and in 2019 reported a HDI rating of 0.606 or medium human development (below the average 0.747 for Asia and Pacific) for Timor-Leste. The HDI is based on dimensions such as gender equality, health, education, and standard of living.

UNDP estimates for the period 2016 (most recent survey data available) that 45.8% of the population are multi-dimensionally poor while an additional 26.1% are classified as vulnerable to multi-dimensional poverty. Approximately 30.7% are living below the income poverty line of US\$1.90 per day (UNDP, HDI Report 2020).

The qualitative survey of households and businesses conducted as part of the study provides a snapshot on social demographic and economic background.

The key comparison demographics drawn from the surveys are as follows:

- **Income:** Of the survey respondents in the rural, peri-urban, and urban the distribution of income level was evenly represented across each location. The total reported income levels were as follows:
 - 50% reported an income of less than US\$150 per week
 - 44% reported an income of US\$150-400 per week
 - 6% reported an income of above US\$400 per week
- **Employment:** The survey found the government sector to be the largest employer in both the Baucau and Covalima locations with males reporting over 50% more employment in this sector than females. Women reported 50% less employment than men, with women in Baucau having better employment outcomes than their counterparts in Covalima. A larger number of men were self-employed in Baucau than in Covalima.
- **Education:** Access to education was evenly distributed across the audit locations, with more women attending high school and university than men. There was a greater representation of higher education in Baucau than Covalima locations for both male and female.
- **Essential services:** The survey found that 100% of urban, peri-urban, and rural households have access to electricity in both the Baucau and Covalima locations. Access to water supply was not consistent and ranged from 100% in Covalima urban area to 9% in Covalima peri urban and Baucau rural areas. Of note, the Covalima rural responses showed a 95% access to water supply. Sanitation systems also showed high variability ranging from 90% in Covalima urban area to 5% in the rural area. Similarly, Baucau urban area showed an 81% access while nil was reported in the Baucau peri-urban and rural areas. Stormwater systems were only in place in the Covalima and Baucau urban areas and not reported elsewhere. Waste collection services were not reported in any of the audit locations.

Within the Major sampling strata, i.e., urban, peri-urban, and rural an effort was also made to capture a representation of “high”, “medium” and “low” income areas in the sampling.

Planned in consultation with our sub consultant and with input from SPREP, the parameters used to identify income level are grouped as follows:

- **Low income:** below US\$150 per week
- **Medium income:** between US\$150 and US\$400 per week
- **High income:** above US\$400 per week

Governance Framework and Stakeholders for Waste Management³

Legislation Instruments

The key legislative instruments (Decree Laws), impacting waste governance in Timor-Leste are:

- **Decree Law 38/2020**, Created of National Authority for Water and Sanitation - ANAS, I.P, Article 4, Propose accompanies and ensure the execution of the National Policy in the field of water resources, to guarantee its sustainable and integrated management, as well as its supervision and inspection of the public water supply sector, sanitation of urban wastewater and urban solid waste.
- **Decree Law 3/2012** delegates authority to the Government for environmental protection matters
- **Decree Law 26/2012** Basic Law on the Environment, administered by the Public Prosecutors Office. This law defines wastes including hazardous wastes and allocates responsibilities to government, industry, and citizens for solid waste management. The law prescribes collection, storage, processing, reduction, reuse, and recycling responsibilities and includes State responsibility for the establishment of landfills and waste treatment processes, while prohibiting the import of hazardous wastes. The law has provision for penalties for noncompliance.
- **Decree Law 3/2016** Statute of Municipal Administrations delegates responsibility to the Municipal Administrations and Authorities for the investment in and maintenance of solid and liquid waste management systems
- **Decree Law 33/2008** Hygiene and Public Order prohibits the dumping of wastes on public sites and roadsides and imposes fines and penalties for same. This law is administered by the National Directorate of Community Health
- **Decree Law 5/2016** National System of Protected Areas defines the offence of illegal dumping and prescribes the associated fines/penalties for same to individuals and companies
- **Decree Law 2/2017** Urban Solid Waste Management System prescribes the legal framework for urban solid waste management systems for the Municipality of Dili and the remaining twelve capital city municipalities.

Policy Instruments

The Timor-Leste national Strategic Development Plan 2011-2030 covers three key areas: social capital, infrastructure development and economic development. The sets a pathway with guidelines to improve the management of urban wastes, control pollution and protect the environment. The National Directorate of Basic Sanitation Services which sits within the Ministry of Public Works is the responsible agency for policy development and planning for waste management.

The National Sanitation Policy sets standards and guidelines and designates roles and responsibilities to government agencies for its implementation including five-year plans for waste reduction, reuse, and recycling.

³ Information sourced from *Pacific Region Solid Waste Management and Recycling, PRIF, 2017* and *Assessment of Legislative Frameworks Governing Waste Management in Timor-Leste, SPREP, November 2020*

Ministries responsible for the implementation of the policy are the:

- **Ministry of State Administration** through the Directorate of Urban Organisation has responsibility for planning and development of solid waste management systems. The Directorate of Local Development, Directorate of Local Administration and Directorate of National Support and Administration of Villages each have responsibilities for the management of solid waste in urban areas including public places.
- **Ministry of Health** through the Directorate of Community Health for the coordination of sanitation systems at a national and district level
- **Ministry of Infrastructure** through the Directorate of National Basic Sanitation (Ministry of Public Works, Water, Sanitation, Hygiene and Waste Management Division) is responsible for the provision of sanitation services in the urban and rural areas; the Directorate works in close coordination with the Ministry of State Administration regarding solid waste systems
- **Ministry of Economy and Development:** The State Secretary for the Environment is responsible for pollution control and the management of dangerous wastes; the State Secretary for Rural Development and Cooperatives is responsible for commercial/private sector usage of sanitation goods, services, and installations
- **Ministry of Education** is responsible for ensuring hygiene and sanitation is included in the school curriculum and for planning and maintaining hygiene and sanitation systems in the schools
- **Ministry of Tourism, Commerce and Industry** is responsible for the monitoring of sanitation and hygiene in tourist, commercial and industrial locations
- **Ministry of Finance** is responsible for the provision of integrated budgets that align with national and local priorities
- **Ministry of Social Solidarity** is responsible for assisting vulnerable communities access to sanitation and hygiene facilities

At an international level, Timor-Leste has ratified the following multi-lateral environmental agreements and conventions:

- Montreal Protocol on substances that deplete the ozone layer
- Kyoto Protocol that operationalizes the United Nations Framework Convention on Climate Change to limit and reduce greenhouse gases (GHG) emissions

While Timor-Leste is not a signatory to the 1995 Waigani Convention, it is a Special Observer to the Pacific Islands Forum. Similarly, Timor-Leste is not a signatory to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

Australia has however set in place provisions for the import of hazardous wastes from Timor-Leste legislated by the *Hazardous Waste (Regulation of Exports and Imports) (Imports from East Timor) Regulations 2003*.

Study Methodology

Waste Audit Planning

TWM collaborated with the National Focal Point to finalise planning for the waste audits. The waste audit plan closely reflected provisions contained within the *PRIF Methodology, 2019*. Monitoring of the COVID-19 situation and associated government responses to manage the containment of the virus which included lock downs, travel restrictions and imposition of ‘sanitary fences’ put in place to prevent the movement of residents into or out of certain municipalities. Specific audit planning was required regarding responsible management of the audit team during in relation to COVID-19 preventative measures, and these were reinforced continually throughout the project.

Occupational Health and Safety

A project risk register was prepared for the initial project planning. A detailed Health, Safety, Security and Environment Management Plan specific to the audit environment in Timor-Leste was also prepared for the project and updated to increase the COVID-19 measures to be followed during the project. Further to this a set of Job Safety Analysis and Safe Work Procedures were developed for each of the key stages of auditing:

- Conducting qualitative surveys
- Audit sample collection
- Sorting, classifying, and measuring audit samples

A standard audit site layout was implemented at both audit sites due to the need to integrate safely with the operations of the functioning waste management site. Further to these planning measures, checklists were drawn up for the monitoring and management of safety and emergency equipment installed in the vehicles and at the audit site, and for provisioning of personal protective equipment (PPE).

Finally, all training including induction training provided detailed instruction on the use and maintenance of PPE, safe use of audit equipment and identification and management of hazardous materials and utilization of safe work procedures for the stages of waste auditing. In the case of the Baucau and Covalima the Heads of Hamlets (Village Leaders) participated in the interview phase of the audits and were issued with PPE before conducting these activities.

Confidentiality

The waste audit team members were instructed on the terms of confidentiality at the commencement of the project. The identity of the participants, audit sample characteristics or items within a sample have not and will not be shared by this study.

Waste Audit Locations

The three audit sample locations for Timor-Leste were selected in consultation with SPREP, NAO and ANAS.IP. Baucau, Covalima and Ermera were recommended as suitable audit locations. Audits at the third location were not conducted due to increasing spread of COVID-19 during the project. Initially Emera was to be the first audit location, however this municipality went into lockdown early in August 2021 and the project progressed to the Baucau municipality as the first audit location intending to leave Emera to last. However, during the project and in compliance with changing travel restrictions put in place by the Timor-Leste Government, the district of Aileu was eventually selected to replace Ermera.

Delays due equipment freight and alternate resourcing attributable to disruptions caused by the pandemic combined with a short delay to the commencement of the Covalima audit due to availability of key stakeholders meant the project collided with a new set of COVID travel restrictions. A decision was subsequently made, in the interests of safety and regarding project administration not to proceed with the third audit.

Throughout the project the safety of all stakeholders was prioritised given the interfaces between the audit team and the community and the project activities that were to be conducted. This became increasingly complex with the rising COVID-19 infection rates in the country. Household qualitative audits and quantitative surveys were initially planned for the locations shown in **Table 2**. The sampling fractions detailed below formed the target data strata for the study.

Table 2: Major sampling data strata for Timor-Leste - Target

Major Sampling Strata	Target Sampling Fraction	Target Number of Samples
Baucau <ul style="list-style-type: none"> • Urban • Peri-urban • Rural 	33.33%	69 samples from households without access to collection services distributed evenly with 23 participants in each of the urban, peri-urban, and rural locations. Households provided with audit sample bags to contain 4 days of waste materials.
Covalima <ul style="list-style-type: none"> • Urban • Peri-urban • Rural 	33.33%	69 samples from households without access to collection services distributed evenly with 23 participants in each of the urban, peri-urban, and rural locations. Households provided with audit sample bags to contain 4 days of waste materials.
Ermera <ul style="list-style-type: none"> • Urban • Peri-urban • Rural 	33.33%	69 samples from households without access to collection services distributed evenly with 23 participants in each of the urban, peri-urban, and rural locations. Households provided with audit sample bags to contain 4 days of waste materials.

Waste Audit Training

As a core requirement of the project, waste audit training was delivered to local counterparts. To ensure success of the training and subsequent audits, TWM prepared a comprehensive suite of resources including planning, data recording and analysis tools specifically for the project (originally delivered as part of the PacWaste Plus project in PNG) and contained in a training manual. These resources were required to be translated to Tetum, the national language of Timor-Leste. TWM engaged the services of a sub-consultant to undertake this work and to deliver the training to participants under the guidance of TWM Project Manager and Project Coordinator.

The training and training resources combined were designed to provide the tools for future audits to be conducted consistent with the methodology recommended by the *PRIF Methodology, 2019* and were subsequently provided electronically in USB to the key National stakeholders of the project, NAO Authorising Office and the National Authority for Water and Sanitation. A full day of waste audit training was held at the NAO offices in Dili on the 6th of August 2021.

The training provided both theoretical and demonstrated approaches to planning and conducting a waste audit and covered the following topics:

- Planning a waste audit
- Sample collection, labelling and identification
- Conducting a waste audit
- Sorting measurement and data recording
- Waste audit analysis and reporting
- Risk assessment / job safety analysis
- Audit site set up
- Review of audit data sheets
- Overview of procedure for auditing
- Primary and secondary sorting and classification of samples, measurement, and data recording
- Storage of completed data sheets

Twelve participants from the NAO and ANAS.IP, the National Authority for Water, Sanitation, Hygiene and Waste Management Division offices in Dili attended the training. Of those participants four trainees also joined the half day training sessions conducted in the Baucau and Covalima audit locations, which were designed to introduce the practical audit delivery.

These training sessions were primarily attended by staff from the Municipal Services for Water Sanitation and the Environment and the Head of Hamlets who actively participated in the implementation of the audit projects in each of the locations.

A total of 52 nationals of Timor-Leste were trained in waste auditing with four of those participants attending more than one session. **Table 3** provides the organisation represented by each of the participants.

Table 3: Waste Audit Training Participants

Participants	Organisation
Seven participants	Dili NAO
Five participants	Dili ANAS.IP
Sixteen participants	Baucau SMASA; ANAS.IP; Chief of Villages
Twenty-four participants	Covalima SMASA; ANAS.IP; Market and Tourism Management Dept; Head of Hamlets

The project has demonstrated its approach to building in-country capacity for the delivery of waste audits consistent with the *PRIF Methodology, 2019* to continue baseline and comparison waste audit programs into the future. Refer to the *PacWaste Plus Waste Audit Training Report Timor-Leste, August 2021* for further information.

Qualitative Surveying

Qualitative surveys were conducted with the households and businesses who were to participate in the audit program. The interviews were conducted by three teams comprising TWM sub consultant, Head of Hamlets, ANAS.IP representatives and members of the Municipal Water, Sanitation and Environment divisions in each of the audit locations. Throughout the interview days the TWM Project Manager and Project Coordinator were online and available to respond to any questions arising.

TWM were advised by its Sub Consultant and the National Focal Point that prior consent would be required from each of the participating households and businesses and that this would be sought during the qualitative interviews and introduction to the project.

Audit personnel selected every third to fifth house in the street or general location where formal streets were not in place. If consent was given on introduction of the project, the qualitative survey was conducted. Interviewees were provided a background of the PacWaste Plus Programme, the waste audits and project objectives.

A total of 120 households and 20 businesses (across two audit locations) were interviewed over a period of five days. The selection of businesses was based on the business type within the range of businesses required by the PRIF Methodology, 2019.

Each interview took around 30 minutes to conduct, and the information provided by the participant was handwritten into the preformed template. The completed template was scanned and filed, and the entries then entered an excel workbook for analysis.

Interviews included questions on the following issues:

- Demographic Information including household numbers, ages, work and educational background (for households only)
- Income level (for households only)
- Disposal behaviour by material types
- Collection services
- Willingness to pay for collection/ disposal systems
- Current recycling behaviours including further source separation
- Level of awareness about current waste services
- Access to amenities (electricity, sanitation, stormwater infrastructure)
- Consumption habits
- Waste volume over a period of one week

A Job Safety Analysis (JSA) was prepared for this activity to support the safe conduct of household and business surveys which also formed part of the waste audit training manual provided to the participants.

Quantitative Auditing

The audit sample selection and schedule were prepared in collaboration with the local Municipal Water, Sanitation and Environment staff and the Head of Hamlets. As waste collection services are not provided to these locations, the sample period and collection timeframe did not need to correlate with regular household waste collection services. The policy of prior consent from individual householders presents an opportunity for the size and characteristics of the audit sample to be influenced, either intentionally or otherwise, and should be considered when considering the audit findings. The selection of samples was in accordance with the data strata defined in the agreed Waste Audit Plan which split samples between urban and peri urban areas and in low, medium, and high-income locations. However, the number of samples in each location was reduced from 23 to 20 after concerns from the Sub Consultant, that given the lack of experience in the audit teams, the full quota of samples may not be achieved within the timeframe allocated (see **Table 4**).

