

The Domestic Solid Waste Generation & Characterization Study on Upolu & Savaii Islands

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1.0. INTRODUCTION.

This report presents the findings of two Solid Waste Generation Surveys conducted on the island of Upolu in October 2006, and again in October 2007 on the island of Savaii. These studies were funded under the Climate Change Project coordinated by the Meteorology Division of the Ministry of Natural Resources and Environment. While this Climate Change Project's focus was mainly on climate change aspects associated with waste and greenhouse gases generation, the waste data generated from these two surveys were highly needed for national planning purposes. These important waste data and information provided the basis of future waste management programs and actions to be conducted and implemented by the Ministry of Natural Resources and Environment to properly manage the generated solid waste generated from households in Samoa.

1.1. Background Information

Solid waste generation and characterization studies provide important data and information to assist national governments and responsible waste management organizations and agencies in designing and developing appropriate strategies, plans, programs and actions for the management of solid waste. It is an important tool to obtain appropriate data for planning purposes and shall not be ignored if programs and actions are to be successful. The procedure for the collection of data and information on solid waste generation and composition is outlined in the Guides for Municipal Solid Waste Management in the Pacific Island Countries (WHO, 1996) and the Guidelines For Municipal Solid Waste Planning in Small Island Developing States in the Pacific Region (SPREP, 1999). Both documents highlight the importance of responsible national waste management organizations understanding the nature of the solid waste generation and waste stream for appropriate actions.

The generation rate of solid waste which is expressed as the amount of waste (kg) generated by one person on a daily basis; the composition of the generated waste which is expressed as the percentage of different components of the generated waste (i.e. green waste, plastics, paper, glass, metals and etc), as well as the volume and density of the generate waste are highly required to determine, plan and design waste equipments (sizes of bins, size of rubbish trucks and etc); type of facilities and services (treatment plants, waste landfill sizes, collection and recycling services. Furthermore, these information forecast the operation costs of the above mentioned services and

operations, and determining the feasibility of waste minimization initiatives (recycling and etc) that are relevant and appropriate to the generated solid waste.

1.2. Rationale

There has been some concern over the availability of information on the quantity and composition of the solid waste streams generated in Small Island Development States (SIDS). This has contributed to the failure of organizations responsible for solid waste management in many SIDS to put in place appropriate actions to address and manage associated problems. The quantity and composition of the waste streams enable policy and decision makers to identify problems within the existing waste management practices, as well as determining waste reduction tools and initiatives, and the feasibility of setting up recovery and recycling systems (UNEP, 2002).

The Regional Solid Waste Management Strategy 2005 adopted by Pacific Leaders during SPREP Meeting in 2005 encourages Pacific Islands to develop national strategies as management tool to help with the effective management of solid waste in the island nations. Developing and implementing successful national solid waste strategies depend on the availability of waste data as highlighted above. With the Ministry of Natural Resources and Environment's plan to develop a National Solid Waste Management Strategy with a five years outcome, the data and information from these waste surveys provide the basis of such a National Strategy.

The National Waste Management Policy 2001 which provides the general framework of waste management in Samoa emphasizes the need to conduct regular waste audits to collect update waste information for appropriate actions, as well as to monitor the changing nature of solid waste generation in Samoa.

The great dependence and reliance of our people nowadays to imported goods and products to support daily life, combined with the increasing population and improved development in Samoa have influenced the nature of the generated solid waste from both domestic and commercial sources. Nowadays, the nature of solid waste composition has changed from an organic dominated waste stream to inorganic because

of the influx of imported non biodegradable goods and products to support development projects and the lifestyle of Samoan people.

1.3. Objectives of the Surveys

- To study and understand the current status of solid waste generation in the urban and rural areas for appropriate actions.
- To determine the type of facilities required (recycling services, sizes of rubbish trucks for collection services, sizes of wheelie bins and other waste equipments) to improve waste services in Samoa.
- To identify factors associated with the generation of domestic solid waste in the urban and rural areas.
- To determine the types of waste minimization and recycling initiatives appropriate for the generated domestic solid waste

Specific Objectives:

To find out and determine the following waste data and information:

1. Generation rate of the domestic solid waste (kg/person/day)
2. Composition of the generated domestic solid waste.
3. Volume and density of the generated domestic solid waste

2.0. METHODOLOGY

The two separate surveys were carried out in accordance with the standard procedures set under the WHO Solid Waste Generation and Characterization Guidelines as attached (Annex 1: Solid Waste Generation and Characterization Procedure).

