

Solid Waste Characterization and Generation Study 2011.

VAITELE.



Waste Management Section

Division of Environment and Conservation

Ministry of Natural Resources and Environment



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ACKNOWLEDGEMENT.

This study is an important tool for short to long term planning for waste management in the urban area. The issue of waste management is still a challenge for most of the Small Developing States including Samoa as land area is an issue while at the same time; the citizens are highly depended on imported goods to sustain lifestyles.

The study was made possible by the technical and financial support from JICA through the Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management in the Pacific Island Countries (J-PRISM) and SPREP with collaboration with the Ministry of Natural Resources and Environment.

The study was intended to recruit volunteers from the National University of Samoa to participate but due to inconvenient timing clashing with exam preparation for students, the study was then undertook by the Waste Management Section staff and casual workers.

We acknowledge the participated household for allowing the staff to enter their respective residents and participate through out the course of the study. We also acknowledge the participation of 7 commercial activities in ascertaining data on the commercial sector's waste composition and generation for the first time in this nature of study.

The data and information collected is of great importance is satisfying the objectives of the study for future appropriate action to take to sustainably manage solid waste in the country.

ABSTRACT

The study was conducted at Vaitele residential area for domestic waste and various commercial activities in Apia and Vaitele for commercial waste category. The sample collection and measurement took approximately two weeks for both sectors to complete.

Vaitele has been identified as the most populated area in the country. The preliminary result of 2011 census estimated that the population is 7,000. The area has been subdivided up into Vaitele-tai, Vaitele-uta and Vaitele-fou where Vaitele-tai is mainly an industrial zone. The subdividing of the area as freehold lands encourages people from all over the country to purchase land for various reasons especially convenient access to education, jobs and escape from the traditional day to day affairs of the rural villages.

40 households randomly selected in the area through the usual waste collection route with 7 commercial activities were selected for analysis.

In the domestic sector, the waste generation rate is 0.38 kg/person/day with 0.01kg/m²/day for the commercial sector. For composition of wastes generated, green waste dominates waste generated daily for both domestic and commercial sectors.

1.0 Introduction

1.1 Background

This report highlighted the outcome of the baseline survey conducted at Vaitele village to ascertain the quantity and composition of solid waste generated at source. Vaitele village is the most populated village in the whole country with an estimated population of 7,000.

The data and information collected from this study were highly required to provide the basis for future waste management programs and actions to be conducted and implemented by the Ministry of Natural Resources and Environment.

This report was a result from the collaboration effort of the Ministry of Natural Resources and Environment, SPREP and the J-PRISM project. It is one of the deliverables and components of the project with funding and technical support from the J-PRISM project office.

1.2 Information on Vaitele

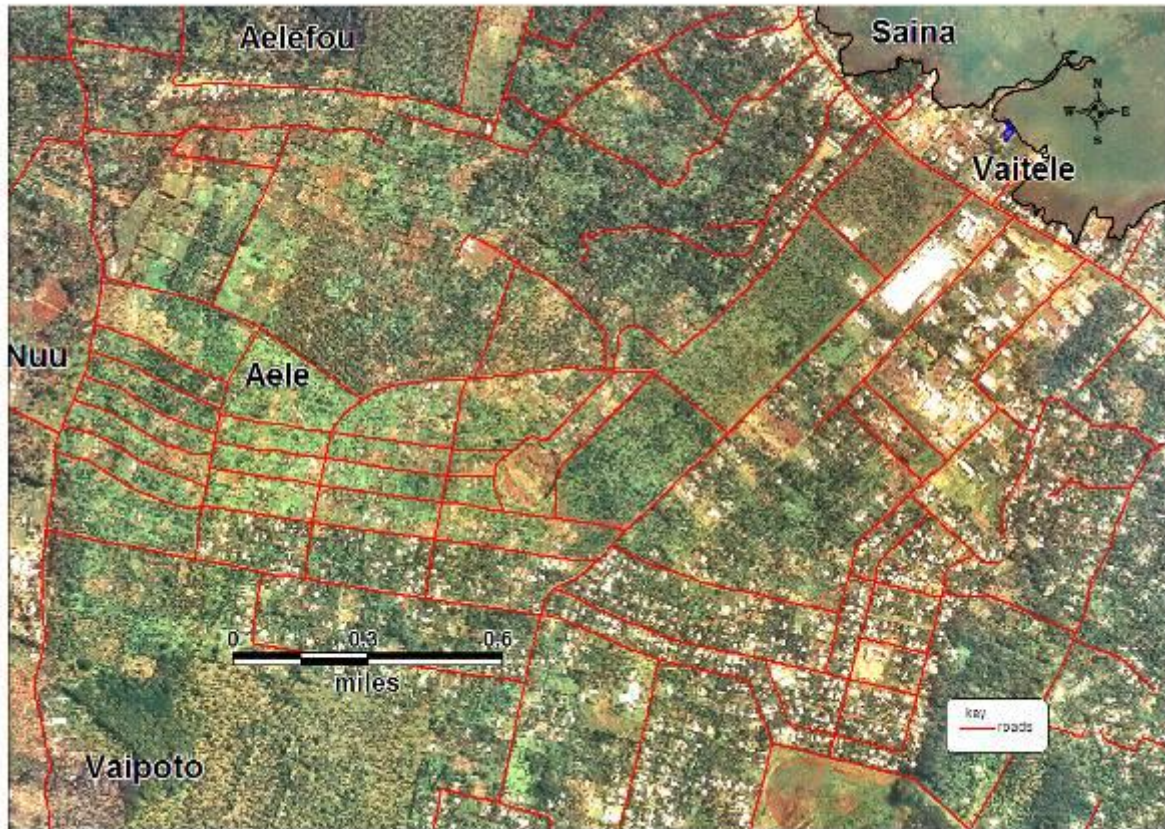
Vaitele has been identified as the largest and fastest growing peri-urban area on the peripheries of Apia. It is located at the Faleata West district on the western side of Apia. A report by MNRE for Urban Governance Pilot Project stated that Vaitele was a single traditional coastal village before the 1900's. During the colonial era, the Germans purchase the whole of Vaitele Uta and Vaitele Fou for a major coconut plantation. The arrangement of this purchase is not clear.