Table 4: Major sampling data strata for Timor-Leste - Actual

Major sampling strata	Targeted Sampling Fraction	Number of Actual Samples
Baucau <ul style="list-style-type: none"> • Urban • Peri-urban • Rural 	33.33%	60 samples from households without access to collection services distributed evenly with 20 participants in each of the urban, peri-urban, and rural locations. Households provided with audit sample bags to contain 4 days of waste materials.
Covalima <ul style="list-style-type: none"> • Urban • Peri-urban • Rural 	33.33%	60 samples from households without access to collection services distributed evenly with 20 participants in each of the urban, peri-urban, and rural locations. Households provided with audit sample bags to contain 4 days of waste materials.
Ermera <ul style="list-style-type: none"> • Urban • Peri-urban • Rural 	33.33%	Nil samples from households. The project was unable to proceed due to COVID restrictions imposed by Government.
		Total: 120

Samples were collected from the third to fifth house in a street, dependent on those properties where prior consent had been given.

Participants were issued specific waste disposal bags for the purpose of collecting and storing waste over a three-day period which would be collected ahead of the normal collection service. The bags were positioned separately on their property to be collected by the audit team on the defined day.

The target audit strata were unable to be followed for the overall auditing of 180 household samples as during the audit, the Government of Timor-Leste imposed a lockdown on the Ermera district. As this district was initially scheduled to be the first audit (of three), a decision was made to commence with Baucau and await the lifting of the lockdown to undertake the audits in Ermera as the last location for the project.

Ultimately, after the audits were conducted at the second location, Covalima, the Government imposed strenuous travel limitations due to an outbreak of the Delta strain of the virus in Dili and in districts throughout the country. Aileu was identified as a replacement third audit location, however due to COVID-19 travel restrictions and the resultant delays to the project delivery, these audits were unable to proceed.

Three teams of four (including the driver) utilised three utility vehicles to collect the samples. One team was led by the TWM Sub consultant and the others by the ANAS.IP staff from Dili.

The samples were tagged with sample number, location and strata type and recorded into the sample collection data sheet along with additional observational information, including photographic evidence prior to placing in the collection vehicle. The sample number was recorded against the sample which was then used to track the sample throughout the audit process.

In all audit areas audits, the Head of Hamlet assisted the teams to ensure full participation in the audits and compliance with audit sample procedures. A total of 60 samples were collected in Baucau and further 60 samples in Covalima.

Audit templates for recording collection samples and audit data were prepared and translated early in the project and provided to participants as part of the waste audit training manual as were the job safety analysis which were prepared to support the safe implementation of the audit activities.

Twenty business properties were audited in Baucau and Covalima comprising:

- Administration and offices including Covalima (2) and Baucau (2)
- Food outlets including restaurants and cafes Covalima (2) and Baucau (1)
- Hotels including accommodation providers Covalima (3) and Baucau (3)
- Supermarket, including small and large supermarkets, Covalima (1) and Baucau (2)
- Retail outlets Covalima (2) and Baucau (2)

The auditing of the samples followed the methodology for sorting, material classification and measurement as prescribed by the PRIF Methodology, 2019, refer to the **Appendix A** Audit Material Categories.

However, this was not the case for the audit data sourced through the Dili Urban Services Improvement Sector Project Technical Assistance, GHD for ADB, December 2015 publication. This was a landfill-based audit program that measured incoming vehicles to the Tibar site in Dili.

Desktop Research on Waste Service Provision

Waste Service Distribution

While no household or business collection services were identified in either of the audit locations, it is understood the Dili Public Administration provides communal disposal points throughout the Capital City and that otherwise some areas are serviced by private sector businesses.

Waste Collection Service

Household and commercial waste collection services were not identified as being provided in the Baucau and Covalima audit locations.

Financial Mechanisms for Waste Management

In the Covalima and Baucau audit locations it is understood that user fees / revenues are not collected from the households and businesses as there are no waste collection services provided by the administrations in these areas. The costs for maintaining open dumping sites that are used in Baucau and Covalima would be assumed to be little given the minimal management e.g., predominantly burning and maintenance of the sites. This of course does not account for costs associated with the legacy environmental damage or potential human health conditions incurred because of lack of formal operations and containment infrastructure at these sites. The study was unable to confirm if advance disposal revenues are collected from import levies, however it seems unlikely that these systems would be in place.

Disposal Facilities

Covalima

The Covalima disposal site is in Haemanu, in the eastern part of Covalima approximately 18-19km from Suai City. The site is approximately 70mx120m in size and is accessed 2km in from the main road. It is understood that while the site is privately owned it is maintained by a SMASA staff member who also monitors the liquid waste facilitates (comprising concrete bunkers) that are located close to the disposal site. Regular burning is the predominant management methodology for the site. Two pits have been dug at this site, each approximately 10m wide, 50m long and 6m in depth. However, it is apparent that surface dumping is also occurring frequently outside of the pits. Material types observed at the disposal site during the assessment included glass jars and bottles, cardboard, plastic water bottles. However, advice received suggests the site is also used for the disposal of medical/healthcare wastes, but these materials were not observed.

Baucau

In Baucau, two disposal sites in the villages of Bahu and Trilolo were assessed. Each of the sites are without liner/barriers systems, are unfenced and are used for surface dumping only. In both cases the sites are open access via an internal road which people use to unload their wastes to avoid driving over areas previously used for disposal. Material types observed at the disposal sites during the assessment included water bottles, steel containers, aluminium cans, glass bottles, glass jars, zinc alum sheeting and other metals. The site ownership is unclear, and while the sites appear to be unmanaged, there are signs of burning occurring. It would seem this is done on an ad hoc basis. Each site is located approximately 5-6km from the main road and are approximately 1 hectare in size. These sites are being temporarily used ahead of the planned construction of a landfill in the Seichal area located to the east of Baucau⁴.

⁴ Information provided by SMASA staff, Bacau

Dili

In Dili, there are approximately 200 concrete bunker disposal points located throughout the city for community use. These bunkers (sometimes with skip bins) are manually cleared by collectors and transferred to the Tibar disposal site which is managed by the Dili District Administration servicing the city and part of the Liquica District.

Tibar disposal site comprises controlled dumping areas where materials are spread, partially compacted by bulldozers operating at the site before profiling and intermediate covering however fires are common on the site. It is unknown whether the disposal areas are clay lined. The site is located approximately 25km from Dili, is approximately 25ha in total area with approximately 12ha cleared for waste receipt. Tibar has been operational for a period of 25 years. It is understood a new engineered landfill will be constructed at Tibar soon and planning for the remediation of the current disposal site is underway.

Table 5: Disposal Facilities

Location	Facility Type	Facility Name	Comment
Baucau	Open disposal sites	Bahu Tirilolo	These sites are uncontained. Ownership is unknown.
Covalima	Pit disposal	Haemanu	Privately owned
Dili	Concrete bunker disposal pits	Community use	Pits are concrete bunkers
Dili	Controlled disposal site	Tibar landfill	

Management of Health Care Wastes

A previous study⁵ reported a 2007 World Bank project was to install dual chamber incinerators and provide staff training for each of Timor-Leste's major hospitals. This study was unable to obtain an update on the operating capacity or operational status of these incinerators.

During the project, an interview was held with the Hospital Director at Covalima. The Director explained the hospital has its own Incinerator, which was supported by SPREP, but it was not fully installed and therefore not operational. The hospital also has a bio system for wastewater which is not functioning properly. Solid wastes are stored by the hospital cleaners and the materials are transferred to the Haemanu disposal site each week at which time it is burnt immediately. The hospital storage area is approximately 16m² with a roof covering and is gated to manage entry.

Hazardous Waste Management Systems

The segregation of household hazardous wastes is uncommon with most materials being treated as general domestic waste. This finding is supported by the presence of items such as batteries and e-wastes in the household audits conducted by this study. However, these were in exceedingly small quantities – a finding corresponding to a previous audit conducted at the Tibar landfill, by GHD in 2015.

For Baucau and Covalima, the end disposal point in the uncontrolled dumping sites in their localities. These sites are unlined and without daily management.

⁵ Preparing the Urban Services Improvement Sector Project, GHD, 2015

Recycling Facilities

Current information on recycling facilities in Timor-Leste were unable to be obtained for this study. The assessments conducted in Baucau and Covalima did not find local recycling to be occurring nor located any recyclers in these areas.

Previous studies⁶ located numerous private sector recyclers operating in the plastics and steel commodities. However, it is not known whether these operations are still active given changes to the Chinese market, once a large procurer of recyclable materials, and due to the impacts of COVID-19.

It is further understood a memorandum of understanding has been signed by the Government of Timor-Leste for the construction of a general recycling plant⁷.

Data Validation

In both cases the data was entered independently by two team members - one for household and one for business. The entered data was then reviewed by the data analyst for any anomalies. Following this a selection of random entries were reviewed by the project manager for consistency with the supplied data. Data validation was conducted during entering of the data to the workbooks to compare the sum of the waste components with the total weight of the sample.

The study also compared data from the Baucau and Covalima audits with data sourced from the *Dili Urban Services Improvement Sector Project Technical Assistance, GHD for ADB, December 2015* publication, forecast data in *What a Waste: A Global Review of Solid Waste Management, 2012 World Bank* and the PacWaste Plus Waste Audit Program in Papua New Guinea, TWM PNG Ltd 2021. **Table 6** shows a comparison of these average waste generation data.

Table 6: Average waste generation rates

Audit Location	Waste Audit Conducted	Av. Generation per Capita (per day)	Data Source
East Asia & Pacific	2012	0.95kg (increasing to 1.5kg in 2025)	<i>What a Waste: A Global Review of Solid Waste Management, 2012 World Bank</i>
Dili	2015	0.37kg	<i>Dili Urban Services Improvement Sector Project Technical Assistance, GHD for ADB, December 2015</i> Sourced from SPREP
Baucau	2021	0.39kg	PacWaste Plus Audit
Covalima	2021	0.49kg	PacWaste Plus Audit
Lae	2021	0.30kg	Supplied by JICA
Roku Village	2021	0.39kg	PacWaste Plus Audit

Note: East Asia & Pacific per capita rate is calculated to be 1.31kg using a .04% per annum increase as per World Bank forecast *What a Waste: A Global Review of Solid Waste Management, 2012 World Bank*.

⁶ Pacific Region Solid Waste Management and Recycling, PRIF, 2017 and Dili Urban Services Improvement Sector Project Technical Assistance, GHD, 2015

⁷ Assessment of Legislative Frameworks Governing Waste Management in Timor-Leste, SPREP, November 2020

The results in **Table 6** show that the data from this study does not align with the forecasts the World Bank has made for the broader East Asia and Pacific region.

The variation between the per capita generation rate estimates from this study and others in the region may be explained by normal statistical variation in the samples, some change across time, and inconsistency in sampling and classification methodologies used between the audits.

Averaging the waste generation findings from Baucau and Covalima audits with the findings from the previous GHD study found a per capita estimate of 0.41kg per capita per day for the prior study, which compares favourably to the 0.44kg average found by this latest study.

A further comparison of the primary classification findings was undertaken to find similarities with historical data, refer **Table 7**. The data is expressed as a percentage of the overall waste samples audited. Noting the comparison below has relied on high level data from the Dili audit 2015 audits as detailed data sets were not provided to this study. The data from this study is within the range found by other similar audits, except for the cardboard and paper findings from the Covalima audit.

Table 7: Similar Audit Location Data Comparisons

Audit Location	Waste Audit	Organic*	Cardboard Paper &	Textiles	Plastics*	Metals*	Glass *	Hygiene *	Miscellaneous*	Hazardous
Dili	2015	45%	22%	2%	18%	1%	2%	N/A	3%	N/A
Baucau	2021	56%	7.7%	3%	12%	8 %	7%	2%	N/A	3%
Covalima	2021	48.5%	35.5%	2.5%	6%	3%	0.6%	2%	N/A	1.5%
Lae PNG	2021	44%	7%	11%	14%	1%	9%	7%	1%	5%
Roku Village, PNG	2021	42%	8%	4%	22%	7%	5%	6%	1%	4%

Note: that due to rounding, the table data entries may not sum to 100% total.

The 2015 audit conducted in Dili classified and measured the waste samples according to the primary categories in **Table 7** above. Whereas the 2021 PacWaste Plus audits measured to the more granular secondary material categories as prescribed in the *PRIF Methodology, 2019*.

To allow for comparison the secondary categories have been grouped into their respective primary classification (following):

- Organic includes betelnut, bones, garden waste, timber
- Plastics includes all polymers
- Metals include ferrous and non-ferrous
- Glass includes ceramics
- Hygiene includes baby nappies
- Miscellaneous includes leather and rubber

Audit Findings

The sections below detail the findings from the qualitative surveys and the quantitative audits conducted in Baucau and Covalima.

Household Surveys

When reading the qualitative audit outcomes, consideration needs to be given to the matter of respondent's privacy. In some cases where local auditors were interviewing local householders, the data outcomes may not be fully reliable in that information may have been withheld or mis-reported to the interviewer.

Where percentages may not arrive at a total 100% this indicates that not all respondents provided an answer to that question and only the response rate is reported in this circumstance.

Access to Services

None of the 120 households surveyed in Baucau and Covalima have access to waste collection services.

Household Waste Separation

All respondents were asked about the level of waste material separation at the household level. There was some inconsistency in reporting separation and then treatment of these materials. Given the absence of recycling markets the purpose for separation while not clear, appears to be associated with ensuring the efficient burning of the wastes and in a small number of cases, to recover containers for repurposing. Once burnt, the ash and remaining waste materials, that are non-combustible or don't burn easily, are buried in pits in yards or dumped to uncontained disposal sites. **Table 8** below provides a snapshot of the responses and should be read as follows:

Organic wastes are in the main separated for use in garden, composting or may be used as animal feedstock. Of the remaining materials in the waste stream, it appears that some separation is occurring. However, confirmed information regarding supply to recycling agents was not forthcoming to the survey and the audit team were not able to locate stockpiles of recycled materials such as glass, plastics, steel. A small number of respondents reported glass jars and bottles are separated for reuse at home or school. Given the relatively high reporting of separation of aluminium and steel cans, it is thought these may be used for storage or repurposed for use in other applications e.g., flattened and used as a building, machinery repair material.

Table 8: Level of Waste Separation in Households

Material Type	Urban	Peri-urban	Rural
Organics	100%	45%	48%
Cardboard and paper	21%	47%	57%
Plastics	21%	50%	73%
Aluminium and steel cans	24%	65%	83%

Waste Generation

The household interviews asked a range of questions regarding the types and volumes of waste generated by the occupants and the method of managing wastes in their household. A bag/box measure was used to determine the volume of waste generated in households. It could be reasonably expected that the bag/box measure may compare to 20L per bag or box. Note the interview data did not provide detailed descriptions of 'other'.

Table 9: Weekly waste generation Baucau

Rubbish generation per week reported by bag/box	Urban	Peri-urban	Rural
1-2 bags/box	47%	95%	14%
3-4 bags/box	33%	-	-
5-6 bags/box	9%	-	-
9-10 bags/box	9%	-	-
Other	8%	5%	86%

The respondents estimate on how much waste generated each week using a bag/box measure in Covalima are provided in **Tables 10**.