Families involved during the two surveys were randomly selected along the government solid waste collection routes. Trash bags were labeled and given to the selected families to store their generated rubbish and these bags were collected, assessed and analyzed on a daily basis for six to seven consecutive days.

Slides 1: Performing Solid Waste Assessment and Analysis.



In addition, the selected households were interviewed (refer to the attached copy and sample of the questionnaire used for the Savaii survey. This part of the survey was not carried out properly during the Upolu survey because of limited time available, and thus the information presented were mainly extracted from the Savaii survey.

Slide 2: Interviewing and Analysis of Information.



Solid Waste Generation & Characterization Surveys, Upolu & Savaii, 2008

3.0. STUDY AREA

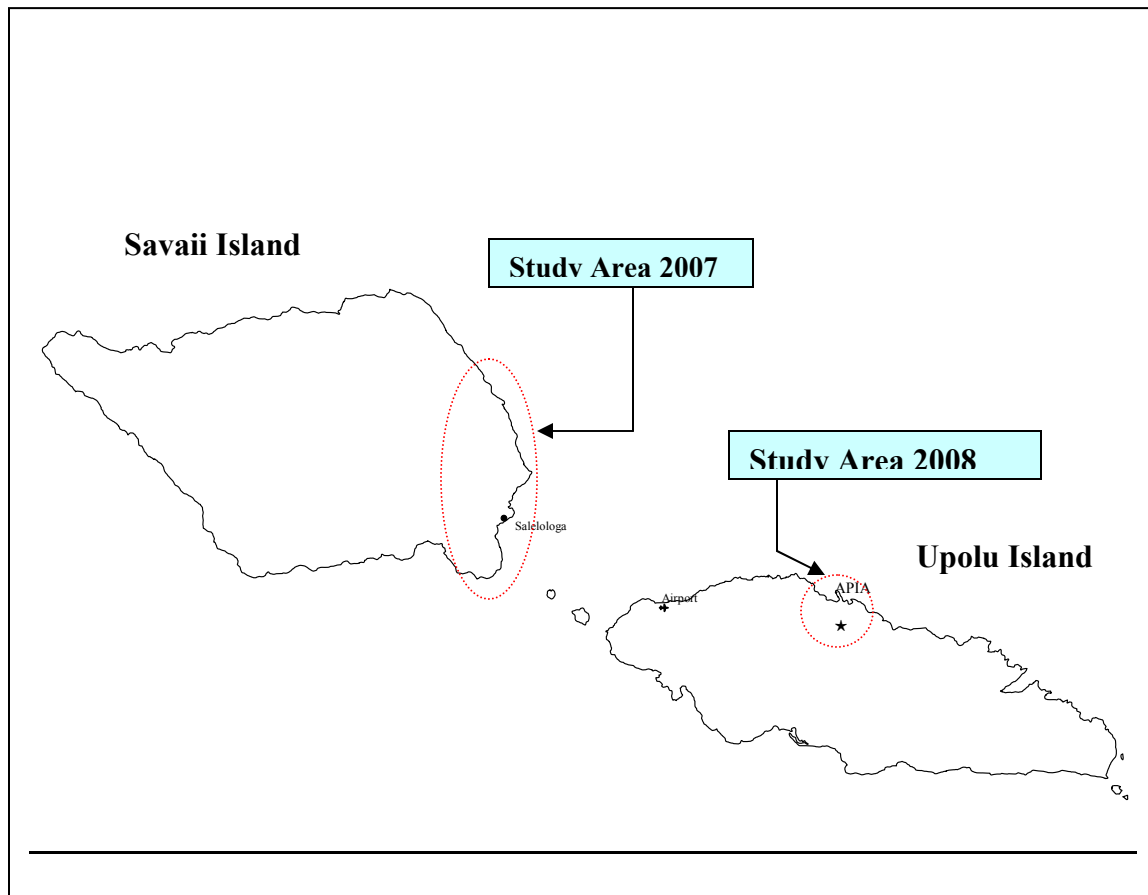
3.1. 2006 Waste Survey, Upolu Island

The selected study area for the waste survey in 2006 covered collection routes within the Apia town area (Vaiala to Taufusi, Lalovaea and Fugalei) and the surrounding Western Urban areas (villages between Vaimoso and Vaitele new settlements). More than 80 households were involved during this survey.