The German coconut plantation was transferred to the Government after WW1 and eventually came under Samoa Land Corporation through the years with a clear instruction that the area near the coast should be utilized for industrial activities while inland areas be used for residential housing.

Government through Samoa Land Corporation began subdividing and selling land more than two decades ago. Thus, all Vaitele is currently subdivided mainly for private residents and businesses.

Apia is a magnet attracting those living in rural areas due to the opportunities on offer including jobs, better schooling and convenient ways to obtain western lifestyle. For this reason, the demand for privately owned land in Vaitele is high.

Map of Vaitele:



2.0 Overview of Solid Waste Management in Samoa

2.1 Country Information

Samoa is located south of the equator, precisely halfway between Hawaii and New Zealand in the Pacific region in the Pacific Ocean. The total land area is 2,934 km² consisting of two larger islands of Upolu and Savaii which accounts for 99% of the total land area with 8 smaller islets.

The islands were originated by volcanic activities. The highest point is Mt Silisili, at 1,858 meters. Samoa was previously located east of the International Dateline

but in 2011 the country moved to the west of the International Dateline. This change took effect on the night of 29 December so that the Friday was skipped altogether and the following day was Saturday 31 December.

The climate is equatorial/monsoonal, with an average annual temperature of 26.5°C, and a rainy season from November to April.

2.2 Institutional Arrangement

At the National Level, the Division of Environment and Conservation of the Ministry of Natural Resources and Environment (MNRE) is the responsible agency that implements the Waste Management activities. Within the Division of Environment and Conservation (DEC), Waste management is one of its five sections. The MNRE is responsible for the development and implementation of regulations, strategies and policies in regards to waste management.

3.0 Past and Present Situation of Tafaigata Landfill

In the past, all wastes were disposed of at Vaitoloa a coastal village within the urban area. As solid waste became a concern due to pollution and nuisance faced by the nearby villages, Tafaigata on the island of Upolu was then opened in 1992 for waste disposal. During the time, it was just open dumping with numerous open burning. In fact, there was no control and or management. However in 2003, Samoa adopted the Fukuoka Method of semi-aerobic landfill system. Construction was then commenced with funding from JICA and was commissioned in 2006. Tafaigata landfill is located about 10 miles from Apia on a government land. Feasibility studies were carried out and the site was then chosen for the purpose of waste disposal as it was reasonable far from residential area.

The total land area is 100 acres with only 10% is currently utilized for waste disposal.

3.1 Access

The landfill is not fenced but the only entry is through the front gate where the office is located. Therefore, the entry is controlled and restricted to vehicles for disposal purposes. Each vehicle is charged with a tipping fee subject to the type of vehicle and the waste transported.

3.2 Odor and flies

During open dumping, odor and flies were a major concern. However, since adoption of the Fukuoka Method, there is no odor and less flies due to regular application of soil cover.

3.3 Segregation on site

Currently, there is no segregation at source. Segregation thus, is only implemented at the landfill. Green and bulky wastes are diverted to their respective disposal site where only general wastes are disposed at the landfill.

3.4 Waste Pickers

This was identified as a problem in the past due to vandalism damaging some assets and components of the landfill system. However, the problem is now under control as only 11 waste pickers are allowed to enter upon signing an agreement in which guidelines were spelled out for each to abide by.

4.0 Collection and Transportation System

The government through the MNRE contracted out waste collection to private companies through a government tender process. As a tradition, significant amount of the solid wastes are generated from households and commercial sectors within the urban area.

The collection system only covers households on each inhabited islands. However, each commercial sector is responsible for transporting their respective wastes to the landfill. The collection routes follow public sealed roads and collection points are situated on road sides and each household are responsible for construction of their platforms as transits.

All inhabited islands are divided into collection zones and separate contractors are responsible of each zone. There are two zones on Savaii island, one zone for Manono and Apolima islands and eleven zones on Upolu island. For Manono and Apolima islets, the contractor collects the wastes using alias/small boats then transports these wastes to Tafaigata landfill for disposal.

Table 4.1: Collection Zones

Zone	Villages
A	Apia Town Area
B1	Vaimoso – Alafua, Vaimea – Moamoa, Lalovaea - Lotopa
B2	Vaitele – Siusega – Falelauniu, Vaigaga – Elisefou, Vaiusu – Tuanaimato, Lepea – Tuanaimato, Pesega/Lotopa – Tuanaimato, Faleula tai - Nuu
C1	Tanugamanono - Malololelei
C2	Leone – Levili, Faatoia – Lelata, Vaivasetai – Vaivaseuta – Toomatagai, Moataa - Letogo
D1	Laulii to Falevao
D2	Le Mafa, Tiavea-tai, Tiavea-uta, Samusu-tai, Samusu-uta, Lotopue, Saleaumua, Mutiatele, Satitoo, Malaela, Ulutogia, Vailoa, Lalomanu, Lepa, Saleapaga, Aufaga, Vavau, Lotofaga, Utulaelae, Sapoe, Matatufu.
E1	Faleula – Leulumoegatuai, Faleula - Nuu
E2	Leulumoegatuai – Falelatai, Leulumoegatuai – Aleisa - Siusega
F1	Tiavi – Mulivai (Safata), Siumu - Falealili
F2	Tafitoala – Lefaga, Faleaseela – Matafaa - Tanumalala
Manono & Apolima islands	All villages on the islands
Savaii East	Salelologa – Aopo (Itu-o-tane)
Savaii West	Salelologa – Asau (Itu-o-salega)

4.1 Identified Issues of Existing Waste Collection System

Solid waste management is still an issue for Samoa as a whole. As mentioned, the collection route follows the public sealed roads whilst other residents residing at the back of public roads are not serviced. Though private access roads to these households exist, they are not wide enough for collection trucks. However, they are either share waste platforms with neighbors or responsible for transporting their wastes to the landfill and paying the tipping fee. Currently, there is no segregation at source which contributes significantly to the huge amount of waste disposed at the landfill.