Table 10: Weekly waste generation Covalima

Rubbish generation per week reported by bag/box	Urban	Peri-urban	Rural
1-2 bags/box	48%	60%	90%
3-4 bags/box	52%	-	5%
5-6 bags/box	-	-	-
Other	-	30%	5%

Note: Respondents may not have answered all questions and in these cases the qualitative data appears incomplete. However, the data in **tables 9 and 10** should be read as percentage of overall interviews conducted for the location.

Waste Disposal Methods

The Baucau and Covalima qualitative surveys found there to be no existing collection services in either location.

The common practice for dealing with wastes is primarily burning and burial in yard or taken to the disposal points. Respondents advised that waste is predominantly managed daily or every few days.

In Dili, a series of communal disposal points are utilised throughout the city. Waste collection is a service also provided by the private sector.

Willingness to Pay

The survey sought responses regarding the level of satisfaction with current waste disposal methodologies and the willingness to pay for improved services. Collated responses are highlighted in **Table 11**. The responses to these questions did not always align where respondents were dissatisfied and suggested changed or additional services e.g., bulky waste collections, separate collections for recycled materials but did not show a willingness to pay for improved services.

Table 11: Satisfaction with Rubbish Disposal Services

Methods for waste disposal	Urban	Peri-urban	Rural
Satisfied with current method for waste disposal	17%	37%	36%
Identified improvements to waste collection services	83%	60%	64%
Improved how	<ul style="list-style-type: none"> • Government should provide a collection system • Need a designated garbage disposal area • Community should better manage their waste 		
Willingness to pay for an improved service	67%	66%	26%

Note: Respondents may not have answered all questions and in these cases the qualitative data appears incomplete. However, the data in **table 11** should be read as percentage response of overall interviews conducted for the location.

The key findings from the willingness to pay question are shown below noting these are shown as an average of the responses:

- Urban: 27% depended on the amount being affordable
- Peri-urban: 50% were willing to pay \$0.20
- Rural: 74% unwilling to pay

The survey sought responses regarding the level of awareness within communities on waste management and its impact. Collated responses are highlighted in **Table 12**.

Table 12: Awareness of Impacts from Poor Waste Management – Response Ranking

Survey Question	Urban	Peri-urban	Rural
Is the way in which waste is managed an issue	YES: 98%	YES: 87%	YES: 93%
Why? What are the key impacts	1. Damage to human health and the environment	1. Damage to human health and the environment 2. Eyesore and Odours	1. Damage to human health and the environment

Household Data

The study analysed data from within each of the income level groups across the audit locations. However, the outcomes for the income level groups must be read with some caution as the declaring of income level to local interviewers may have resulted in a bias in reporting, therefore the data outcome may have been influenced.

While the income level group data may be unreliable, we have included this information in the report to be consistent with the approach taken with the previous PacWastePlus report for Papua New Guinea.

Analysis of waste generation rates and composition has been done in accordance with the classifications prescribed by the *Audit Methodology, 2019*, noting existence of any exceptional items as found during the audits.

The data provided in **Tables 13 to 16** is derived from the 2021 audits.

The data provides detailed per household and per capita waste generation rates for the combined and low, medium, and high-income levels independently for each of the urban, peri-urban, and rural audit locations.

Table 13 highlight the combined result of waste generation of all income levels in the rural, urban, and peri urban in Baucau and Covalima.

Table 13: Waste Generation All Income Levels Combined

All Income Levels Combined Waste Generation Per Day		
Waste Audit	Per household (kg/pd)	Per capita (kg/pd)
Baucau Peri Urban	1.4	0.27
Baucau Rural	3.0	0.57
Baucau Urban	2.1	0.34
Covalima Peri Urban	2.8	0.56
Covalima Rural	2.8	0.56
Covalima Urban	2.1	0.36

Table 14 highlight daily waste generation rate for low-income household levels in the rural, urban, and peri urban in Baucau and Covalima.

Table 14: Waste Generation Low Income Households

Low Income Household Waste Generation Per Day		
Waste Audit	Per household (kg/pd)	Per capita (kg/pd)
Baucau Peri Urban	1.53	0.29
Baucau Rural	3.3	0.64
Baucau Urban	2.1	0.34
Covalima Peri Urban	2.6	0.52
Covalima Rural	5.8	1.14
Covalima Urban	2.1	0.36

Table 15 highlight daily waste generation rate for medium income household levels in the rural, urban, and peri urban in Baucau and Covalima.

Table 15: Waste Generation Medium Income Households

Medium Income Household Waste Generation Per Day		
Waste Audit	Per household (kg/pd)	Per capita (kg/pd)
Baucau Peri Urban	1.3	0.25
Baucau Rural	2.0	0.39
Baucau Urban	2.0	0.33
Covalima Peri Urban	3.1	0.62
Covalima Rural	1.3	0.27
Covalima Urban	2.2	0.38

Table 16 highlight daily waste generation rate for high income household levels in the rural, urban, and peri urban in Baucau and Covalima.

Table 16: Waste Generation High Income Households

High Income Household Waste Generation Per Day		
Waste Audit	Per household (kg/pd)	Per capita (kg/pd)
Baucau Peri Urban	-	-
Baucau Rural	3.53	0.67
Baucau Urban	-	-
Covalima Peri Urban	-	-
Covalima Rural	2.4	0.47
Covalima Urban	-	-

The above daily average waste generation rates were compared with those found in a previous landfill audit conducted the Dili 2015 (GHD).

While the audit was not based on the *PRIF Methodology, 2019*, it found the following waste generation estimates that fall within the .25 to .67 range findings of this study:

- Colmera: 2.4kg per household / 0.38kg per capita
- Kaikoli: 1.6kg per household / 0.26kg per capita
- Farol: 3.1kg per household / 0.48kg per capita

Refer to the pie charts in **Figures 1-6** which set out the individual waste generation data for high, medium, and low-income households in each of the audit locations. All measures quoted in this section are percentages by weight.

Rural Sample General Findings

An average 0.56kg per capita and 2.9kg per household daily waste generation rate initially seemed high for a rural location in comparison with the urban data findings. It is considered the sample size per household may have been influenced by this audit's temporary provision of a 'waste collection service' where there is not normally one available, and thus may have resulted in additional materials in the waste sample and a larger waste generation finding.

Urban Sample General Findings

The daily waste generation rates were remarkably similar between Baucau and Covalima urban areas with an average 2.1kg per household and 0.35 per capita. In general, the Covalima sample held the greater level of organics and the Baucau sample a greater level of packaging wastes, specifically plastics, cardboard, and paper.

Peri-Urban Sample General Findings

The peri-urban audits found a significant difference between the Baucau and Covalima samples. Covalima generation rates are double those of Baucau and the study found a vast difference in organic waste generation with Covalima material composition showing 66% organics and Baucau 37%. In the reverse, Baucau showed around 50% more plastics and textiles in the samples audited than Covalima.

Recyclable Material Distribution

This section provides a breakdown of the key findings from the quantitative waste audits. It is presented by primary waste type (category) and further described by sub or secondary classifications included in the primary category. This section also provides an analysis of the distribution of materials that could be made available for recovery and recycling and presents the findings for each primary material category.

Primary Category: Organics

The audit measured the following secondary or sub classifications:

- food
- wood and timber
- garden organics
- other organics
- betelnut
- shells and bones

Overall, the audit samples, not surprisingly organic waste is the highest contributor, ranging between 84% and 29% of the Baucau rural high income and the Covalima rural low-income samples respectively. Garden organics were the most highly represented material at an average of 2.9kg in the Baucau rural high-income sample to 0.5kg in the Baucau peri urban low-income sample.

Primary Category: Metals

The audit measured the following secondary or sub classifications:

- aluminium cans
- aluminium
- steel containers
- metal other

Metals measured between 0.3% and 14% in the Covalima rural low-income sample and Baucau Peri Urban medium income samples respectively. The greatest contributor to the metals waste stream is steel cans followed by aluminium, aluminium cans, and metals other.

Primary Category: Cardboard & Paper

The audit measured the following secondary or sub classifications:

- cardboard
- liquid paper board (LPB)
- composite
- paper
- tetrapak

There was a significant difference in how paper and cardboard measured across the household samples at between 2.5% (Baucau Rural High Income) and 61.8% (Covalima Rural Low Income) from each of the audit locations. Baucau measured no cardboard, but elevated levels of composite materials followed by LPB and paper respectively. Covalima's audit findings were equally distributed between material types, however still a high composite material outcome. Covalima rural low income recorded the highest with LPB containers in the waste stream followed by cardboard and composite materials across all samples.

Primary Category: Glass

The audit measured the following secondary or sub classifications:

- glass bottles
- glass jars
- glass fines
- glass other

Glass measured approximately 4% of the combined waste samples across both locations. The Baucau rural sample recorded the highest and Covalima rural, the lowest rate of glass. Across all locations glass jars represented the highest portion of glass subcategory in the waste samples.

The Covalima business data registered only glass jars, where the Baucau findings were glass jars, followed by bottles and other glass. The largest amount of glass was found in the retail samples.

Primary category: Plastics

The audit measured the following secondary or sub classifications:

- PET (Polyethylene terephthalate) containers
- HDPE (High Density Polyethylene) containers
- LDPE containers
- PVC containers
- EPS (expanded polystyrene)
- PS (Polystyrene)
- PP (Polypropylene)
- Flexible/film
- Other plastics

Data for the various polymer types (listed above) were collected from the 2021 audits. These are presented in **Table 17**. The audits recorded plastics as 2.4% in the high-income sample of Baucau rural area and 20.8% in the Baucau peri urban low-income sample.

PET and flexible plastics were the highest contributor to the plastics waste stream throughout all location samples. In the single use plastics category, the data was similar across the two locations however Covalima registered a much higher level of lightweight supermarket bags (16%) and beverage containers.

While Baucau had the greatest presence of takeaway containers, heavy carry bags and cigarette packets.

Table 17: Average composition of the household plastics waste stream

Plastic Polymer	Percentage of each plastic type within the plastic waste sample	Percentage of each plastic type within the overall household waste sample
PET containers (1)	41.55%	4.73%
HDPE containers (2)	4.96%	0.56%
LDPE containers (4)	0.88%	0.10%
PVC containers (3)	1.79%	0.20%
EPS - polystyrene	0.18%	0.02%
PS (6)	0.00%	0.00%
PP (5)	0.27%	0.03%
Flexibles/film	27.86%	3.17%
Other plastic	1.25%	0.14%

Note: The above data should be read as e.g. PET containers made up 41.55% of the combined plastic (Table 17) and single use plastic (Table 18) waste sample which in turn represented 4.73% of the overall household waste sample for the study.

Data was also collected on each of the sub classifications for single use plastics presented separately in **Table 18**.

Table 18: Average composition of the household single use plastics waste stream

Single Use Plastic Type	Percentage of each plastic type within the plastic waste sample	Percentage of each plastic type within the overall household waste sample
Beverage containers	1.41%	0.16%
Cigarette butts	0.48%	0.05%
Cigarette packets	4.11%	0.46%
Straws	0.00%	0.00%
Coffee cups	0.52%	0.06%
Bags – heavy carry bags	3.8%	0.43%
Bags – supermarket lightweight	10.32%	1.17%
Takeaway plastic other	0.46%	0.05%
Takeaway styrofoam	0.09%	0.01%
Takeaway paper	0.00%	0.00%
Takeaway lids	0.00%	0.00%
Bottle lid	0.00%	0.00%

Note: The above data should be read as e.g. beverage containers made up 1.41% of the combined plastic (Table 17) and single use plastic (Table 18) waste sample which in turn represented 0.16% of the overall household waste sample for the study.

Hazardous Waste Distribution

There were minimal hazardous wastes found across the audit samples.

- Tyres were overwhelmingly the most predominant item, followed by electrical items and fluorescent bulbs. Given the even distribution of the ‘tyre’ data throughout all income levels and locations, rubber may have been treated as tyre in the audit data.
- E-waste (Computer and mobile phones) were recorded in the rural samples, particularly Covalima whereas electrical items were only found in the urban and peri urban samples.
- Batteries (Lithium batteries) were the most highly recorded of all batteries and only the rural samples contained batteries. The absence of cell batteries in the waste stream could be attributable to the extremely high (nearly 100%) access to electricity services across all audit locations. The lack of mobile phone batteries in the samples is attributable to the small presence of mobile phones found in the samples.

Composition of the hazardous waste stream found in household samples collected during the waste audit is reflected in **Table 19**.

Table 19: Composition of the household hazardous waste stream

Material	Percentage of each hazardous waste type within the hazardous waste sample	Percentage of each hazardous waste type within the overall household waste sample
Batteries		
Non-rechargeable	0.00%	0.00%
Rechargeable	0.00%	0.00%
Lead acid	0.00%	0.00%
Mobile batteries	0.00%	0.00%
Power tool	0.00%	0.00%
Lithium batteries	0.16%	<0.01%
Lithium ion	0.00%	0.00%
Other batteries	0.03%	<0.01%
E-waste		
Computer	0.06%	<0.01%
TV's	0.00%	0.00%
Mobile phones	0.79%	0.02%
Electrical items	21.45%	0.66%
Toner cartridges	0.00%	0.00%
Household Hazardous		
Paint	1.59%	0.04%
Fluorescent	8.29%	0.25%
Household chemicals	0.00%	0.00%
Asbestos	0.00%	0.00%
Clinical (medical)	0.11%	<0.01%
Gas bottles	0.00%	0.00%
Hazardous other	0.13%	<0.01%
Waste oil	1.33%	0.04%
Tyres	66.00%	2.03%

Note: The data in Table 19 should be read as e.g., tyres made up 66.00% of the household hazardous waste stream which represented 2.03% of the overall household waste sample for the study.

Hygiene Waste Distribution

Of this category, baby nappies were overwhelmingly the largest recorded material representing 97% of the combined hygiene waste stream and 3% of the overall household waste sample.

Detailed Household Waste Composition

Figures 1-6 provide a series of pie charts to present the major categories of the household waste audit. The results are broken down by location (Baucau or Covalima) *urban*, *peri urban* and *rural* by low, medium, or high-income level.

The pie charts show an average household waste composition by weight found by this study. For comparison purposes, the data sourced from the *Dili Urban Services Improvement Sector Project Technical Assistance, GHD for ADB, December 2015* shows the representation in the overall waste stream as follows:

- Total Paper: 22%
- Total Organics: 45%
- Total Glass: 2%
- Total Plastics: 18%
- Total Metals: 1%
- Total Other: 3%

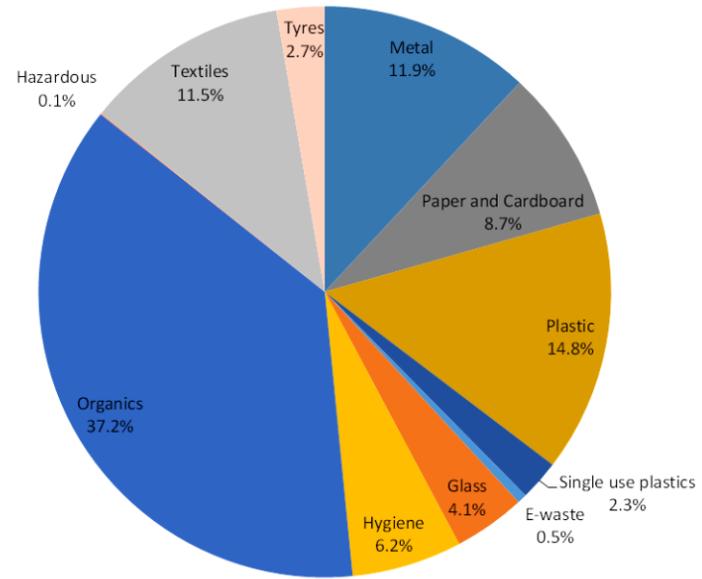
The waste composition in each of the following pages is broken down into high, medium, and low-income households as well as the combined sample result. Whilst we report high, medium, and low waste breakdowns in these panel sets the results should be treated with caution at this level of disaggregation.

