スリランカ国

スリランカ国
廃棄物管理分野に関する
情報収集・確認調査

ファイナル・レポート
（資料編）

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1　優先地方自治体廃棄物事業調査結果（現地再委託成果）

1.1 Kataragama PS

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1 Introduction

The purpose of this survey is to obtain the current data regarding Solid Waste Management (SWM) at Kataragama Pradeshiya Sabha (KPS). The data collection survey was conducted from 6th November 12th November, 2015 by a team of expert dispatched by Waste To Energy Technologies Limited.

This report consists of brief summaries of survey methods and results. The additional primary data and records are available as soft copies. The preliminary data collection was conducted through four comprehensive surveys which are;

i. **Waste Composition Survey (WCS)** is to gather information on Physical Composition of MSW collected by KPS.
ii. **Waste Generation Survey (WGS)** is to gather information on waste generation sources at KPS based on secondary data available at KPS and other relevant organizations.
iii. **Public Opinion Survey (POS)** is gather information on public opinion on current waste management in KPS. The POS was conducted through a questionnaire survey that covers different types of waste generators in the KPS area.
iv. **Final Disposal Site Survey (FDSS)** is to collection data on final MSW disposal site of KPS based on secondary data as well as field recordings & visits to the site.

1.1 Background conditions of Kataragama Pradeshiya Sabha

Kataragama is a pilgrimage town sacred to all religions of Sri Lanka, especially for Buddhist and Hindus. And also people from South India and foreign tourists also go there to worship and site seining. The town has the Ruhunu Maha Kataragama devalaya, a shrine dedicated to Skanda-Murukan also known as Kataragama-devio. In addition, Kataragama houses the ancient Kiri Vehera Buddhist stupa. The Ruhunu Maha Kataragama devalaya and Kiri Vehera Buddhist stupa are the main attractions in the area and the Kataragama township and majority of citizens are depends on those religious places for their day-to-day social and economical activities.

Kataragama Pradeshiya Sabha is in the Monaragala District of Uva province, Sri Lanka. It is 228 km (through A2 highway) South-East of Colombo. Although Kataragama was a small village in medieval times, today it is a fast-developing township surrounded by jungle in the southeastern region of Sri Lanka. Since the 1950s the city has undergone many improvements with successive governments investing in public transportation, medical facilities, and business development and hotel services. It adjoins the popular Yala National Park.

Table 1-1 Basic fact sheet of Kataragama Pradeshiya Sabha

Item	Description
Province	Uva Province of Sri Lanka
District	Monaragala
Local Authority Status	Pradeshiya Sabha
Year of Establishment	1987 by Pradeshiya Sabhas Act (No. 15 of 1987)
Location in Relation to	Kataragama PS lies North to Hambantota on South-East of Sri Lanka

	228 km away from Colombo
Extent of the Authority Area	607.92 sq.km
No. of Council Members	29
No. of Villages	5 GN divisions (35 villages)
No. of Dwellings	4, 664
Population PS record (2012 statistics)	22, 415 (2012 statistics)
Average Population Density	0.37 p/ha

As shown in Land used pattern in KPS area showed that 8, 800 hectares are controlled by UDA, 447 hectares are belonged Temples and Devala, and also 71% of are classified as forest and other reserves.

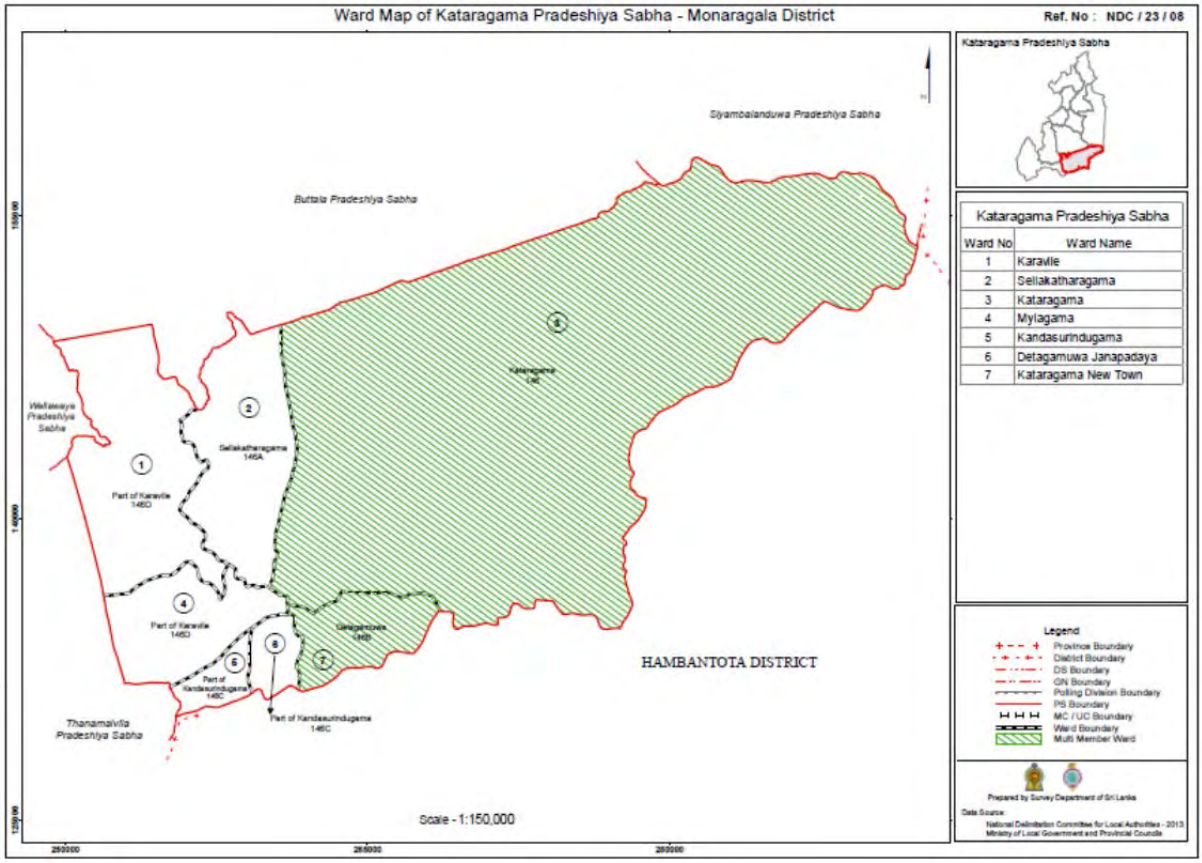


Figure 1-1 Administration area of Kataragama Pradeshiya Sabha and its land use pattern

The population of KPS was 22, 145 individuals in 4, 759 families of 4, 664 households. Its floating population increases tremendously during festival season, as it is a place of visitors from all around the country and abroad for worshiping and touring the famous shrine and other religious monuments. The festive season also attracts a large number of businessmen, transitory merchants, security persons, beggars and other service providers.

Kataragama PS collects waste at Kataragama, Sella Kataragama and Detagamuwa and dispose at the sites at same areas. The waste generated at the Devalaya is be managed by Devalaya itself and dumped in the lands belongs to the Devalaya. Kataragama PS is very different from other Pradesheeya Sabhas due to it being located in a sacred area and pilgrim numbers to Kataragama

increase especially during the weekends and holidays. Therefore the main waste generators are floating pilgrims. There are Guest houses, and other restaurants situated. The PS collects tax from these restaurants and guest houses.

With a daily floating population exceeding 20 times its inhabitants of 22, 145 during the festival season (Mid of July to mid of August each year), Kataragama presents many challenges in dealing with waste. Main waste generators are pilglims, Hotel, Restaurants etc. The Household collection only covers a small area close to the town. No schedule of collection of waste and only a minor officer controls the collection service. The tractors the PS has are old and trailers are corroded due to fruit juice generated in the waste. As dogs and cows attack waste bins placed in shops waste is always scattered in the town area.

Figure 1-2 Major religious places and event in Kataragama

2 Waste Composition Survey (WCS)

The primary purpose of this survey is to ensure a standard approach to waste physical composition analysis for the purposes of understanding the composition of waste delivered to final disposal facility which was collected from KPS area. Information generated by WCAs will be useful to KPS as well as administrators/policy makers to improve the efficiency and overall effectiveness of waste management systems.

All the MSW collected within KPS is disposed off at several dumpsites in Kataragama. However, the main dumpsite is the Galapitayaya dumpsite in the reservation forest. At the beginning of the access road to the Galapitayaya dumpsite, Kataragma MSW Compost facility lies. Therefore the WCS survey was conducted at MSW composting facility in Gam-Udawa road.

2.1 Methods of waste composition Survey

2.1.1 Classification of Wastes at Disposal Facility

This study was conducted to assess the physical composition of MSW samples collected from KPS and delivered to the final disposal facility by collection vehicles.

2.1.2 Sampling frequency

The WCA was carried out for a full waste collection cycle starting from Friday (6th November 2015) to Thursday (12th November 2015).

2.1.3 Bulk-Sampling for WCS

An effective WCA programme must be based on waste samples that are representative of the target area as a whole (usually a whole local authority), be sufficient to take account of variation in waste arising whilst also being affordable within the project budget. A good sampling strategy is essential to achieving this difficult balance. Thus it is needed to ensure that a 'good' sample is obtained within the constraints of time and cost.

Waste collection vehicles, especially four wheel tractors trailers (4-wheel tractors) are filled from bottom to the top of the trailer, thus making a distinguished vertical stratification in the tractor. The filling pattern becomes more complex when the garbage is discharged in bags. Therefore, as shown in エラー! 参照元が見つかりません。, profile sampling from collection vehicles was adapted in this study. The profile sample was taken from the back of the trailer, measuring at least 1/8 of the length of the trailer. Therefore, the size of the composite sample was found to be varied from 100 and 150 kg.

Thereafter, all the large and over sized waste particles were manually shredded into smaller particles. At the first round of shredding, larger particles were cut in to small the size particles with knife and scissors (Figure 2-1).

Unloading a profile sample from collection vehicle

Sorting of larger particles for disintegration

Sorting and grading of waste while disintegrating

Figure 2-1 Waste sampling and preparation for detail composition analysis

The size of the bulk sample was reduced to a workable size by Coning and Quartering technique. Finally the sample was reduced to a more manageable size as the actual classification of materials was carried out by hand. The Coning and Quartering technique involved the following:

a) The sample was placed on the floor and thoroughly mixed by shovel, manually.
b) The sample was then placed in a uniform pile of approximately 0.8 m high.
c) The pile was divided into four quarters using straight lines perpendicular to each other.
d) Either pair of opposite corners was removed to leave half the original sample.
e) The process was repeated three times until the desired sample was obtained.

2.1.4 Measurement of physical composition

2.1.4.1 Specific gravity of waste

To measure the bulk density of a sample, the following procedure was followed:

a) Weighed and recorded a volumetrically celebrated bucket of known volume (50 L)
b) Poured the sample into the bucket until it was overflowing
c) Settled the contents of the bucket by dropping it three times from a height of 10 cm
d) After settling the waste, waste-filled bucket volume was measured
e) Weight the bucket and its contents was recorded
f) The bulk density was estimated by dividing the waste weight by filled volume, as kg/m^3.

2.1.4.2 Physical composition analysis procedure

Once the sample size was determined and a reduced or workable sample was obtained, the following procedure was carried out.

a) Sorted reduced sample and pick out larger items first e.g. glass, paper, plastics.
b) Separated waste into following categories,
    i. Kitchen waste
    ii. Paper
    iii. Textiles
    iv. Grass & Wood
    v. Soft Plastic
    vi. Hard Plastic
    vii. Rubber & leather
    viii. Metals
    ix. Glass
    x. Stones & Ceramics
    xi. Others
c) Weighed the separated waste using an accurate top loading balance and recorded on standard form
d) Any remaining material which did not fall into any of prescribed categories was passed through a 4 mm mesh sieve and classified as ‘components smaller than 4 mm mesh’.

2.2 Waste composition survey results

A summary of the results of the waste composition survey conducted in KPS are tabulated below.

Table 2-1 Summary results of MSW physical composition survey in Kataragama PS

Sample		BD	KW	PP	TEX	GR	S-PL	H-PL	R&L	ME	GL	ST	OTH
Collection Date		Percentage (%)											
06/10	Sam-1	592.1	81.8	3.0	0.4	9.6	4.5	0.1	0.1	0.1	0.1	0.4	0.0
07/11	Sam-1	538.5	66.2	9.3	3.1	10.0	6.8	0.2	0.5	0.2	0.8	2.9	0.0
07/11	Sam-2	581.1	66.8	4.8	1.7	14.1	3.3	1.0	0.8	0.2	0.5	6.8	0.0
08/11	Sam-1	569.8	71.7	6.9	0.0	19.5	1.1	0.2	0.1	0.0	0.0	0.6	0.0
09/11	Sam-1	793.8	86.3	4.4	0.2	8.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0
09/11	Sam-2	575.0	65.2	9.0	0.5	22.6	1.8	0.0	0.0	0.0	0.1	0.8	0.0
09/11	Sam-3	578.9	66.6	9.5	0.8	14.8	7.3	0.5	0.1	0.1	0.1	0.1	0.0
09/11	Sam-4	583.3	49.5	5.0	0.1	36.6	5.8	0.6	0.6	0.2	0.8	0.8	0.0
10/11	Sam-1	378.4	6.2	5.9	0.0	60.0	3.5	1.4	0.0	0.0	0.6	22.4	0.0
10/11	Sam-1	750.0	78.6	4.5	0.1	2.5	9.7	1.1	0.0	0.8	0.1	2.5	0.0
10/11	Sam-2	452.0	28.8	8.9	0.9	21.0	3.3	0.5	0.1	0.2	0.0	36.2	0.0
11/11	Sam-1	526.1	63.3	11.0	0.5	12.2	5.2	1.4	0.0	0.4	5.0	1.0	0.0
11/11	Sam-2	659.7	78.6	3.0	0.0	16.5	1.4	0.2	0.0	0.0	0.0	0.4	0.0
11/11	Sam-3	787.5	77.2	13.9	0.0	8.5	0.3	0.0	0.0	0.0	0.0	0.1	0.0
Average		597.6	63.3	7.1	0.6	18.3	3.9	0.5	0.2	0.2	0.6	5.4	0.0
Stranded Deviation		118.2	22.0	3.3	0.9	14.6	2.8	0.5	0.3	0.2	1.3	10.6	0.0
Mean Error		30.5	5.7	0.8	0.2	3.8	0.7	0.1	0.1	0.1	0.3	2.7	0.0
Median		580.0	66.7	6.4	0.3	14.5	3.4	0.4	0.0	0.1	0.1	0.8	0.0

BD- Bulk density (kg m^{-3}), KW- Kitchen waste, PP- Paper, TEX- Textile, GR-Grass & wood, S-Pl- Soft plastics, H-PL- Hard plastics, R&L- Rubber & leather, ME- Metal, GL- Blass & bottles, ST- Stones & ceramics, OTH- Other

The analysis showed that the amount of food & kitchen waste is the highest portion (average 63.3%). However, except in one collection load, the amount of garden waste in the collection is comparatively low which is equal to 18.3 % on average. Another notable feature is the variation of composition among collection vehicles; some are having higher percentage of garden waste (10/11 sample 1) and one load is having higher portion of stones and ceramics (10/11 sample 2). The average waste composition derived from the 14 samples is shown in Figure 2-2.

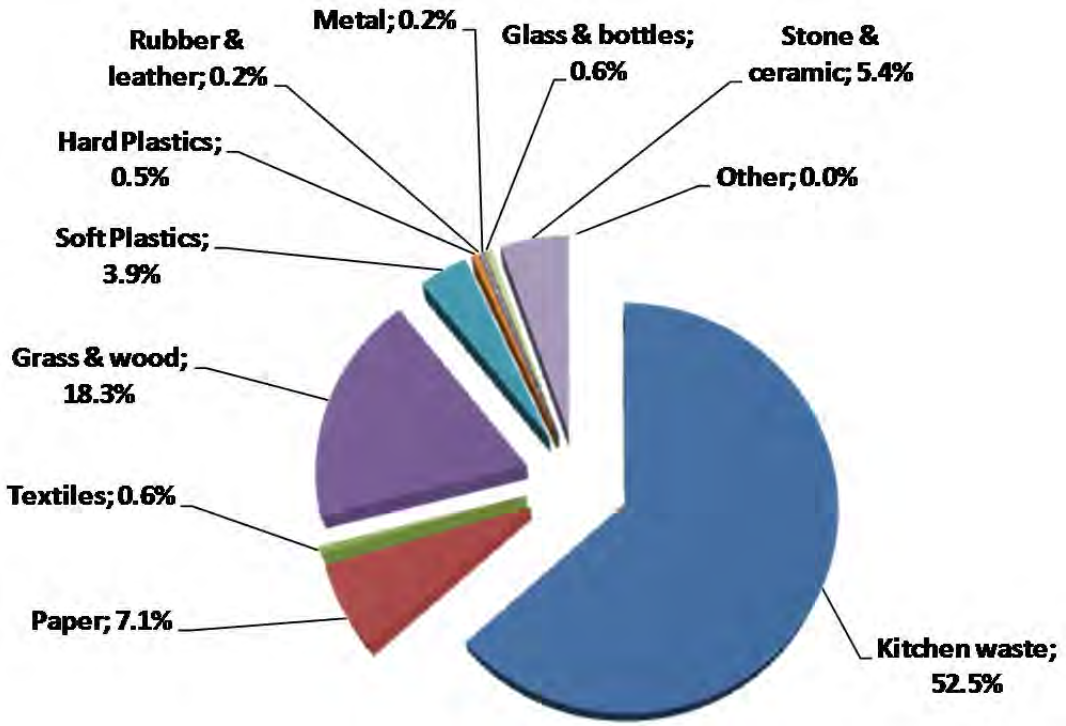


Figure 2-2 Average physical composition of MSW in Kataragama PS

The above figures shows that collected waste are suitable for composting. However, it is noted that collected mixed waste contains considerable amount of stones & ceramics which have to be separated to make good quality compost.

It also showed that the percentages of more profitable recyclable materials (hard plastic, metal, and glass) are reasonably low (0.2 – 0.5 %), also the percentages of less profitable materials (paper, soft plastic, textile) are on lower range (3.8 – 7.1 %) compared to other LAs in Sri Lanka.

3 Waste Generation Survey (WGS)

In order to obtain general information on waste generation amounts, the data available at waste management section of the Health Department and Revenue Department of KPS was used. Some of the data was available in the form of formal records and reports which were treated as the most precise secondary data while the data collected from official interviews with KPS officers was treated as verification data. Thus, the survey data was collected through different methods;

a) Recording and compiling of published and verified data by KPS,
b) Reading and recording of unpublished & non-confidential data available at KPS,
c) Recording and official statistics available at Kataragama Divisional Secretariat office, and
d) Official person-to-person interview with relevant officers at KPS for verification of data.

The numerical data was collected as specified in following Table 3-1.

Table 3-1 Type of data collected for WGS in Kataragama PS

Source	Description
Household	Each number of following category households was surveyed; 1) High income level, 2) Middle income level and 3) Low income level.
Commercial	Each number of following category restaurants was surveyed; 1) Large size restaurants, 2) Middle size restaurants and 3) Small size restaurants. Each number of following category shops was surveyed; 1)Organic shops (large) 2)Organic shops (middle) 3)Organic shops (small) 4)Non-Organic shops (large) 5)Non-Organic shops (middle) 6)Non-Organic shops (small)
Hotels	Each number of following category hotels was surveyed; 1) Large size hotels 2) Middle size hotels and 3) Small size hotels.
Markets	Number of stalls and types
Institutions	Each number of following institute was surveyed; 1) Schools 2) Hospitals (government) 3) Hospitals (private) 4) Public office 5) Bank/private office 6) Buddhist temples 7) Hindu temples 8) Mosques 9) Churches 10) Navy/Police/ Army bases 11) Others
Industries	Wastes from any industries.

Source	Description
Other	Public parks and other public facilities
Construction and demolition	Wastes originating from construction, rehabilitation and demolition activities, etc.
Hazardous (Special)	Management and collection of hazardous wastes originating from various sources, including household items

3.1 Waste Generation Survey Results

The records indicate that the total residential population within KPS is 22, 145 (Source: Divisional Secretariat, Kataragama 2015). The Kataragama PS area consists of 5 Grama Niladari (GN) divisions as shown in below Table 3-2 .

Table 3-2 Population statistics of villages in KPS area

GN Division	Village name	Total population
Sellakataragama	Kohomba digana/salmal palassa	4120
	Sellakataragama town	
	Akkara wissa	
	Old buttala road	
	Raja mawatha	
Karavile	Karavile thanamalwila road	3500
	Krushi Gammanaya	
	Punchi Dambe/Maha Dambe	
	Mailagama	
	Diyawara Gammanaya	
	Galahitiya	
	Passara Yaya	
	Gestupana	
Detagamuwa	Peragirigama	4061
	Wallimathagama	
	Kochchipathana/sithulpawwa road	
	katagamuwa Road Manikpuragama	
	Kataragama Town	
	Kandasurindu mawatha	
	Kanda Road	
Kataragama	nagaha Weediya	5387
	Gothamigama	
	Sramuddi Mawatha	
	Gaminipura	
	Gothamigama 2 Adiyara	
Kandasurindugama	Detagamuwa 1 piyawara	5347
	Detagamuwa 2 piyawara	

GN Division	Village name	Total population
	Detagamuwa 3 Piyawara	
	Kanda Road	
	raja Mawatha	
	Gamudawa	
	Niwasa 35	
	Kandasurindugama	
	Wiharamahadewi Gama	
	Murungalanda	
Total		**22, 415**

As shown in following Table 3-3, Kataragama PS own and control only a small number of public properties and institutes.

Table 3-3 Type and number of municipal establishment own by Kataragama PS

Public **Property**	No of units
Library	3
Ayrvedic Medical Center	1
Cemetery	5
Play Ground	1
Montessori	20
Weekly Fair	1
Lavatory	196

Following Table 3-4 shows the number of government and privet/non-government establishments within Kataragama PS.

Table 3-4 Number of government and privet institutions within Kataragama PS

Type of institute	No of units
Schools	5
Hospitals	1
Divisional secretary offices	1
Government Banks	3
Post office	3
Other Government office	23
Police stations	1
Privet Banks	4
Buddhist temples	32
Hindu Kovils	3
Mosques	1

A major portion of MSW is generated from commercial sector in the city. Following Table 3-5 shows the number of different commercial (business) establishments in KPS area.

Table 3-5 Types and number of business establishments in KPS area

Type of business	No of units
Grocery	67
Rest House	277
Sweet Selling	86
Restaurant	15
Saloon	6
Pharmacy	5
Farm Shop	1
Bakery	3
Fish Shop	2
Beauty Saloon	2
Grinding Mills	2
Fruit Shop	31
Rice mill	2
Saw mill & Work Shop	1
Hotel	5
Communications	1

In addition, Kataragama PS has listed number of large waste generating businesses and has estimated the quantities of waste generated as shown in Table 3-6.

Table 3-6 Type and estimated waste quantities from large waste generators in KPS area

Name of large waste generator	Tractor loads per month
Wishaka rest	1
Hindu rest house	1
Sea bank rest	1
Sri Lanka insurance	0.5
Paradise Hotel	1
Dutugemunu rest house	1
Government officers rest house	1
Colombo YMBA Rest House	1
Manik sisila rest house	1
Army rest house	1
Sumaga rest house	1
Gangarama rest house	1
Thilina rest	0.5
Niro rest	1
Mandara roshen hotel	5

Name of large waste generator	Tractor loads per month
Sunsungchitta rest house	1
Gandewi Kovil	1
Gurugedara rest house	1
Muslim rest house	1
Hotel sunflower	1
Hashani glass center	0.5
Lake house rest house	1
Sri Lanka Harbour	0.5
Sathosa rest house	1
Saamwil holiday resort	1
Construction training & development center	0.5
Harbour rest house	1
National saving bank	1
Edirisingha rest	1
Ud garden	1
Rivinka rest	1
Dewasi rest	1
Sampath bank rest house	1
Thisara rest	1

4 Public Opinion Survey (POS)

This Public Opinion Survey (POS) was commissioned to identify a range of household waste management matters in relation to the household sector. Information on household waste management practices and information on householders' experiences with waste collection delivery services was collected for the purpose of improving our understanding of householder's experiences and attitudes and also to better understand prevailing situation in householder's point of view. The purpose of this survey research included;

a. To collect information on public attitudes to the waste management and environment in broader,
b. To value aspects of environmental health and protection,
c. To provide information on experiences with Local Authority's waste management service and,
d. To provide information on household waste management practices.