Furthermore, green and recyclable wastes are collected during the operations. Both rural and urban settlements are covered by the service respectively Upolu, Savaii, Manono and Apolima islands. Below are the main existing issues relate to the collection system.

4.1.1 Collection Vehicles

Previously, open tipping trucks were used for waste collection by private contractors. This poses some issues in the like of dropping of some collected wastes along the road during operation. Some contractors are now in possession of rubbish compactors while others are still using open trucks. However, this is one of the conditions that a contractor should comply with when bidding for the delivering of the service. Those who were success from the tendering process and do not possess a compactor is given a probationary period of twelve months and should have in place a compactor before the end of this period.

4.1.2 Collection containers/storage

Some households are still using half 44 gallon drums as storage for collection. Though these storage gallons look admirable with paintings, they are exposed and thus rust in a short period of time. Nevertheless, encouraging of construction of platforms either wooden or steel saw that most households now use trash bags as storage. However, some platforms are not high enough and stray dogs always access tearing and spreading wastes underneath the platforms and thus make the collection operation difficult.

4.1.3 Collection Points

As already mentioned, collection points are road sides frontage each residents but some are not located along public roads. Depending on the relationship of residents, some do share platforms while others presumably burn, bury or dump their wastes somewhere else.

Some individual transport their wastes themselves to the landfill but face with paying a tipping fee.

4.1.4 Contractors Compliance

The contract between MNRE and contractors clearly highlights the conditions of the service. However, some do not comply with these conditions and specifications from time to time. In addition, some do not follow the agreed collection schedule or change their schedule without a prior consent from the ministry. Another issue is the incomplete collection of a respective zone on the schedule days.

4.2 Suggestion for Improvement

4.2.1 Capacity Building

There is still an outstanding issue on improving capacity for appropriate waste collection vehicles. MNRE through its tendering of the service encourages successful contractors to upgrade and adopt rubbish compactors for efficient and effective delivering of the service.

4.2.2 Enforcement of Waste Management Act

There is a great need for the enforcement of the Waste Management Act. Since the Waste Management section has limited staff, the ministry is relying on the general public especially village mayors for an extending arm in enforcement.

4.2.3 Segregation and 3Rs

Since segregation at source is not implemented but taking the amount of wastes disposed of at the landfill into consideration, it is then about time to put in place initiatives to minimize wastes coming in to the landfill. Despite the fact that segregation is done at the landfill, recovering of recyclables is not efficient due to the type of items each recycling companies collect/accept. The previous study highlighted that green waste dominates the amount of waste disposed at the landfill as households do not practice home composting. This is a fact especially in the urban area where land for plantation is an issue whilst in the rural area; households traditionally use green waste for mulching.

As a component of the J-PRISM plan of operation, waste minimization is one of the key activities to be implemented in the urban area. This will be implemented on a step by step basis where consultations, workshops and education are critical aspects beside segregation home composting and separate collection for recyclables. It is piloted at Vaitele with the aim of extending until the whole urban area is covered.

4.2.4 Finance

The government is solely carrying the burden of financially engaging in solid waste management. Currently, the ministry through the Waste Management Section is managing various waste related contract services mainly, litter maintenance in Apia town area; Public toilets maintenance; Public cemetery maintenance; lawn maintenance in Apia town area; Rubbish collection services and landfill maintenance.

At its annual budgeting, the DEC allocates budget for operations for its five sections' activities including waste management. As the DEC budget allocation do not separate amount allocated to each sections, this pose some issues as some sections utilizes the allocation while sacrificing activities of others. There is a need to allocate certain amount for each section to operate. However, for waste contract services, the government through the Tenders Board allocates funding for these services depending on the successful bid price tendered.

5.0 Intermediate Treatment and Final Waste Disposal

5.1 Open Burning

Open burning at household is a common intermediate method despite the collection service in place. This is commonly observed especially for green wastes. However, specific clauses in the Waste Management Act prohibit burning of wastes in any manner disregard whether its private or public lands.

5.2 Pit Burying

Traditionally, this is one of the common treatment households practice especially for bulky waste like tins, glasses etc. This practice is mainly to avoid mosquito breeding.

5.3 Sorting/Segregation

Sorting is practiced at a smaller scale by some schools, organizations, businesses and beach resorts. This is an assistance provided by the Pacific Recycle Company where they provide special bins for recyclables and themselves are responsible for the collection and emptying of these bins.

5.4 Composting

Some NGOs are encouraging and practice composting in the like of Women in Business Inc where they promote organic farming. In the rural area, it is a common practice to use food scraps and leftovers as a feeding stock for subsistence pig farms.

5.5 Final Waste Disposal

All solid wastes collected from Manono, Apolima and Upolu are disposed at the Tafaigata landfill. Similarly for Savaii island, the collected wastes are disposed at the Vaiaata landfill. The two landfills are opened six days a week including public holidays for eight hours a day.

All incoming vehicles are screened at the gate for appropriate disposal and to check for prohibited materials especially hazardous materials before commencing to the landfill area.

6.0 Waste Generation

6.1 Previous Waste Generation Study

The previous study by Sagapolutele and Rasch was carried out in three different areas. The Apia area, Vaitele and Savaii island. For comparison purposes, this report extracts the result of waste composition from Vaitele area respectively.

Table 6.1 Waste composition for Vaitele in 2007.