The overall sample result represents a stratified mean by income level for the audit locations and therefore sample sizes within each income strata are not necessarily sufficient to produce a low variation statistical result.

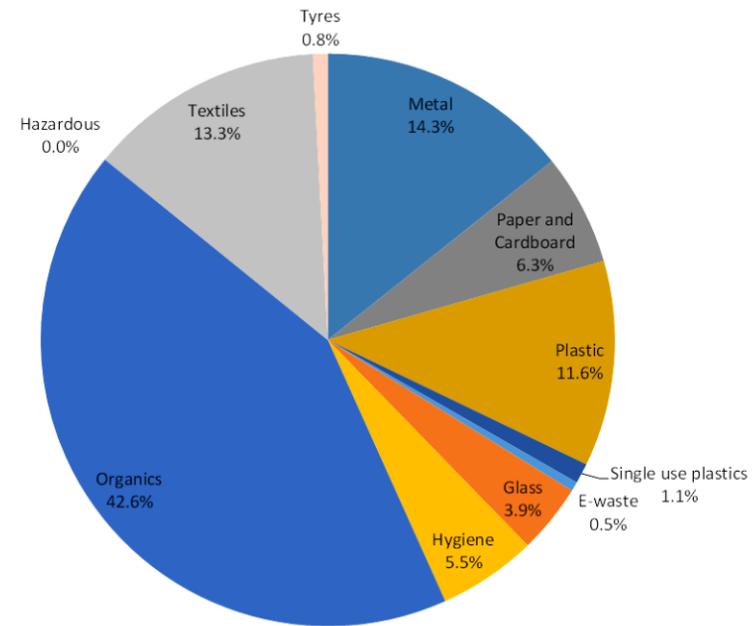
Additionally, the income level grouping may have been biased due to a potential reticence on behalf of the respondent to reveal income level to a local or known interviewer.

Fi Figure 1: Baucau Peri-urban household waste audit results

Baucau Peri Urban Household All Income Waste Composition by Weight



Baucau Peri Urban Household Med. Income Waste Composition by Weight



Baucau Peri Urban Household Low Income Waste Composition by Weight

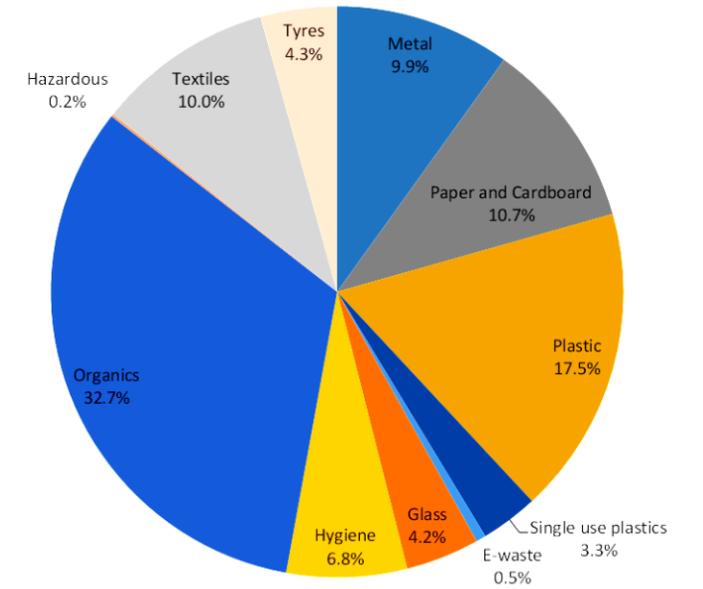


Figure 2: Baucau Urban household waste audit results

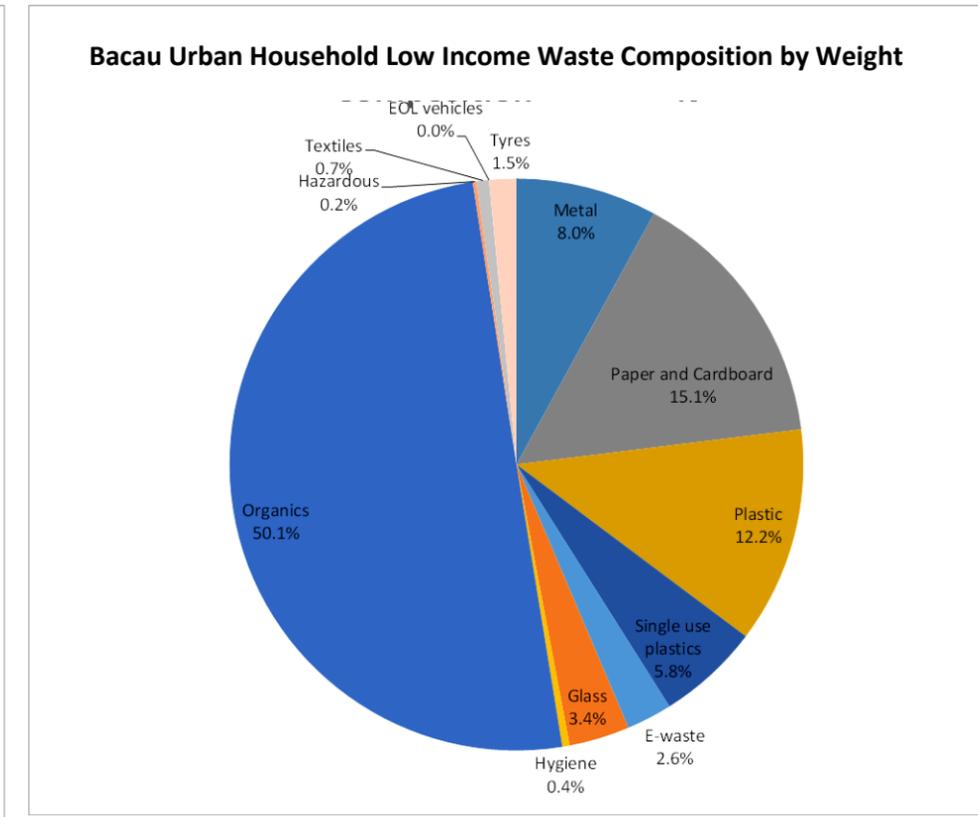
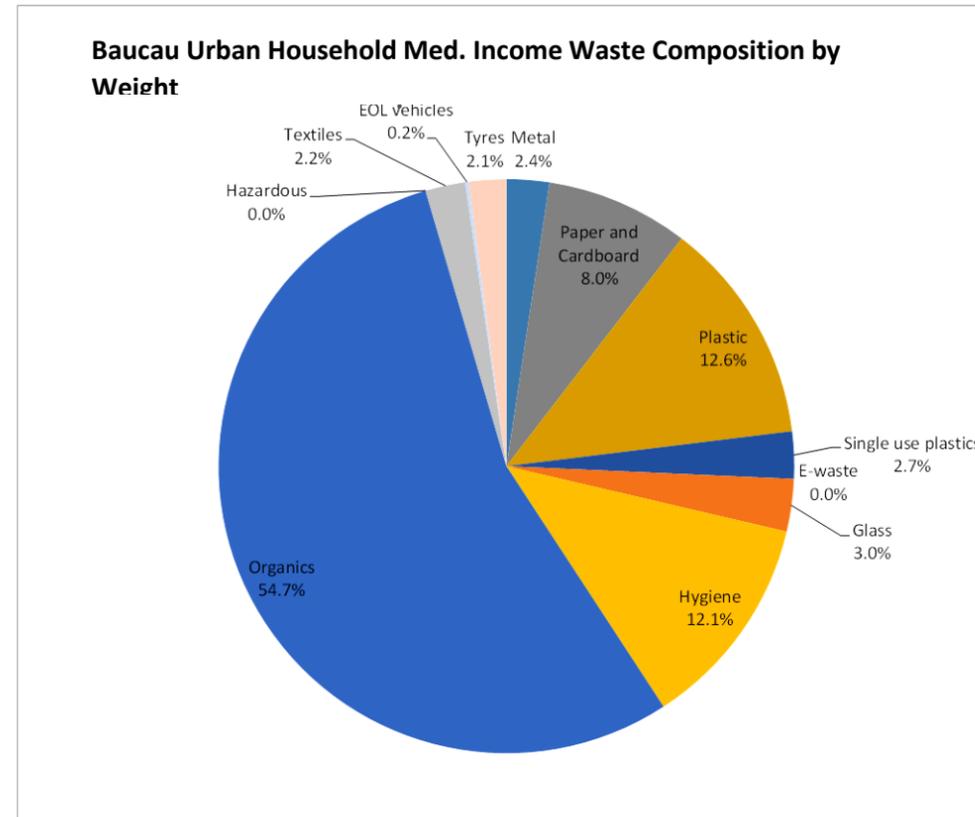
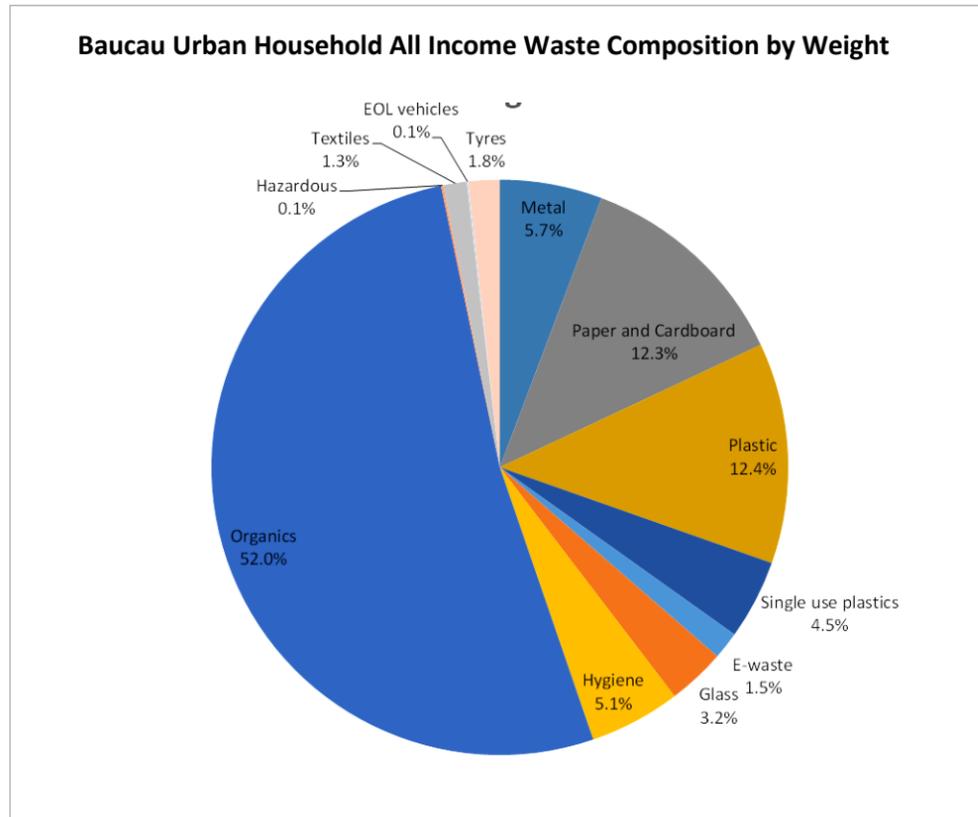