4.1 Public opinion survey methodology

The number of samples from Kataragama identified as 200 households, but size of the sample increased to 226 during the implementation to increase the accuracy. The selection of households and areas within Kataragama PS was done after a consultative discussion with MSW section officers at KPS and JICA expert team members.

The survey was executed by a team of university students who were trained about the questionnaire, survey methodology and the data entering before dispatched to their respective fields. A senior expertise took the leadership and continuously supervised the field survey. The selected households were first educated about the survey, its main objectives and asked their cooperation before starting the field survey. In addition business and institutes, large waste generators, hospitals recycling shops and large public markets were also surveyed using appropriate questionnaires prepared in consultation with JICA experts.

Table 4-1 Category and number of samples for Public Opinion Survey

Category	Survey Area	Number of samples
High-income households	Wedahitikanda Rd, Sellakataragama Rd, Thanamalwila Rd, Passara Yaya Rd,	34
Middle-income Households	Old Buttala Rd, Lakshmi Devala Rd, Samudri Mw, New Buttala Rd, Sellakataragama Rd, Gamsaba Niwasa	86
Low-income Households	Old Buttala Rd, Samudri Mw, New Buttala Rd, Sellakataragama Rd, Kawantissa Mw,	41
Businesses /Service organization	New Town, Main Street, Sellakataragama, Wadahitikanda Rd	44
Large waste generators		18
Markets		1
Recycling shops		1

Category	Survey Area	Number of samples
Hospital		1
Total		**226**

The questionnaires were available in all languages (English/Sinhala/Tamil); however the questionnaire form was filled by the interviewer based on interviewees' response. The collected information was recorded in digital form using Microsoft Excel and reviewed for accuracy. The data was analyzed in detail for different objectives that generate an overview of the survey.

4.2 Results of Public Opinion Survey

- ✓ 99% of the surveyed households are Sinhalese, with 1 % of Tamils. Data on the average number of people per household and monthly income is set out in below Table 4-2.

Table 4-2 Average and standard deviation values of income and family size

Category	Family size	Income (Rs/month)
High	4.3 ± 0.9	172, 500 ± 175, 780
Middle	4.4 ± 1.2	48, 012 ± 9, 295
Low	4.0 ± 1.4	23, 476 ± 6,995
	No of workers	**Income (Rs/month)**
Business	2.6 ± 2.4	3, 677, 386 ± 3, 813, 062

- ✓ In Kataragama PS, only 44 % of surveyed households are provided with a garbage collection service, of which 36 % stated they use this service. Only 41 % of surveyed households are "very satisfied" with present SWM service provision, while 39 % are "somewhat satisfied".

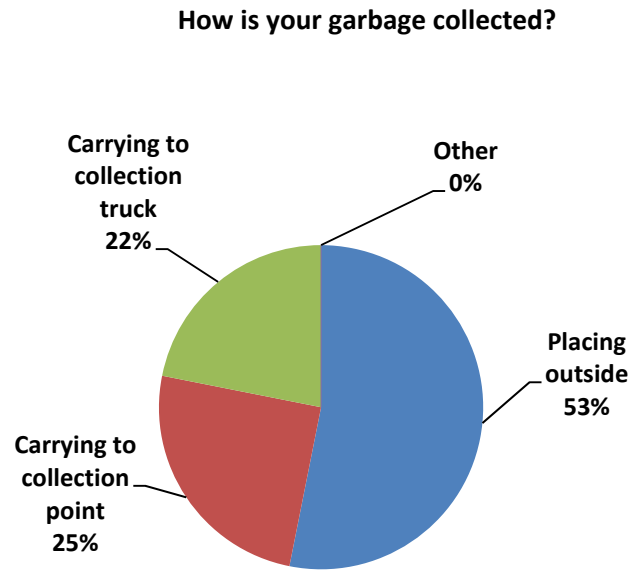


Figure 4-1 Method of garbage discharge by residence in KPS area

- ✓ Out of the Households' who use the garbage collection service, the main methods of waste discharge are shown in Figure 4-1. The most common methods are discharging it outside their premises for house to house collection (53 %) and carrying garbage to collection point (25 %) and to collection truck (22 %).
- ✓ Out of households who use the service, only 11 % receive a daily garbage collection service while 56 % stated that they received the service 2-3 times/week.
- ✓ 61 % of surveyed households discharge garbage as soon as it is generated and 28 % discharge their garbage daily.
- ✓ In general, adult females handle waste in about 84 % of surveyed households.
- ✓ As shown in Figure 4-2, only 7 % of households separate their garbage into organic and inorganic waste at the source of generation. Only 3 % of surveyed households are not/less willing to cooperate with source separation for recycling. Rests of the household are very much willing (89 %) and somewhat willing (1 %) to cooperate in source separated garbage collection system.
- ✓ Further, 72 % of surveyed households stated that there are recyclable collectors or someone who comes to collect their reusable or recyclable materials. Hence, informal recycling system is well established in Kataragama PS area.

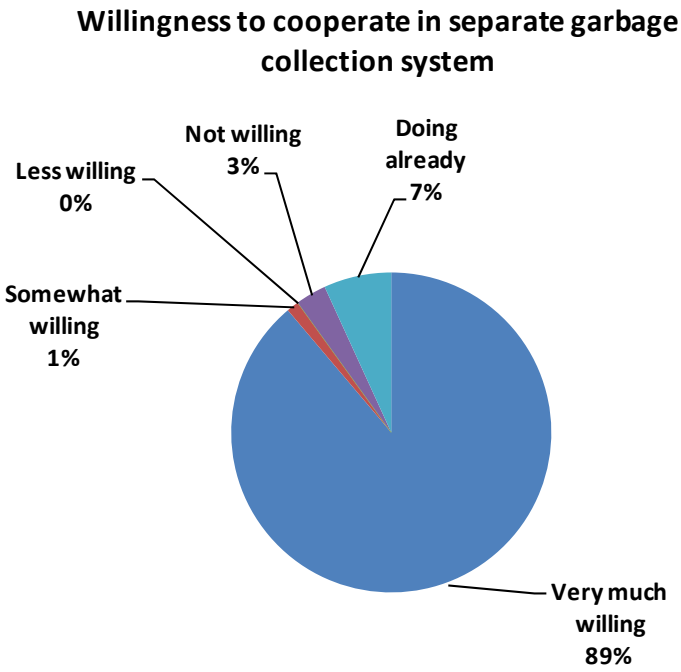


Figure 4-2 Willingness of residence for a source separated garbage collection system in Kataragama PS

- ✓ Only 13 % of surveyed households use kitchen/garden waste for composting and used the finished compost for their own garden.
- ✓ Not many surveyed households (75 %) have ever discussed proper garbage discharge methods at the community level.
- ✓ A notable feature is that 100 % households stated that SWM awareness programmes are very necessary

- ✓ 75 % of household do not like to pay for SWM service mainly because of the revenue tax they paid for KPS. The average WTP (willingness to pay) for improved SWM services is 42 ± 91 Rs/month per household.
- ✓ Out of all surveyed households, 12 % stated that they sale/give-off Glass & Bottle for recycling and 39 % of residence sale/give-off Plastics for recycling. But only 1 % of households sale/ give-off can & metal for recycling. Cardboard and paper recycling were 1 % and 19 % respectively.

5 Final disposal site survey (FDS)

5.1 Introduction the FDS of Kataragama PS

5.1.1 Survey Method

The data and information in this report were collected from various sources including published reports, verified data from Kataragama Pradeshiya Sabha, Manager- Kataragama Maha Devala and direct interview with officers & workers at disposal site.

5.1.2 Target of Survey

The survey is focus on obtaining general information on waste receiving, handling, disposal, facility management, environmental monitoring and legal adherences.

5.1.3 Data Sampling

The numerical data was collected as specified in following Table 5-1.

Table 5-1 Data collected during the final disposal site survey

	Survey Items	Method
1	Current condition of final disposal site and its surroundings	
	✓ Disposal method and structure	Records, visual observation
	✓ Soil-covering	Records, visual observation
	✓ Land owner	Records
	✓ Residual area	Records, visual observation
	✓ Leachate water	Records, visual observation
	✓ Waste picker	Records, visual observation, interview
	✓ Scattering waste, smoke, fire, offensive odour, animals and so on	Records, visual observation
2	Operation and Management of final disposal site	
	✓ Environmental Protect License and Environmental Clearance	Record
	✓ Personnel	Records, interview
	✓ Operation vehicles, their maintenances and drivers	Records, interview
	✓ Weighbridge	Records, interview
	✓ Waste collection data	Records, interview
	✓ Supervisory method	Records, interview
3	Waste amount to final disposal site (24 hours, 7 days)	Records, Survey
4	Adverse impact near by residences	Records, Survey
5	Implementation status of geological, topographic and EIA survey for new final disposal site	Records, interview
6	Progress situation for new final disposal site	Records, interview
7	Court case	Records, interview

5.2 Current condition of final disposal sites and its surroundings

5.2.1 Kataragama waste disposal sites

Waste generated in the Maha Devala and Kirivehera premises are entirely done by Devala administration by using its own four wheel tractor for collection and maintaining a separate dumpsite within Maha Devala areas.

Kataragama PS collects waste from all other PS areas and disposed in two permenet dumpsites and one temporally dumpsite that is known as illegal dumpsite.

Therefore, as shown Figure 5-1 in there are four dumpsites within Kataragama area at present.

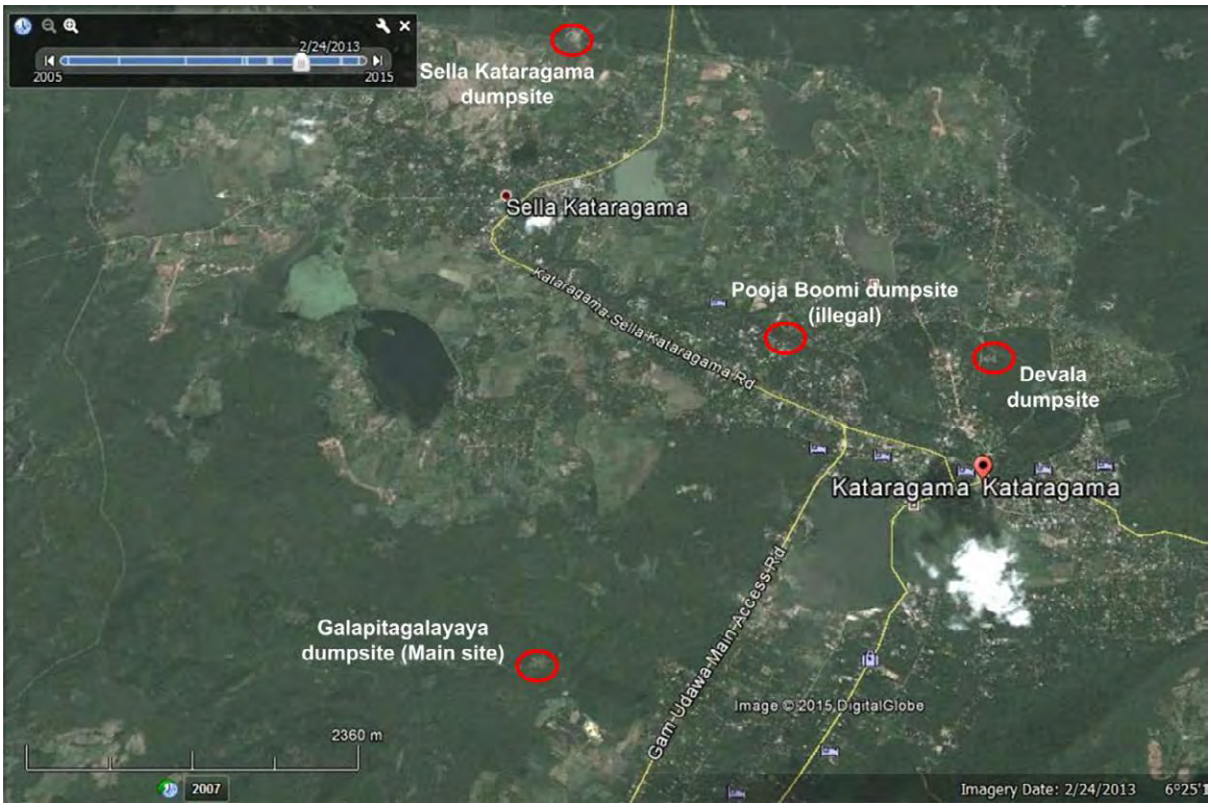


Figure 5-1 MSW dumpsites within Kataragama PS area

5.2.2 Brief overview of four dumpsites in Kataragama PS area

5.2.2.1 Galapitayaya dumpsite

The available records showed Galapitayaya Dumpsite was started in early 90s and continue to shift within the forest for several places. Waste dumping at present location started in early 2000s.

The site is located within crown land own by Department of Forest and Government Agent of Monaragala. Scavenging of wild elephants is the major thread to Wildlife in the forest, among many other environmental problems associated with the site.

Approximately 2 hectares of land has already been covered with waste up to 2-3 m high.

Location of Galapitayaya dumpsite and composting facility

Picture of Galapitayaya dumpsite

Access road to dumpsite through forest

Elephants scavenging on waste

Figure 5-2 Location and evvironment around Galapitayaya dumpsite

There is a composting facility which was constructed by Swedish Donor Agency (Figure 5-3). The composting facility receives one tractor load of waste per day. After receiving, mix waste is sorted and filled into large waste bin with passive aeration system. The composting facility includes two separate buildings for recyclable storage and finish compost storage. In addition there is a small biogas unit (100 kg/day) which supply Bio-gas for workers restroom.

Composting facility- Kataragama Ps

Passive aerated composting bins - Kataragama Ps

Figure 5-3 Composting facility of Kataragama PS

5.2.2.2 Devala dumpsite

Devala dumpsite is located within the land area managed and controlled by Maha Devala. The site has also been used as a soil burrow pit in recent days. The waste is unloaded at the site and no any control measures are taken to manage the waste and protect the environment. Thus, site has become a scavenging ground for cattle and wild animals.

Figure 5-4 Environment around Devala Dumpsite of Kataragama

5.2.2.3 Sellakataragama dumpsite

Sellakataragama is a small township belongs to KPS on Buttala-kataragama highway. The Sellakataragama township is located 4 km away from the Kataragama town, therefore MSW collected in Sellakataragama area is dumped in a small dumpsite. The selllakataragama dumpsite has also been used for few decays though the daily waste disposal amount is comparatively low.

As shown in Figure 5-5, the site is managed without any environmental or health control measures.

Figure 5-5 Sellakataragama dumpsite

5.2.2.4 Illegal dumpsite near Menik Ganga (river)

Kataragama PS operate a temporally dumpsite near Menik river during the surveyed duration (October-November, 2015). There are no records or formal evidence on the existence of this dumpsite; however the site observation showed that at least 3-5 tractor loads of waste are being dumped at the site (Figure 5-6).

Figure 5-6 MSW dumpsite near the Menik Ganga- Kataragama

5.2.3 Waste receiving and disposal

None of the surveyed dumpsites has proper recording system to account number of waste loads discharged at the site. Therefore, the waste discharged at each dumpsite was recorded for a one week period and shown in .

Table 5-2 Sources and quantities of waste disposed four dumpsites in Kataragama

Date	Galapitayaya	Composting facility	Sellakataragama	Devala
		Tonnes per day		
7-Nov-15	3.7	0.0	11.1	7.4
8-Nov-15	7.4	0.0	3.7	7.4
9-Nov-15	3.7	0.0	11.1	7.4
10-Nov-15	11.1	3.7	3.7	7.4
11-Nov-15	7.4	0.0	7.4	7.4
12-Nov-15	7.4	0.0	7.4	7.4
13-Nov-15	3.7	3.7	7.4	7.4

5.2.4 Current condition of final disposal site and its surroundings

1	**Current condition of final disposal site and its surroundings**	
1.1	Disposal method and structure	✓ All other MSW collection vehicles emptied its waste at the dumpsite. No specific control measures apply for selection of dumping area. Thus, **Open Dumping** is practiced. ✓ All other wastes are dumped on the ground
1.2	Soil-covering	✓ Daily covering of waste by soil is not practiced
1.3	Land owner	✓ Galapitayaya: ownership lies with Department of Forest and Government Agent – Monaragala. There is a 10 acre land allocated for composting facility and for a future landfill development ✓ Sellakataragama: ownership lies with Government Agent – Monaragala ✓ Devala: ownership lies with Maha Devala- Kataragama ✓ Illegal dumpsite: ownership lies with Maha Devala- Kataragama
1.4	Residual area	✓ Galapitayaya: Approximately 2 hectares ✓ Sellakataragama: Approximately 1 acre ✓ Devala: Approximately 1 hectares ✓ Illegal dumpsite: Approximately 1 acre
1.5	Leachate water	✓ No leachate collection and treatment system
1.6	Waste picker	✓ None
1.7	Scattering waste, smoke, fire, offensive odor, animals	✓ Waste is dumped in the forest or bare lands ✓ No fire and smoke witness at any dumpsite ✓ Elephants are scavenging on Galapitayaya dumpsite ✓ Cows and monkeys scavenging on Devala dumpsite

5.2.5 Operation and Management of final disposal site

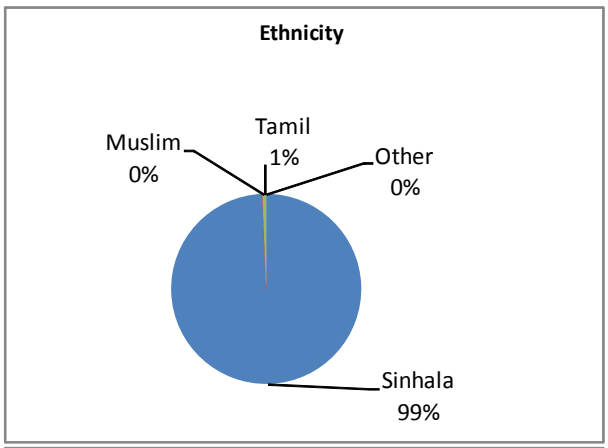
2	**Operation and Management of final disposal site**	
2.1	Environmental Protect License and Environmental Clearance	✓ None
2.2	Personnel	✓ No site supervisors or labors available at any dumpsite
2.3	Operation vehicles, their maintenances and drivers	✓ None ✓ Kataragama PS has employed PS own backhoe loader and tractor for repairing the access road to the Galapitayaya dumpsite (~ 1 km). The soil backfilling workload has been estimated as 5 days.
2.4	Weighbridge	✓ None
2.5	Waste collection data	✓ None
2.6	Supervisory method	✓ None
3.0	Waste amount to final disposal site (24 hours, 7 days)	✓ A summary is shown in Table 5-2
4.0	Adverse impact nearby residences	✓ Galapitayaya: No residence around the dumpsite within 1.5 km radius ✓ Sellakataragama: close proximity is about 200 m from the dumpsite. Residences around the dumpsite complain about flies and offensive odor ✓ Devala: No residence around the dumpsite within 500 m radius. ✓ Illegal dumpsite: No residence around the dumpsite within 500 m radius. However, the dump site is very close to a bathing place of Menik Ganga

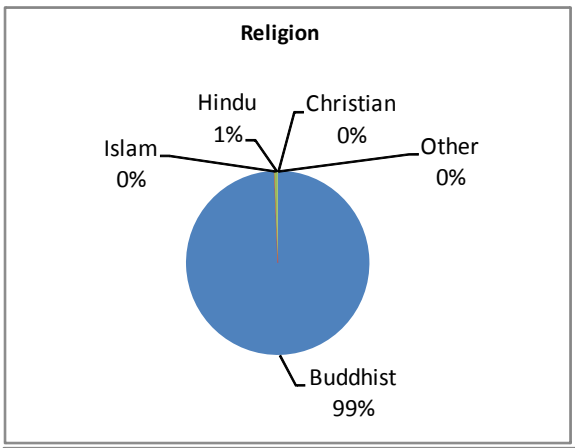
2	**Operation and Management of final disposal site**	
5.0	Implementation status of geological, topographic and EIA survey for new final disposal site	✓ None
6.0	Progress situation for new final disposal site	✓ None
7.0	Court case	✓ None ✓ Central Environmental Authority and Divisional Secretariat have made verbal complains against the illegal dumpsite near Menik ganga. Kataragama PS is now excavating large soil pits on the site to bury the waste.

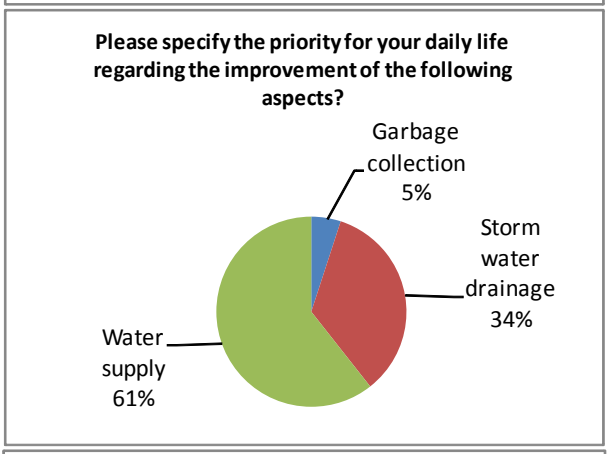
Annex

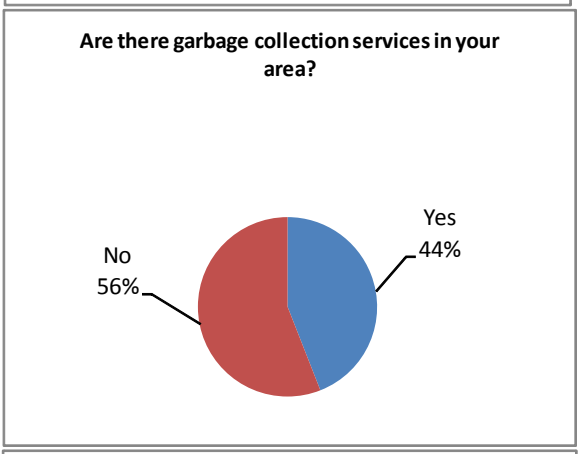
KATARAGAMA PRADESHIYA SABHA

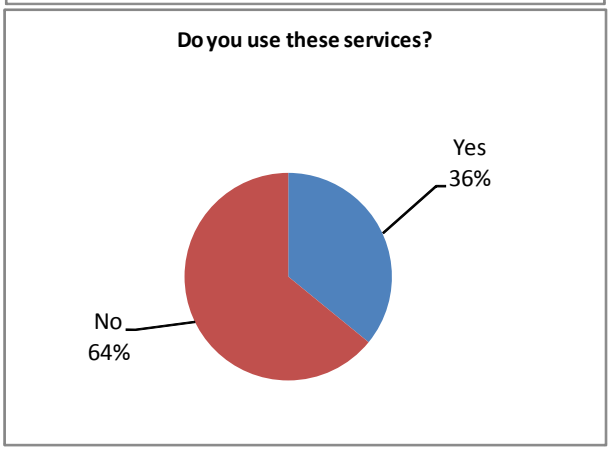
Response to Public Opinion Survey for Household