3.2. 2007 Waste Survey, Savaii Island

The selected study area for the waste survey in 2007 was along the main road from Salelologa to Puapua, and Salelologa to Gautavai. As part of this survey, interviews with the selected families were carried out prior to the commencement of the survey on Monday. During these interviews, the families were advised regarding the purpose of the study and the need for their support to provide true information as requested during this survey.

Figure 1: Map of the Study Areas



3.0. RESULTS

The results collected from both surveys are attached (Appendix 2, 3 & 4).

1. Generation Rate (amount of waste generated per person per day)

Apia urban areas survey: 0.5kg per person per day (refer Appendix 2)

Savaii areas survey: 0.4kg per person per day (refer Appendix 3)

There is a higher generation rate in the Apia urban areas compare to Savaii by 0.1kg per person per day , equivalent to 100kg of waste generated from 1000 people per day (refer to attached tables).

2. Composition of generated waste

The following tables (1, 2 & 3) summarize the outcomes of the generated solid waste contents collected from the two surveys highlighted above. The Upolu survey in 2006 is unique as the households covered are from two separate areas (within the Apia area & the outer surrounding urban areas), and thus this study indicates any difference with the nature of the waste generation at these areas for the Ministry of Natural Resources and Environment to consider when planning collection services to these areas and other services in the future.

Table 1: Composition of the Apia Area Generated Solid Waste

CATEGORIES	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Total weight (Kg)	%
Green Waste	12.85		12.00	15.15	13.40	12.20	12.60	78.20	48.90
Food Scraps		7.90	2.86	4.85	3.60	3.10	2.45	24.76	15.40
Paper	0.40	1.45	0.25	0.20	0.50	0.80	0.38	3.98	2.49
Cardboard	0.25	2.60	1.60	0.30	1.20	1.70	1.15	8.80	5.50
Plastic bags / Papers	2.00	1.90	0.71	0.50	1.40	1.80	2.10	10.41	6.50
Plastic Bottles / Containers	0.35	0.80	0.75	0.15	0.60	0.50	0.86	4.01	2.50
Glass	0.20	0.20	0.40	0.90	0.55	0.30	0.35	2.90	1.80
Metals	1.45	3.10	1.75	0.30	2.10	1.90	1.80	12.40	7.70
Textiles	1.40	0.25	1.64	1.05	1.30	1.55	1.60	8.79	5.50
Others		3.15	0.30	0.25	0.75	0.67	0.40	5.52	3.40
Total	18.90	21.35	22.26	23.65	25.40	24.52	23.69	159.77	99.69

The composition of the waste generated within the Apia areas is high in green waste and food scraps. This is due to the fact that the households within the Apia area do not have sufficient land space to dispose of any generated green waste and food scrap. Food scraps as usual are given to pigs and dogs. However, settlements within the Apia area

given the limited land spaces available are restricted from owning pigs or dogs. Plastic bags and papers, as well as metals (mostly empty cans) are the next waste categories with high contents.

Table 2: Composition of the Surrounding Urban Areas Generated Solid Waste

CATEGORIES	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Total weight (kg)	%
Green Waste	6.75	1.00	11.85	13.70	12.30	12.80	10.40	68.80	40.10
Food Scraps		11.20	1.25	1.05	0.55	1.50	4.30	19.85	11.65
Paper	1.05		0.29	0.30	0.30	0.35	0.40	2.69	1.60
Cardboard	1.25	1.35	2.41	1.05	1.35	1.40	1.40	10.21	6.00
Plastic bags / Papers	5.20	2.25	0.95	0.75	0.45	1.20	2.10	12.90	7.50
Plastic Bottles / Containers	1.10	0.95	1.26	0.45	3.10	1.20	1.35	9.41	5.50
Glass	0.95	0.95		0.25	0.45	0.60	0.70	3.90	2.20
Metals	1.46	2.15	2.45	1.05	1.10	2.10	2.10	12.41	7.20
Textiles	1.50	0.65	2.01	1.00	0.15	2.40	3.70	11.41	6.70
Others	3.10	2.15	2.45	3.50	2.95	2.20	2.40	18.75	11.00
Total	22.36	42.20	24.92	23.10	22.70	24.52	28.85	170.33	99.45

The green and food scraps contents were also higher for the generated solid waste collected from the outer urban surrounding areas. Plastic category (bags, papers and bottles) was the second category followed by metals which was mostly empty cans.