Figure 3: Baucau Rural household waste audit results

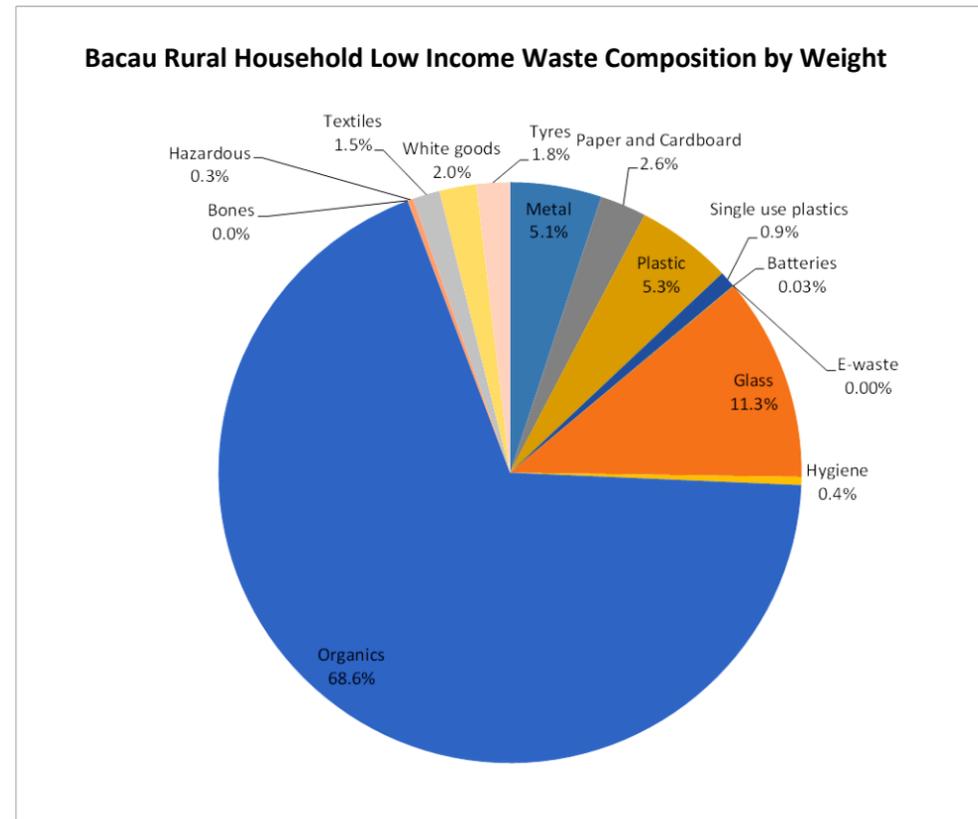
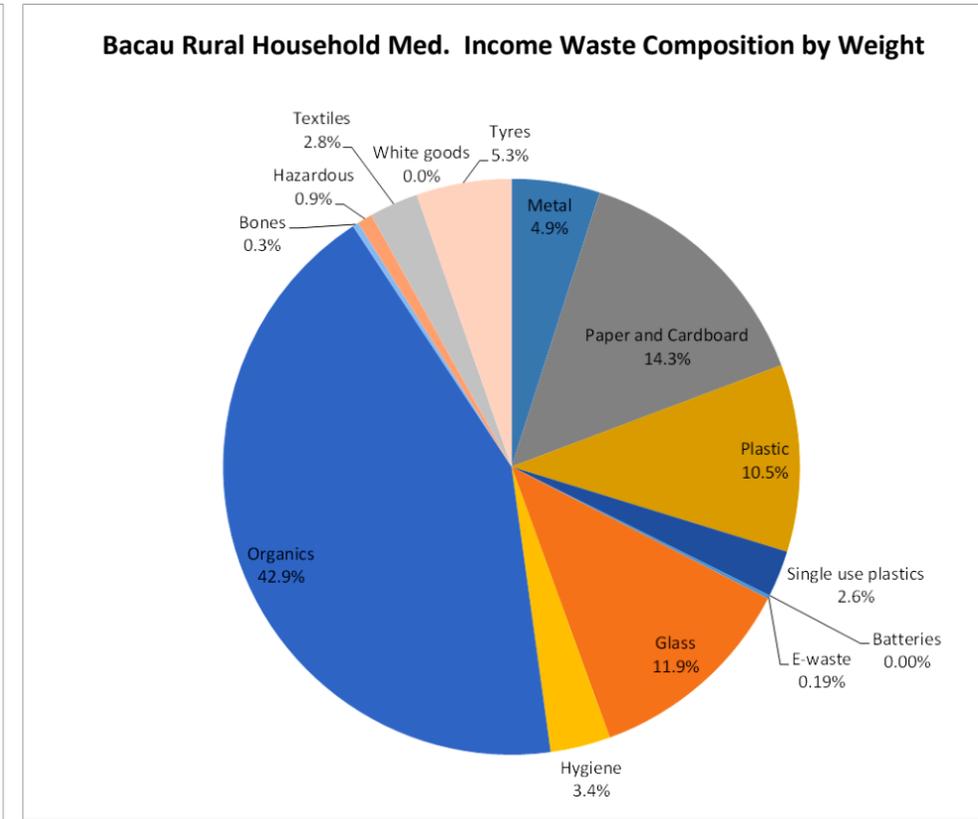
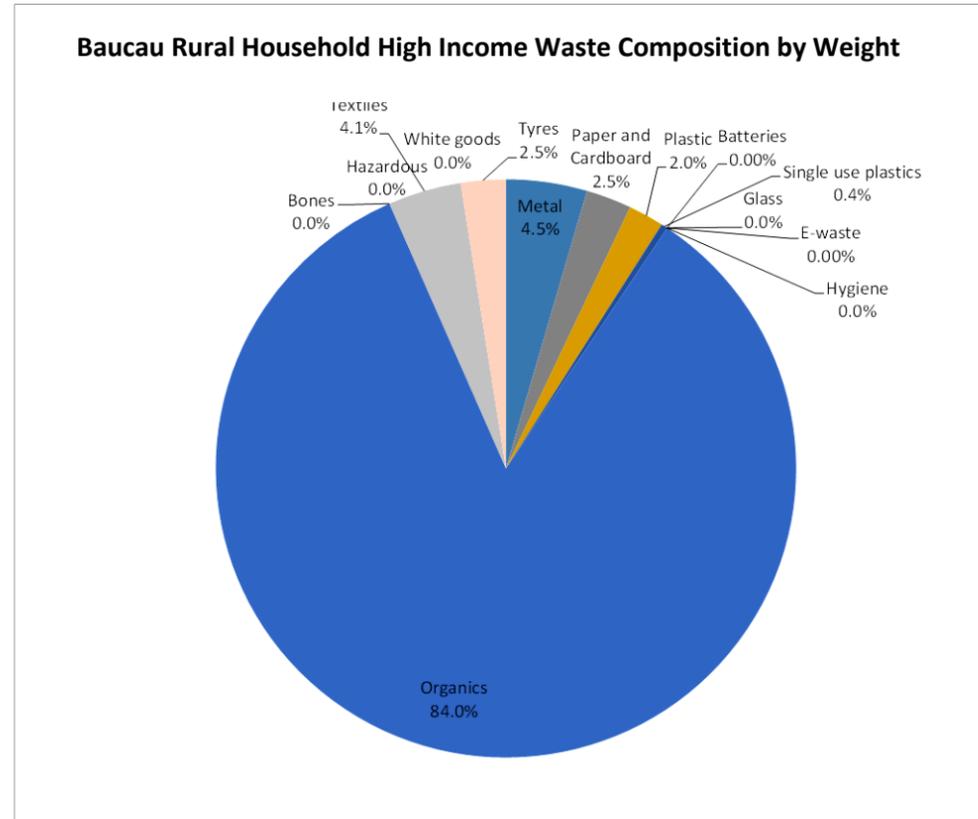
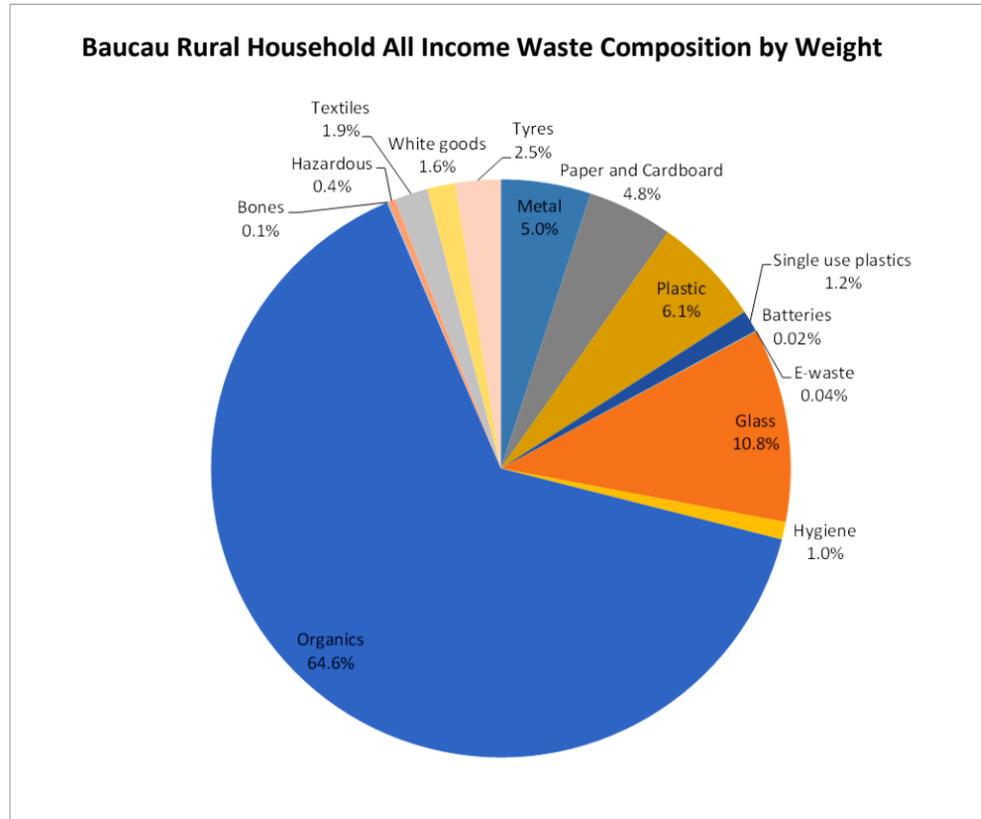


Figure 4: Covalima Peri-urban household waste audit results

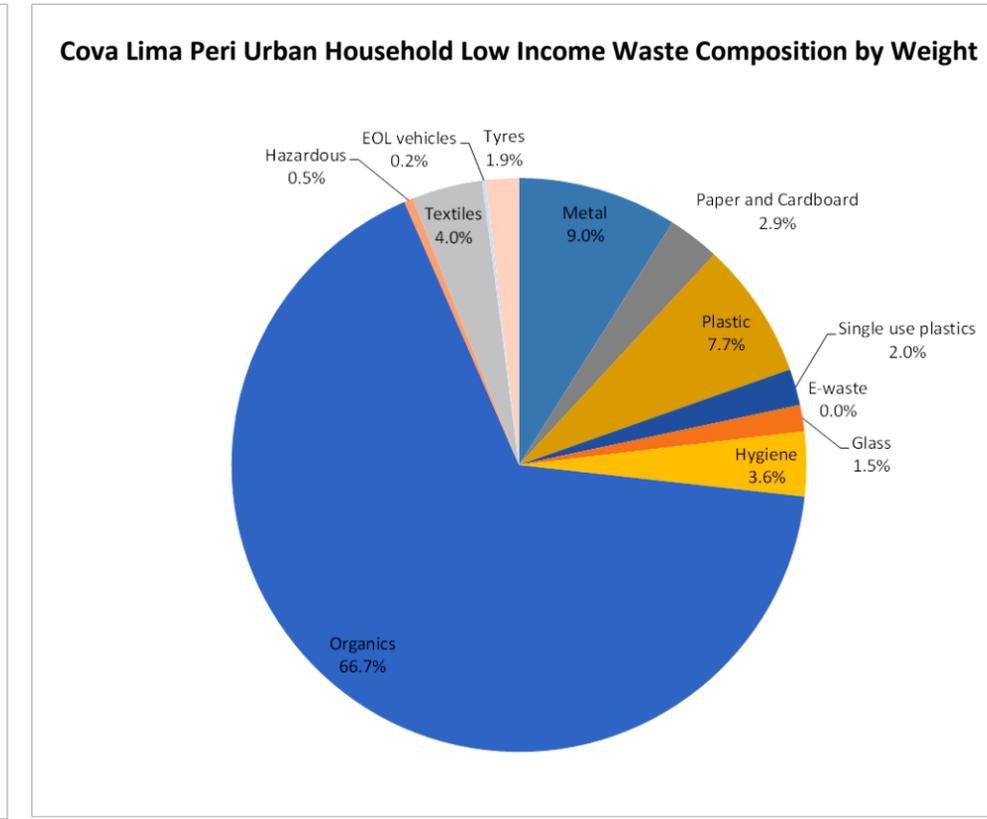
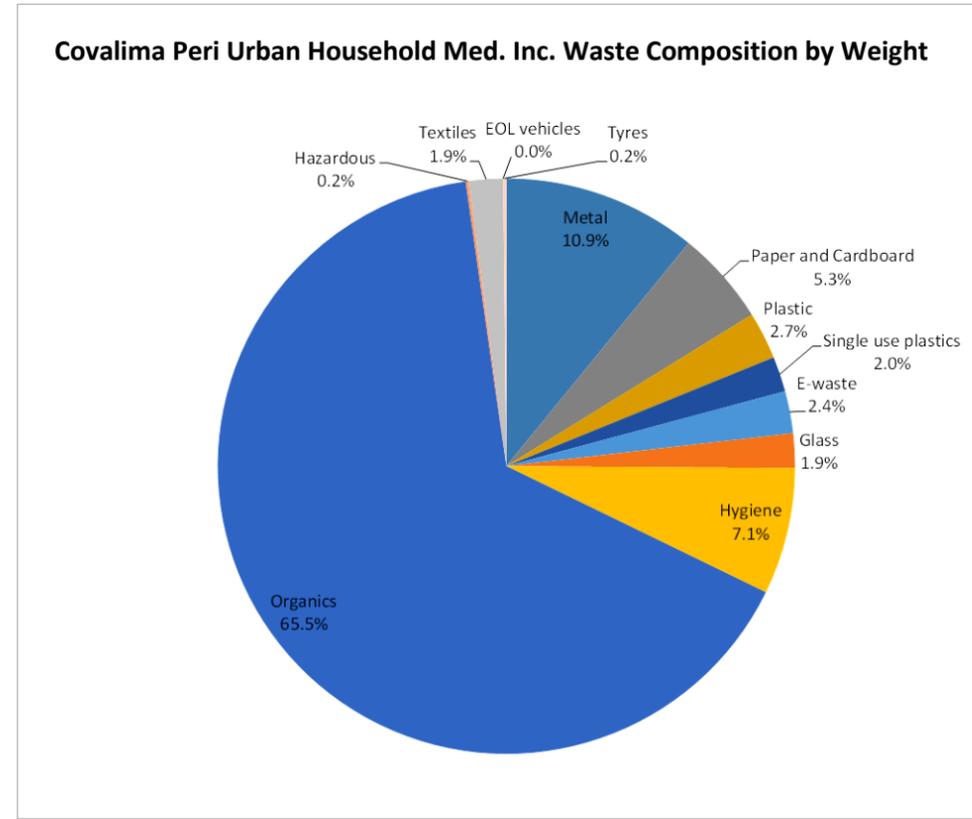
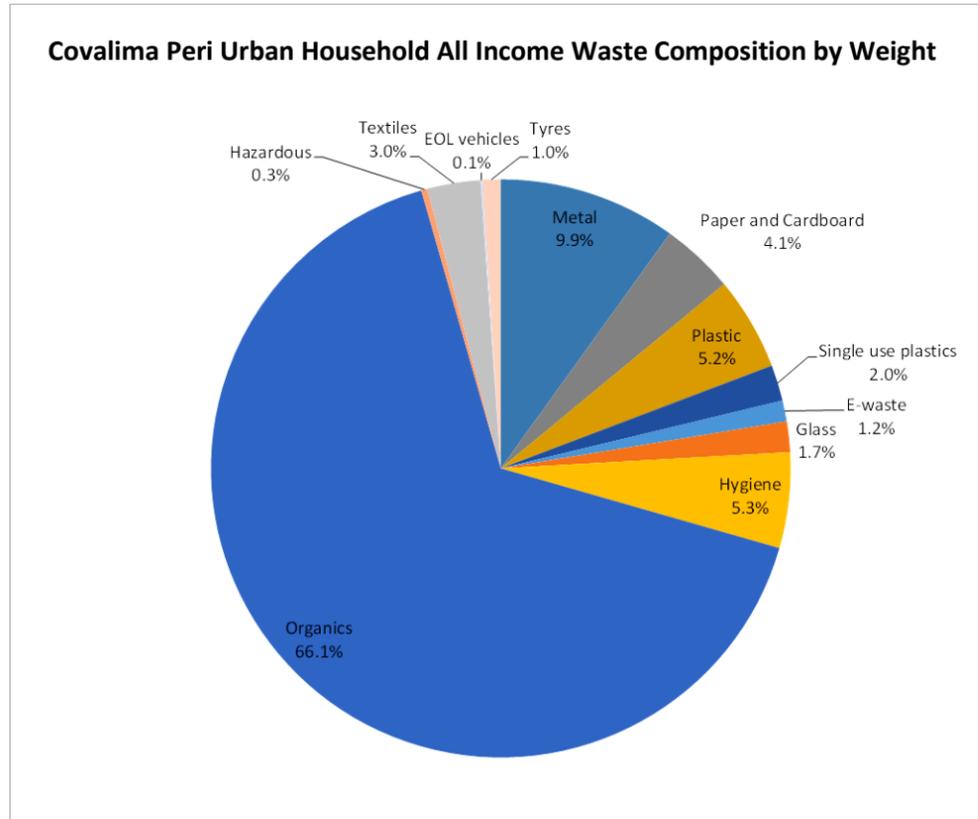
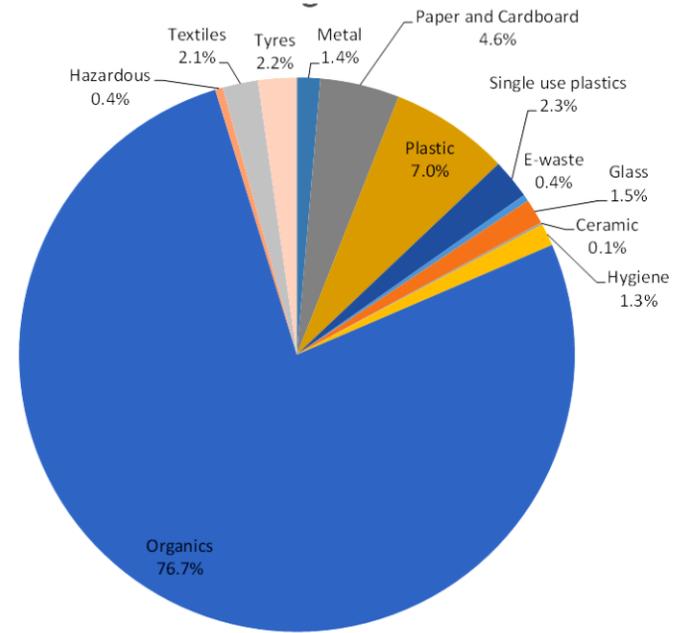
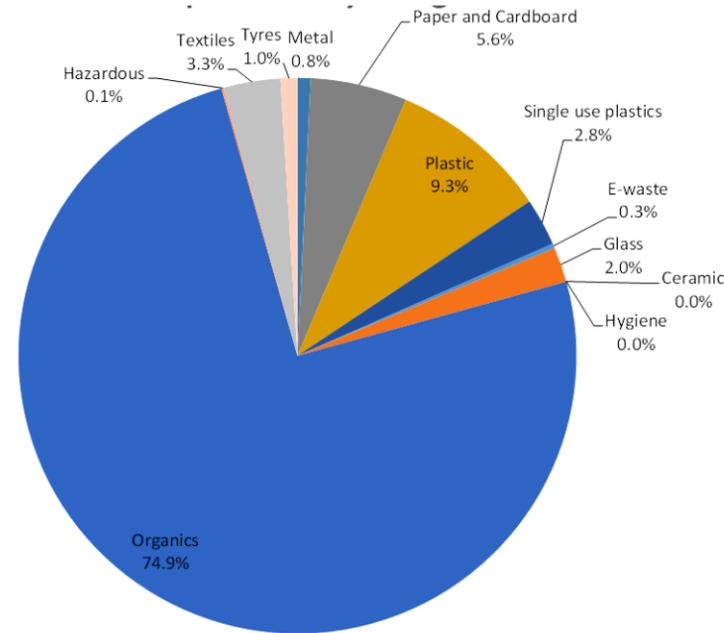