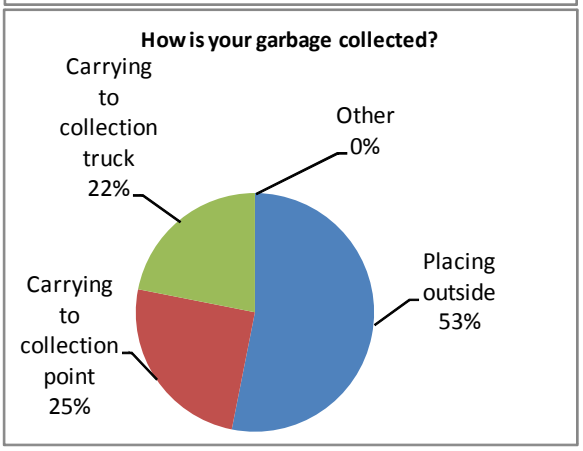




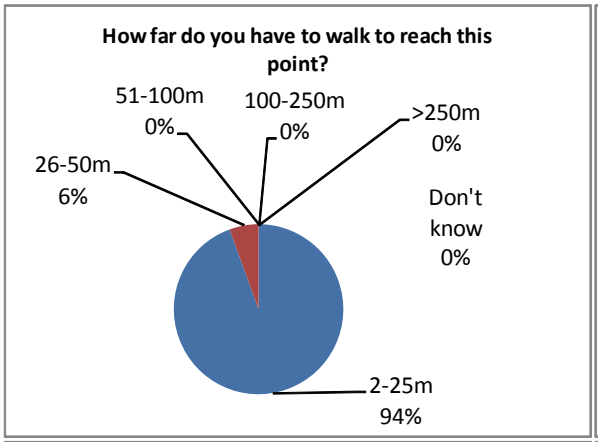


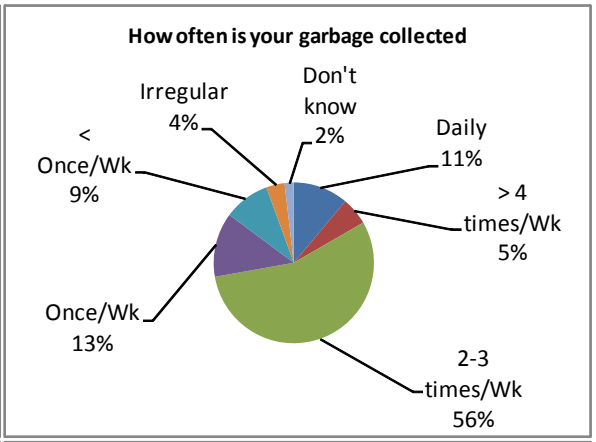


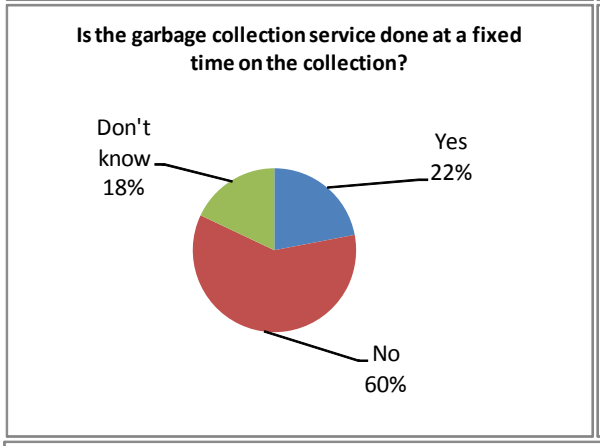


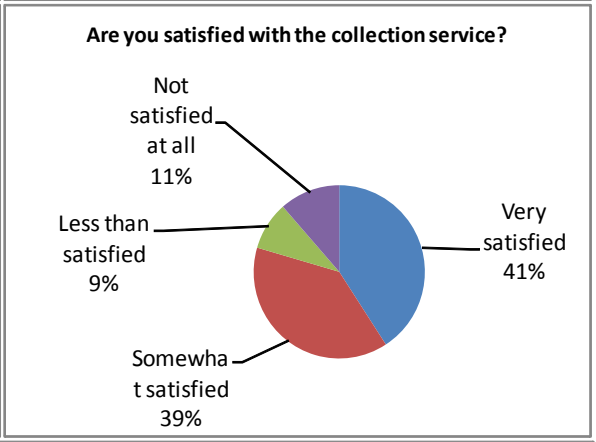


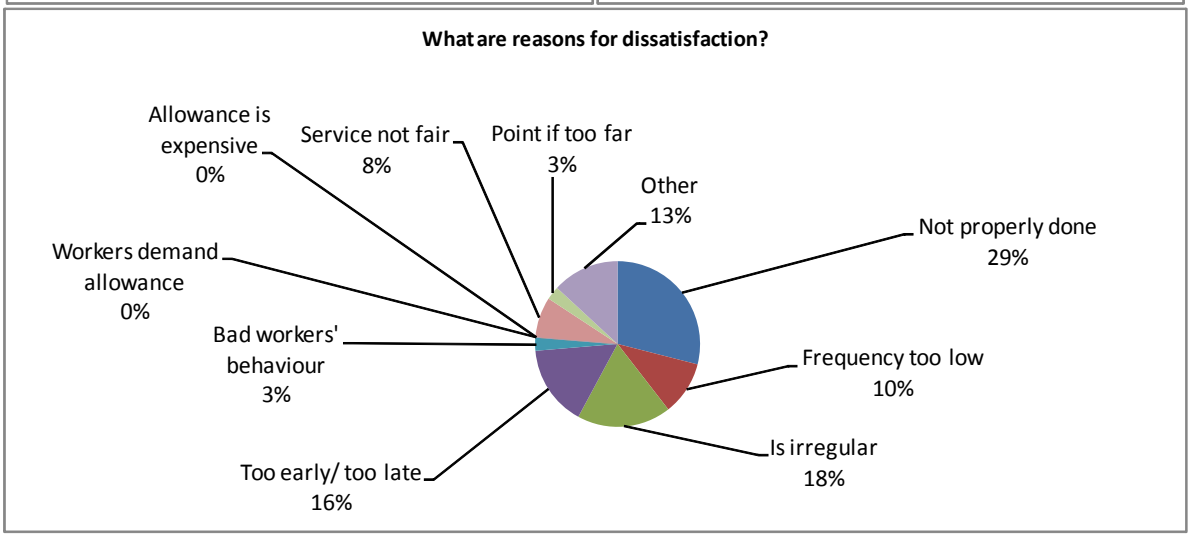
Response to Public Opinion Survey for Household





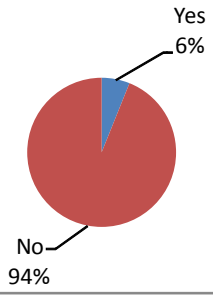




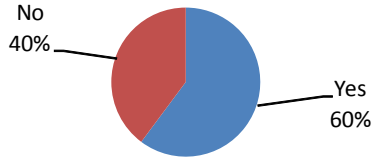


Response to Public Opinion Survey for Household

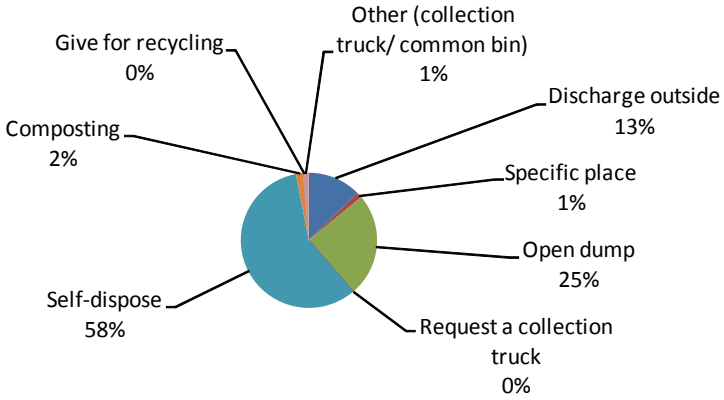
Have you ever complained about the garbage collection service to the authorities in the last three years?



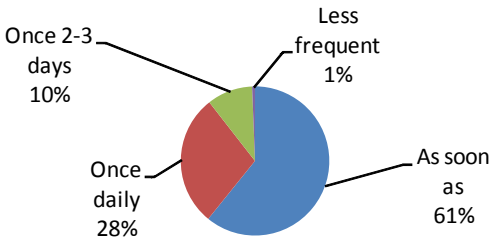
Do you want to receive a garbage collection service? (only for persons who do not have garbage collection services in the area)



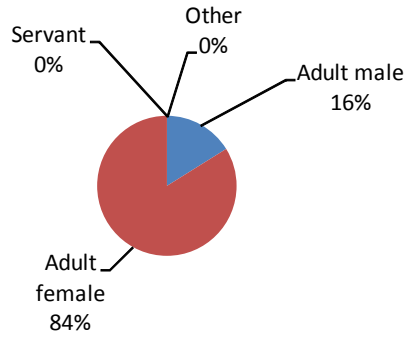
How do you dispose off garbage generated in your premises?



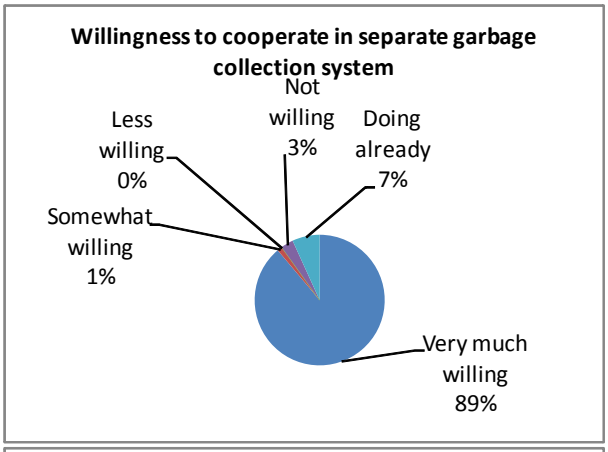
How often do you dispose off garbage generated in your premises

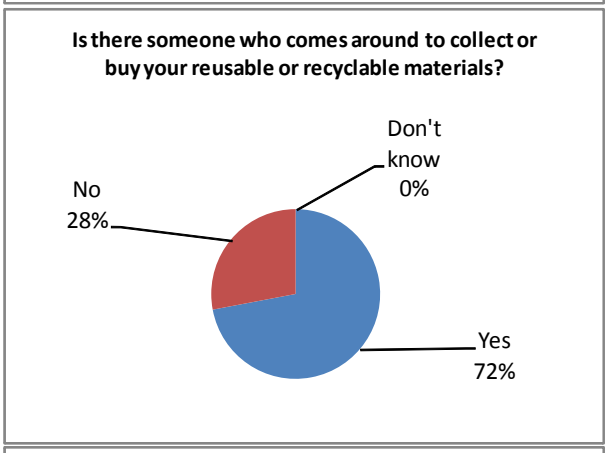


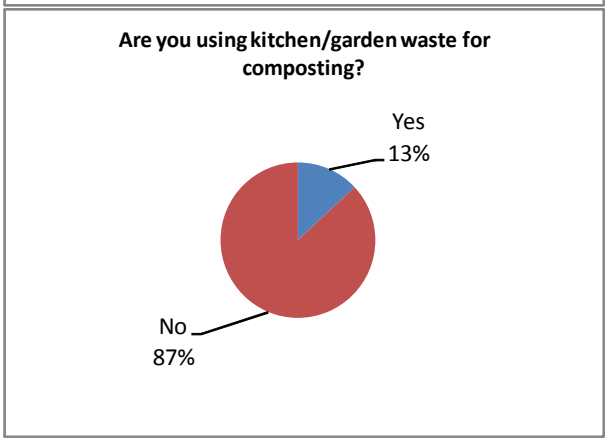
Who mainly handles wastes at home?

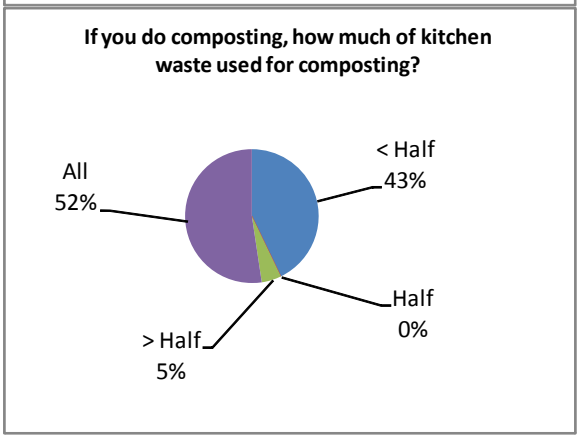


Response to Public Opinion Survey for Household



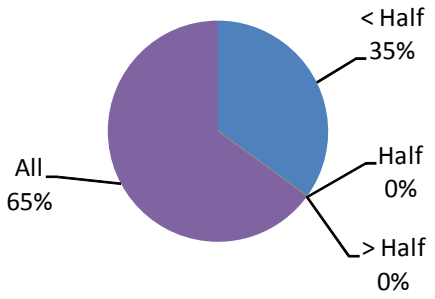




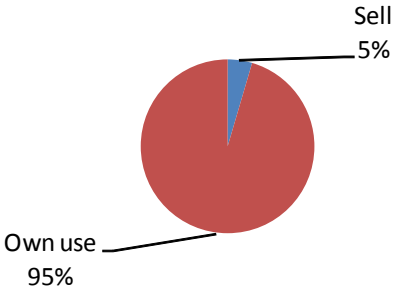


Response to Public Opinion Survey for Household

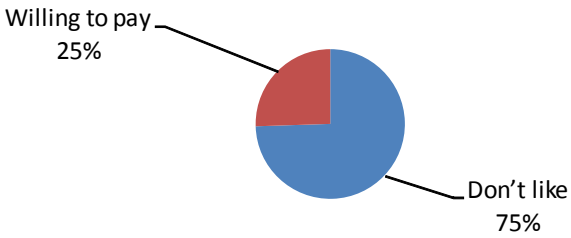
If you do composting, how much of garden waste used for composting?



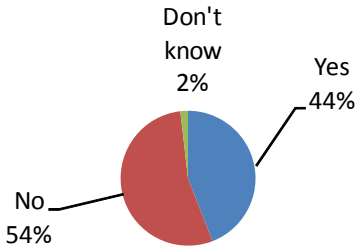
What do you do with produced compost



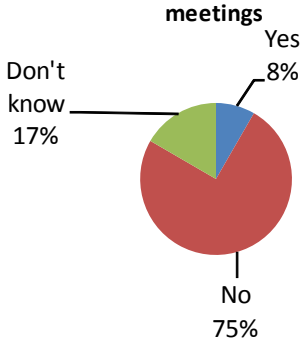
Suppose that you are satisfied with the service of Municipal solid waste management, either as is or as a result of improvement. Think for a moment about the largest amount of money that your household would be willing to pay each month as a garbage colle



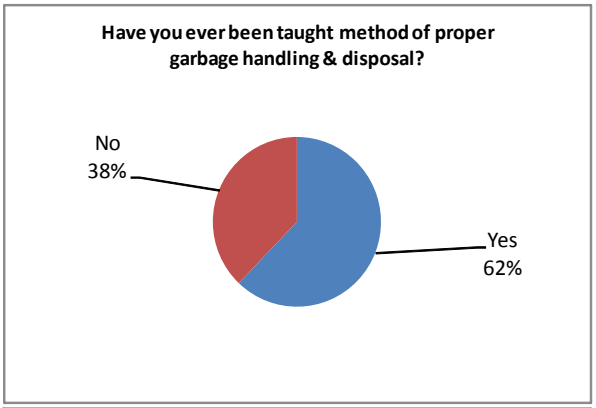
Do you have any community-based organizations to solve not only the waste problems but also other community problems?

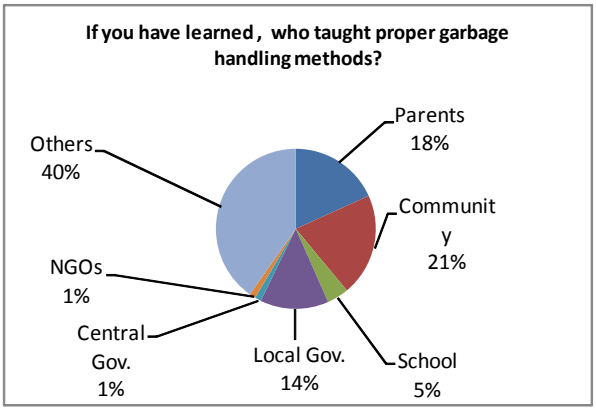


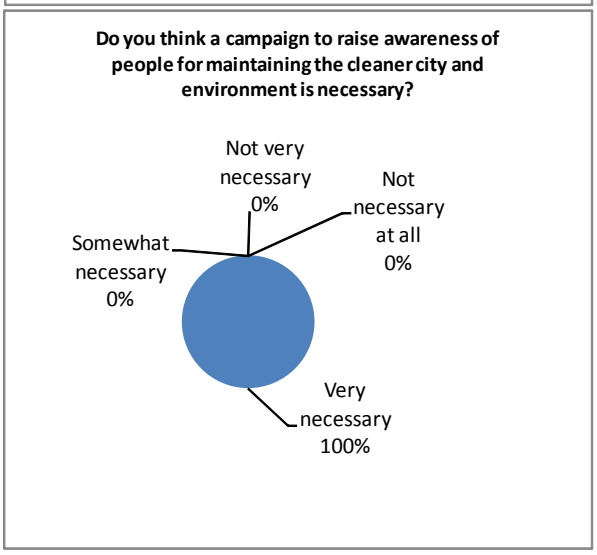
Have you ever discussed the methods of proper garbage handling and discharge at the meetings



Response to Public Opinion Survey for Household







1.2 Thamankaduwa PS

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1 Introduction

The purpose of this survey is to obtain the current data regarding Solid Waste Management (SWM) at Thamankaduwa Pradeshiya Sabha (TPS). The data collection survey was conducted from 11th November to 18th November, 2015 by a team of expert dispatched by Waste To Energy Technologies Limited.

This report consists of brief summaries of survey methods and results. The additional primary data and records are available as soft copies. The preliminary data collection was conducted through four comprehensive surveys which are;

i. **Waste Composition Survey (WCS)** is to gather information on Physical Composition of MSW collected by TPS.
ii. **Waste Generation Survey (WGS)** is to gather information on waste generation sources at TPS based on secondary data available at TPS and other relevant organizations.
iii. **Public Opinion Survey (POS)** is gather information on public opinion on current waste management in TPS. The POS was conducted through a questionnaire survey that covers different types of waste generators in the TPS area.
iv. **Final Disposal Site Survey (FDSS)** is to collection data on final MSW disposal site of TPS based on secondary data as well as field recordings & visits to the site.

1.1 Background conditions of Thamankaduwa Pradeshiya Sabha

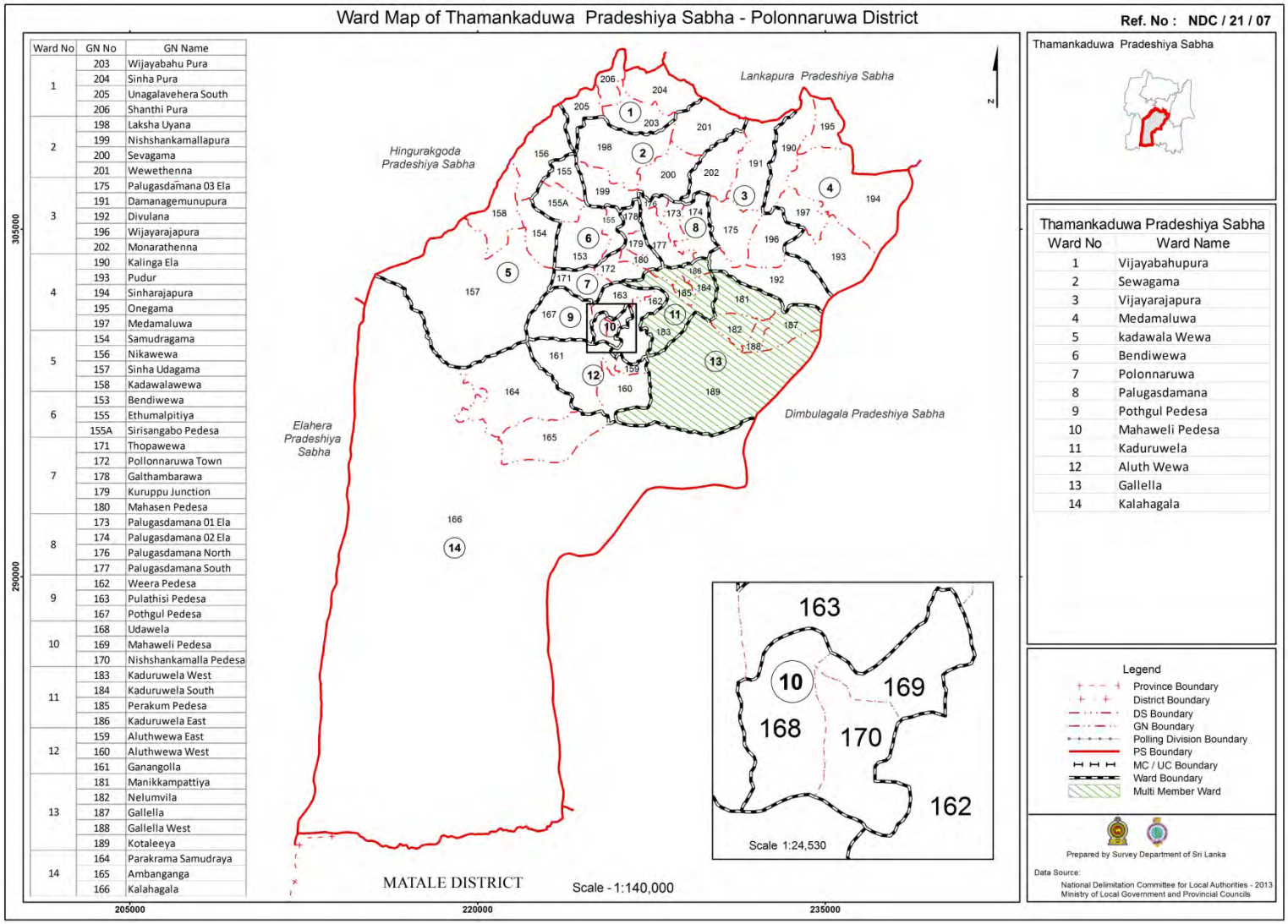
Thamankaduwa is the major township in Pollonnaruwa District of North Central province of Sri Lanka. The Thamankaduwa Pradeshiya Sabha is bordering to several other local authorities in Pollonnaruwa District; Hingurakgoda PS, Lankapura PS and Elahera PS. Matale district lies on the south of Thamankaduwa PS. At present, the Thamankaduwa Divisional secretariat is coincide with Thamankaduwa PS area.

Thamankaduwa PS consists of few townships in Pollonnaruwa District; Pollonnaruwa new town, Palugasdamana town and Kaduruwela town. Most of those townships were developed after the Mahaveli Development project during mid 1980s.

The area of the TPS is about 445 km^2 and major part of the PS area is covered with forest. The main town is stretch on the Habarana-Batticaloa highway on North West direction.

In general the topography is almost flat with well built irrigation reservoir & channel sytems and navigable road system.

Thamankaduwa area has typical tropical climate with two rainy seasons occur; major during the North East monsoons (October to December) and the minor rainy season occurs during the South West monsoon (April and May). The period between the South West Monsoon and the North East Monsoon is the dry season extending from June to September.



Ward No	GN No	GN Name
1	203	Wijayabahu Pura
	204	Sinha Pura
	205	Unagalavehera South
	206	Shanthi Pura
2	198	Laksha Uyana
	199	Nishshankamallapura
	200	Sevagama
	201	Wewethenna
3	175	Palugasdamana 03 Ela
	191	Damanagemunupura
	192	Divulana
	196	Wijayarajapura
	202	Monarathenna
4	190	Kalinga Ela
	193	Pudur
	194	Sinharajapura
	195	Onegama
	197	Medamaluwa
5	154	Samudragama
	156	Nikawewa
	157	Sinha Udagama
	158	Kadawalawewa
6	153	Bendiwewa
	155	Ethumalpitiya
	155A	Sirisangabo Pedesa
7	171	Thopawewa
	172	Pollonnaruwa Town
	178	Galthambarawa
	179	Kuruppu Junction
	180	Mahasen Pedesa
8	173	Palugasdamana 01 Ela
	174	Palugasdamana 02 Ela
	176	Palugasdamana North
	177	Palugasdamana South
9	162	Weera Pedesa
	163	Pulathisi Pedesa
	167	Pothgul Pedesa
10	168	Udawela
	169	Mahaweli Pedesa
	170	Nishshankamalla Pedesa
11	183	Kaduruwela West
	184	Kaduruwela South
	185	Perakum Pedesa
	186	Kaduruwela East
12	159	Aluthwewa East
	160	Aluthwewa West
	161	Ganangolla
13	181	Manikkampattiya
	182	Nelumvila
	187	Gallella
	188	Gallella West
	189	Kotaleeya
14	164	Parakrama Samudraya
	165	Ambanganga
	166	Kalahagala

Thamankaduwa Pradeshiya Sabha	
Ward No	Ward Name
1	Vijayabahupura
2	Sewagama
3	Vijayarajapura
4	Medamaluwa
5	kadawala Wewa
6	Bendiwewa
7	Polonnaruwa
8	Palugasdamana
9	Pothgul Pedesa
10	Mahaweli Pedesa
11	Kaduruwela
12	Aluth Wewa
13	Gallella
14	Kalahagala

Figure 1-1 Administrative map of Thamankaduwa PS area

2 Waste Composition Survey (WCS)

The primary purpose of this survey is to ensure a standard approach to waste physical composition analysis for the purposes of understanding the composition of waste delivered to final disposal facility which was collected from TPS area. Information generated by WCAs will be useful to TPS as well as administrators/policy makers to improve the efficiency and overall effectiveness of waste management systems.

2.1 Methods of waste composition Survey

2.1.1 Classification of Wastes at Disposal Facility

This study was conducted to assess the physical composition of MSW samples collected from TPS and delivered to the final disposal facility by collection vehicles.