Table 3: Composition of the Savaii Area Generated Solid Waste

CATEGORY	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Total Weight	Percentage
Green waste	22.7	21.3	17.2	14.1	17.7	21	114	42
Food Scraps	1.3		3.5	2	2.6		9.4	3.4
Paper	1.5	1.5	1.5	1.1	1.1	1.5	8.2	3
Cardboard	0	1.6	1.9	2	2.9	2.5	10.9	4
Plastic Bag/Paper	2.6	2.5	9.9	2.5	1.5	2.25	21.25	8
Plastic Bottles/Container	3.3	1.5	1.6	1.9	1.7	1.5	11.5	4.1
Glass	1.8	4.5	4.5	3.1	3	5	21.9	8
Metals	7.5	8	4.4	8.5	11.5	5.75	45.65	5.1
Textiles	3.5	3.5		2.9	4.5		14.4	5.3
Others	1.4		1.4	3.9	3	7	16.7	6
TOTAL	45.6	44.4	45.9	42	49.5	46.5	273.9	100%

Green waste also dominates the content of the waste generated and collected in Savaii selected areas, follows by plastics (bags, papers and bottles), glasses and metals (empty cans and etc). The content of food scraps in contrast with the Upolu survey was very low. This is due to the fact that any generated food scraps in the rural areas are given to pigs or dogs.

3. Density of the Generated Waste

BULK DENSITY			
DENSITY	Apia	Vaitele	Savaii
Volume (kg)	1155	1170	1799
Weight (kg)	159.77	170.33	116
Density (kg/L)	0.14	0.16	0.06

The above results indicate the compactness of the generated waste, as well as the expected volume of waste generated from families. These information are vital in determining the sizes of wheelie bins for households in the future, as well as the size of rubbish trucks to be used under the government solid waste collection program. To demonstrate the above results into planning equipments and facilities:

Apia Waste Density = 0.14 kg / L

- = 16.8 kg of waste fills the MNRE 120L green wheelie bins with yellow lids
- = 16.8 kg per 0.12 cubic meter.
- = 139.4 kg per cubic meter.
- = 1,115.2 kg of waste per readymade rubbish truck of 8 cubicmeter size.

Vaitele Waste Density = 0.16 kg / L

- = 19.2 kg of waste fills the MNRE 120 L green wheelie bins with yellow lids.
- = 19.2 kg per 0.12 cubic meter
- = 159.36 kg per cubic meter
- = 1,274.8 kg waste per readymade rubbish truck of 8 cubicmeter size

Savaii Waste Density = .06 kg / L

- = 7.2 kg of waste fills the MNRE 120 green wheelie bins with yellow lids
- = 7.2 kg per 0.12 cubic meter
- = 58.76 kg per cubic meter
- = 470.8 kg waste per readymade rubbish truck of 8 cubicmeter size.

The densities of the collected generated waste from different areas covered during the two surveys (Upolu - 2 sites; Savaii - 2 sites) suggest that the generated waste is compactable. It is recommended under the WHO Guidelines that a density of about 400 kg / cubicmeter of waste suggest that the generated waste is too heavy because of high contents of metals and other waste that cannot be compressed. This is very important when deciding on the type of rubbish trucks to be used in delivering waste services.

4. Responses to the Survey Questionnaires (for the Savaii Survey)

- The overall response as reflected from the filled questionnaires indicate that few families pay special care and attention to the way they dispose of their generated solid waste.
- About 45% of the families surveyed were aware of the collection schedule and some did not even make use of it. Some disposed of their waste at their backyards.
- Before the government collection service, most of the families surveyed disposed of their waste at their backyards by burying underground (mostly for empty cans and glasses) while green waste were used as mulch to banana plantations behind the villages or to reclaim waterlogged land areas behind the villages. Some wastes were also burnt.
- The rubbish collection services collect rubbish from the villages twice a week.
- The most common types of waste generated by most families were plastics, tin cans and diapers.
- Green wastes generated were mostly disposed of at backyards while plastic and other waste were given to collection services in place.
- An average number of 9 members were recorded from the surveyed families.
- An average of three workers earned income for these families while most of them rely heavily on remittances and help from overseas families.
- Some villages like Lalomalava, village committees and church ministers have encouraged beautification and cleanliness inspections in the villages so rubbish is no longer dumped in their backyards like before.