Figure 5: Covalima Urban household waste audit results

Covalima Urban Household All Income Waste Composition by Weight



Covalima Urban Household Med. Income Waste Composition by Weight



Cova Lima Urban Household Low Income Waste Composition by Weight

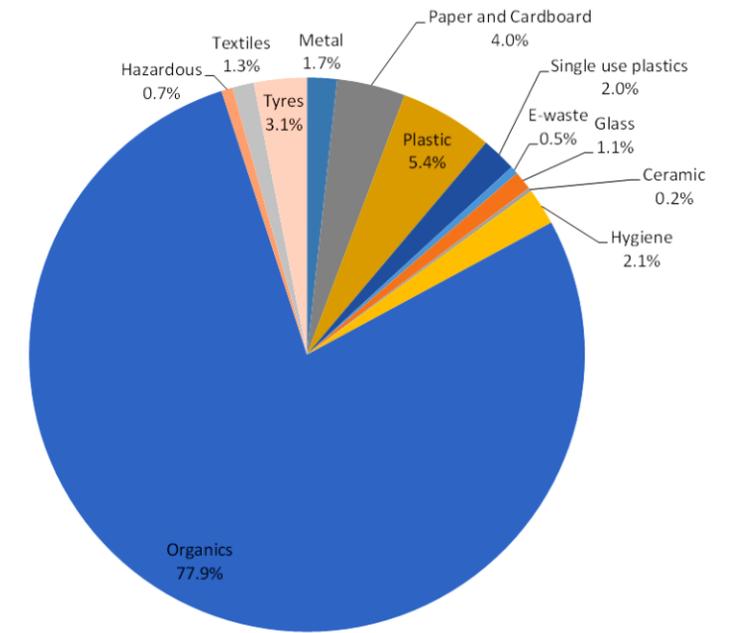
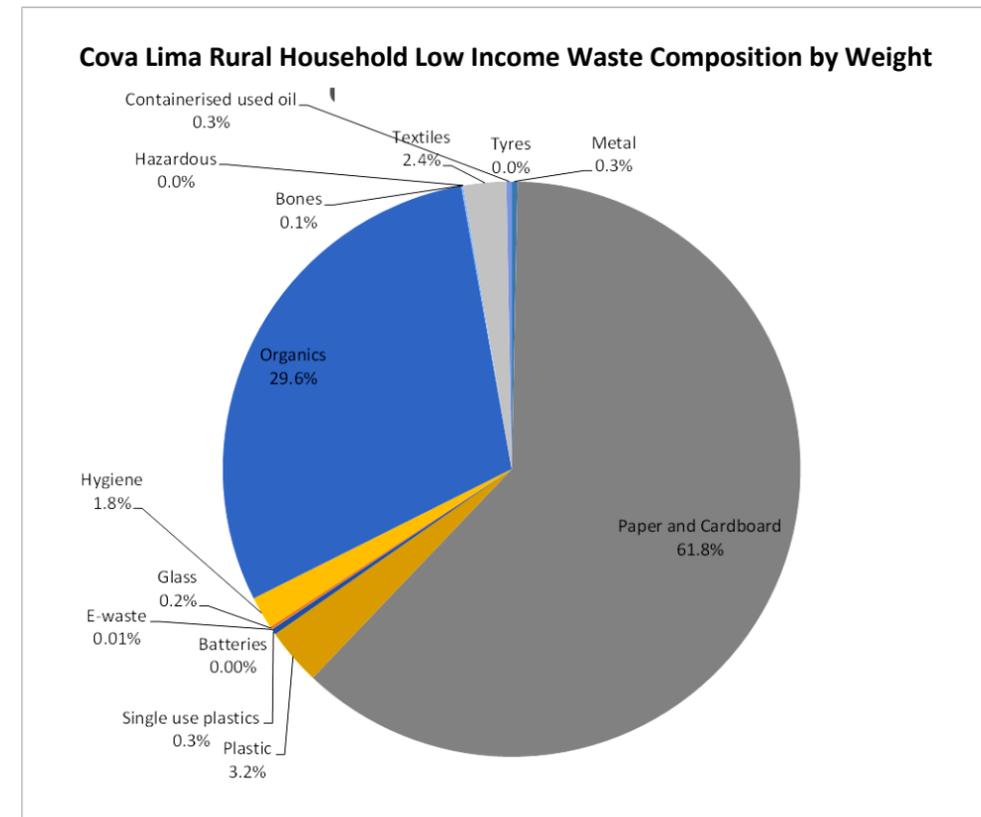
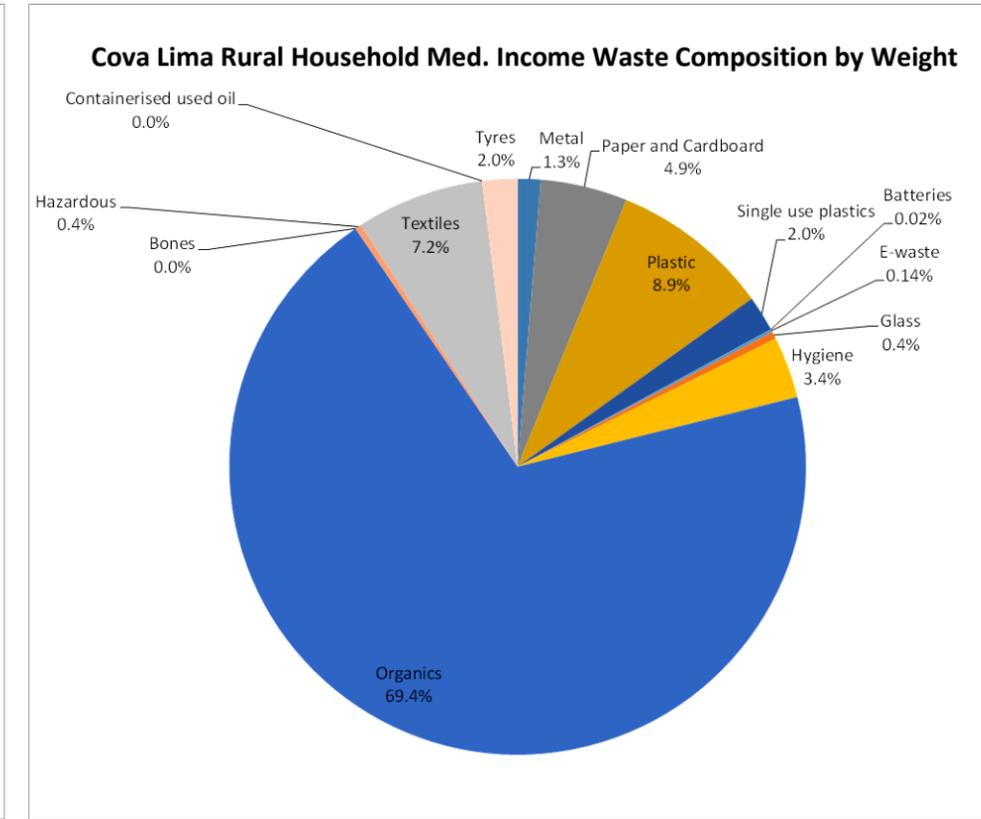
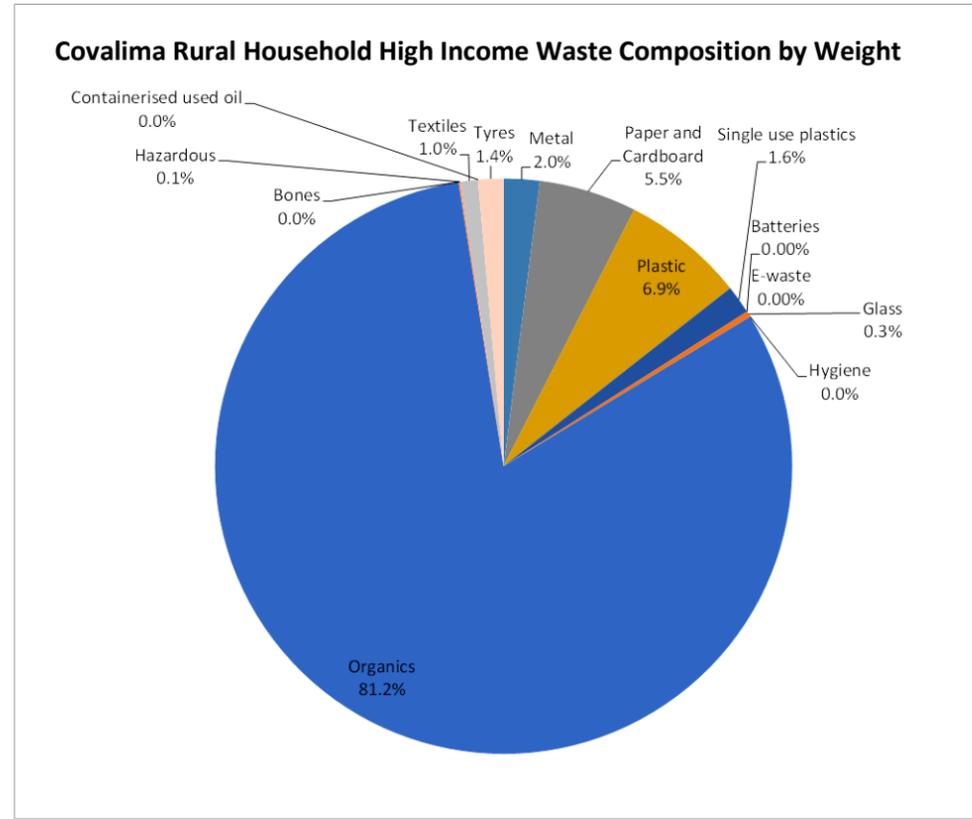
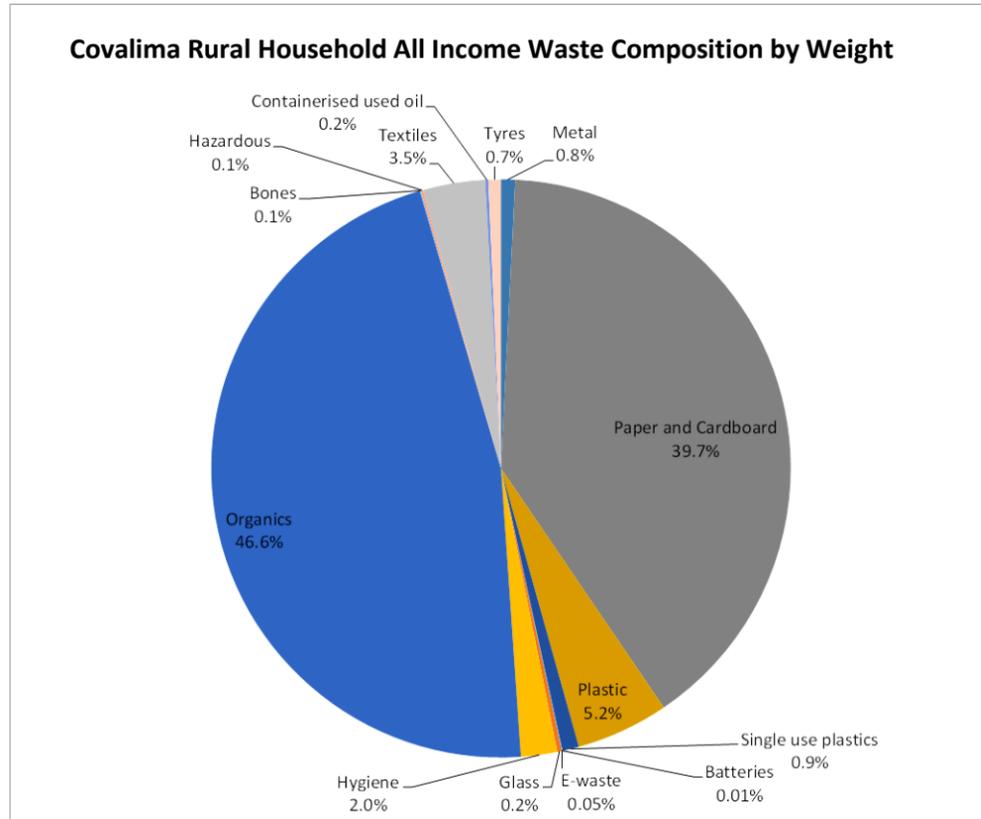


Figure 6: Covalima Rural household waste audit results



Business Surveys

The following business types in Baucau and Covalima took part in the study:

- Administration office
- Restaurant food outlet
- Supermarket
- Retail
- Hotel

Qualitative surveys were conducted with all participating businesses however from the responses provided it is apparent there was a caution in sharing business information to the project.