2.1.2 Sampling frequency

The WCA was carried out for a full waste collection cycle starting from Monday (12th Thursday November 2015) to Wednesday (18th November 2015).

2.1.3 Bulk-Sampling for WCS

An effective WCA programme must be based on waste samples that are representative of the target area as a whole (usually a whole local authority), be sufficient to take account of variation in waste arising whilst also being affordable within the project budget. A good sampling strategy is essential to achieving this difficult balance. Thus it is needed to ensure that a 'good' sample is obtained within the constraints of time and cost.

Figure 2-1 Sampling for WCS at TPS, (a) manually unloading the profile sample and (b) unloaded sample

Waste collection vehicles, especially four wheel tractors trailers (4-wheel tractors) are filled from bottom to the top of the trailer, thus making a distinguished vertical stratification in the tractor. The filling pattern becomes more complex when the garbage is discharged in bags. Therefore, as shown in Figure 2-1, profile sampling from collection vehicles was adapted in this study. The profile sample

was taken from the back of the trailer, measuring at least 1/8 of the length of the trailer. Therefore, the size of the composite sample was found to be varied from 100 and 150 kg.

Thereafter, all the large and over sized waste particles were manually shredded into smaller particles. At the first round of shredding, larger particles were cut in to small the size particles with knife and scissors (Figure 2-2).

Figure 2-2 Particle size reduction, mixing and preparation of working sample by coning & quartering technique

The size of the bulk sample was reduced to a workable size by Coning and Quartering technique. Finally the sample was reduced to a more manageable size as the actual classification of materials was carried out by hand. The Coning and Quartering technique involved the following:

a) The sample was placed on the floor and thoroughly mixed by shovel, manually.
b) The sample was then placed in a uniform pile of approximately 0.8 m high.
c) The pile was divided into four quarters using straight lines perpendicular to each other.
d) Either pair of opposite corners was removed to leave half the original sample.
e) The process was repeated three times until the desired sample was obtained.

2.1.4 Measurement of physical composition

2.1.4.1 Specific gravity of waste

To measure the bulk density of a sample, the following procedure was followed:

a) Weighed and recorded a volumetrically celebrated bucket of known volume (50 L)
b) Poured the sample into the bucket until it was overflowing
c) Settled the contents of the bucket by dropping it three times from a height of 10 cm
d) After settling the waste, waste-filled bucket volume was measured
e) Weight the bucket and its contents was recorded
f) The bulk density was estimated by dividing the waste weight by filled volume, as kg/ m^3.

Figure 2-3 Procedure of analysis of physical composition

2.1.4.2 Physical composition analysis procedure

Once the sample size was determined and a reduced or workable sample was obtained, the following procedure was carried out.

a) Sorted reduced sample and pick out larger items first e.g. glass, paper, plastics.
b) Separated waste into following categories,
   i. Kitchen waste
   ii. Paper
   iii. Textiles
   iv. Grass & Wood
   v. Soft Plastic
   vi. Hard Plastic
   vii. Rubber & leather
   viii. Metals
   ix. Glass
   x. Stones & Ceramics
   xi. Others
c) Weighed the separated waste using an accurate top loading balance and recorded on standard form
d) Any remaining material which did not fall into any of prescribed categories was passed through a 4 mm mesh sieve and classified as 'components smaller than 4 mm mesh'.

2.2 Waste composition survey results

A summary of the results of the waste composition survey conducted in TPS are tabulated below.

Table 2-1 Summary results of MSW physical composition survey in Thamankaduwa PS

Sample		BD	KW	PP	TEX	GR	S-PL	H-PL	R&L	ME	GL	ST	OTH
Date		Percentage (%)											
12/11	Sam-1	359	54.6	12.5	1.4	2.8	6.1	0.5	7.0	14.0	1.1	0.0	0.0

Sample		BD	KW	PP	TEX	GR	S-PL	H-PL	R&L	ME	GL	ST	OTH
	Sam-2	332	47.1	12.6	1.8	27.4	6.0	0.6	0.0	0.2	0.6	3.6	0.0
13/11	Sam-1	307	46.8	19.7	0.8	19.0	10.5	2.1	0.7	0.1	0.0	0.3	0.0
	Sam-2	344	42.6	12.4	5.2	16.1	9.3	4.4	3.6	1.4	2.0	2.9	0.0
14/11	Sam-1	444	60.6	16.3	3.1	9.7	6.7	1.6	0.0	0.0	0.3	1.1	0.6
	Sam-2	594	63.8	12.3	1.3	18.8	2.5	0.3	0.0	0.0	0.0	1.0	0.0
15/11	Sam-1	257	49.2	23.4	3.3	6.6	6.9	3.6	0.0	3.7	0.0	3.4	0.0
	Sam-2	494	66.7	13.5	3.4	4.8	9.1	1.1	1.4	0.1	0.0	0.0	0.0
16/11	Sam-1	402	70.0	14.9	1.2	8.0	5.1	0.7	0.1	0.0	0.0	0.0	0.0
	Sam-2	332	37.1	29.4	5.4	8.9	15.3	1.2	0.6	0.5	1.2	0.4	0.0
17/11	Sam-1	369	66.5	15.6	1.7	9.5	4.6	0.5	1.2	0.3	0.0	0.0	0.0
	Sam-2	430	53.9	14.2	2.7	18.6	9.8	0.8	0.0	0.2	0.0	0.0	0.0
18/11	Sam-1	375	54.8	21.0	0.4	14.3	7.1	0.8	0.0	0.3	0.7	0.6	0.0
	Sam-2	280	9.6	7.8	5.7	54.3	14.3	1.8	0.1	1.1	0.6	4.5	0.1
Average		380	51.7	16.1	2.7	15.6	8.1	1.4	1.1	1.6	0.5	1.3	0.0
Stranded Deviation		89	15.6	5.5	1.8	13.0	3.6	1.2	2.0	3.7	0.6	1.6	0.2
Mean Error		23	4.0	1.4	0.5	3.4	0.9	0.3	0.5	1.0	0.2	0.4	0.0
Median		364	54.3	14.5	2.2	12.0	7.0	0.9	0.1	0.2	0.2	0.5	0.0

BD- Bulk density (kg m^{-3}), KW- Kitchen waste, PP- Paper, TEX- Textile, GR-Grass & wood, S-Pl- Soft plastics, H-PL- Hard plastics, R&L- Rubber & leather, ME- Metal, GL- Blass & bottles, ST- Stones & ceramics, OTH- Other

The analysis showed that the amount of food & kitchen waste is making up the bulk (51.7 %). The amount of garden waste in the collection is also on average range is about 15.65. The average waste composition derived from the 14 samples is shown in Figure 2-4.

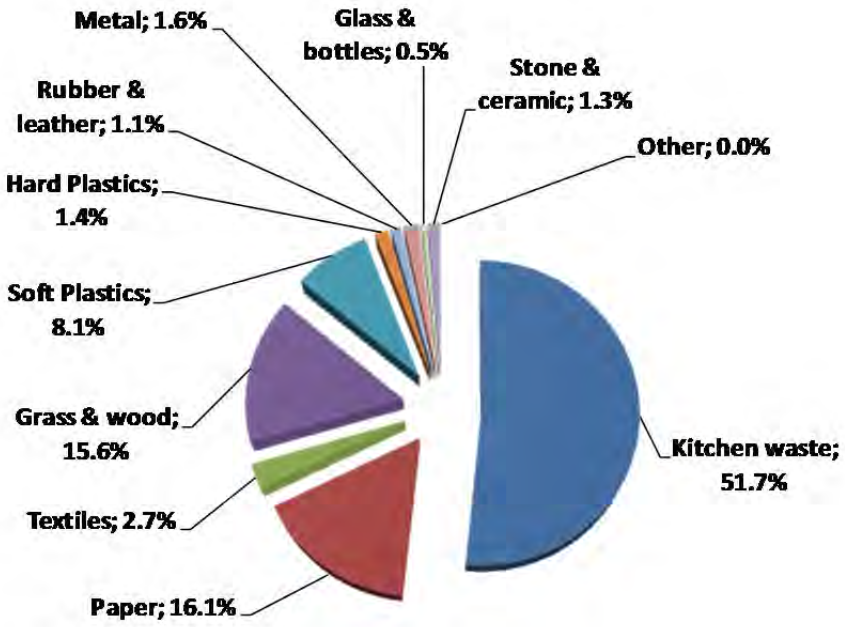


Figure 2-4 Average physical composition of MSW in Thamankaduwa PS

The above figures shows that collected waste are suitable for composting. However, precautions shall be taken to minimize the amount of inert (stones & ceramics) which can eventually lower the quality of produced compost.

It also showed that the percentages of more profitable recyclable materials (hard plastic, metal, and glass) are very small (1.4 – 1.6 %), while the percentages of less profitable materials (paper, soft plastic, textile) are much higher (8.1 - 16.1 %).

3 Waste Generation Survey (WGS)

In order to obtain general information on waste generation amounts, the data available at waste management section of the Health Department, Works Department and Revenue Department of TPS was used. Some of the data was available in the form of formal records and reports which were treated as the most precise secondary data while the data collected from official interviews with TPS officers was treated as verification data. Thus, the survey data was collected through different methods;

a) Recording and compiling of published and verified data by TPS,
b) Reading and recording of unpublished & non-confidential data available at TPS,
c) Recording and official statistics available at District Secretariat, Thamankaduwa Divisional Secretariat offices, and
d) Official person-to-person interview with relevant officers at TPS for verification of data.

The numerical data was collected as specified in following Table 3-1.

Table 3-1 Type of data collected for WGS in Thamankaduwa PS

Source	Description
Household	Each number of following category households was surveyed; 1) High income level, 2) Middle income level and 3) Low income level.
Commercial	Each number of following category restaurants was surveyed; 1) Large size restaurants, 2) Middle size restaurants and 3) Small size restaurants. Each number of following category shops was surveyed; 1)Organic shops (large) 2)Organic shops (middle) 3)Organic shops (small) 4)Non-Organic shops (large) 5)Non-Organic shops (middle) 6)Non-Organic shops (small)
Hotels	Each number of following category hotels was surveyed; 1) Large size hotels 2) Middle size hotels and 3) Small size hotels.
Markets	Number of stalls and types
Institutions	Each number of following institute was surveyed; 1) Schools 2) Hospitals (government) 3) Hospitals (private) 4) Public office 5) Bank/private office 6) Buddhist temples 7) Hindu temples 8) Mosques 9) Churches 10) Navy/Police/ Army bases

Source	Description
	11) Others
Industries	Wastes from any industries.
Other	Public parks and other public facilities
Construction and demolition	Wastes originating from construction, rehabilitation and demolition activities, etc.
Hazardous (Special)	Management and collection of hazardous wastes originating from various sources, including household items

3.1 Waste Generation Survey Results

The records indicate that the total residential population within TPS is 88,912 (Source: Divisional Secretariat, Thamankaduwa 2015). The Thamankaduwa PS area consists of 55 Grama Niladari (GN) divisions as shown in below Table 3-2.

Table 3-2 Household population (GN level) within Thamankaduwa PS area

GN Division	Population	GN Division	Population
Badiwewa	1107	Mahasen Pedesa	1204
Samudragama	1456	Mahikkampattiya	2276
Athumalpitiya	1840	Nelum wila	1672
Sirisagabo Pedesa	2375	Kaduruwela Western	1679
Nikawewa	1123	Kaduruwela South	5600
SinhaUdagama	2053	Paramum Pedesa	1872
Kadalawewa	1645	Kaduruwela Estern	1639
Aluthwewa Estern	860	Gallalle Estern	2309
Aluthwewa Western	952	Gallalle Western	1311
Ganangolla	2661	Kotaleeya	837
Weera Pedesa	2549	KalingaEla	1589
Pulathisi Pedesa	1585	Damana Gamunupura	1105
Parakrama Samudraya	992	Divulana	1255
Abanganga	2008	Pudur	879
Kalahagala	2157	Sinharajapura	1181
Pothgul Pedesa	2015	Onagama	960
Udawela	1908	Wijayarajapura	1126
Mahaweli Pedesa	1561	Madamaluwa	1216
NissankaMalla Pedesa	1860	Laksha Uyana	1870
Thopawewa	1503	Sri Nisshankamalla Pura	2282
Polonnaruwa Town	3092	Sewagama	1956
Palugasdamana 1 Ela	983	Wawethanna	1010
Palugasdamana 2 Ela	1632	Monarathanna	1280
Palugasdamana 3 Ela	1247	Wijayabhahupura	1020
Palugadamana North	987	Sinhapura	1130

GN Division	Population	GN Division	Population
Palugadamana South	1642	Unagalawehera	1041
Galthabharawa	1029	Shanthipura	1431
Kuruppu Junction	1360		

As shown in following, Thamankaduwa PS own and control a number of public properties and institutes.

Table 3-3 Type and number of municipal establishment own by Thamankaduwa PS

Public property	No of Units	Public property	No of Units
Libraries	5	Aryurvedha Dispensaries	3
Reading centres	1	Quarters	4
Municipal parks	1	Crematorium	1
Play grounds	5	Fire distinguish unit buildings	1
Market complexes	2	Solid waste Management Centres	1
Cemetery	24	Shop rooms	34
Bus stand complexes	1	No of rent out shop rooms	240
Slaughter house	1	Buildings	8
Fish stalls	9	Buddhi maddapaya	1
Meat stalls	3	Pradeshiya Sabah gathering hall	1
Public toilets	7	Cinema	1
Pola premises	2	Community centres	8
Community centres	6	Common water taps	12
Preschools	3	Bathing Places	3

Thamankaduwa city host most of the government and privet sector institutes in the Polonnaruwa District. Following Table 3-4 shows the number of government and privet/non-government establishments within Thamankaduwa PS.

Table 3-4 Number of government and privet institutions within Thamankaduwa PS

Type of institute	No of units	Type of institute	No of units
Government		**Privet**	
Schools	52	Hospitals	4
Higher education institutes	9	Banks	9
Hospitals	1	Aruradic dispensaries	13
Hospitals - Clinics	5	Insurance and Finance	19
District Secretariat office	1	Sport clubs	32
Divisional secretary offices	1	Cultural centres	1
Banks	16	Art institutes	21
Main Post offices	2	Video halls	5
Sub. Post offices	17	**Other**	

Type of institute	No of units	Type of institute	No of units
Police stations	2	Civil Security Committees	55
Court	1	Sport clubs	32
Agrarian Service Centres	2	Youth and sport societies	95
Other government institutes	446	Youth societies	55
Religious		**Cultural Centres**	1
Buddhist temples	41	Play grounds	41
Hindu Kevil's	1	Gymnasiums	10
Mosques	22	Town halls	2
Churches	5	Community halls	85
Dharma Schools	41		

A major portion of MSW is generated from commercial sector in the city. Following Table 3-5 shows the number of different commercial (business) establishments in TPS area.

Table 3-5 Type and number of business premises within Tamankaduwa PS area

Type of business	No of units	Type of business	No of units
Middle size restaurants	53	Paint sale	19
Small size restaurants	99	Well rings and anicut tubes sales	1
Canteens and tea shops	85	Building blocks sales	3
cool drinks and fruit juice	12	Flower pot and floor tiles (concrete) sale	12
Vegetable/ Fruit shops (large)	30	Ornamental fish	3
Retail shops	709	Fish raring accessories	1
Glossary shops	52	Sweeping ticket sale	8
General wholesale shops (large)	21	Drinking water sale	3
Textile trading shops (large)	108	Book shops	3
Furniture sales shops	14	Stationary	45
Vehicle spare parts	18	News paper, magazine	12
Bicycle spare parts	4	School items	27
Fish sales stalls	5	Jewellery	26
Barber shops	33	CCTV	1
Pharmacy (clinics and pharmacy)	18	Building material sales	33
Bars	5	Cement sales	18
Sweets	16	Roof tiles sales	1
Ice-cream and yogurt	6	Lime powder sale	3
milk sales	3	Hotels	
Curd	3	Large size hotels	8
Freeze Chicken	47	Middle/ small size hotels	60
Chick pea	3		
Soup	9	Industries	
Wood Carvings	1	Bakery products	30

Type of business	No of units	Type of business	No of units
Clock sales	1	Furniture	10
PVC pipe sales	3	Chilli mills	21
washing machine sales	3	Rice mills	204
Gem sales	4	Grain mills	14
Radio and TV spare parts	5	coconut mills	9
Electric and Furniture sale	19	Granite mills	1
Gas sales	20	Granite plate mills	1
Motor vehicle sales	6	Granite workshop	2
Bicycle sales	5	Granite production	15
Tinker and Spray	1	Saw mills	18
Motorcycle	13	Joss stick production	5
Nuts and bolts sale	1	Soap production	2
Tyre and tube	10	Lamp drapery (Pahan thira)	1
Motorcycle spare parts	6	Souvenir production	2
Hand tractor spare parts	2	Notice board production and preparation	3
Computer sales	11	Jewellery manufacturing	13
Computer spare parts	6	Gem products	2
Battery sales	6	Textile various	3
Agrochemical sales	10	Ready made garments	82
wood sales	9	Fruit processing	4
Wood furniture	7	Sweets production	66
Wedding invitation sale	1	Agricultural tools and equipment manufacturing	22
Festival items	8	Wood ware manufacturing	42
Fishing tools	1	Cement products	33
Offerings	2	Leather products	2
Glass sale	1	Welding smithies	65
All goods	5	Roof tiles and tiles production	28
Plastic goods	7	Pottery production	28
shoes sales	27	Coir products	9
Cushion	6	Ornamental goods production	12
Sales items	5	Yoghurt production	4
DVD and Video sales	12	Ice-cream production	3
Mobile sales	30	Curd production	25
Mobile cards	1	Milk bottling	2
Glass	10	Communications	35
Asbestos sale	5	Mobile telephone repair	10

4 Public Opinion Survey (POS)

This Public Opinion Survey (POS) was commissioned to identify a range of household waste management matters in relation to the household sector. Information on household waste management practices and information on householders' experiences with waste collection delivery services was collected for the purpose of improving our understanding of householder's experiences and attitudes and also to better understand prevailing situation in householder's point of view. The purpose of this survey research included;

a. To collect information on public attitudes to the waste management and environment in broader,
b. To value aspects of environmental health and protection,
c. To provide information on experiences with Local Authority's waste management service and,
d. To provide information on household waste management practices.

4.1 Public opinion survey methodology

The number of samples from Thamankaduwa identified as 200 households, but size of the sample increased to 206 during the implementation to increase the accuracy. The selection of households and areas within Thamankaduwa PS was done after a consultative discussion with Municipal commissioner, MSW section officers at TPS and JICA expert team members.

The survey was executed by a team of university students who were trained about the questionnaire, survey methodology and the data entering before dispatched to their respective fields. A senior expertise took the leadership and continuously supervised the field survey. The selected households were first educated about the survey, its main objectives and asked their cooperation before starting the field survey. In addition business and institutes, large waste generators, hospitals recycling shops and large public markets were also surveyed using appropriate questionnaires prepared in consultation with JICA experts.

Table 4-1 Category and number of samples for Public Opinion Survey

Category	Survey area	Number of samples
High-income households	Nissankamallapura, Nuwara Rd, Circular Rd, Wewa Rd, New Town	28
Middle-income Households	Circular Rd, Dakunu Ela Rd, Wasundara RD, Lake Rd, Nissankamallapura	71
Low-income Households	Circular Rd, Arama Rd, Wasundara Rd, New Town Rd, Bediwewa	51
Businesses /Service organization	New Town, Pollonnaruwa, Thopawewa,	37
Large waste generators		12
Hospitals		2
Markets		2

Category	Survey area	Number of samples
Recycling shops		2
NGO		1
Total		**206**

The questionnaires were available in all languages (English/Sinhala/Tamil); however the questionnaire form was filled by the interviewer based on interviewees' response. The collected information was recorded in digital form using Microsoft Excel and reviewed for accuracy. The data was analyzed in detail for different objectives that generate an overview of the survey.

4.2 Results of Public Opinion Survey

- ✓ 97% of the surveyed households are Tamil with only 3 % Muslims. Data on the average number of people per household and monthly income is set out in below Table 4-2.

Table 4-2 Average and standard deviation values of income and family size

Category	Family size	Income (Rs/month)
High	4.4 ± 0.8	61,500 ± 9,965
Middle	4.3 ± 1.3	35,451 ± 6,594
Low	4.5± 1.3	16,569 ± 5,917
	No of workers	**Income (Rs/month)**
Business	3.0 ± 2.2	963,919 ± 3,904,081

- ✓ In Thamankaduwa PS, only 55 % of surveyed households are provided with a garbage collection service, of which only 68% stated they use this service. Only 35 % of surveyed households are "very satisfied" with present SWM service provision, while 53 % are "somewhat satisfied".

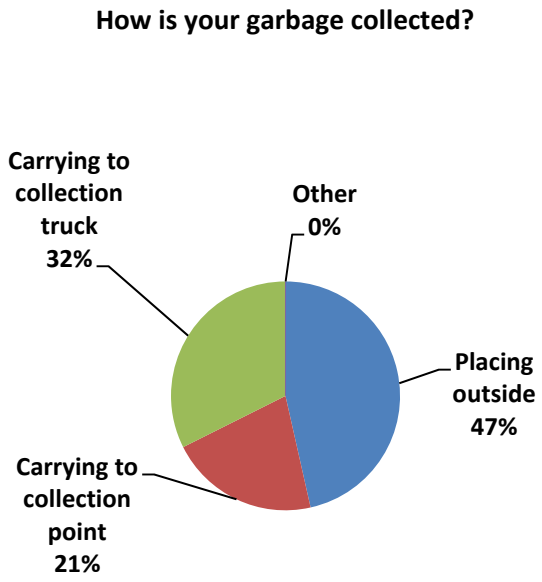


Figure 4-1 Method of garbage discharge by residence in TPS area

- ✓ Households' main methods of waste discharge are shown in Figure 4-1. The most common methods are discharging it outside their premises for house to house collection (47 %) and carrying garbage to collection truck (32%), and 21% residence disposed waste at designated disposal points.
- ✓ Only 6% of surveyed households receive a daily garbage collection service while 35 % stated that they received the service once/week while 51% received the service 2-3 times/week. However, 64% discharge their garbage as soon as it is generated and 34 % discharge their garbage daily, the gap between discharge and collection being slightly greater for the residence far away from city center. The discrepancy between these figures explains the large amount of discarded garbage present on many streets around Thamankaduwa.
- ✓ In general, adult females handle waste in about 53 % of surveyed households.
- ✓ As shown in Figure 4-2, 48 % of surveyed households are practice source separation. And also, only 91 % of surveyed households stated that there are recyclable collectors or someone who comes to collect their reusable or recyclable materials. Hence, an informal source separation recycling system is not well established in Thamankaduwa PS area.

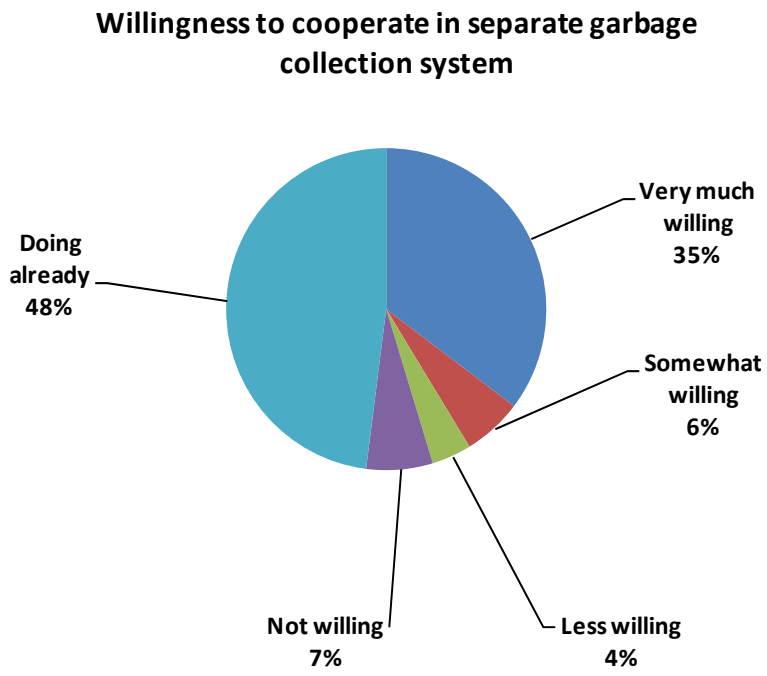


Figure 4-2 Willingness of residence for a source separated garbage collection system in Thamankaduwa PS

- ✓ Only 23 % of surveyed households use kitchen/garden waste for composting and used the finished compost for their own garden.
- ✓ Only 31% of households have ever discussed proper garbage discharge methods at the community level.
- ✓ 96 % households stated that SWM awareness programmes are very necessary while rest of 4 % stated “somewhat necessary”.
- ✓ The average WTP (willingness to pay) for improved SWM services is 56 ± 76 Rs/month per household. However 49 % of household do not like to pay for SWM service.
- ✓ Out of all surveyed households, 24 % stated that they sale/give-off metal for recycling and 12 % of residence sale/give-off tins & cans for recycling. The glass and bottle recycling is practiced by 26 % of households while the plastic recycling is 8 %. Percentage of household who involved in paper recycling was low (11 %).