Waste Category	2007
Green Waste	40.10%
Food Scraps	11.65%
Paper	1.60%
Cardboard	6.00%
Plastic bags/papers	7.50%
Plastic bottles/Containers	5.50%
Diapers/Sanitary pads	-
Glass	2.20%
Metals	7.20%
Textiles	6.70%
Others	11.00%

From the above result, there was a high composition percentage in both green waste and food scraps. These two categories should have been used in composting and thus should not end up in the landfill for final disposal. However, it was a fact that the land area per household (an average of $\frac{1}{4}$ acre/household) is insufficient for green waste and food scraps to dispose of. As a usual practice, food scraps are fed to the pigs and dogs but limited land space restricted households from owning pigs.

The 2007 study highlighted that the average daily generation was 0.48kg per person per day at Vaitele respectively.

6.2 Current Waste Generation Survey

Recently, the waste management unit conducted a waste survey in the urban area for households and seven commercial activities. Vaitele village was used as a sample area. The estimated population is 7,000 which identify Vaitele by far the most populated area in the country.

6.2.1 Waste Generation at Household

A baseline survey was conducted from 25 to 31 October 2011 for Households. Forty households were randomly selected as a sample from Vaitele residential area following the waste collection route. The procedure for the survey is discussed at 10.0 below.

The result from the study highlighted that generation rate by the household sector is 0.38 kg/person/day with a density of 0.16 kg/L. Total family size of the 40 household surveyed was 393. The previous study by Sagapolutele and Rasch indicated that the generation rate for the Vaitele area was 0.48 kg/person/day. This shows a slight reduction in comparison but this fluctuates from time to time.

From the findings of the survey, it is estimated that approximately 2,660 kg (2.66 tonnes) of waste is generated per day or 970.9 tonnes per year.

For density, 19.2 kg of waste generated can fill a 120L wheelie bin thus 159.36 kg/m³ therefore 1,274.88 kg of waste per 8 cubic meter size rubbish compactor.

6.2.2 Waste Generation at Commercial Sector

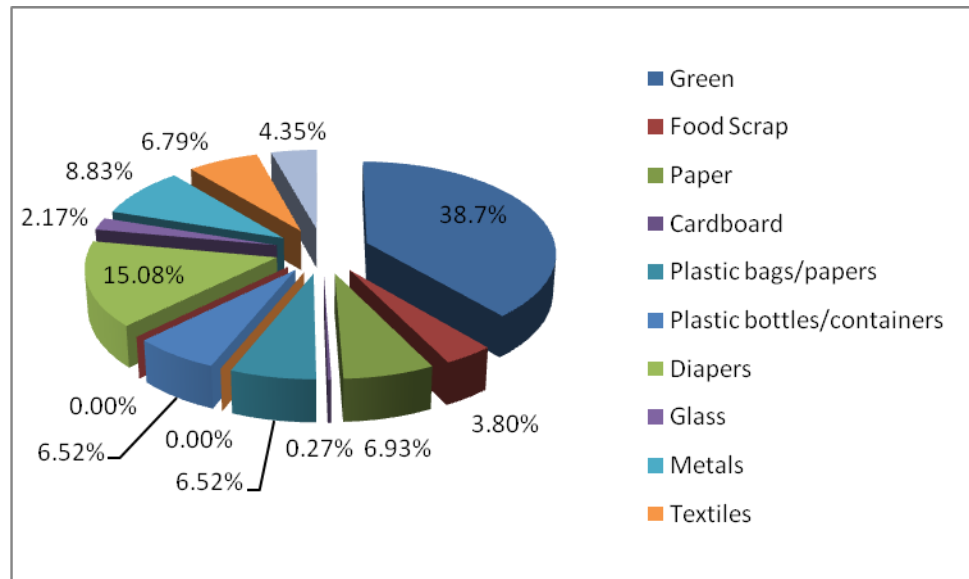
There was no data and/or information from the Commercial sector thus recommended by the previous study as this area was in great need for baseline information. As a result, Commercial sector was included during this study. Seven Commercial areas were chosen for this study: hotel, school, supermarket, office, public market, restaurant, and bar/night club.

This study indicated that the daily generation rate is 0.01 kg/m²/day with a density of 0.11 kg/L.

6.2.3 Domestic Waste Composition

Table 6.2.3 Domestic Waste Composition.

Categories	Days							Total Weight	%
	1	2	3	4	5	6	7		
Green	24.5	34.5	32.5	9	18.5	16.5	7	142.5	38.7%
Food Scrap	5.5	0	1	0.5	2	2	3	14	3.80%
Paper	5	2.5	5	5	4	2	2	25.5	6.93%
Cardboard	0	0	0	0.5	0.5	0	0	1	0.27%
Plastic bags/papers	7	3	3	4	2.5	2.5	2	24	6.52%
Plastic bottles/containers	4	3	6	4.5	3.5	1	2	24	6.52%
Diapers	13.5	4	10.5	9	6	2	10.5	55.5	15.08%
Glass	2	0.5	1	2.5	1	0.5	0.5	8	2.17%
Metals	3	5.5	7.5	10.5	1	2	3	32.5	8.83%
Textiles	1	7.5	1	3	1	6	5.5	25	6.79%
Others	2.5	1	1	9.5	1	0.5	0.5	16	4.35%
Total								368	100.0%



From the above results, Green Waste dominates the composition of waste collected during the survey followed by Diapers/Sanitary pads. The significant amount of Green waste is due to that fact as

mentioned by Sagapolutele and Rasch, land space is limited to dispose generated green waste. Food scrap on the other hand is mainly bread and scraps of taro and breadfruit as limited land space again unable to raise pigs to feed this waste to.