Covalima Businesses

All business survey respondents confirmed access to electricity; 80% have access to water supply, 90% access to sanitation systems and 30% have access to waste collection services.

Baucau Businesses

In Baucau all business respondents have access to electricity and water supply with only 40% having access to sanitation systems. One respondent advised access to a waste collection service, however there was no detail provided on the service supplier, and therefore the response to this question has been treated with caution. Most of the businesses report burning rubbish as a means of disposal of plastics, cardboard, and paper.

Business Data

Refer to the pie charts in **Figure 7-8** which sets out the individual waste composition data for each business type group by each of the audit locations. All measures quoted in this section are percentages by weight and the discussion under each business type quotes composition measurements that have been taken as an average over all samples in the audit.

The overall findings from the total business samples are as follows:

- Metals 2.7%
- Paper and cardboard 16.8%
- Plastics 18.7%
- Glass 8.9%
- Organics 46.8%
- Textiles 1.3%
- Hygiene 4.4%
- Hazardous .4%

Administration office category general findings

The predominant material type found in the administration office sample was surprisingly plastics which overall made up the highest primary category at 58%, noting the higher contributor to this was PET followed by flexible plastics. Paper and cardboard were the second highest contributor at 26%, followed by organics, with the Baucau sample showed higher amounts of organics than Covalima.

Food outlet category general findings

The predominant material type found in the food outlet/restaurant sample was not surprisingly, organics at 77%. This was followed by plastics at 14% and metals at 3%.

Hotel category general findings

The predominant material type found in the hotel sample was organics at 48% of the overall sample. Followed by plastics at 24% plastics, (primarily PET and flexible) and glass at 9%. Hazardous waste comprised tyres and fluorescent lights at 2%. There was a significant difference in the audit sample materials between Baucau and Covalima. For these individual samples Baucau had 51% plastics while Covalima had 12%. Conversely Covalima had a larger presence of glass and 62% organics while Baucau had 11%.

Retail category general findings

The predominant material type found in the retail category was surprisingly 50% organics where a larger portion of cardboard and paper would have been expected, it only being 6% of the combined retail business samples. Glass followed at 16% and 11% plastics. The significant difference between the two locations were Baucau 56% organics and Covalima 22%: Covalima 28% paper and cardboard and Baucau only 2%. Covalima had 14% textiles with Baucau 0%.

Supermarket category general findings

The predominant material type found in the combined supermarket samples was paper and cardboard at 53% followed by organics at 21% and plastics at 15%. Once again there were significant differences between the samples at each audit location. Cardboard and paper (63%) and organics (28%) were the primary materials in the Baucau sample while glass (40%) and plastics (38%) had the greatest presence in the Covalima sample.

Recyclable Material Distribution

This section provides a breakdown of the key findings from the quantitative waste audits. It is presented by primary waste type (category) and further described by sub or secondary classifications. This section provides an analysis of the distribution of materials that could be made available for recovery and recycling.

Primary Category: Organics

The audit measured the following secondary or sub classifications:

- food
- wood and timber
- garden organics
- other organics
- betelnut
- shells and bones

Organics made up approximately 47% of the combined business waste stream. Represented in the highest proportion by garden waste followed by food waste. There was no evidence of betelnut and bones/shells in the samples. Understanding the level of organics in the waste stream is critical to being able to evaluate potential carbon emissions and determine data on which to model potential alternative technologies to treat organic wastes such as composting and power generation.

Primary Category: Metals

The audit measured the following secondary or sub classifications:

- aluminium cans
- aluminium
- steel containers
- metal other

Aluminium cans were the predominant metal across all business samples followed by steel including tin containers. Metal products made up approximately 3% of the business waste stream.

Primary Category: Paper and Cardboard

The audit measured the following secondary or sub classifications:

- cardboard
- liquid paper board (LPB)
- composite
- paper
- tetrapak

Cardboard and paper overall made up approximately 16% of the business waste stream across both Baucau and Covalima. The predominant materials type in this category was composite at 11% mostly found in the Baucau business audits. This was larger than expected and greater than cardboard and paper combined, therefore consideration should be given to misidentification in the audit process for this material.

Primary Category: Glass

The audit measured the following secondary or sub classifications:

- glass bottles
- glass jars
- glass fines
- glass other

Glass jars were the primary type of glass recorded across all business samples and as expected were found in larger quantities in the hotel, retail, and supermarket business categories. In comparison the glass bottles were found in much smaller quantities and only in the restaurant/food outlet business category in Baucau. Glass made up approximately 9% of the business waste stream.

Primary Category: Plastics

Of the plastics waste stream PET is the highest contributor to the plastic wastes (42%) followed by flexible/film plastics (24.5%) with the remaining plastic polymers made up of HDPE, PVC, EPS polystyrene and plastic other. The polymer types of LDPE, PP5 and 6 were not recorded at all in the plastic waste stream sample.

Lightweight supermarket bags (9.5%) made up the greater portion of the single use plastic stream, followed by heavy plastic carry bags (5.6%) and cigarette packets (3%).

Table 20 present data for the various polymer types (listed above) collected from the 2021 audits.

Table 20: Composition of the business plastics waste stream

Plastic Polymer	Percentage of each plastic type within the plastic waste sample	Percentage of each plastic type within the overall business waste sample
PET containers (1)	42.21%	7.90%
HDPE containers (2)	1.29%	0.24%
LDPE containers (4)	0.00%	0.00%
PVC containers (3)	5.78%	1.08%
EPS – polystyrene	3.38%	0.63%
PS (6)	0.00%	0.00%
PP (5)	0.00%	0.00%
Flexibles/film	24.56%	4.59%
Other plastic	2.06%	0.38%

Note: The above data should be read as e.g., PET made up 42.2% of the combined business plastic (Table 20) and single use plastic (Table 21) waste stream which represented 7.90% of the overall business waste sample for the study.

Table 21 present data on each of the sub classifications for single use plastics collected from 2021 audit.

Table 21: Composition of the business single use plastics waste stream

Plastic Polymer	Percentage of each plastic type within the plastic waste sample	Percentage of each plastic type within the overall business waste sample
Beverage containers	0.00%	0.00%
Cigarette butts	0.12%	0.02%
Cigarette packets	3.01%	0.56%
Straws	0.78%	0.14%
Coffee cups	0.17%	0.03%
Bags – heavy carry bags	5.66%	1.06%
Bags – supermarket lightweight	9.50%	1.77%
Takeaway plastic other	1.27%	0.23%
Takeaway Styrofoam	0.14%	0.02%
Takeaway paper	0.00%	0.00%
Takeaway lids	0.00%	0.00%
Bottle lid	0.00%	0.00%

Note: The above data should be read as e.g., lightweight supermarket bags made up 9.50% of the of the combined business plastic (Table 20) and single use plastic (Table 21) waste stream which represented 1.77% of the overall business waste sample for the study.

Hazardous Waste Distribution

The analysis found a relatively small presence of hazardous wastes in the audit samples (which is consistent with audits in similar locations), and like the household data findings. Result of the finding is highlighted in **Table 22**. Key findings include:

- The most consistently recorded material were tyres found in both the Baucau and Covalima samples
- E-waste: Electrical waste in Covalima and fluorescent bulbs in Baucau samples
- Batteries: No batteries were found in any of the business samples

Table 22: Composition of the business hazardous waste stream

Material	Percentage of each hazardous waste type within the hazardous waste sample	Percentage of each hazardous waste type within the overall business waste sample
Batteries		
Non rechargeable	0.00%	0.00%
Rechargeable	0.00%	0.00%
Lead acid	0.00%	0.00%
Mobile batteries	0.00%	0.00%
Power tool	0.00%	0.00%
Lithium batteries	0.00%	0.00%
Lithium ion	0.00%	0.00%
Other batteries	0.00%	0.00%
E-waste		
Computer	0.00%	0.00%
TV's	0.00%	0.00%
Mobile phones	0.00%	0.00%
Electrical items	27.43%	0.09%
Toner cartridges	0.00%	0.00%
Business Hazardous		
Paint	0.00%	0.00%
Fluorescent	16.26%	0.05%
Household chemicals	0.00%	0.00%
Asbestos	0.00%	0.00%
Clinical (medical)	0.00%	0.00%
Gas bottles	0.00%	0.00%
Hazardous other	0.00%	0.00%
Used oil	0.00%	0.00%
Tyres	56.30%	0.20%

Note: The above data should be read as e.g., electrical items made up 27% of the business hazardous waste stream which represented 0.09% of the overall business waste sample for the study.

Detailed Business Waste Composition

The following section provides a series of pie charts to present the major categories of the business waste audit.

The results are broken down by business type (hotel, food outlet/restaurant, office, retail, and supermarket) in each of the audit locations: Covalima and Baucau. The findings refer to the business waste stream composition by average weight.

Whilst the report the different waste generation (from domestic and business waste) the results should be treated with caution at this level of disaggregation.

The overall sample result represents a stratified mean by business type and sample sizes within each business type are not necessarily sufficient to produce a low variation statistical result.

Table 23 provide the waste generation rate for each business type assessed in Baucau.

Table 23: Baucau Business Waste Generation

Business Type	Av # Staff	Kgs per business per day
All	15	6.9
Hotel	7	2.2
Retail	7	15.8
Restaurant	7	6.9
Office	47	2.6
Supermarket	7	9.3

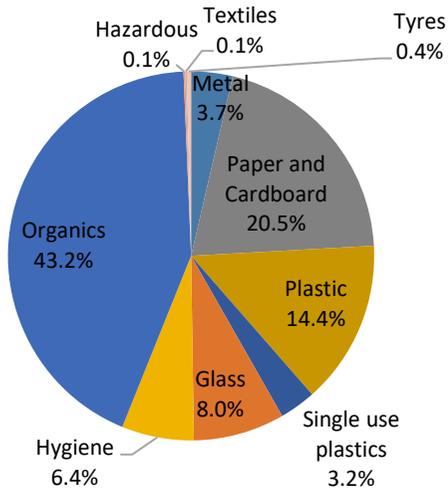
Table 24 provide the waste generation rate for each business type assessed in Covalima.

Table 24: Covalima Business Waste Generation

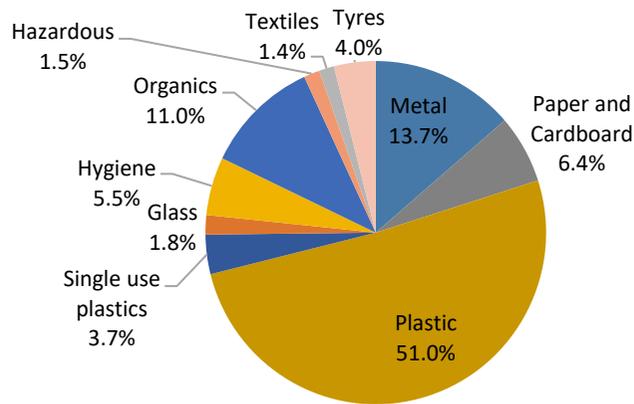
Business Type	Av # Staff	Kgs per business per day
All	15	4.4
Hotel	7	5.6
Retail	7	3.1
Restaurant	7	7.5
Office	47	1.6
Supermarket	7	3.0

Figure 7: Baucau Business Waste Audit Results

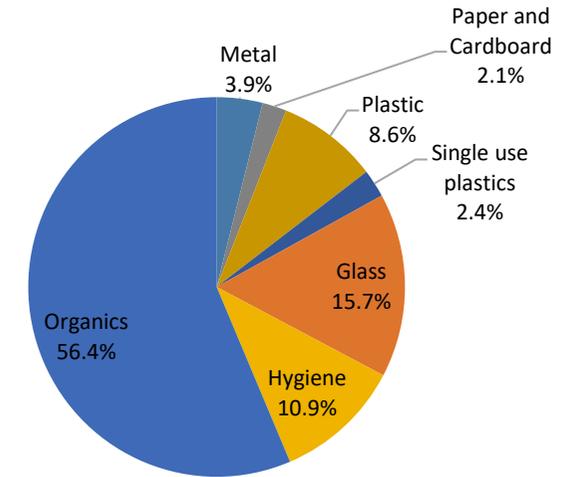
Baucau Business All Waste Composition by Weight



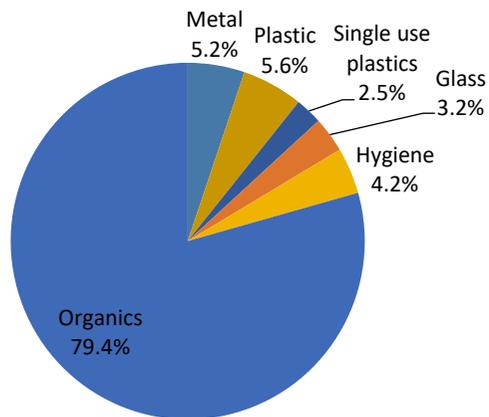
Baucau Business Hotel Waste Composition by Weight



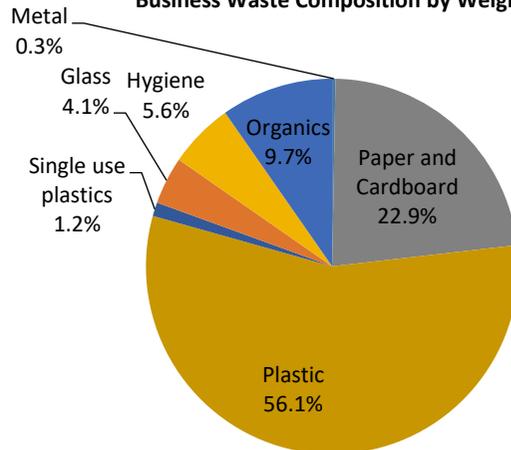
Baucau Business Retail Waste Composition by Weight



Business All: Waste Composition by Weight



Business Waste Composition by Weight



Baucau Business Supermarket Waste Composition by Weight

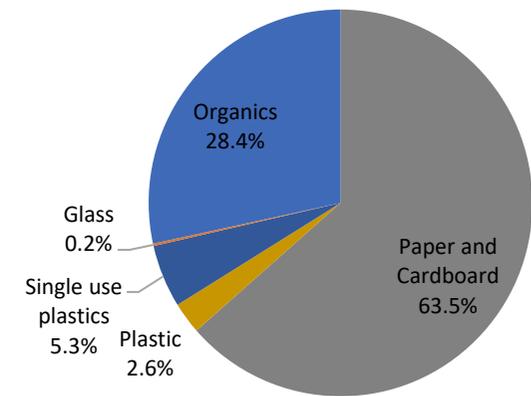
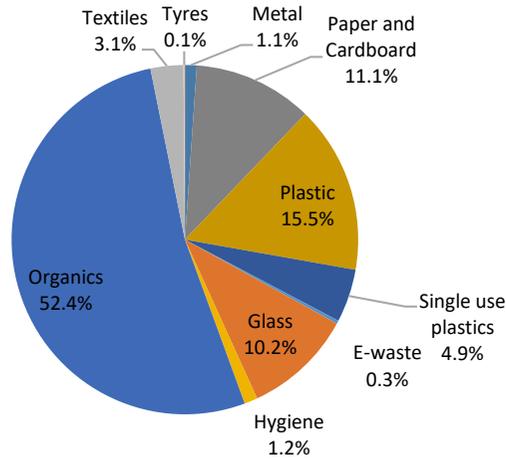
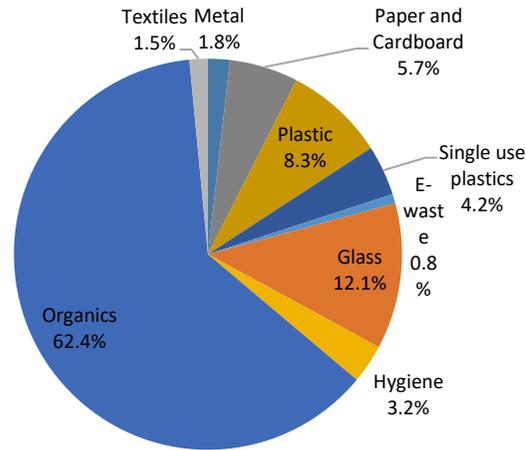