5 Final disposal site survey (FDS)

5.1 Introduction to the FDS at Thamankaduwa PS's

5.1.1 Survey Method

The data and information in this report were collected from various sources including published reports, verified data from Thamankaduwa Pradeshiya Sabha, and direct interview with responsible authorities at disposal site.

5.1.2 Target of Survey

The survey is focus on obtaining general information on waste receiving, handling, disposal, facility management, environmental monitoring and legal adherences.

5.1.3 Data Sampling

The numerical data was collected as specified in following Table 5-1.

Table 5-1 Data collected during the final disposal site survey

	Survey Items	Method
1	Current condition of final disposal site and its surroundings	
	✓ Disposal method and structure	Records, visual observation
	✓ Soil-covering	Records, visual observation
	✓ Land owner	Records
	✓ Residual area	Records, visual observation
	✓ Leachate water	Records, visual observation
	✓ Waste picker	Records, visual observation, interview
	✓ Scattering waste, smoke, fire, offensive odour, animals and so on	Records, visual observation
2	Operation and Management of final disposal site	
	✓ Environmental Protect License and Environmental Clearance	Record
	✓ Personnel	Records, interview
	✓ Operation vehicles, their maintenances and drivers	Records, interview
	✓ Weighbridge	Records, interview
	✓ Waste collection data	Records, interview
	✓ Supervisory method	Records, interview
3	Waste amount to final disposal site (24 hours, 7 days)	Records, Survey
4	Adverse impact near by residences	Records, Survey
5	Implementation status of geological, topographic and EIA survey for new final disposal site	Records, interview
6	Progress situation for new final disposal site	Records, interview
7	Court case	Records, interview

5.2 Current condition of final disposal site and its surroundings

5.2.1 Final Disposal Site of Thamankaduwa PS

Final disposal site is located in Gallella, about 8.5 km away from the Polonnaruwa town on Polonnaruwa-Batticalloa main road. The site lies within Kotaleeya GN division of Thamankaduwa Divisional Secretariat Division in Polonnaruwa District of the North-Eastern Province of Sri Lanka.

The final disposal site is situated close to the National Livestock Development Board (NLDB) premises 500 m away from the Pollonnaruwa- Baticaloa highway. The final disposal site is scrub forest lands extend to Mahaveli Forest Reserve along the lower Mahaveli River catchment.

The site is bordering to staff quarters of Milco-NLDB factory on North, residential areas on East and other sides to the Forest.

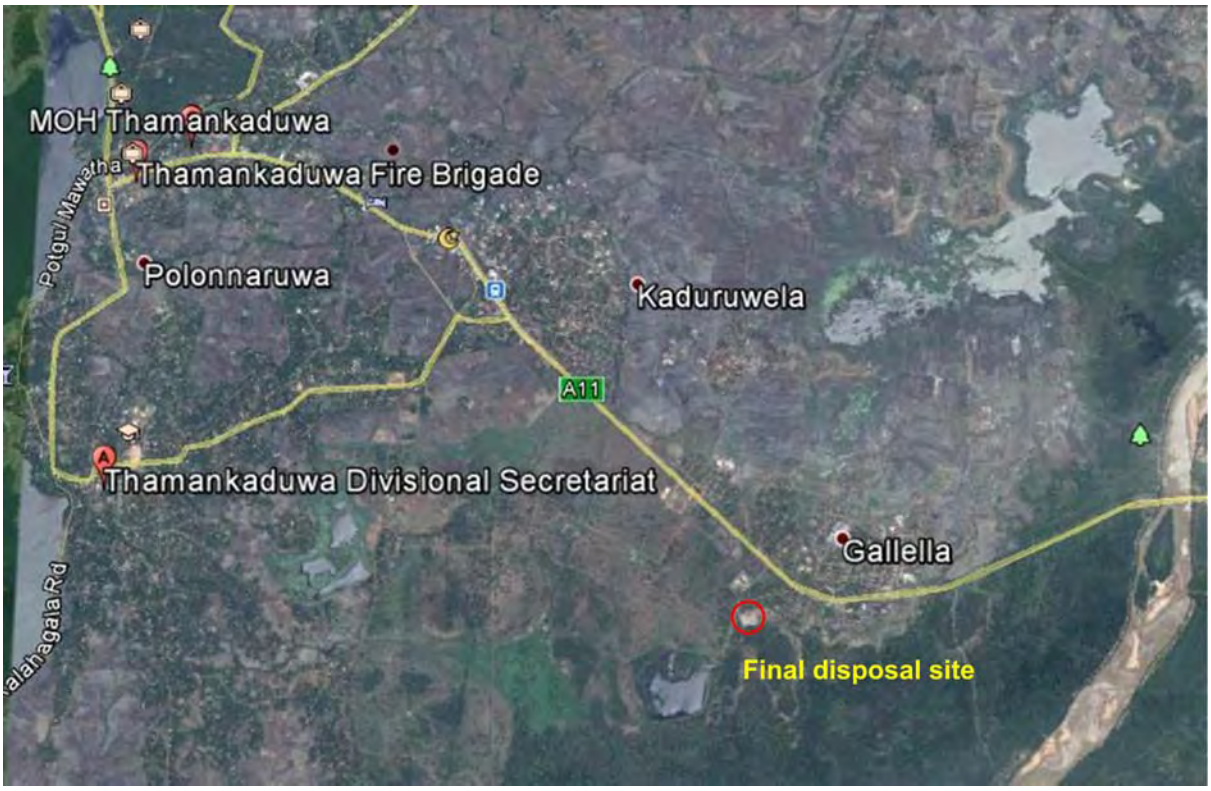


Figure 5-1 Location of Thamankaduwa PS's MSW dumpsite in Thamankaduwa

5.2.2 Extend and landform

At present, a 1.621 hectare land has been allocated for the dumpsite by Department of Forestry and Wildlife.

Except the residential areas, surrounding area is covered with shrubs and forest vegetation. The site is at the edge of a major forest reserve in dry zone of Sri Lanka; therefore scavenging of wild elephants is the major thread to Wildlife in the forest, among many other environmental problems associated with the site. Thus, Department of wildlife has recently built an electric fence around the dumpsite in addition to a 3 m deep, 2 m wide and 500 m long soil trench along the periphery of the

site. However, it was observed that elephants enter the site breaking the trenches and even the electric fence.

Figure 5-2 Environment around the Thamankaduwa MSW disposal site

The landform is a flat terrain except the areas where the trench & bunds were built.

Figure 5-3 Protective measures to prevent elephants entering the site

5.2.3 Waste receiving and disposal

The available records show that Thamankaduwa PS delivers approximately 7 to 18 tonnes of MSW to the site. In addition, on average, 24 m^3/month of toilet waste is also emptied at the site.

Table 5-2 Daily waste disposal amount at Thamankaduwa site

Survey date	4-wheel tractor	Tipper truck	Total
		Tonnes/ day	
12/11/2015	11.8	2.2	13.9
13/11/2015	9.4	4.3	13.7
14/11/2015	7.1	2.2	9.2
15/11/2015	7.1	0.0	7.1
16/11/2015	9.4	8.6	18.0
17/11/2015	7.1	8.6	15.7
18/11/2015	9.4	2.2	11.6

There is no formal recyclable collection system established in TPS area. However, residences are request to sort the waste at household level. The delivery of segregated waste is doe through normal collection, thus unloading of segregated waste at the dumpsite is difficult. Thus, workers dumped all the waste at the dumpsite, unless otherwise recyclable wastes are packed in large plastic bags.

The highly organic waste generated from weekly Pola and market areas are filled into the large biogas reactors. However, the reactors are not functioning well, thus it is practice as strategy to prevent elephant entering the site for scavenging on food & vegetable waste.

5.2.4 Site infrastructure facilities

The integrated site includes a composting facility, recyclable storing facility and large scale biogas reactors (4 tanks) as auxiliary waste management facilities.

However, the biogas facility is not operated properly due to technical problems associated with design and maintenance. Therefore, the reactors are used as temporally anaerobic digesters for food & vegetable waste.

The composting facility does not have adequate space for operation thus compost production is very limited.

The recyclable storing facility is used for storing marketable recyclables. The collected materials are sold as bulk through open tenders, once a reasonable quantity is collected.

In addition, the site has a security gate, office building with workers rest room and basic site services such as electricity and water supply.

Figure 5-4 Auxiliary MSW management facilities at Thamankaduwa dump site

5.2.5 Management of the dumpsite

At present, the dumpsite management is done by PS workers stationed at the site. Following table show the management structure and human resources at the Thamankaduwa dumpsite.

Table 5-3 Administration structure and human resources available at Sundarapola site

Human resources	Number of persons
Municipal Secretary (Administration)	1
Public Health Inspector (Administration)	1
Resident site officers	
Site supervisors –(Permanent position)	1
Men labours–(Permanent position)	3
Women Labour - (Permanent position)	1
Security guard -Day time (Permanent positions)	1
Security guards –Night (Permanent position)	1

The daily machine and labor operation records are available at the site office. The records showed that the site operation cost nearly Rs. 286,000 per month, excluding direct wages for supervisor and security personals.

Table 5-4 Monthly operational cost of the dumpsite

Item	Backhoe loader	Tractor Loader & mover	Grass Cutter	Bulldozer	Total
		Rs / month			

Fuel	33,199	36,187	402	None	
Insurance/Revenue	385	Not paid		None	
Repair/Service	17,581	12,717	80	None	
Rental fee	-	-	-	9000	
Operators Salary	34,800	33,800	None	None	
Monthly Amount	85,965	82,704	482	9000	
Working factor for final disposal site	20%	50%	100%	100%	
Total Cost	17,193	41,352	482	9000	**286,131**

View of the waste disposal site from the boundary

Active filling area

Leachate contaminated rainwater flow

Waste dump without soil cover

Figure 5-5 present status of Thamankaduwa disposal site

5.2.6 Current condition of final disposal site and its surroundings

1	Current condition of final disposal site and its surroundings	
1.1	Disposal method and structure	✓ Incoming waste loads (tractors, trucks and gully bowsers) are recorded at the entrance gate. ✓ Selected vehicles which contain food & vegetable wastes are unloaded into biogas reactors (1 tractor load/day) ✓ All other MSW collection vehicles emptied its waste at the dumpsite. No specific control measures apply for selection of dumping area. Thus, **Open Dumping** is practiced. ✓ Site supervisor explained that the Thamankaduwa PS employs bulldozer when there is a requirement for leveling the waste. A privately own bulldozer is rented out for 1-2 days every month. In addition a tractor loader & mover is also employed at site for waste handling every other day. ✓ Sewage is discharged to a shallow pit excavated on the dump
1.2	Soil-covering	✓ Covering of waste by soil is not practiced
1.3	Land owner	✓ Thamankaduwa PS the ownership of the land
1.4	Residual area	✓ Approximately 50% of the allocated 1.621 ha area has already been covered with waste
1.5	Leachate water	✓ No leachate collection and treatment system ✓ Leachate and surface water flow towards the forest through the dredged channel ✓ Many small leachate ponds and pits (1-5 m^2) are scattered on the dump site ✓ Sewage is discharged to pits excavated on the dump
1.6	Waste picker	✓ None
1.7	Scattering waste, smoke, fire, offensive odor, animals	✓ Waste is dumped everywhere on the dumping site ✓ Polythene, papers and other soft materials have blown all over the area by the wind. Polythene and soft plastic bags have blown more than few hundred meters away from the site and deposited on trees in forest. ✓ Labors set fire on selected waste (garden waste/ textile waste/ paper waste) within the dumpsite ✓ The fly breeding is a problem throughout the year ✓ There are more than 50 stray dogs reside in the dump site

5.2.7 Operation and Management of final disposal site

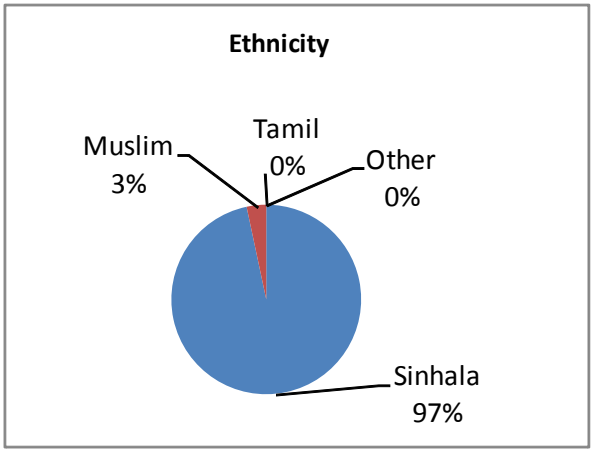
2	Operation and Management of final disposal site	
2.1	Environmental Protect License and Environmental Clearance	✓ None
2.2	Personnel	✓ 1-Supervisor –Morning (Permanent position) ✓ 3-Men labors (Permanent position) ✓ 1-Women labor (Permanent position) ✓ 1-Security guard for day time (Permanent position) ✓ 1- Security guard for night time (permanent position)
2.3	Operation vehicles, their maintenances and drivers	✓ Tractor loader/ mover (currently out of order and on repairs) ✓ (A Bulldozer is hired every 6 months for 10-12 hours) ✓ TPS own backhoe loader is used to unload waste from biogas tank. Work load is 50-60 hours/month
2.4	Weighbridge	✓ None
2.5	Waste collection data	✓ A record book is available
2.6	Supervisory method	✓ Municipal Secretary do the overall supervision ✓ Public Health Inspector(PHI)- 1 nos ✓ Those three officers are regularly inspecting the site and instruct the site supervisor for necessary actions. Officer-in-charge is responsible for coordinating with municipal officers for solving daily management issues as well as other contingency matters. ✓ Site supervisor is responsible for daily operation and labor control
3.0	Waste amount to final disposal site (24 hours, 7 days)	✓ A summary is shown in Table 5-2
4.0	Adverse impact nearby residences	✓ Odor problem ✓ Fly problem

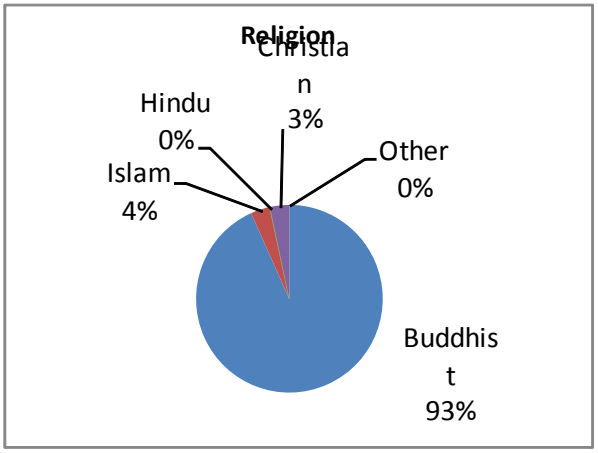
2	**Operation and Management of final disposal site**	
		✓ Elephant roaming around the dumpsite pose a threat on nearby residence ✓ Scattering of materials by wind is a problem for residence around the dumpsite
5.0	Implementation status of geological, topographic and EIA survey for new final disposal site	✓ None
6.0	Progress situation for new final disposal site	✓ None ✓ However, a project report including the estimate for Improvements to the solid waste management center has been submitted to Thamankaduwa DS office, Department of wildlife and Central Environmental Authority for possible funding. The project evaluation is in progress. The total estimated cost for project is Rs. 14.7 million as follows. i. Proposed composting Shed – 6,023,819.31 ii. Internal Road construction - 5,671,308.00 iii. Proposed shorted Roof - 255,090.00 iv. Proposed toilet facility - 1,503,751.78 v. Contingencies - 1,345,396.91 vi. Total Estimate (Rs) -14,799,366.00
7.0	Court case	✓ None

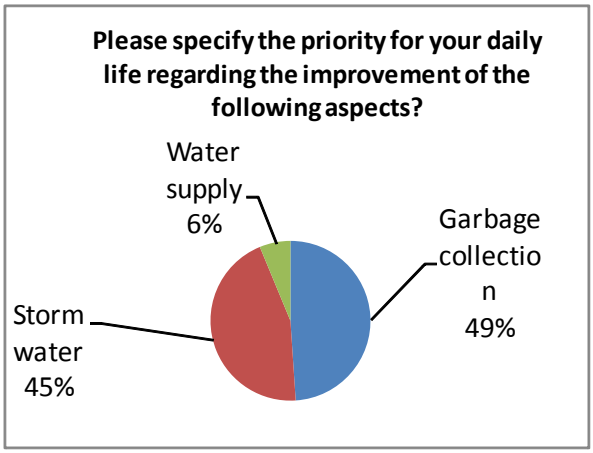
Annex

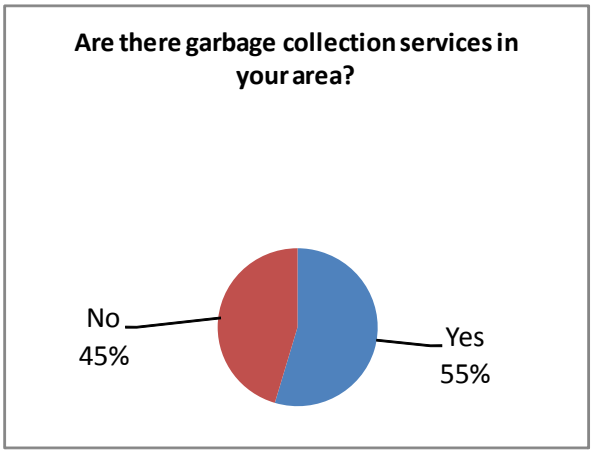
THAMANKADUWA PRADESHIYA SABHA

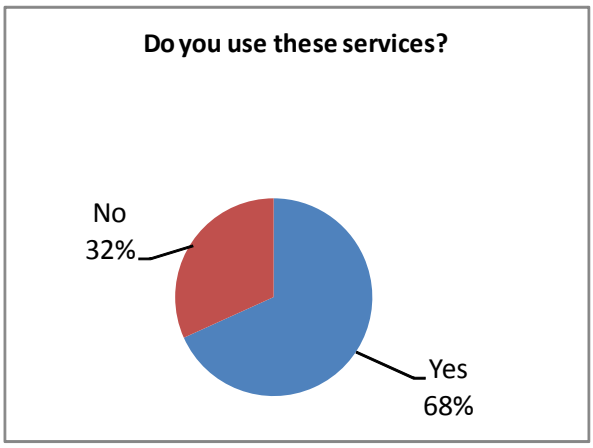
Response to Public Opinion Survey for Household

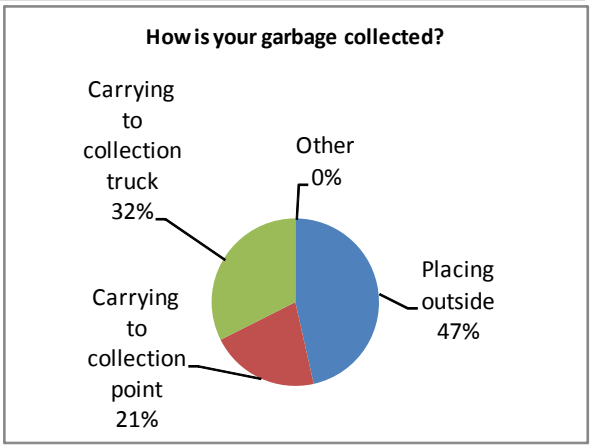












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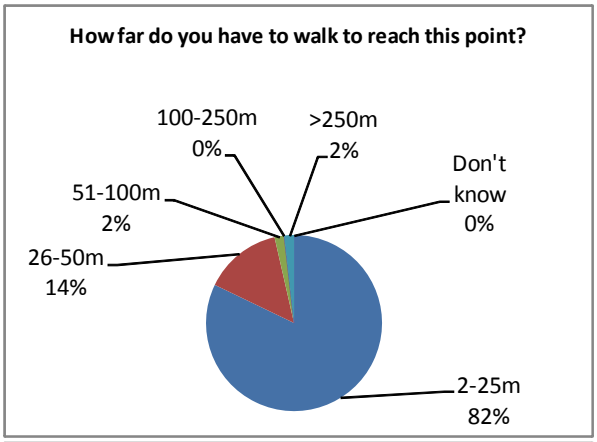

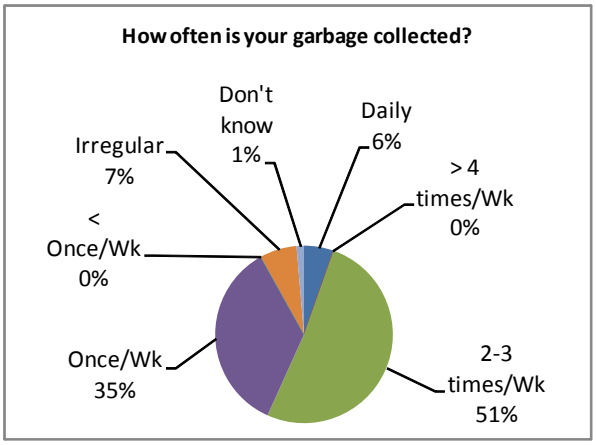

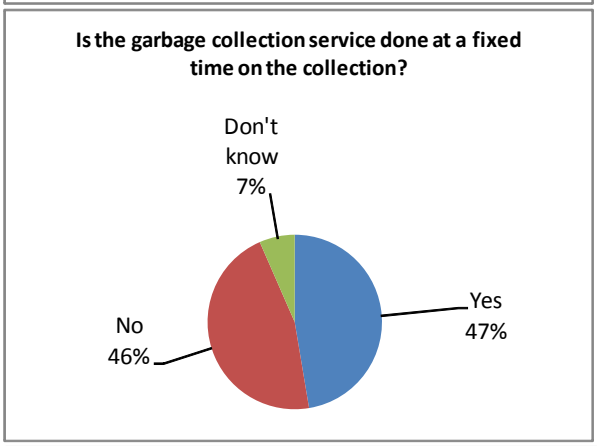

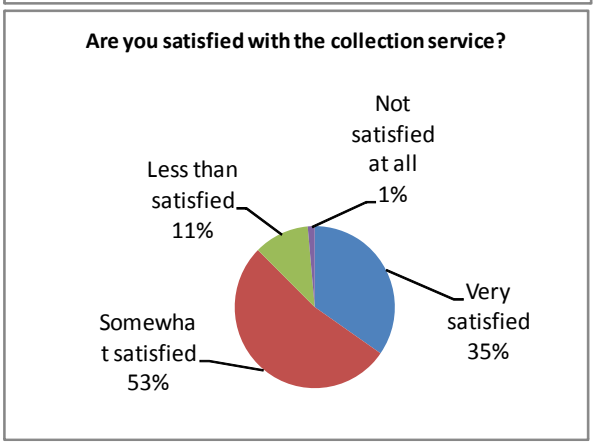

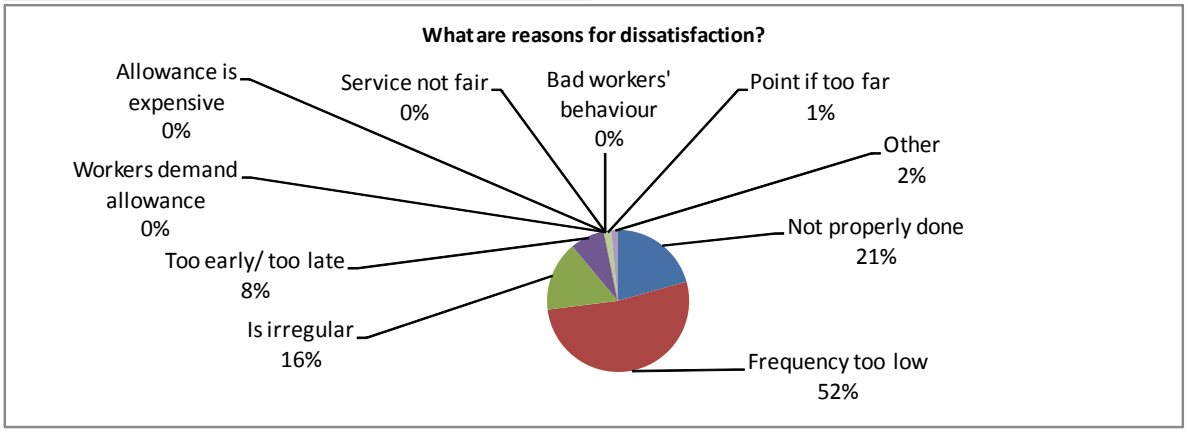

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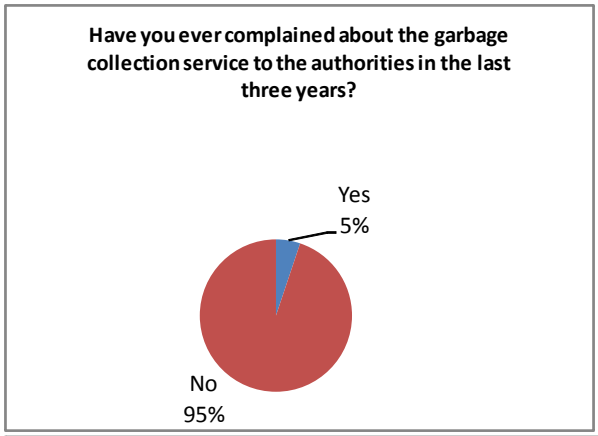