4.0. CONCLUSION

The outcome of the two waste surveys performed on two different islands is very crucial as far as waste management concerns. These will be incorporated in the national plans designed to address identified waste problems to protect human health and our surrounding environment, as well as maintaining the natural beauty of Samoa as a safer and cleaner destination for tourists.

4.1. Generation Rate

The generation rates for all the different areas covered during the two surveys clearly reflect the nature of solid waste generation in the Small Island Developing States (SIDS). The average generation rate of solid waste in SIDS is about 0.5 kg per person per day, while the generation rate at developed countries like the United States of America, Japan and others is 1kg per person per day or more. With the changing lifestyle and improved standard of living in Samoa, an increase in the generation rate for Samoa is expected in the next 10 years and thus this should be taken into account when designing appropriate national policies and plans.

4.2. Composition

Organic waste (waste that naturally degrades) from green waste and food scraps dominates the composition of domestic solid waste by about 50%. Plastics and metals categories are the next components with high contents. This is the usual nature of solid waste generation in SIDS, and thus appropriate strategies can be put in place as tools to appropriately deal with these waste with higher contents. For instance, the setting up of appropriate recycling operations such as composting for the generated organic waste, as well as recycling of plastics and other waste materials. About 70% to 80% of the generated solid waste during the two surveys can be recycled. If recycling operations are available in Samoa, only 20% to 30% of the generated solid waste will eventually end up at the waste landfills.

4.3. Density

The densities of the generated waste from different areas being covered during the two surveys are generally not high, and thus this shall be taken into account when planning and designing appropriate waste equipment such as rubbish trucks, wheelie bins and other waste facilities. The density of 400 kg per cubicmeter is generally considered as high and thus the use of proper rubbish compactors is not recommended. The densities also suggest that wheelie bins of sizes between 100 L and 120L are more appropriate for household waste if waste minimization is to be achieved. Having larger wheelie bins will encourage households to fill in their bins and will therefore not helping in the reduction of waste at source.

4.4. Waste Management Services

The areas covered during these two surveys are collected under the government rubbish collection service two times a week. Private contractors selected under the government tendering system provide these services throughout Samoa on both Upolu and Savaii islands. The responses from the selected households suggest that these two services on a weekly basis are provided to the above areas by the assigned contractors. There is no separation of waste at source because all the generated waste is collected during these two collection services. There are recycling companies for empty cans, plastic bottles and scrap metals, but they do not provide national collection services to collect these waste materials throughout the country, unless on special request to the responsible private companies. If recycling is to be encouraged nationally, there is a need to incorporate the collection of recyclable waste materials under the current government rubbish collection program.

4.5. Public Awareness and Education

The responses from the households selected suggest that the public is not fully aware of waste management services in place. There is also lack of understanding with the adverse impacts of poor waste disposal practices to the environment such as burning of waste and illegal dumping at other areas not designated as official waste landfills. The families surveyed were not fully aware of the collection schedule and the types of waste covered under the existing government collection services.

In light of the information presented above, the following actions are highly recommended to the Ministry for implementation in the future if funding allows:

5.1. Future Waste Surveys.

There is a need to repeat doing this similar waste survey every two years in order to update the Ministry with the changing waste streams for appropriate actions given the impacts of developments in Samoa, combined with the changing lifestyles and the influx of imported goods and products nowadays.

5.2. Commercial Solid Waste Generation & Characterization Studies.

There is an urgent need to carry out similar waste surveys for the generated commercial waste in Samoa. While there is much information now available on domestic solid waste, there has been no survey conducted to determine the generation rates of commercial solid waste from different companies, businesses and organizations. Commercial waste collection and disposal is not covered under the government service, and thus businesses and organization bring their own generated waste to the waste landfills. It is crucial to understand the nature of commercial solid waste generation for appropriate actions and this shall be taken as soon as possible. While effort is put in controlling waste generation at domestic sources, there is a need for similar effort to control and regulate solid waste generation from commercial sources in order to effectively reduce the amount that eventually end up at both waste landfills.

5.3. Incorporation of findings to National Plans.

The baseline information extracted from the two waste surveys conducted at both Upolu and Savaii islands shall be considered and incorporated in the national plans such as the National Waste Management Policy and the National Solid Waste Management Strategy for appropriate actions.