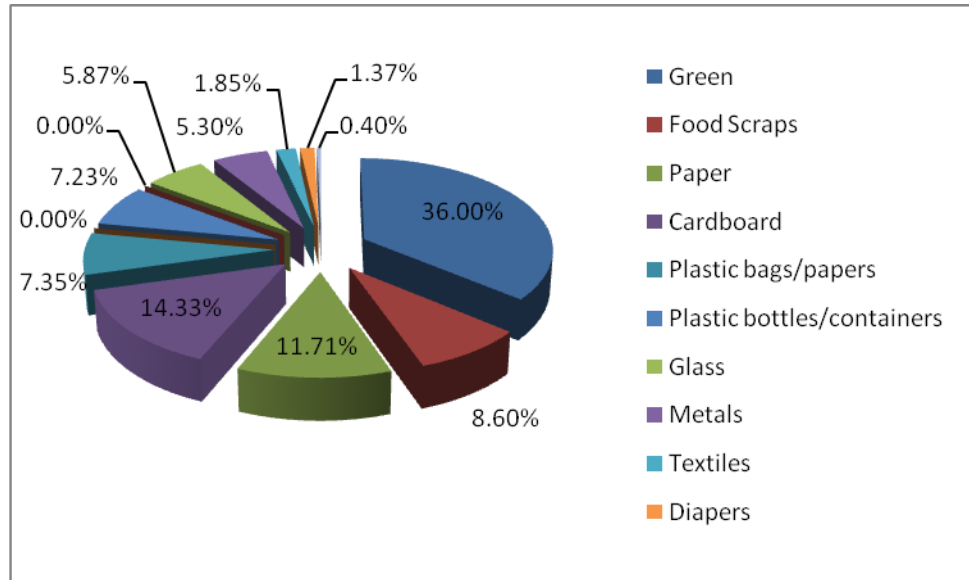
Total daily waste disposed at Tafaigata landfill is 52.6 kg.

Successful implementation of waste segregation at source and home composting initiatives of the 3R's concept, sees that about 57.85% of the waste should not be disposed at the landfill. For instance, 42.5% of the total waste disposed should be used for composting majorly for green wastes and food scraps. Considering the current capacity of recycling companies, 15.35% of the total waste should be diverted for recycling.

6.2.4 Commercial Waste Composition

Table 6.2.4 Commercial Waste Composition

Categories	Days							Total	%
	1	2	3	4	5	6	7		
Green	110	112	130	50	95	0	135	632	36.00%
Food Scraps	9	40.5	60	24.5	8.5	0	8.5	151	8.60%
Paper	41.5	30	25.5	44	21.5	0	43	205.5	11.71%
Cardboard	33.5	54.5	55	40.5	33	0	35	251.5	14.33%
Plastic bags/papers	19	27	24.5	15	15.5	0	28	129	7.35%
Plastic bottles/containers	17.5	24.5	23.5	27.5	13	0	21	127	7.23%
Glass	12.5	14	22.5	20	15.5	0	18.5	103	5.87%
Metals	12	15.5	17	13.5	15.5	0	19.5	93	5.30%
Textiles	17.5	3.5	3	2.5	1	0	5	32.5	1.85%
Diapers	4	5.5	2.5	4.5	1.5	0	6	24	1.37%
Others	2.5	1.5	1.5	0.5	0.5	0	0.5	7	0.40%
Total								1755.5	100.00%



The above results indicated that Green Waste dominates the composition in the commercial sector followed by Cardboard. The Green Waste is mainly from the Public Market and plant clippings from the Hotel. Cardboard category is mainly packaging materials from all seven activities but mainly from the Hotel and Supermarket.

Similar to Domestic wastes, 57.13% of the waste generated should not be coming in the landfill for final disposal. Green and Food Scraps wastes (36% and 8.6%) should be used for composting at the landfill. However, a joint project between MNRE and Women in Business Development Incorporated (WIBDI) sharing a shredder for composting did not work out as it should be. This is due to the fact that the mobile shredder is much needed by the latter's clients, thus currently the WIBDI uses the equipment on a full time basis.

Combining waste composition from both sectors, it is estimated that the daily waste disposed at Tafaigata landfill is 303.4 kg or 110,741 kg/year.

7.0 Education and Awareness

The Ministry has been carrying out various awareness programmes not only at the community level but also at the schools both in the urban and the rural areas. However, the attitudes of the general public have not changed resulting in littering and illegal dumping. Enforcement of legislations is thus a priority to assist in the Education and Awareness programmes in elimination of adverse habits.

8.0 Existing Legislations and Policies

8.1 Disaster and Emergency Management Act 2007.

An ACT to provide for the management of disasters and emergencies in Samoa by effective planning and risk reduction, response and recovery procedures and the promotion of coordination amongst the response agencies, and for related purposes.

8.2 Lands, Surveys and Environment Act 1989.

An ACT to consolidate The Land Ordinance 1959 and its implementation and also to make provision for the conservation and protection of the environment and the establishment of National Parks and other forms of protected areas and to enlarge the functions of Department of State and for matters incidental thereto.

8.3 Ministry of Health Act 2006.

An ACT to establish and define the functions and powers of the Ministry of Health, the Minister and the Chief Executive Officer of the Ministry and for related purposes.

8.4 National Health Service Act 2006.

An ACT to provide for the National Health Service and related purposes.

8.5 Planning and Urban Management Act 2004.

An ACT to establish a Planning and Urban Management Agency and to implement a framework for planning the use, development and protection of land in Samoa in the present and long-term interests of all Samoans and for related purposes.

8.6 Quarantine (Biosecurity) Act 2005.

An ACT to consolidate the law relating to the importation of regulated articles and associated biosecurity risk and control of pests and diseases of animals, plants and the wider environment.

8.7 Village Fono Act 1990.

An ACT to validate and empower the exercise of power and authority by Village Fono in accordance with the custom and usage of their villages and to confirm or grant certain powers and to provide for incidental matters.

8.8 Waste Management Act 2010.

An ACT to provide for the collection and disposal of solid wastes and the management of all wastes in Samoa, and for related purposes.