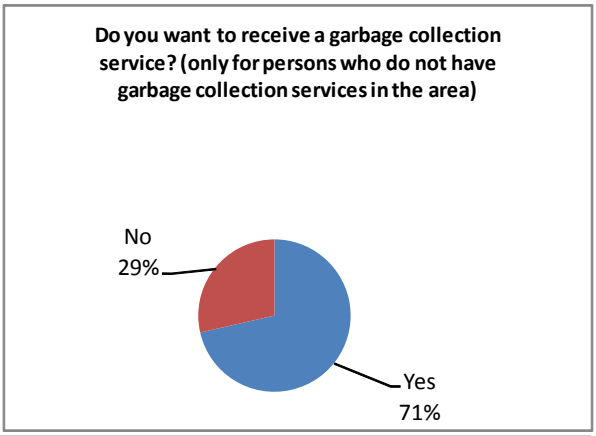

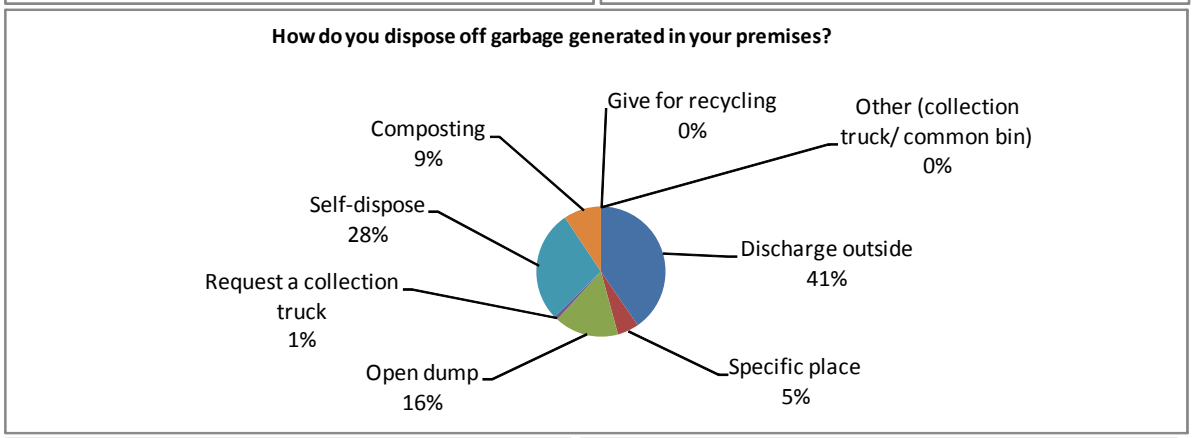

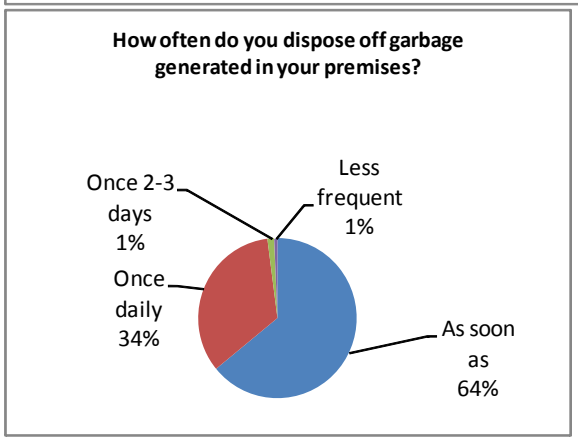

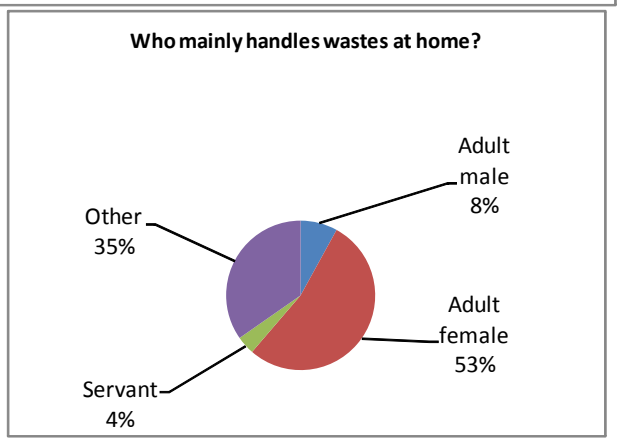

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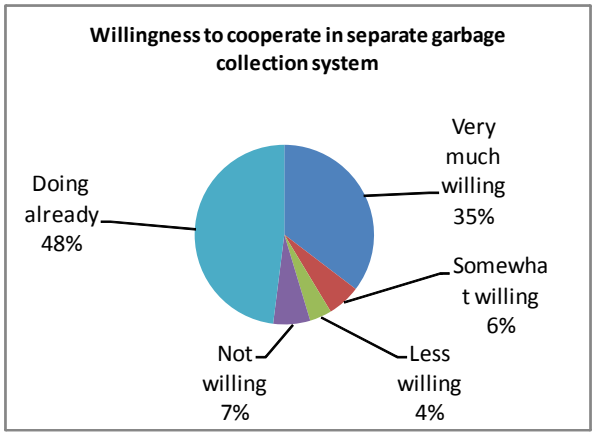

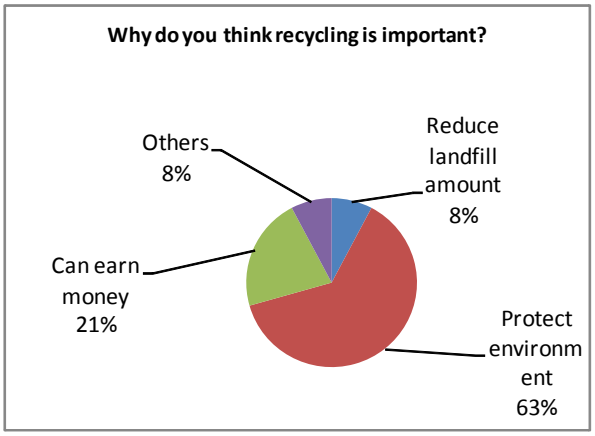

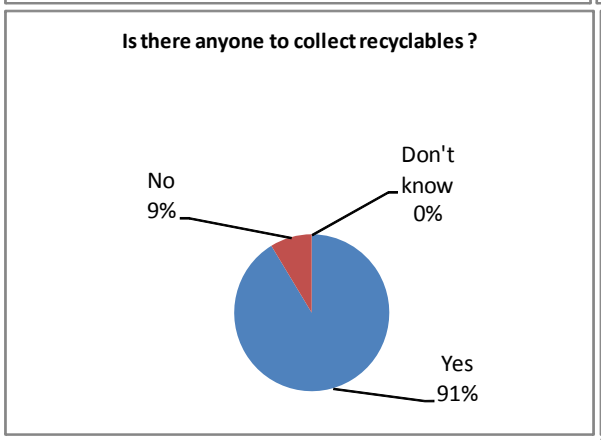

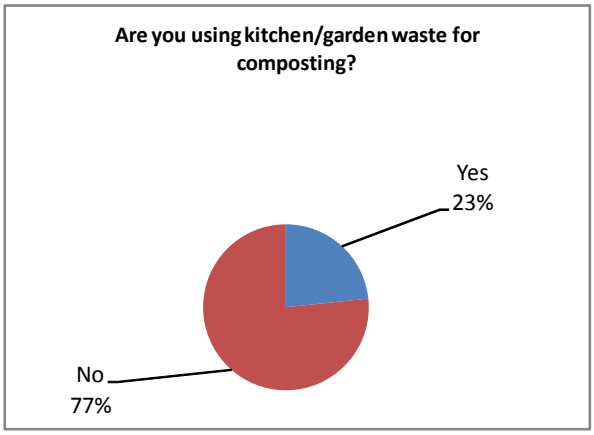

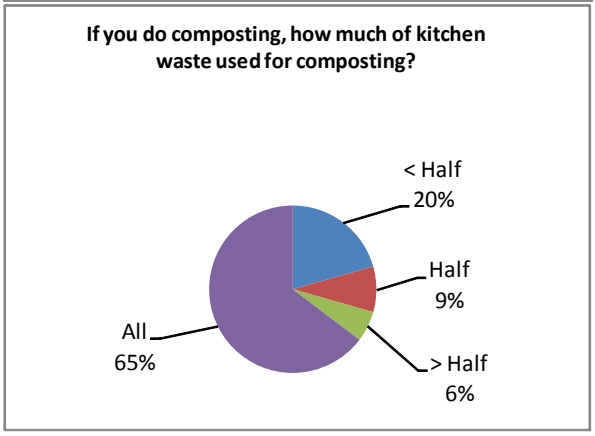

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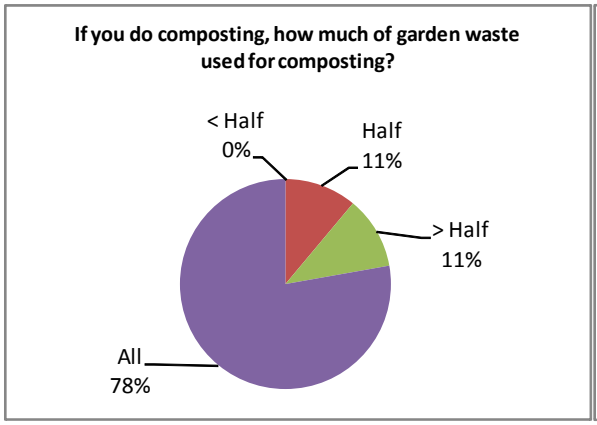

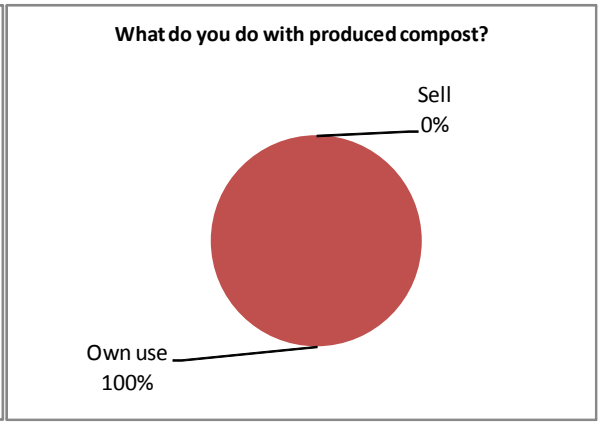

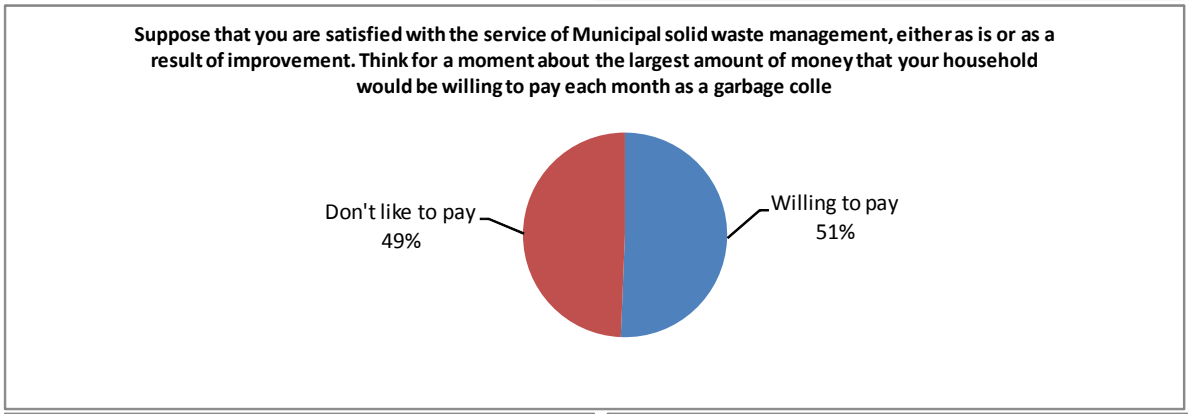

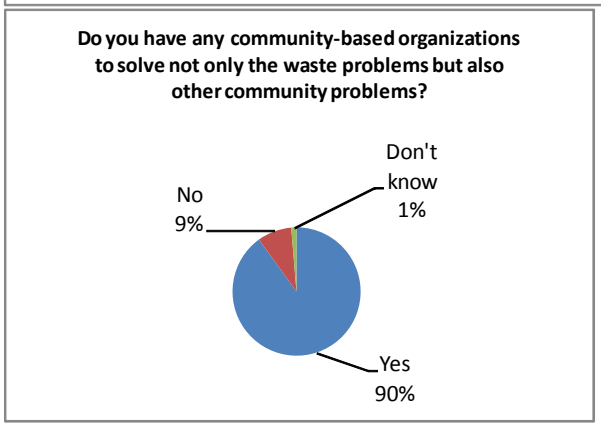

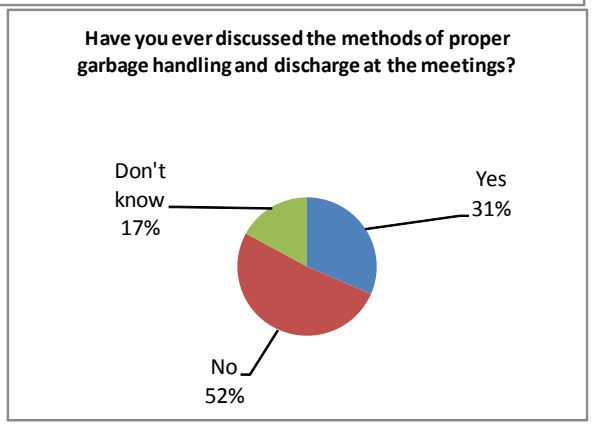

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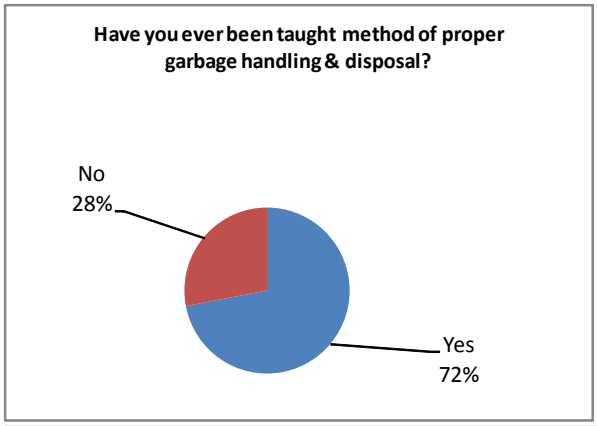

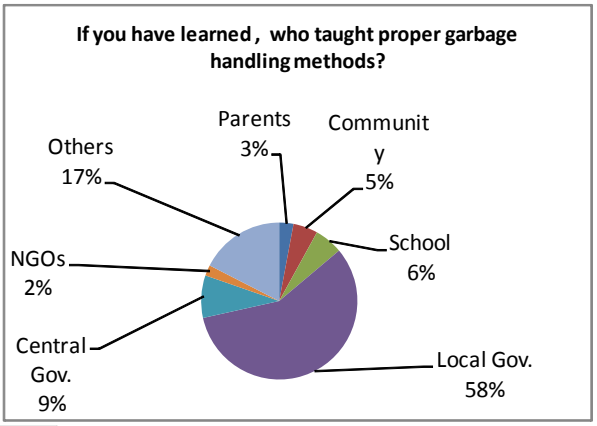

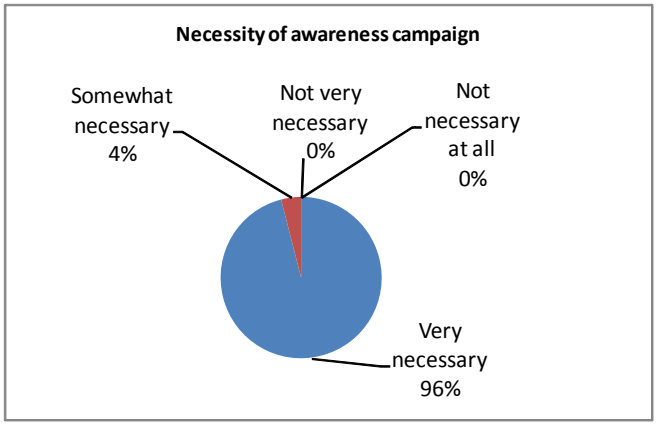

1.3 Jaffna MC

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1 Introduction

The purpose of this survey is to obtain the current data regarding Solid Waste Management (SWM) at Jaffna Municipal Council (JMC). The data collection survey was conducted from 19th October to 26th October, 2015 by a team of expert dispatched by Waste To Energy Technologies Limited.

This report consists of brief summaries of survey methods and results. The additional primary data and records are available as soft copies. The preliminary data collection was conducted through four comprehensive surveys which are;

i. **Waste Composition Survey (WCS)** is to gather information on Physical Composition of MSW collected by JMC.
ii. **Waste Generation Survey (WGS)** is to gather information on waste generation sources at JMC based on secondary data available at JMC and other relevant organizations.
iii. **Public Opinion Survey (POS)** is gather information on public opinion on current waste management in JMC. The POS was conducted through a questionnaire survey that covers different types of waste generators in the JMC area.
iv. **Final Disposal Site Survey (FDSS)** is to collection data on final MSW disposal site of JMC based on secondary data as well as field recordings & visits to the site.

1.1 Background conditions of Jaffna Municipal Council

The local Government structure and system which got initiated with the introduction of the local Board from July 1906, the Urban District Council from 01st January 1923, the Urban Council from 01st January 1940 culminated in the promulgation of the Municipal Council with effect from 01st January 1949 under the provision of the Municipal Council Ordinance No 29 of 1947.

The Jaffna Town lies in the Southern part of Jaffna Peninsula between 9° 38’ North and 9° 42’ North and between 79° 59’ East and 80° 3’ East. It is the District Head Quarters for Jaffna District, which consist of most parts of Northern Sri Lanka. The area of the Town is about 20.20 km^2 and the town is longer in the East – West direction measuring a maximum of 6 km in length and its width varies from 8.5 to 4.0 km. The Jaffna lagoon forms the Southern boundary of the town. The Municipal Council consists of Jaffna and part of Nallur Divisional Secretariat Division.

In general the topography is almost flat, the highest elevation is one 10 MSL and no sharp gradients are noticeable. There is no natural stream.

Jaffna peninsula has typical tropical climate with two rainy seasons occur; major during the North East monsoons (October to December) and the minor rainy season occurs during the South West monsoon (April and May). The period between the South West Monsoon and the North East Monsoon is the dry season extending from June to September. The average rainfall is 1300 mm with mean annual air temperature of 26.2 °C.

2 Waste Composition Survey (WCS)

The primary purpose of this survey is to ensure a standard approach to waste physical composition analysis for the purposes of understanding the composition of waste delivered to final disposal facility which was collected from JMC area. Information generated by WCAs will be useful to JMC as well as administrators/policy makers to improve the efficiency and overall effectiveness of waste management systems.

2.1 Methods of waste composition Survey

2.1.1 Classification of Wastes at Disposal Facility

This study was conducted to assess the physical composition of MSW samples collected from JMC and delivered to the final disposal facility by collection vehicles.

2.1.2 Sampling frequency

The WCA was carried out for a full waste collection cycle starting from Monday (20th October 2015) to Sunday (26th October 2015).

2.1.3 Bulk-Sampling for WCS

An effective WCA programme must be based on waste samples that are representative of the target area as a whole (usually a whole local authority), be sufficient to take account of variation in waste arising whilst also being affordable within the project budget. A good sampling strategy is essential to achieving this difficult balance. Thus it is needed to ensure that a 'good' sample is obtained within the constraints of time and cost.

Figure 2-1 Sampling for WCS at JMC, (a) manually unloading the profile sample and (b) unloaded sample

Waste collection vehicles, especially four wheel tractors trailers (4-wheel tractors) are filled from bottom to the top of the trailer, thus making a distinguished vertical stratification in the tractor. The filling pattern becomes more complex when the garbage is discharged in bags. Therefore, as shown in Figure 2-1, profile sampling from collection vehicles was adapted in this study. The profile sample

was taken from the back of the trailer, measuring at least 1/8 of the length of the trailer. Therefore, the size of the composite sample was found to be varied from 100 and 150 kg.

Thereafter, all the large and over sized waste particles were manually shredded into smaller particles. At the first round of shredding, larger particles were cut in to small the size particles with knife and scissors (Figure 2-2).

Figure 2-2 Particle size reduction, mixing and preparation of working sample by coning & quartering technique

The size of the bulk sample was reduced to a workable size by Coning and Quartering technique. Finally the sample was reduced to a more manageable size as the actual classification of materials was carried out by hand. The Coning and Quartering technique involved the following:

a) The sample was placed on the floor and thoroughly mixed by shovel, manually.
b) The sample was then placed in a uniform pile of approximately 0.8 m high.
c) The pile was divided into four quarters using straight lines perpendicular to each other.
d) Either pair of opposite corners was removed to leave half the original sample.
e) The process was repeated three times until the desired sample was obtained.

2.1.4 Measurement of physical composition

2.1.4.1 Specific gravity of waste

To measure the bulk density of a sample, the following procedure was followed:

a) Weighed and recorded a volumetrically celebrated bucket of known volume (50 L)
b) Poured the sample into the bucket until it was overflowing
c) Settled the contents of the bucket by dropping it three times from a height of 10 cm
d) After settling the waste, waste-filled bucket volume was measured
e) Weight the bucket and its contents was recorded
f) The bulk density was estimated by dividing the waste weight by filled volume, as kg/ m^3.

Figure 2-3 Procedure of analysis of physical composition

2.1.4.2 Physical composition analysis procedure

Once the sample size was determined and a reduced or workable sample was obtained, the following procedure was carried out.

a) Sorted reduced sample and pick out larger items first e.g. glass, paper, plastics.
b) Separated waste into following categories,
    i. Kitchen waste

ii. Paper
iii. Textiles
iv. Grass & Wood
v. Soft Plastic
vi. Hard Plastic
vii. Rubber & leather
viii. Metals
ix. Glass
x. Stones & Ceramics
xi. Others

c) Weighed the separated waste using an accurate top loading balance and recorded on standard form
d) Any remaining material which did not fall into any of prescribed categories was passed through a 4 mm mesh sieve and classified as 'components smaller than 4 mm mesh'.

2.2 Waste composition survey results

A summary of the results of the waste composition survey conducted in JMC are tabulated below.