5.4. Continuing Participation of the National University

It is highly recommended for the Ministry of Natural Resources and Environment to make appropriate arrangement to allow for the continuing participation of the National University of Samoa in carrying out these surveys in the future. This will not only provide projects for Environmental Science and Sciences students to fulfill their studies obligations but will also provide update waste data and information from time to time. This will also enhance capacity building on waste management research skills in Samoa.

5.0. REFERENCES CITED

1. MNRE, 2001; National Waste Management Policy 2001, Apia, Government of Samoa
2. SPREP, 1999, Guidelines for Municipal Solid Waste Management Planning in Small Island Developing States in the Pacific Region, Apia, Samoa.
3. UNEP, 2002; A Directory of Environmentally Sound Technologies for the Integrated Management of Solid, Liquid and Hazardous Waste for Small Island Developing States (SIDS) in the Pacific Region.
4. WHO, 1996; Guides for Municipal Solid Waste Management in Pacific Islands, Kuala Lumpur, Malaysia.

Friday, 5th Oct 2007.

- 8.00am: First survey team to Savaii (MNRE Staff: Ms Mato Liliko & Ms Risa Mirunaka); Three NUS Students
- 4.00pm: Second team to Savaii (Mr Faafetai Sagapolutele & Ms Katenia Rasch)
- 7.00pm: Dinner and briefing survey team by Survey Team Leader
Checking questionnaires, and equipments required for the survey.

Saturday, 6th Oct 2007.

- 7.30 am : Breakfast
- 8.00 am: Survey team divided into two groups.
Team A – Salelologa road junction to Puapua village.
Team B – Salelologa road junction to Satupaitea village
- Selection of 100 samples between Puapua village and Satupaitea by selecting every 10th family starting from the Salelologa Road junction covering both sides of the road.
 - Visiting the identified families and interviewed with the set questions
 - Explaining the purpose of the survey.
 - Gave each family from the selected families a trash bag to be collected on Sunday morning.
- 12.00 noon: Two collection teams arrived at the Forestry Compound at Maota with full loads of trash bags collected from selected Families.
- 12.30 pm: Weighing of collected samples
Segregating of waste to study their composition.
- 2.00 pm : Weighing and Segregation of waste completed – trucks with waste transported to Vaiaata landfill for disposal.
- 2.30 am: Returned to Hotel.
- 7.00 pm: Dinner
Inputting data to computer and discussion of some issues learned during the first day of the survey for improvement.

Sunday, 7th Oct 2007 : same schedule for the rest of the week.

- 7.30 am : Breakfast.
- 8.00 am: Collect trash bags from the selected families.
While at the same time giving them another trash bag for Monday, 8th Oct 2007.
- 12.00 noon: Two collection teams arrived at the Forestry Compound at Maota with full loads of trash bags collected from selected Families.
- 12.30 pm: Weighing of collected samples
Segregating of waste to study their composition.
- 2.00 pm : Weighing and Segregation of waste completed – trucks with waste transported to Vaiaata landfill for disposal.
- 2.30 am: Returned to Hotel.

7.00 pm: Dinner

Inputting data to computer and discussion of some issues learned during the first day of the survey for improvement.

Monday, 8th Oct 2007 to Sunday, 14th Oct 2007.

Same schedule

Monday, 15th Oct 2007 - Left for Apia

BRIEFING FOR THE SURVEY TEAM

DOMESTIC SOLID WASTE AUDIT - SAVAII ISLAND, 6TH OCT - 14TH OCT 2007

Introduction:

With funding now available for Samoa to prepare a special National Strategy particularly for Solid Waste Management, it is significant to collect update waste data and information as cornerstone and basis of such an important plan. In addition, such an information is vital in determining the amount of methane generated at waste landfills in Samoa, a green house gas that the Meteorology Division is studying under the Green House Project.

Purpose:

To collect baseline waste information and data required for planning purpose.

Outcomes:

a). Generation Rate (kg per person per day) - The amount of solid waste generated by an individual person per day for 7 days. Such an information is very important as it can be used to forecast the amount of waste estimated to be generated from a village, district, an area or zone, the entire country.

b).Composition of Waste (%) – This information is vital as it determines the amount of waste that can be recycled, minimized through various initiatives or disposed of at rubbish dumpsites.

c).Volume / Density – This information is important in finding out the compactness of waste. A lower density means that the waste is lighter and can be compacted, thus suggesting the use of rubbish compactor. The type of wheelie bins and transfer