8.9 National Waste Management Policy 2001.

The purpose of this policy is to propose guidelines for the minimization, control and management of wastes and pollution.

9.0 3R Initiatives

9.1 Recycling

There are a few private recycling companies existed in the country. Some are operated on both main islands of Upolu and Savaii. They are mainly:

- Pacific Recycle Co. Ltd
- West End Co. Ltd
- Singapore Motor
- Demolition Depot

The Pacific Recycle Co. Ltd operated next to the Waste Unit Office at Tafaigata is the most prominent of all existing recyclers. They have assisting in various ways not only to the ministry but also beach resort operators and some schools. Their assistance falls in the provision of recycling receptacles

to schools and resort operators and responsible for collecting and emptying of these receptacles.

The accepted recyclables is limited to scrap metals, tins, aluminum cans, car bodies, iron roofing, plastic bottles/containers and car batteries. There is still a challenge for paper and cardboard recycling as none is currently existed. One of the major challenges for recycling companies is the cost incurred in shipping of the materials to overseas markets. As Samoa like other Pacific states are isolated from the markets especially Japan and China. The return from the operation is just enough for them to operate.

Samoa Breweries Limited is the only company that has been implementing the reuse of returnable bottles for decades both for beer and soft drinks glass bottles. They are paying out 20 sene for 750ml bottles and 10 sene for 450ml bottles.

9.2 Composting

A few Non-government Organizations are currently engaged in composting. Women In Business Developments Incorporated (WIBDI) is the prominent NGO that works with the community in promoting organic farming using compost. Currently, they are working with 728 growers and each farmer must meet certain requirements in order to be a certified organic farmer.

There is still a need for composting at the landfill to make use of the enormous amount of green waste coming in. However, in order to meet this challenge, a shredder must be at the compound on a full time basis.

10.0 Methodology

10.1 Equipment/Materials

- ✓ Trash bags for collection of wastes – (40 households x 7days)
- ✓ Weighing scale – 2 hanging scales for weight measurement
- ✓ Buckets – 3 20L buckets for weight and volume measurement
- ✓ 2 Tarpaulins – waste sorting
- ✓ Gloves – protection of crew
- ✓ Clipboards – for filling questionnaires and data recording
- ✓ Shovels – waste sorting and final disposal
- ✓ Measuring tape – measurement of floor area of commercial sites where possible

10.2 Other Equipment/Materials

- Vehicle (dyna truck) to collect and transport waste from households/commercial sites to landfill for measurement and disposal.
- Crew
 - 1 driver
 - 2 workers for loading and off loading of trash bags
 - 3 workers for weighing and sorting
 - 1 recorder
 - 1 supervisor to check on any errors that might derive during weighing

10.3 Before Actual Study Day

It is the responsibility of the team leader to check that all required equipment/materials are sufficiently available. In addition, he/she has to brief the crew on the purpose of the exercise and the procedures to be thoroughly followed.

- Briefing of the team
- Check that all required equipment/materials are available
- Dispatch questionnaires
- Vehicle daily running sheets are filled (for records)
- Fuel (receipts kept for records)
- Crew is organized and ready mentally and physically

10.4 Step Undertaken

- i. Assign numbers to each households and commercial activities for the purpose of data recording and analysis;
- ii. Visit each assigned households filling in questionnaires and issue trash bags (with numbers marked) for collection on the very next day;
- iii. Collect trash bags from households and issue another trash bag;
- iv. Transport collected bags to landfill for measurement, sorting, recording and disposal;
- v. Repeat iii and iv above for the next 7 days;
- vi. Weigh each bags and record the weight in the data sheets according to the numbers assigned to each households;
- vii. Open trash bags and empty contents into buckets until they become full. The buckets are then be emptied and the contents spread on the tarpaulins. Repeat this process until all bags are emptied and count the number of bucketful loads, which is recorded for volume estimation;

- viii. Separate the wastes on tarpaulins into different types (green, food scraps, plastic bags/papers, plastic bottles/containers, glass, metals, textiles and diapers). Separated wastes is put into buckets for weight measurement;
- ix. Measure the weight of each type of waste and record in the data sheets;
- x. Dispose all waste properly and clean the equipment used.
- xi. Repeat the process for seven consecutive days.

10.5 Methodology for Waste Characterization

10.5.1 Preparation

The same preparation as mentioned in 10.4 above.

10.5.2 Procedures

Same procedure as mentioned in 10.4 above.

10.5.3 Calculation

Domestic Daily Generation Rate:

Total Weight/Total Household Size/7days.

1039kg/393individual/7days

0.38kg/person/day

Thus multiplying by the total population and will get an estimate what the whole area generates on a daily basis.

Volume:

Total Number of bucket loads X volume of bucket = Daily total Volume;

Mean Density = Grand total weight/Daily total volume

Grand total weight = 368 kg

Total Number of bucket loads = 117

Volume of bucket used = 20 L

Daily total volume = $117 \times 20 = 2340$

(mean) bulky density = $368/2340 = 0.16$ kg/L

11.0 Limitations and Recommendations

11.1 Survey Area and Frequency:

The survey was supposed to cover the whole urban area including the residences at and around the Apia area but due to a number of factors, the study was limited to Vaitele. There is a great need for updated information on the data from the urban area for reliable data for the whole urban area. A study is then recommended for every three years to cover the whole said area. In addition, there is also an urgent need to conduct a similar study to update the information collected by the 2006 study in Savaii as a numerous developments have been witnessed in the new Salelologa township.

11.2 Public Awareness and Appreciation:

The Ministry has conducted numerous awareness programs in both schools and community levels. However, there is still a need for effective initiatives to educate the public on the issues pertaining waste management. Effective t.v. spots to deliver messages are also required. Generally, the public think that the government should be solely responsible for waste management without taking into considerations that everyone generates waste thus it is everyone's responsibility to manage waste.