Figure 8: Covalima Business Waste Audit Results

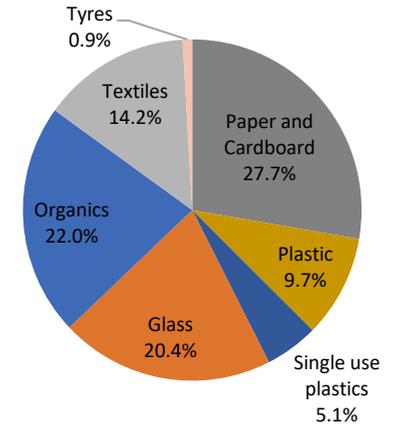
Covalima Business All Waste Composition by Weight



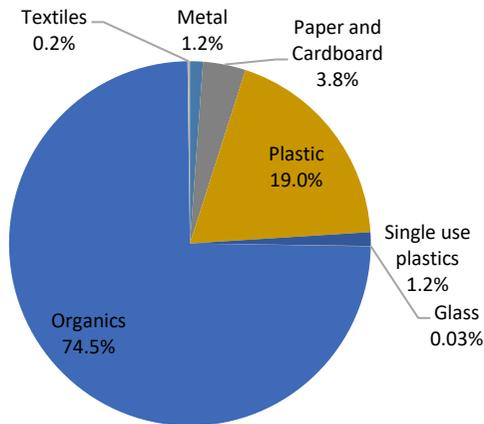
Covalima Business Hotel: Waste Composition by Weight



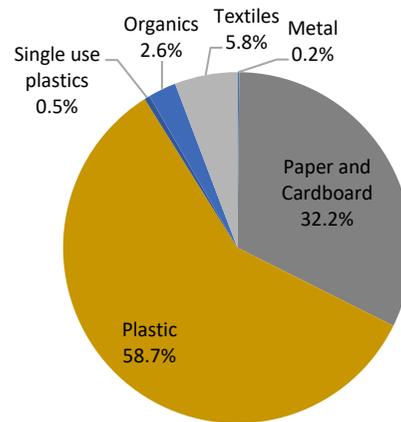
Covalima Business Retail Waste Composition by Weight



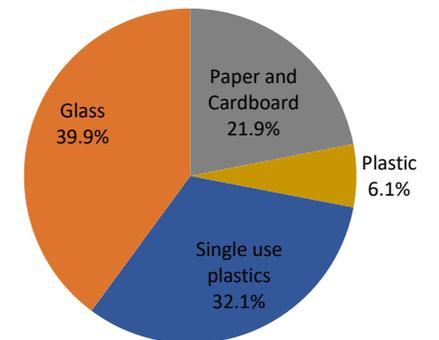
Covalima Business Restaurant Waste Composition by Weight



Covalima Business Office Waste Composition by Weight



Covalima Business Supermarket Waste Composition by Weight



Landfill

The Tibar disposal site at Dili is the only formal landfill in Timor-Leste. It is understood all other districts rely on open and uncontrolled dumping sites for disposal. However, as the audit was conducted in Baucau and Covalima this can only be confirmed for these locations.

Recovered Material Stockpiles

The audit did not find recovered materials stockpiles in either of the Baucau and Covalima locations. Nor did the Sub Consultant identify any recyclers in these locations.

Customs Data

The Timor-Leste Customs Service provided commodity data to the study based on a series of the international Harmonised Commodity (HS) Codes aligned to the waste product categories in the *PRIF Methodology, 2019*.

Based on the HS codes, the import export entries for the 2020 year were collated by the Customs Authority and provided to the study through the National Focal Point and this data is provided in **Table 25** Timor-Leste 2020 Import Export Data. The data correlates with the published Observatory of Economic Complexity (OEC), 2017 findings which shows used textiles to be a significant export commodity.

The data is interesting in that it provides a single vision of the extent of the incoming commodities against the outgoing. However, marrying the import commodities to those of a corresponding waste product export can be a somewhat of an opaque process as it relies on the correct usage of the HS codes in the shipping and customs declarations.

As there is not always a 'waste' category a HS code may be selected based on a broader category or duties applied and therefore the data output may not be consistent or dependable.

The known disruptions to the recycling sector that have been attributed to recent Chinese import restrictions and the associated containment of COVID-19 is thought to have impacted the projects' ability to confirm recycling rates.

While recycling companies/agents have operated in Dili and it is understood there have been exports of packaging wastes in the past, it appears recycling may not have been as prevalent in the outer lying districts of Timor-Leste given the absence of stockpiled recovered materials and recycling agents in the audit locations.

Table 25: Timor-Leste 2020 Import and Export Data

IMPORTS		
Year	Description	Weight (KG)
2020	Beverages	
	Soft drink	26,581,660.99
	Beer	10,266,299.91
	Wine	822,088.89
	Electronics	
	Mobile phone	791,344.08
	TV's	185,030.58
	Toner Cartridges	17,353.01
	Construction Material	
	Corrugate iron	1,443,169.53
	Cement	235,812,473.49
	Zinc	341,163.50
	Others	
	Textiles	14,905.15
	Tyres	2,094,078.72
	Furniture	54,160.81
	Fire extinguishers	175,425.75
	Fire retardant/proofing	641,204.08
	Building insulation agent	10,278,066.40
	Hazardous	
	Paint	681,325.28
	Fluorescent tubes	9,720.24
	Pesticides	344,290.11
	Fertilisers	28,890.56
	Clinical products	344,290.11
	Mercury containing material	23,280.00
	Containerised Used Oil	18,091,852.00
	Fuel	185,574,660.30
	Plastics	
	Autoclaving bags	2,236,145.78
Shrink wraps	975,961.51	
Microfilms	1,425.53	
Plastics packing bag	2,236,145.78	

EXPORTS		
Year	Description	Weight (KG)
2020	Scrap Metal & Aluminium	2,477,664.00
	Used Clothing	2,477,664.00
	Container Aluminium Cans	1,018,100.00

Source: Timor-Leste Customs Authority

Conclusion and Recommendations

The findings from this study provides insight into the waste generation and waste stream composition in two locations in Timor-Leste. The findings also detail the differences between low, medium, and high-income level households and the influences on waste generation in these locations, but these outcomes should be treated with some caution due to the privacy concerns some respondents may have had in reporting income.

The per capita waste generation findings were commensurate with similar Pacific locations and a previously conducted audit in Timor-Leste.

None of the households surveyed had access to a waste collection service and alternate methodologies for managing wastes were described as burning and disposal at uncontained dumping areas. Most respondents burnt plastics, and this should be of significant concern given the health and environmental impacts associated with this activity. This strongly supports future consideration of programs that are focused on the construction of appropriately contained disposal facilities and community collection services for wastes.

While survey respondents expressed a strong understanding of the potential risks to human health and the environmental from poor waste management practices, there was a marked difference in the willingness to pay and a strong perception that Government had sole responsibility in this area. The survey found the government sector to be the largest employer in both Baucau and Covalima with males reporting over 50% more employment in this sector than their female counterparts.

Access to electricity services were recorded as almost 100% through urban, peri-urban, and rural areas. Access to other essential services such as sanitation systems were between 80-90% in urban areas reducing to nil in the peri-urban and rural areas. This finding was similar for water supply although Covalima rural area had an 80% access to water.

Access to education appears equally distributed between male and female residents. However, access to employment is quite different with only 50% of the female respondents having work income opportunities.

The consolidated data shows a waste stream that is unsurprisingly weighted by organics, with a significant representation of packaging wastes in the order of plastics, paper, cardboard, and metals. The study has further reported a granular set of estimations on the presence of the plastic polymer types found in the waste streams which may be useful in modelling future container stewardship schemes and collection systems. The findings on the per capita rates between income regimes and audit locations are provided in the pie charts and the body of the report.

The study, however, has been unable to provide the same level of detail for hazardous wastes due to a limited presence of these materials in the waste stream. Historical audits conducted by a third party were similar in their low recording of hazardous waste and this may be due to limited usage of these materials in the community.

The findings from this study speak to a seriously under resourced waste management system in Timor-Leste. There are significant challenges in managing the wastes of a growing population. The application of producer and user responsibilities implemented through financial mechanisms at all government levels (e.g., levies, import tax, fee for service) will underpin urgently needed improvements required to manage wastes in an equitable, safe, and sustainable manner. These initiatives would also create investment certainty for the private sector to build infrastructure and deliver waste services that are efficient, compliant, and able to be sustained over the longer term on a commercial basis.

The continuing development of legislation for waste management must be accompanied by adequate levels of resourcing to the regulator to enable compliance monitoring and the consistent enforcement of environmental protection laws. This study further recommends comparison audits continue to be conducted in future in accordance with the *PRIF Methodology, 2019* to enable accurate measurement of changes in waste generation and the efficacy of improvements made to waste management systems.

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Appendices - Appendix A: Audit material categories

Primary Category	Secondary Category	Description
Metal	Aluminum cans (NCDC category 12 Aluminum Cans)	Alcoholic sodas and spirit-based mixers, beer and soft drink, Food cans, pet food cans, aerosols, industrial cans
	Aluminum recyclable	Steel Packaging
	Steel containers	Alcoholic sodas and spirit-based mixers, beer, soft drink, Food cans, pet food cans, aerosols, industrial cans, clean/empty paint cans
	Metal other (NCDC category 12 Other Metals)	100% ferrous items that are not cans/tins/packaging materials, any other steel, Beer bottle tops, jar lids, composite ferrous items for which the weight of the ferrous metal is estimated to be greater than the other material items, Foils 100% aluminum items that are not cans/tins/or packaging materials, any other aluminum
Fishing	Fishing/seafood metal	
	Fishing/seafood plastic	
	Fishing/seafood wood	
Paper and Cardboard	Cardboard NCDC category 5 Cardboard	Cardboard without corrugation (glossy and non-glossy), cereal boxes, business cards,
	LPB (NCDC category 6 Tetra Pack)	Soy milk cartons, some fruit juice cartons, UHT/long-life milk
	Composite	Composite paper items for which the weight of the paper is estimated to be greater than the weight of the other materials
	Paper (NCDC category 7 Other Papers)	Office paper, writing pads, letters, envelopes, books, Newspapers, newspaper like pamphlets, paper, magazines, brochures, wrapping paper, labels, paper packaging (no plastic or wax coating)
Plastic	PET containers (NCDC category 9 PETT bottles)	(Polyethylene) – soft drink, flavored water, fruit juice, sports drinks, plain water (carbonated/non-carb), Food containers, mouthwash containers, detergent bottles
	HDPE containers	(High-density polyethylene) milk and flavored milk bottles Bleach bottles, oil containers, food containers
	LDPE containers	(Low-density polyethylene) squeeze bottles
	PVC containers	(Polyvinyl chloride) clear cordial and juice bottles, Detergent bottles
	PP	Bottles and containers
	EPS	Yoghurt and dairy containers, vending cups, clam shells
	PS	Meat and poultry trays, vending cups, fragile-item packaging
	PP	Bottles and containers
	Flexibles/Film	No shopping bags, just chip packets and other MLM packaging
	Other plastic (NCDC category 10 Other Plastics)	
Single use plastic	Beverage containers	the total count from the beverage container sort
	Cigarette Butts	
	Cigarette Packets	

Primary Category	Secondary Category	Description
Single use plastic	Beverage containers	
	Branded carry bags	
	Bags - supermarket type	
	light weight carries bags	
	Takeaway containers plastic other than EPS	
	Takeaway containers Styrofoam	
	Takeaway containers	
	Bottle lids	
Battery	Non-rechargeable	Common batteries, AAA, AA etc. single use
	Rechargeable battery	Common batteries (rechargeable), AAA, AA etc. rechargeable
	Lead acid batteries	Large batteries used in vehicles or other machinery
	Mobile battery	Batteries used in mobile phones
	Power tool battery	Batteries used in power tools
	Lithium battery	Small lithium batteries
	Lithium-ion battery	Batteries used in electric cars
	Other battery	All other battery types
E-Waste	Computer Equipment	Keyboard, monitor, hard drives, printers, etc.
	TVs	TVs
	Mobile Phones	Mobile phones, phones, pads, charges, car kits, Bluetooth
	Electrical Items & Peripherals	Radio, iPod, Gameboys, stereos, speakers, VCR, DVD players, power tools, wiring and cables, small electrical items (toaster, blender, etc.), computer discs, cassettes, DVDs, CDs
	Toner Cartridges	Printer and toner cartridges
Glass	Glass bottles NDCD category 14 Glass ex. ceramics	Recyclable (all colors) – beer bottles, wine bottles, spirit cider/fruit-based, flavored water, fruit juice, sports drinks, plain water
	Glass Jars	Non-beverage containers (all colors) – sauce bottles, jam jars, vegetable oils, other food containers
	Glass fines	Mixed glass or glass fines < 4.75 mm
	Glass other	Plate glass (window and windscreen), Pyrex, mirror glass, Corning ware, light globes, laboratory and medical glass, white opaque glass (e.g., Malibu alcohol bottles)
Hygiene	Feminine hygiene	Used disposable feminine hygiene products
	Pharmaceutical	
	Nappies	Used disposable nappies/diapers
	Medical waste	Sharps, human tissue, bulk bodily fluids and blood, any blood-stained disposable material or equipment
	Other sanitary waste	
Organics	Food NDCD Category 1 vegetables/putrescible	Vegetable/fruit/ meat scraps
	Wood/timber	

Primary Category	Secondary Category	Description
	Garden organics	Grass clippings, tree trimmings/pruning, flowers, tree wood (< 20mm diam)
	Other organics NCDC category 2 bones	Animal excrement, mixed compostable items, cellophane, kitty litter Bones
	NCDC category 3 Betelnut/buai	Betelnut/buai
Hazardous	Paint	Containers containing paint (dry or wet)
	Fluorescent Tubes	Fluorescent tubes; compact fluorescent lamps (CFLs)
	Household Chemicals	Containers containing bleach, cleaning products, unused medical pills
	Asbestos	Asbestos and asbestos containing products or building materials
	Clinical (medical)	Sharps, human tissue, bulk bodily fluids and blood, any blood-stained disposable material or equipment
	Gas Bottles	Gas bottles
	Mercury	Mercury used in medical applications
Hazardous Other NCDC category 15	Any other hazardous material	
Other	Textiles NCDC category 8	Wool, cotton, and natural fibre materials
	White goods	
	Ceramics NCDC category 14 ceramic exc. glass	
	Containerised used oil	
	EOL renewable energy equip	Includes EOL solar panels
	End of life Vehicles	
	Tyres	
NCDC category 16 miscellaneous		

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