Table 2-1 Summary results of MSW physical composition survey in Jaffna MC

Sample		BD	KW	PP	TEX	GR	S-PL	H-PL	R&L	ME	GL	ST	OTH
Date		Percentage (%)											
20/10	Sam-1	349.1	5.0	4.0	8.8	19.8	10.5	0.8	1.4	0.2	0.7	48.8	0.0
	Sam-2	394.2	20.8	7.8	2.8	43.1	21.8	0.6	0.0	0.9	0.3	1.9	0.0
21/10	Sam-1	411.1	2.2	8.6	3.6	36.4	5.3	0.9	1.9	0.4	0.8	40.0	0.0
	Sam-2	375.4	17.2	8.8	2.0	43.7	11.3	1.6	0.0	0.1	1.8	13.5	0.0
22/10	Sam-1	360.1	2.6	3.0	0.2	53.3	3.0	0.2	0.2	0.2	0.8	36.4	0.0
	Sam-2	280.1	5.8	6.2	3.9	54.2	5.1	2.8	1.2	2.3	1.2	17.2	0.1
23/10	Sam-1	340.4	3.8	10.2	2.5	39.7	4.3	0.1	0.3	0.7	4.0	34.4	0.0
	Sam-2	384.5	4.5	6.2	10.7	49.8	8.3	1.5	0.8	2.0	0.5	15.5	0.3
24/10	Sam-1	356.7	6.4	6.0	3.2	43.6	8.8	1.5	0.3	0.1	2.2	27.6	0.3
	Sam-2	375.4	2.9	3.2	1.4	44.9	5.8	0.1	0.7	0.6	0.5	39.6	0.2
25/10	Sam-1	311.4	4.5	26.7	8.9	23.6	12.2	1.0	0.5	0.4	1.8	20.6	0.0
	Sam-2	344.2	1.2	4.6	2.6	47.9	4.4	0.7	1.2	1.2	0.0	36.0	0.0
26/10	Sam-1	375.4	5.4	4.7	1.1	58.4	6.9	1.2	0.0	0.5	1.5	20.3	0.1
	Sam-2	329.9	5.8	6.5	2.2	47.2	7.1	0.9	0.0	0.7	3.3	26.3	0.0
Average		356.3	6.3	7.6	3.9	43.3	8.2	1.0	0.6	0.7	1.4	27.0	0.1
Stranded Deviation		34.3	5.6	5.9	3.2	10.9	4.8	0.7	0.6	0.7	1.2	12.9	0.1
Mean Error		8.9	1.5	1.5	0.8	2.8	1.2	0.2	0.2	0.2	0.3	3.3	0.0
Median		358.4	4.8	6.2	2.7	44.3	7.0	0.9	0.4	0.6	1.0	27.0	0.0

BD- Bulk density (kg m^{-3}), KW- Kitchen waste, PP- Paper, TEX- Textile, GR-Grass & wood, S-Pl- Soft plastics, H-PL- Hard plastics, R&L- Rubber & leather, ME- Metal, GL- Blass & bottles, ST- Stones & ceramics, OTH- Other

The analysis showed that the amount of food & kitchen waste is very small (1.2- 20.8 %) compared with other parts of the country. However, the amount of garden waste in the collection is comparatively high which ranged from 19.8 % to 58.4 %. Another notable feature is the very high amount of stones & ceramics (1.9 – 48.8 %). The average waste composition derived from the 14 samples is shown in Figure 2-4.

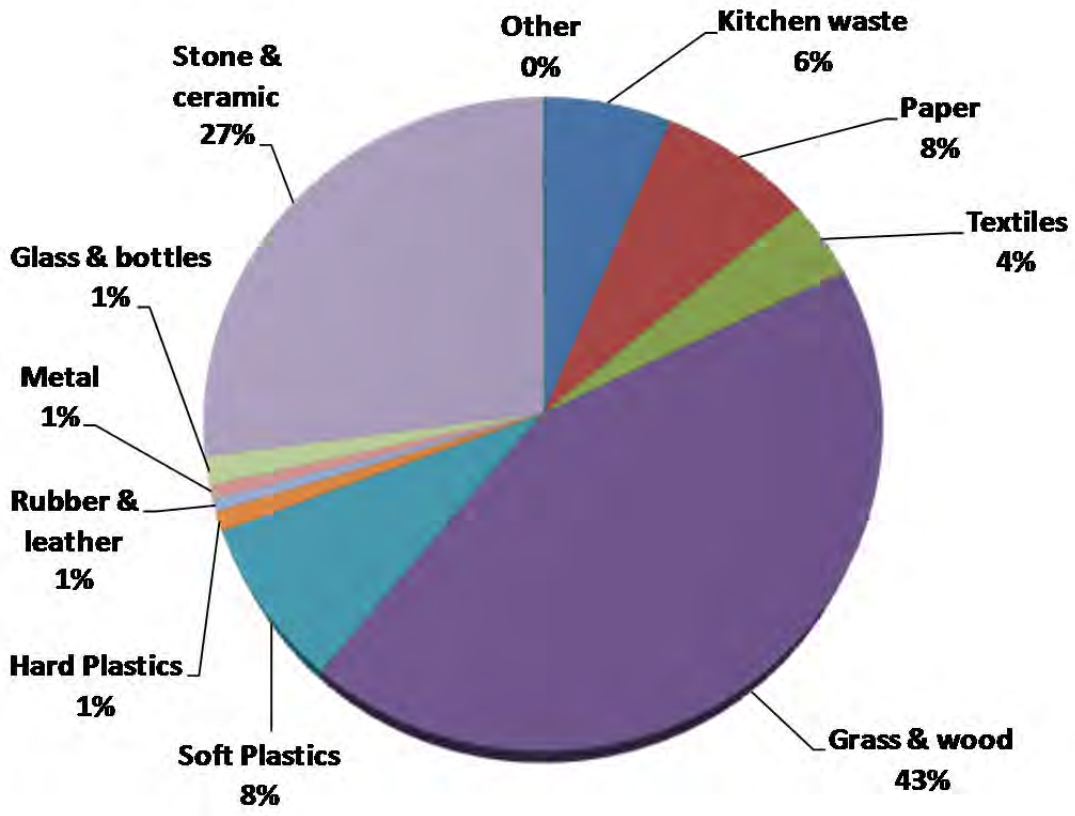


Figure 2-4 Average physical composition of MSW in Jaffna MC

The above figures shows that collected waste are suitable for composting. However, precautions shall be taken to minimize the amount of inert (stones & ceramics) which can eventually lower the quality f produced compost. Waste collected from bazaar and new market (Sample-1 on 25th October) has a lower organic content (28.1 %), as it includes commercial waste which contains more inorganic materials such as paper (26.7 %) and soft plastics (12.2 %).

It also showed that the percentages of more profitable recyclable materials (hard plastic, metal, and glass) are very small (0.1 - 3.3 %), while the percentages of less profitable materials (paper, soft plastic, textile) are much higher (3 - 26.7 %).

3 Waste Generation Survey (WGS)

In order to obtain general information on waste generation amounts, the data available at waste management section of the Health Department, Works Department and Revenue Department of JMC was used. Some of the data was available in the form of formal records and reports which were treated as the most precise secondary data while the data collected from official interviews with JMC officers was treated as verification data. Thus, the survey data was collected through different methods;

a) Recording and compiling of published and verified data by JMC,
b) Reading and recording of unpublished & non-confidential data available at JMC,
c) Recording and official statistics available at District Secretariat, Jaffna and Nallur Divisional Secretariat offices, and
d) Official person-to-person interview with relevant officers at JMC for verification of data.

The numerical data was collected as specified in following Table 3-1.

Table 3-1 Type of data collected for WGS in Jaffna MC

Source	Description
Household	Each number of following category households was surveyed; 1) High income level, 2) Middle income level and 3) Low income level.
Commercial	Each number of following category restaurants was surveyed; 1) Large size restaurants, 2) Middle size restaurants and 3) Small size restaurants. Each number of following category shops was surveyed; 1)Organic shops (large) 2)Organic shops (middle) 3)Organic shops (small) 4)Non-Organic shops (large) 5)Non-Organic shops (middle) 6)Non-Organic shops (small)
Hotels	Each number of following category hotels was surveyed; 1) Large size hotels 2) Middle size hotels and 3) Small size hotels.
Markets	Number of stalls and types
Institutions	Each number of following institute was surveyed; 1) Schools 2) Hospitals (government) 3) Hospitals (private) 4) Public office 5) Bank/private office 6) Buddhist temples 7) Hindu temples 8) Mosques 9) Churches 10) Navy/Police/ Army bases

Source	Description
	11) Others
Industries	Wastes from any industries.
Other	Public parks and other public facilities
Construction and demolition	Wastes originating from construction, rehabilitation and demolition activities, etc.
Hazardous (Special)	Management and collection of hazardous wastes originating from various sources, including household items

3.1 Waste Generation Survey Results

The records indicate that the total residential population within JMC is 91,100 (Source: Divisional Secretariat, Jaffna & Divisional Secretariat, Nallur, 2015). The Jaffna MC area consists of 47 Grama Niladari (GN) divisions as shown in below Table 3-2.

Table 3-2 Household population (GN level) within Jaffna MC area

DN Division	Population	DN Division	Population
GN division	2,015	Navanthurai South	2,771
Nedunkulam	2,120	Navanthurai North	2,446
Colombuthurei East	2,391	Moor Street South	3,546
Colombuthurei West	1,270	Moor Street North	4,849
Passaiyoor East	1,212	New Moor Street	1,629
Passaiyoor West	1,154	Ariyalai North West	1,744
Echchamoddai	3,068	Ariyalai Centre West	1,406
Thirunagar	1,684	Ariyalai South West	1,066
Reclamation East	4,426	Ariyalai Centre	1,649
Reclamation West	3,560	Ariyalai Centre North	892
Gurunagar East	1,793	Ariyalai Centre South	1,027
Gurunagar West	1,436	Iyanarkovilady	1,256
Small Bazaar	787	Vannarpannai North	1,882
Jaffna Town West	1,831	Vannarpannai North West	2,599
Jaffna Town East	2,336	Vannarpannai North East	2,523
Chundikuli South	1,944	Neeraviady	1,985
Chundikuli North	1,439	Kantharmadam North West	1,620
Maruthady	1,618	Kantharmadam North East	2,059
Aththiyady	2,202	Kantharmadam South West	1,245
Sirambiyady	1,231	Kantharmadam South East	1,001
Grand Bazaar	1,549	Nallur North	1,662
Fort	1,985	Nallur Rajathany	604
Vannarpannai	1,485	Nallur	1,506
Koddady	2,029	Nallur Sankiliyanthoppu	3,583
	Total		91,100

As shown in following, Jaffna MC own and control a larger number of public properties and institutes.

Table 3-3 Type and number of municipal establishment own by Jaffna MC

MC properties	Number of establishments
Libraries	7
Municipal parks	2
Play grounds	1
Market complexes	2
Cemetery	6
Vehicle parking complexes	0
Office/ sub-office	0
Slaughter house	1
Fish markets	5
Meat stall/ markets	35
Pola premises	2
Aruradic dispensaries	9
Common wells	19

Jaffna city host most of the government and privet sector institutes in the Jaffna District. Following table shows the number of government and privet/non-government establishments within Jaffna MC that consist of Jaffna and Nallur Divisional Secretariats.

Table 3-4 Number of government and privet institutions within Jaffna MC

Type of Institution	Number	Type of Institution	Number
Institutes (Government)	20	Banks	13
Schools	46	Financial institutes	13
Higher education institutes	0	Specialized leasing companies	5
Teaching Hospitals	1	Preschools	34
Hospitals - Clinics	4	Buddhist temples	1
District Secretariat office	1	Hindu Kovils	60
Divisional secretary offices	2	Mosques	3
Banks	9	Churches	27
Main Post offices	3	Fishermen cooperative societies	10
Sub Post offices	8	Community based organizations (library societies)	5
Nursing training schools	1	Rural development societies	20
Maternity homes	8	Women rural development societies	40
Ayurvedic Dispensary	5	Women task force	14
M.O.H Office	1	Community centres	55
Public health service centres	28	Spot clubs	40
Rural hospital	1	Youth clubs	32
Government Departments	10	Multi purpose cooperative societies	24
Information technology parks	1	UN Agencies (Resource Profile, 2013)	9
National Apprentice & Industrial Training Authority	1	International NGOs (2013)	20

Type of Institution	Number	Type of Institution	Number
Authorities	7	Other foreign agencies (2013)	1
Institutes (Private)	3	NGOs	29
Schools	3		

A major portion of MSW is generated from commercial sector in the city. Following table shows the number of different commercial (business) establishments in JMC area.

Business type	#	Business type	#	Business type	#
Restaurants	79	Cattle Farm	3	Rest House	7
Glossary shops	350	Coir Based Product	43	Saloon	15
General wholesale shops	66	Communication	10	Service Station	2
Textile trading shops	177	Computer Shop	6	Tailoring	77
Electronic equipment sales shop	51	Construction Work	5	Textile Shop	5
Hardware shops	42	Cycle Repair Work	7	Tyres Work	1
Vehicle spare parts shops	56	Decorative Item	5	Video	2
Vehicle repair garages	52	Education Centre	2	Watch Work	3
Saw mills	15	Electrical Repairing	5	Welding Works	58
Vegetable sales shops	1	Fancy Shop	4	Ice plants	4
Fruit sales shops	13	Food Cafe	20	Fish net factories	2
Beauty salon	50	Food Processing	48	Small oil	2
Pharmacy	40	Garland	3	Micro gate grill	10
Medical Shops	3	Grinding Mill	11	Micro Flower Vass Plastic	1
Private Tuition Centres	2	Grocery Shop	1	Coir products	1
Computer Centres	2	Handicraft	25	Pot Shetty soil dish	1
Whole Sales	19	Hard Ware	4	Service repairing small	22
Fancy Shop	3	Jewellery	62	Service communication small	1
Small Industries	5	Lathe Work	1	Service saloon small	3
Food Shops	1	Laundry	7	Small service grinding	1
Jewellery Shops	3	Learners	4	Service	47
Electrical Shops	2	Leather Product	5	Wood based	34
Printers	3	Work Shop	2	Cloth based	21
Filling stations	6	Masonry	7	Light engineering	31
Hotels	86	Metal Carving	2	Palmayra products	5
Furniture	12	Mixture	5	Paper based	8
Saw mills	15	Motor Bike Repair	7	Chemicals	1
Aluminium Fabrication	3	Phone Shop	5	Cement based	2
Bakery	9	Picture Palace	1	Sculpture	1
Beauty Palace	6	Poultry Farm	15	Pottery	1
Carpentry	53	Printer	17		
Casting Industry	2	Radio, TV repairing	4		

4 Public Opinion Survey (POS)

This Public Opinion Survey (POS) was commissioned to identify a range of household waste management matters in relation to the household sector. Information on household waste management practices and information on householders' experiences with waste collection delivery services was collected for the purpose of improving our understanding of householder's experiences and attitudes and also to better understand prevailing situation in householder's point of view. The purpose of this survey research included;

a. To collect information on public attitudes to the waste management and environment in broader,
b. To value aspects of environmental health and protection,
c. To provide information on experiences with Local Authority's waste management service and,
d. To provide information on household waste management practices.

4.1 Public opinion survey methodology

The number of samples from Jaffna identified as 200 households, but size of the sample increased to 223 during the implementation to increase the accuracy. The selection of households and areas within Jaffna MC was done after a consultative discussion with Municipal commissioner, MSW section officers at JMC and JICA expert team members. Jaffna MC has 7 zones as SWM areas; Bazar, Kurunagar, Nallur, Ariyalei, Nawanthurai, Pasaiyoor and Vannar Pannai. Samples were selected from each zone representing approximately equal numbers.

The survey was executed by a team of university students who were trained about the questionnaire, survey methodology and the data entering before dispatched to their respective fields. A senior expertise took the leadership and continuously supervised the field survey. The selected households were first educated about the survey, its main objectives and asked their cooperation before starting the field survey. In addition business and institutes, large waste generators, hospitals recycling shops and large public markets were also surveyed using appropriate questionnaires prepared in consultation with JICA experts.

Table 4-1 Category and number of samples for Public Opinion Survey

Category	Survey area	Number of samples
High-income households	Pasaiyoor, Ariyalai, Navanthurai, Kurunagar, Nallur	39
Middle-income Households	Vannar Pannai, Pasaiyoor, Nallur, Ariyalai, Kurunagar	66
Low-income Households	Vannar Pannai, Pasaiyoor, Nallur, Ariyalai, Kurunagar	61
Businesses /Service organization	Point Pedro Rd, Kurunagar, Beach Rd, St Anthony Rd, A.P. Road, Kandy Rd, NavalarRd	44
Large waste generators		8
Markets		2
Recycling shops		2

Category	Survey area	Number of samples
NGO		1
Total		**223**

The questionnaires were available in all languages (English/Sinhala/Tamil); however the questionnaire form was filled by the interviewer based on interviewees' response. The collected information was recorded in digital form using Microsoft Excel and reviewed for accuracy. The data was analyzed in detail for different objectives that generate an overview of the survey.

4.2 Results of Public Opinion Survey

- ✓ 99% of the surveyed households are Tamil with only 1% Muslims. Data on the average number of people per household and monthly income is set out in below Table 4-2.

Table 4-2 Average and standard deviation values of income and family size

Category	Family size	Income (Rs/month)
High	4.9 ± 1.3	39,744 ± 24,005
Middle	5.0 ± 2.2	18,447 ± 6,742
Low	4.6 ± 2.3	7,782 ± 5,061
	No of workers	**Income (Rs/month)**
Business	3.3 ± 4.5	53,780 ± 121,643

- ✓ In Jaffna MC, 88 % of surveyed households are provided with a garbage collection service, of whom 82% stated they use this service. Only 26 % of surveyed households are "very satisfied" with present SWM service provision, while 45 % are "somewhat satisfied".

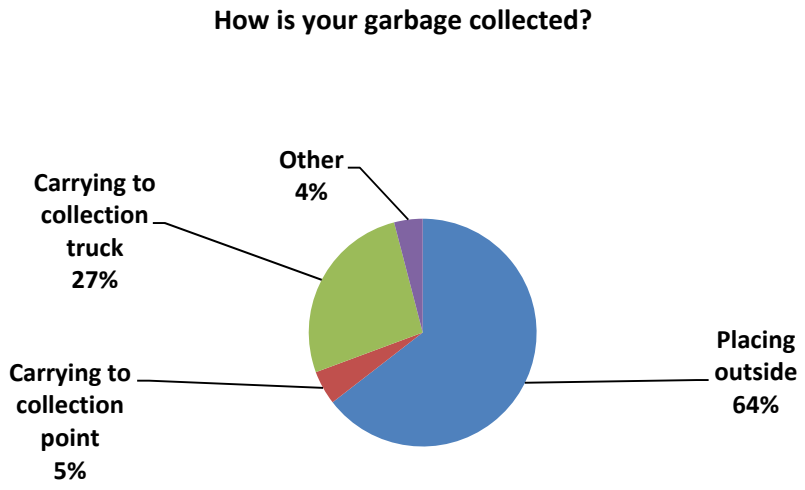


Figure 4-1 Method of garbage discharge by residence in JMC area

- ✓ Households' main methods of waste discharge are shown in Figure 4-1. The most common methods are discharging it outside their premises for house to house collection (51 %) and carrying garbage to collection truck (21%).
- ✓ Only 38% of surveyed households receive a daily garbage collection service while 13 % stated that they received the service less frequent than once/week. However, 73% discharge their garbage as soon as it is generated and 22 % discharge their garbage daily, the gap between discharge and collection being slightly greater for the low income group. The discrepancy between these figures explains the large amount of discarded garbage present on many streets around Jaffna.
- ✓ In general, adult females handle waste in about 76 % of surveyed households.
- ✓ As shown in Figure 4-2, 30 % of surveyed households are not willing to cooperate with source separation for recycling. Ando also, only 59 % of surveyed households stated that there are recyclable collectors or someone who comes to collect their reusable or recyclable materials. Hence, an informal source separation recycling system is not well established in Jaffna MC area.

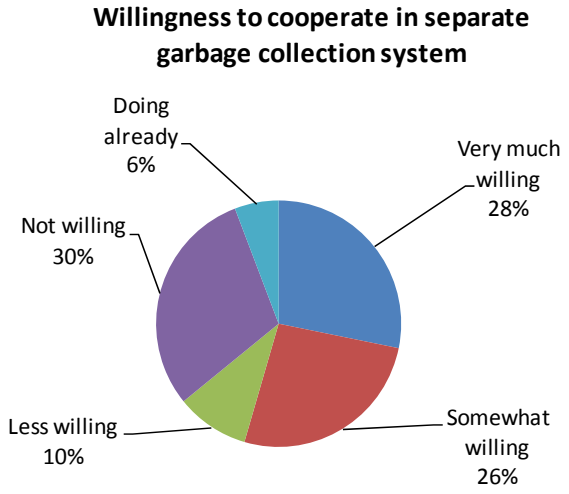


Figure 4-2 Willingness of residence for a source separated garbage collection system in Jaffna MC

- ✓ Only 8 % of surveyed households use kitchen/garden waste for composting and used the finished compost for their own garden.
- ✓ Not many surveyed households (64 %) have ever discussed proper garbage discharge methods at the community level.
- ✓ 57 % households stated that SWM awareness programmes are very necessary while 39 % stated "somewhat necessary".
- ✓ The average WTP (willingness to pay) for improved SWM services is 207 ± 263 Rs/month per household. However 19 % of household do not like to pay for SWM service.
- ✓ Out of all surveyed households, 13 % stated that they sale/give-off metal for recycling and 12 % of residence sale/give-off tins & cans for recycling. The glass and bottle recycling is only practiced by 8 % of households while the plastic recycling is 12 %. Percentage of household who involved in paper recycling (sale or given-off) was low (3 %).

5 Final disposal site survey (FDS)

5.1 Introduction the FDS at Jaffna MC's dumpsite

5.1.1 Survey Method

The data and information in this report were collected from various sources including published reports, verified data from Jaffna Municipal Council, and direct interview with responsible authorities at disposal site.

5.1.2 Target of Survey

The survey is focus on obtaining general information on waste receiving, handling, disposal, facility management, environmental monitoring and legal adherences.

5.1.3 Data Sampling

The numerical data was collected as specified in following **Table 5-1**.

Table 5-1 Data collected during the final disposal site survey

	Survey Items	Method
1	Current condition of final disposal site and its surroundings	
	✓ Disposal method and structure	Records, visual observation
	✓ Soil-covering	Records, visual observation
	✓ Land owner	Records
	✓ Residual area	Records, visual observation
	✓ Leachate water	Records, visual observation
	✓ Waste picker	Records, visual observation, interview
	✓ Scattering waste, smoke, fire, offensive odour, animals and so on	Records, visual observation
2	Operation and Management of final disposal site	
	✓ Environmental Protect License and Environmental Clearance	Record
	✓ Personnel	Records, interview
	✓ Operation vehicles, their maintenances and drivers	Records, interview
	✓ Weighbridge	Records, interview
	✓ Waste collection data	Records, interview
	✓ Supervisory method	Records, interview
3	Waste amount to final disposal site (24 hours, 7 days)	Records, Survey
4	Adverse impact near by residences	Records, Survey
5	Implementation status of geological, topographic and EIA survey for new final disposal site	Records, interview
6	Progress situation for new final disposal site	Records, interview
7	Court case	Records, interview

5.2 Current condition of final disposal site and its surroundings

5.2.1 Final Disposal Site of Jaffna MC

The final disposal site is situated in Kalundai village, at about 6.5 km away from the city center of Jaffna on the left of Jaffna-Karainagar (# AB21) main road. The final disposal site is an abundant saltern situated in Navali South Grama Niladhari division in Sandilipai Divisional Secretariat area, which is also politically administrated by Manippai Pradeshiya Sabha in Jaffna District of the Northern Province of Sri Lanka.

Figure 5-1 Location of Jaffna MC's MSW dumpsite in Jaffna peninsula

5.2.2 History and evolution of the dumpsite

The dumpsite was first started in year 2002. The site was an adjacent land of an abundant saltern. From the beginning, the site was commonly shared by Jaffna Municipal Council and Sandilipai PS. The historical evolution of the dumpsite is illustrated in Figure 5-2.

The west side of the dump extend up to the Jaffna lagoon, approximately 600 m away from the present dumping area. The north of the dumpsite extend up to an flood water regulation channel that originate from an anicut built to regulate flood waters on the right side of the road coming through the paddy fields.

As shown in the Figure 5-3, the nearest residential area is on the opposite site of the main road which is 700 m away from the dumpsite.