11.3 Financial Support:

As mentioned, the government through the Ministry of Natural Resources and Environment provide financial support for waste management. The bulk of the allocated budget is channeled through waste contract services mainly for collection, landfill maintenance and public amenities maintenance.

For the issue of budgeting, there should be enough allocation for various waste operations. Thus, the divisional budget should be separately allocated for different sections within the division.

11.4 3R Initiatives:

Waste minimization is currently an outstanding issue to be appropriately addressed at all levels. Taking the limited land availability for disposal as a characteristic common in Pacific Island Countries, implementing various 3R activities will gradually bail out Samoa from this long term issue. There is also a need for private recycling companies to enhance their capacity in recycling of certain materials that currently not covered.

For example, there is not a single company operated and recycles cardboards except for the public to reuse for other purposes. Globally, there is a decline in resources for extracting certain materials for manufacturing of needed items. Thus, many companies are turning to recycling as a waste to resource initiative.

A pilot waste minimization project will be implemented at Vaitele area. The aim of this pilot project is to cover the whole area and gradually expanded to other urban areas. This is again an initiative that will be funded by the J-PRISM project mirroring the success stories from neighboring island nations who have been implementing this initiative successfully.

From the result of the study, it is found that it is more viable and economical wise to implement a separate collection for recyclables on a fortnightly basis. In the long term and the successful implementation of this initiatives, it is wise to negotiate with recycling companies to implement recyclable collection themselves as it is good for their businesses as they are currently paying out monies for people to bring in these materials whereas it should be the other way around.

11.5 Enforcement of Existing Legislations:

The mentioned legislations, touches one way or another the issue of waste management. However, the principal Act which is the Waste Management Act needs to be enforced. There is a plan in the pipe line to draft a Regulation for this Act but the ministry is trying to secure funding for such.

There is also an alternative to collaboratively work together with other agencies in assisting to put in place appropriate enforcements. Furthermore there is a need for communities to develop village bi-laws under the administration of the village councils.

11.6 Capacity Building and Development:

Ministry of Natural Resources is the only agency that deals with waste management in Samoa. In the Waste Management Unit, there is insufficient number of staff to implement activities. Currently, there are four permanent staff and nine casual workers within the unit. Thus, there is a need to recruit more staff especially for Savaii where there is no staff post existed at the moment.

Though most of the staff have been participated in various trainings on solid waste management, there are still some gaps in which the capacity building is much needed. Thus, these gaps must be indentified and appropriate trainings must also be developed to upgrade the existing knowledge.

11.7 Landfill Improvement Works:

There are two existing landfills in Samoa adopting the Fukuoka Method. Tafaigata landfill which was constructed with financial and technical support from JICA and its duplicate on Savaii; the Vaiaata landfill which was funded by the government. Both landfills are on government lands.

The current scenario at Vaiaata landfill is a concern as there is no access to electricity and there is no office to manage incoming vehicles for discharging. Due to inaccessibility to electricity, the leachate treatment is impossible like the treatment facility at Tafaigata landfill.

In the case of Tafaigata landfill, there is a need to install leachate collection pipes for the new cells. A cost estimate of the materials required was submitted for the supplementary budget for the parliament to endorse. The supplementary budget for the current financial year is discussed in the current parliament session and once it is passed then the Waste Management Unit will proceed with procurement and installation.

12.0 Conclusion

Solid Waste Management will still be an ongoing issue if appropriate actions are not addressed. The baseline data collected in this survey is of great important as the amount of waste generated will increase parallel with the population climb. For the urban areas, promotion of 3R initiatives will assist in minimizing of waste disposed at the landfill thus, prolonging the life of the landfill. Community's participation approach will be much needed on the collective efforts to sustainably manage the waste generated at source together with other simple methods in reducing the signigicant amount of waste generated and disposed at the landfill.

References

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Annex-1: Data Results

1.1 Data Sheet for Daily Generation Rate - Household:

Household No.	Family Sized	Days							Total
		1	2	3	4	5	6	7	
1	6	1.5	0	2	1.5	0	3	0	8
2	7	7	14	4.5	5	9.5	7	6	53
3	12	4.5	15.5	9	10.5	5	5.5	6.5	56.5
4	10	0	5.5	6.5	12.5	6	4	5	39.5
5	7	11	3	6.5	7.5	6	10	6.5	50.5
6	7	6.5	0	8.5	6	4.5	4.5	3	33
7	6	4	3.5	0.5	2.5	2.5	0	0	13
8	8	8	2	7.5	6	6	2.5	3	35
9	14	4	4.5	4	5.5	4.5	7	5	34.5
10	8	0	0	1	6	3	1.5	0	11.5
11	13	1.5	1.5	2.5	4	3.5	0	4	17
12	6	4	2.5	1	0.5	2	2	1	13
13	10	0	1.5	1	3.5	2.5	1.5	4	14
14	14	7.5	10	7	6	5	7	7	49.5
15	11	10.5	3.5	4	8.5	5.5	6	0	38
16	10	9	7.5	5	7.5	6	7.5	7	49.5
17	11	0	0	4	4	3	0	0	11
18	10	0	6	4.5	4	7	6.5	6	34
19	7	0	2.5	10	3.5	0	2	1	19
20	19	3	0.5	2	1.5	3.5	2	2	14.5
21	7	2.5	3.5	2.5	1.5	0	0	1.5	11.5
22	18	3	5	1.5	2	2	1.5	1.5	16.5
23	9	2	2.5	6	3	2.5	2	1.5	19.5
24	13	0	3.5	4	2.5	0	1.5	1.5	13
25	13	0.5	3	1	0.5	4	2.5	0.5	12
26	8	3	0.5	1	1.5	2	0.5	1	9.5
27	6	0	0	10.5	3	6.5	3.5	1	24.5
28	9	8	8	7.5	5	4.5	5.5	4	42.5
29	7	5	1.5	2.5	1.5	2	2.5	1	16
30	10	2	2.5	3.5	4.5	1.5	1	2	17
31	7	4	2.5	1.5	4.5	2	1	1	16.5
32	8	3	3.5	3.5	5.5	3	0	0	18.5
33	6	2.5	0	2.5	2.5	2.5	1	0	11
34	6	3	0	1	7	4.5	7	0	22.5
35	11	6	0	2.5	3.5	2	3.5	7	24.5

36	10	8.5	8	9.5	3.5	3.5	7.5	0	40.5
37	19	4.5	2.5	3	8	0	0	1	19
38	20	8	12	9.5	13.5	2.5	12	9.5	67
39	5	0	1.5	2	1.5	1.5	0.5	0.5	7.5
40	5	17	3	11.5	2	1.5	1	0	36
Total	393								1039

Computation:

(mean) daily generation rate = $(1039)/(393)/7$
= 0.37768
= **0.38 kg/person/day**

1.2 Data Sheet for Volume (Density)

Day	1	2	3	4	5	6	7	Total
No. of bucket loads *	19	19	19	19	14	14	13	117
Daily total volume	380 ltr	380ltr	380 ltr	380 ltr	280 ltr	280 ltr	260 ltr	2340ltr

Volume of bucket used is 20 L.

1.3 Data Sheet for Daily Generation Rate – Commercial:

Commercial Activity No.	Floor Area(m ²)	Days							Total
		1	2	3	4	5	6	7	
1	8,000.00	96.5	144	126	14.5	114	0	188.5	683.5
2	63.99	16.5	9.5	14.5	11.5	20	0	13	85
3	3,242.00	51.5	11	24	10.5	10.5	0	17.5	125
4	88.50	0	89	29.5	66.5	0	0	38	223
5	15,066.9 4	120	116.5	159.5	0	76	0	86	558
6	2,064.50	15.5	7.5	11	13.5	0	0	17	64.5
7	1,199.66	21.5	3.5	21	4	16	0	11	77
	29,725.5 9								1816

Computation:

$$\begin{aligned}
 \text{(mean) daily generation rate} &= (1,816)/29,725.59/7 \\
 &= 0.00872 \\
 &= \mathbf{0.01 \text{ kg/m}^2/\text{day}}
 \end{aligned}$$

1.4 Density

Day	Comm No.	1	2	3	4	5	6	7	Total
No. of bucket loads *	1 Tanoa	34	37	33	38	33	-	54	229
	2 Sydney	5	3.50	3	2.50	4	-	3	21
	3 RLSS	22	9.50	17	9.50	5.75	-	11	74.75
	4 Maota	-	37	15	27	-	-	13	92
	5 Market	23	30	43	-	16.5	-	17	129.5
	6 MNRE	11	5	7	5	-	-	5	33
	7 RSA	9	2.50	15.75	2	6	-	4	39.25
Daily total volume		2080 ltr	2490 ltr	6,675 ltr	1,680 ltr	1,285 ltr	-	2,140 ltr	618.5 no. buckets Total volume - 16,350

Volume of bucket used is 20 L.

1.5 Waste Composition – Household:

Categories	Days							Total Weight	%
	1	2	3	4	5	6	7		
Green	24.5	34.5	32.5	9	18.5	16.5	7	142.5	38.7%
Food Scrap	5.5	0	1	0.5	2	2	3	14	3.80%
Paper	5	2.5	5	5	4	2	2	25.5	6.93%
Cardboard	0	0	0	0.5	0.5	0	0	1	0.27%
Plastic bags/papers	7	3	3	4	2.5	2.5	2	24	6.52%
Plastic bottles/containers	4	3	6	4.5	3.5	1	2	24	6.52%
Diapers	13.5	4	10.5	9	6	2	10.5	55.5	15.08%
Glass	2	0.5	1	2.5	1	0.5	0.5	8	2.17%
Metals	3	5.5	7.5	10.5	1	2	3	32.5	8.83%
Textiles	1	7.5	1	3	1	6	5.5	25	6.79%
Others	2.5	1	1	9.5	1	0.5	0.5	16	4.35%
Total								368	100.0%

Total Daily Waste Disposed (Domestic)

= 368/7 (kg/day)

= 52.6 kg

1.6 Waste Composition – Commercial:

Categories	Days							Total	%
	1	2	3	4	5	6	7		
Green	110	112	130	50	95	0	135	632	36.00%
Food Scraps	9	40.5	60	24.5	8.5	0	8.5	151	8.60%
Paper	41.5	30	25.5	44	21.5	0	43	205.5	11.71%
Cardboard	33.5	54.5	55	40.5	33	0	35	251.5	14.33%
Plastic bags/papers	19	27	24.5	15	15.5	0	28	129	7.35%
Plastic bottles/containers	17.5	24.5	23.5	27.5	13	0	21	127	7.23%
Glass	12.5	14	22.5	20	15.5	0	18.5	103	5.87%
Metals	12	15.5	17	13.5	15.5	0	19.5	93	5.30%
Textiles	17.5	3.5	3	2.5	1	0	5	32.5	1.85%
Diapers	4	5.5	2.5	4.5	1.5	0	6	24	1.37%
Others	2.5	1.5	1.5	0.5	0.5	0	0.5	7	0.40%
Total								1755.5	100.00%

Total Daily Waste Disposed (Commercial)

= 1755.5/7 (kg/day)
 = 250.8 kg

Total Daily Waste Disposed at Tafaigata (Domestic + Commercial)

= 52.6 + 250.8
 = **303.4 kg**

Annex-2 Survey in Photos:



Waste sorting – Household



Green Waste – Household



Measurements of household wastes



Measuring household wastes while Faatamalii records.



Metals generated by households



Green waste generated by households.



Aluminum cans generated by school.



Collecting wastes from office.