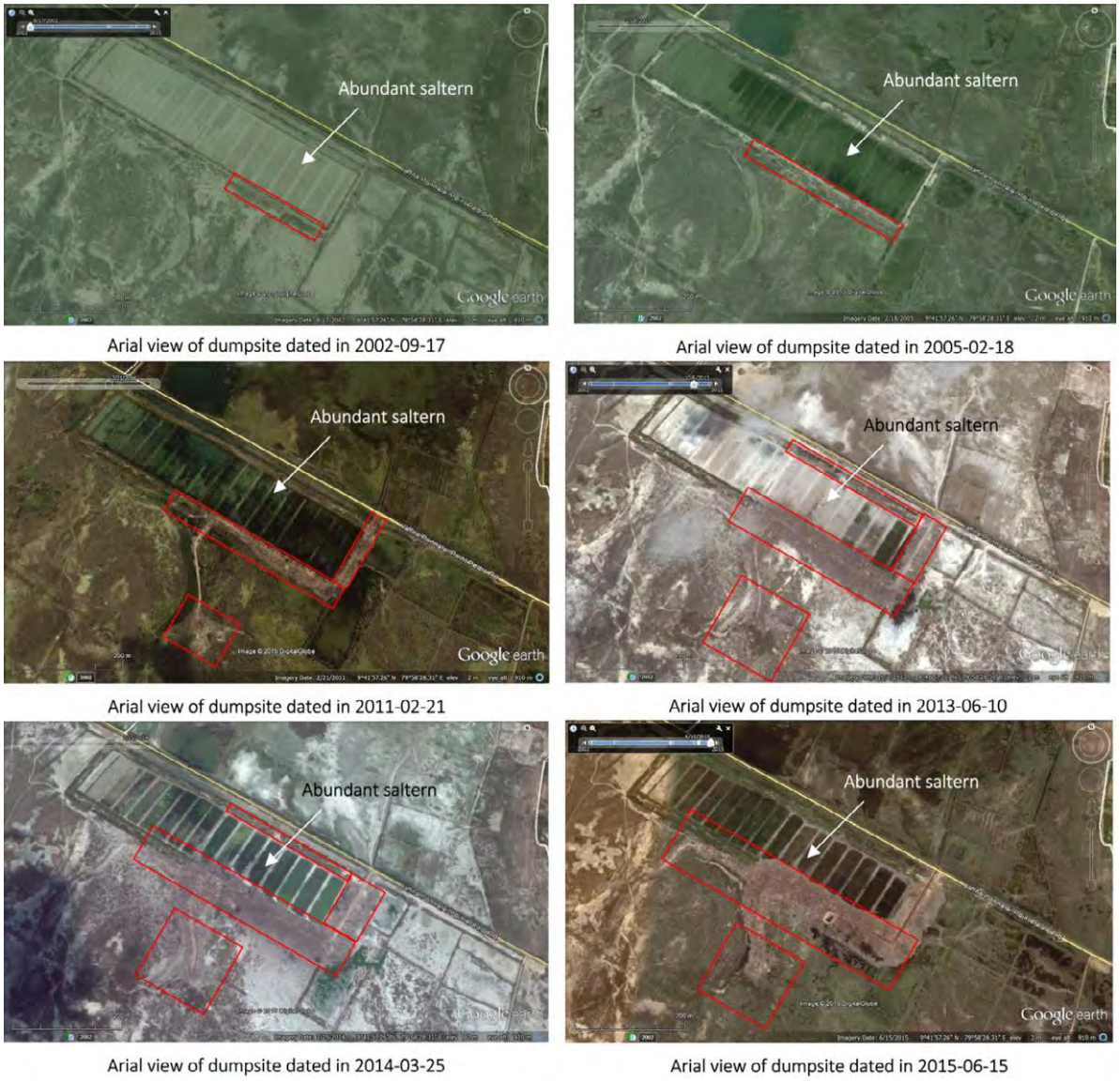


Figure 5-2 Historical evolution of Jaffna MSW dumpsite from year 2002

Figure 5-3 Environment around the Jaffna MC's dumpsite

5.2.3 Extend and landform

At present, a 10 hectare land has been allocated for the dumpsite by Jaffna DS which has been planned to expand up to 20.8 hectares during the future development.

The area is covered with shrubs and grasses with very few small trees on the vicinity. The landform is a flat terrain except the areas where the saltern was built. However, there is plenty of small waster logging depressions on the land that eventually filled with water during the rainy season.

The surroundings of site are with lands leading to the lagoon on the South-West, West and the North-West sides. Other areas are abandoned lands and paddy fields leading more than 1.5 km away from the site. There is a gradual slope towards the lagoon. The opposite boundary is Kallundai canal which flows parallel to the main road. The closet proximity to a residence is approximately 500 m on the East side where only four families are living.

Figure 5-4 A Google image showing the elevation profile from road to the lagoon across the Jaffna MC's dumpsite

5.2.4 Waste receiving and disposal

The existing dumpsite is commonly shared by three Local Authorities in Jaffna District. They are; Jaffna Municipal Council, Valikammum-South Pradeshiya Sabha and Nallur Pradeshiya Sabha.

The available records show that Jaffna MC delivers approximately 50 to 70 four-wheel tractors loads of MSW while the compactor trucks delivers 1 to 3 loads of waste per day. In addition, 4 to 7 loads/day of sewage (toilet waste) collected within Jaffna MC area is also dumped at the site.

Nallur PS delivers approximately 1 to 3 four-wheel tractors loads of MSW to the site. The waste is primarily collected from North sub-urban areas of Jaffna city and Kondavil area in Nallur PS.

Valikammum-South PS delivers approximately 1 to 2 four-wheel tractors loads of MSW to the site. The waste is primarily collected within Chunnakam township of Valikammum-South PS area.

Figure 5-5 Notable features around the Jaffna MC's MSW dumpsite

5.3 Site infrastructure facilities

There is a Barrier Gate (3.5 m wide) just passing the culvert across the Kallundai canal. The 6 m wide entrance road has been repaired in early 2015 with tarmac and sides of the road have been filled

with gravel soil on the old waste. The tarmac extends up to the entrance of the dumpsite which is about 150 m from the entrance gate.

There is a temporally site office adjacent to the gate. The office has a domestic water supply from NWS&DB but not electricity.

There is no permanent or temporally fence around the site.

Toilet waste collected from gully bowser trucks are been emptied to a shallow pit inside the dump. The available records shows average number of gully bowser loads emptied at the site is 4 $\pm$ 1/ day which is equal to 16 m^3 of toilet waste per day.

Figure 5-6 (a) Toilet waste disposal pit and (b) toilet waste collection bowser at Jaffna MC'c MSW dumpsite

5.3.1 Current condition of final disposal site and its surroundings

1	Current condition of final disposal site and its surroundings	
1.1	Disposal method and structure	✓ Incoming waste loads (tractors, compactors and gully bowsers) are recorded at the entrance gate. Each vehicle has been issued a sticker to be pasted by gate keeper on the record book at the entrance ✓ Selected vehicles which contain garden wastes are unloaded on a separate floor area. The collected garden wastes are to be used for composting. ✓ All other MSW collection vehicles emptied its waste at the dumpsite. No specific control measures apply for selection of dumping area. Thus, **Open Dumping** is practiced. ✓ All other wastes are dumped on the ground and spread manually using labor ✓ No machineries are employed at the site. However, site supervisor explained that the Jaffna MC employs bulldozer when there is a requirement for leveling the waste. A privately own bulldozer is rented out for 3-4 days at 6 months interval for the purpose. ✓ Sewage is discharged to a shallow pit excavated on the dump
1.2	Soil-covering	✓ Covering of waste by soil is not practiced
1.3	Land owner	✓ Jaffna Divisional Secretariat possesses the ownership of the land and surrounding area. The area is under the administration area of Manippai Pradeshiya Sabha ✓ However, Jaffna MC has submitted the request to Jaffna Divisional Secretariat to transfer the ownership of the land to Jaffna MC. The application is under review at Provincial Land Commissioner and the Department of Land for transfer of ownership.
1.4	Residual area	✓ Approximately 5.5 ha area has already been covered with waste out the total land area (20.8 hectares).
1.5	Leachate water	✓ No leachate collection and treatment system ✓ Leachate and surface water flow towards the lagoon situated 800 m away from the canter of the dump site ✓ The abundant saltern which is approximately 600 m long, 150 m wide and 2 m deep has been filled with leachate contaminated water to a height of around 0.5 m. ✓ Many small leachate ponds and pits (1-5 m^2) are scattered on the dump site ✓ Sewage is discharged to pits excavated on the dump. The pit often overflows and connected to flowing water down to the lagoon.

1	**<u>Current condition of final disposal site and its surroundings</u>**	
1.6	Waste picker	✓ At present, 10-12 people including 2 women pick materials for selling and their own use ✓ Out of all waste pickers, 6 people used to come and pick firewood for their own household use ✓ Some of pickers are coming from nearby villages, 3-4 km away from the site ✓ Plastic, Metal, Cardboard, Wires, Empty beer cans, Empty Arrack bottles are collected and sold every day to the buyers in Ariyalai (Dyna plastics) and Otamadu Junction ✓ Waste pickers are not visiting the site on heavy rainy days. Some of the waste pickers use safety boots and gloves during the rainy days ✓ The average earning of waste pickers is Rs. 500 - 2000 per day ✓ Waste pickers don't take food/kitchen waste away from the site as animal feed ✓ *See pictures of waste pickers in the Annex i*
1.7	Scattering waste, smoke, fire, offensive odor, animals	✓ Waste is dumped everywhere on the dumping site ✓ Polythene, papers and other soft materials have blown all over the area by the wind. Polythene and soft plastic bags have blown more than 500 m away from the site and deposited on paddy fields, cannels and the lagoon. ✓ Also, some plastic waste have moved with rain waters the lagoon, cannel and the paddy fields ✓ No fire and smoke witness at the dumpsite during the observation (19-26 October, 2015) ✓ Site labors and waste pickers mentioned that there is an offensive odor comes out from waste during the rainy season. ✓ The fly breeding is also accelerated during dry season, but the severity reduces due to heavy winds ✓ There are more than 75 stray dogs reside in the dump site ✓ Approximately 20 numbers of cattle belongs to nearby farmers are used to graze on vegetables and food waste on the site

5.3.2 Operation and Management of final disposal site

2	Operation and Management of final disposal site	
2.1	Environmental Protect License and Environmental Clearance	✓ None
2.2	Personnel	✓ 1-Supervisor –Morning (Permanent position) ✓ 1-Supervisor –Evening (Permanent position) ✓ 2-Labors-works during daytime (Permanent position) ✓ 1-Security guard (Permanent position) ✓ 8-Labors employ for special activities (to pick scattered polythene & plastics around the site, spread heaped waste in the dump etc. (Temporary/contract basis)
2.3	Operation vehicles, their maintenances and drivers	✓ None ✓ (A Bulldozer is hired every 6 months for 3-4 days)
2.4	Weighbridge	✓ None
2.5	Waste collection data	✓ A record book is available
2.6	Supervisory method	✓ MOH (attached to the ministry of health-North province)- 1 nos ✓ Public Health Inspector(PHI)- 1 nos ✓ Officer- in-charge (Waste Management)- 1 nos (Mr. Ashovan) ✓ Those three officers are regularly inspecting the site and instruct the site supervisor for necessary actions. Officer-in-charge is responsible for coordinating with municipal officers for solving daily management issues as well as other contingency matters.
3.0	Waste amount to final disposal site (24 hours, 7 days)	✓ A summary is shown in Annex ii
4.0	Adverse impact nearby residences	✓ Scattering of materials by wind is a problem for nearby farmers and fishermen.

2	**Operation and Management of final disposal site**	
5.0	Implementation status of geological, topographic and EIA survey for new final disposal site	✓ None
6.0	Progress situation for new final disposal site	✓ None
7.0	Court case	✓ Residence around the dumpsite has taken legal action against the Jaffna MC at District Court, and the legal order has been issued to Jaffna MC to rectify the issues on or before. ✓ Further, Jaffna MC has been ordered to find a solution to control wastewater/leachate by January 2016. ✓ The next hearing of the court will be on 11th January 2015. ✓ No official records are available up to date since the court case is still going on.

ANNEXTURE I:

Figure 5-7 A waste picker at the Jaffna MC's dumpsite (dated on 20-10-2015)

Figure 5-8 Municipal labors manually spreading the unloaded waste at Jaffna MC's dumpsite

ANNEX ii: Waste collection amounts

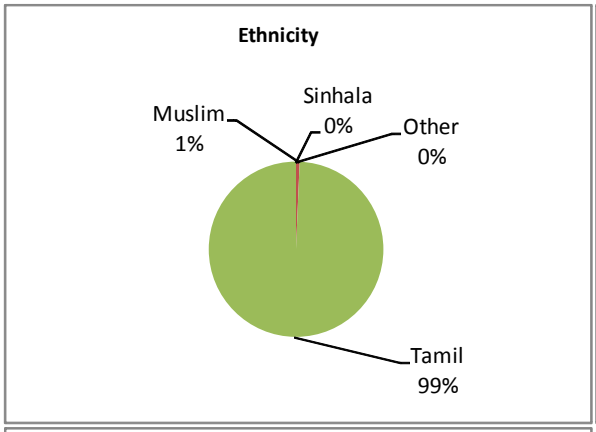
Table 5-2 Estimated waste disposal amount at Jaffna MC's dumpsite

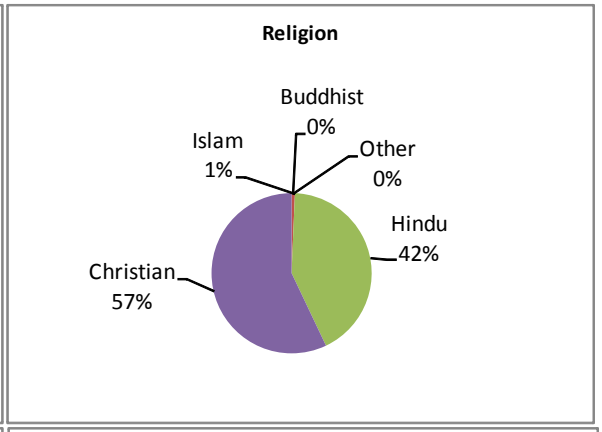
	Jaffna MC	Valikammum-South PS	Nallur PS
Year 2015	**Estimated waste disposal amount (Tonnes/month)**		
April	2, 115	57	210
May	2, 342	95	219
June	2, 925	95	241
July	3, 945	88	249
August	3, 628	95	236
September	3, 438	90	225
October (16-22) 7 days	769	20	15

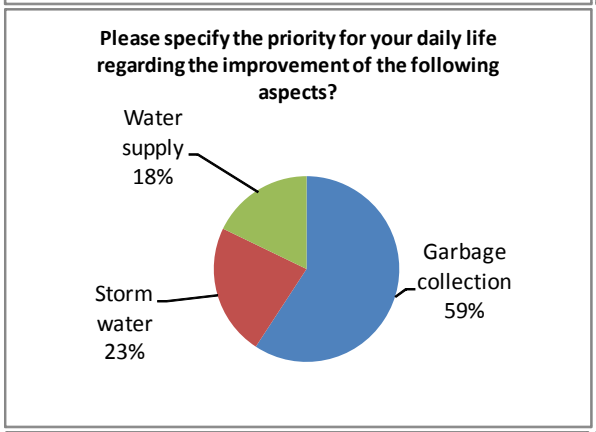
Annex

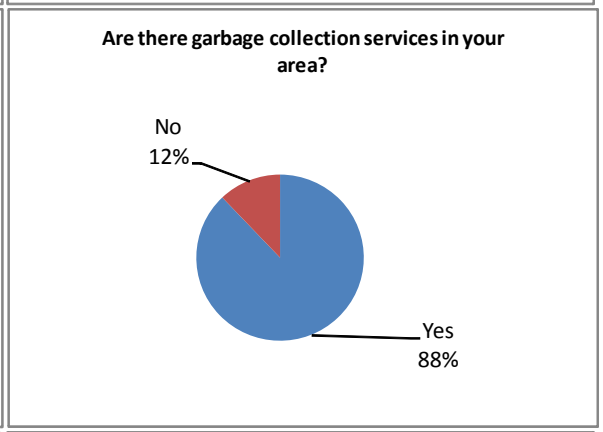
JAFFNA MUNICIPAL COUNCIL

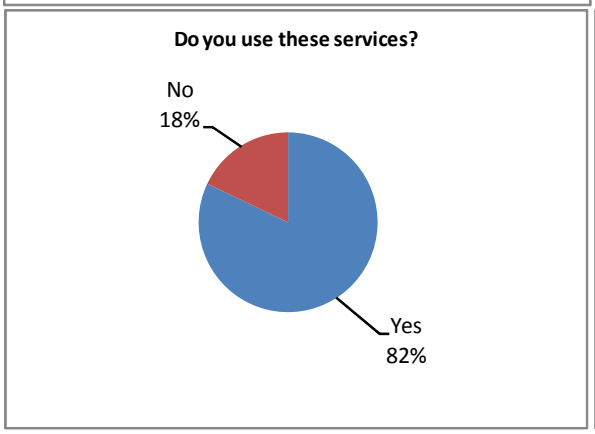
Response to Public Opinion Survey for Household

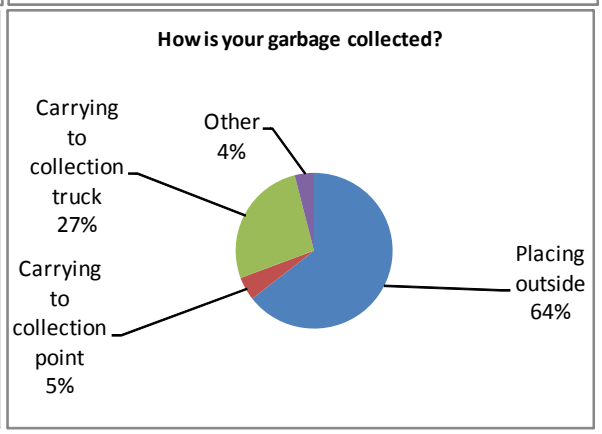












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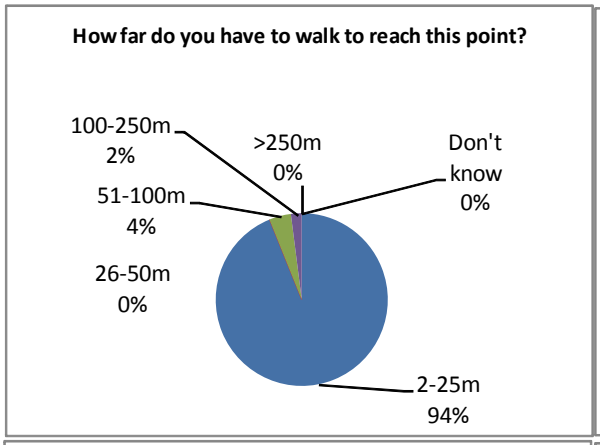

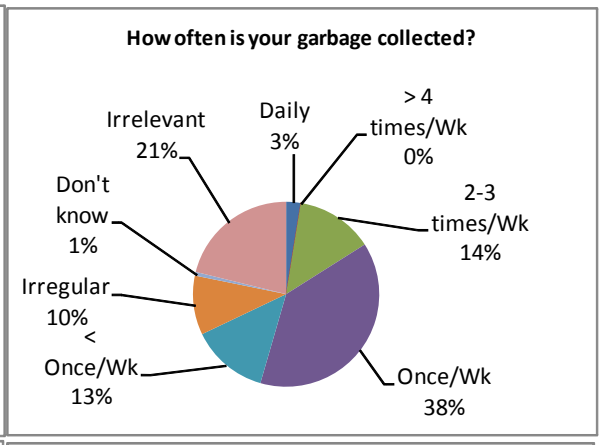

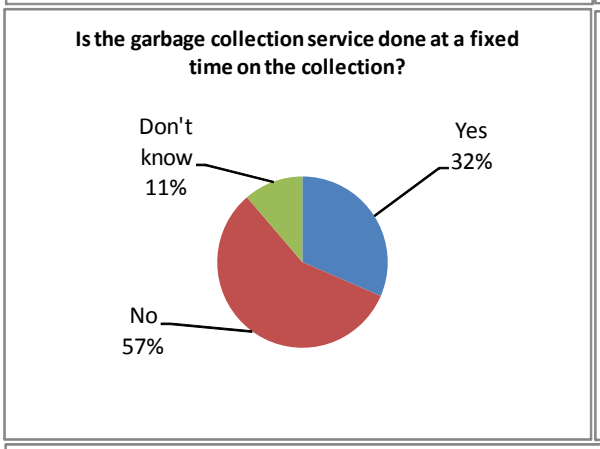

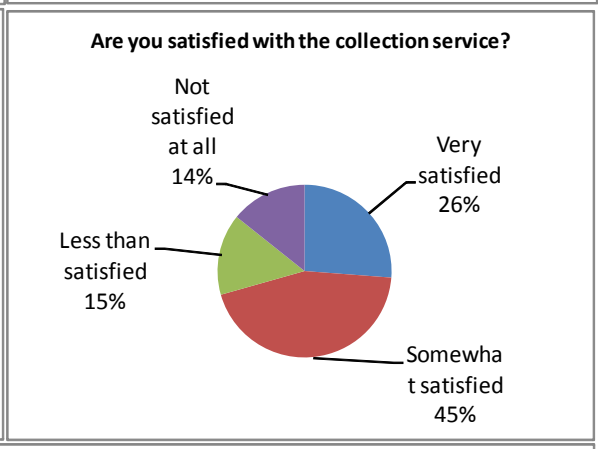

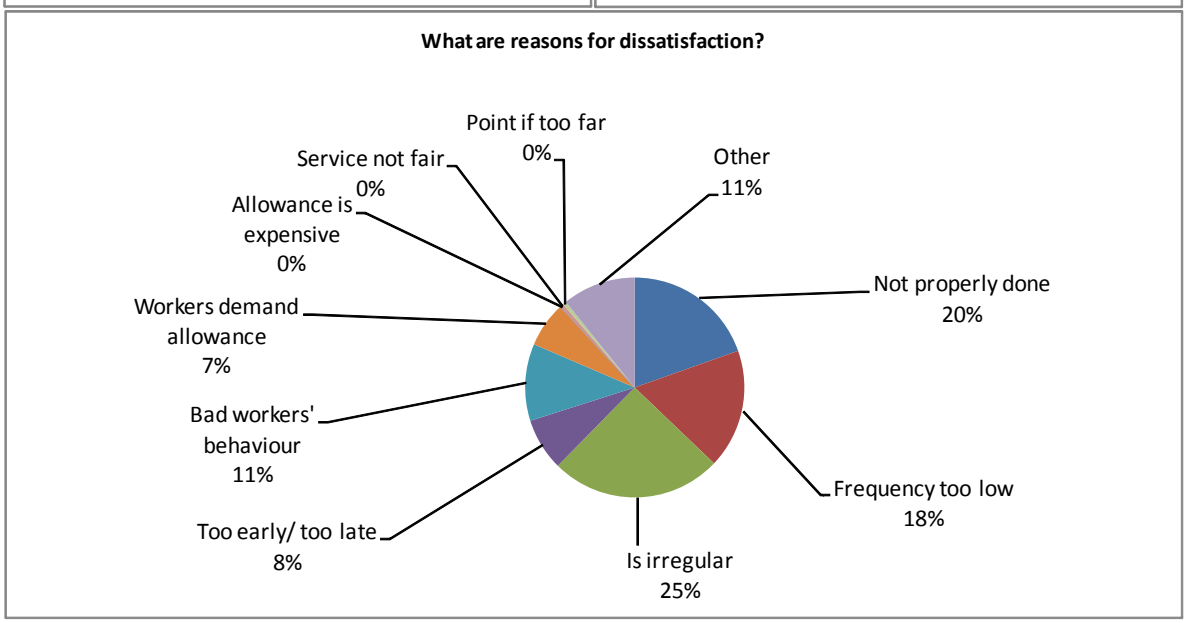

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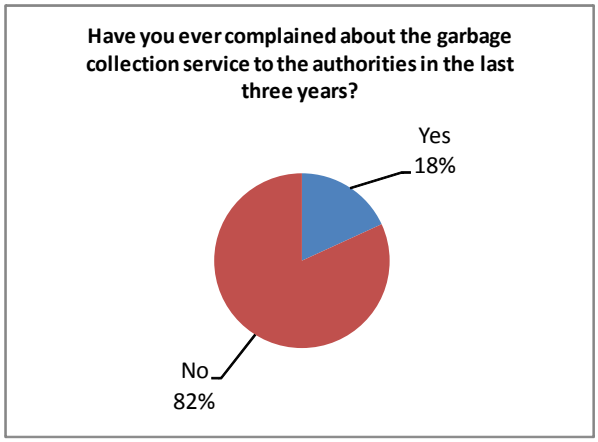

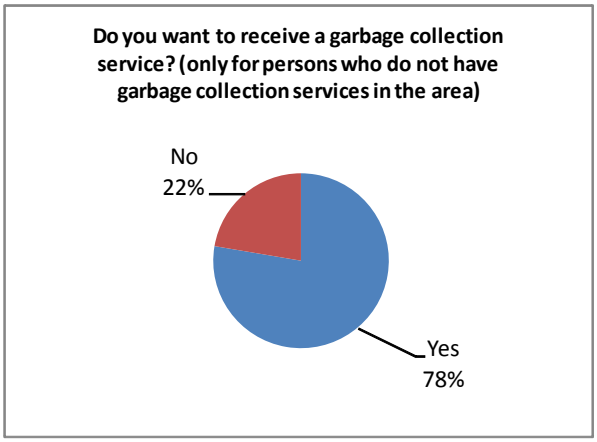

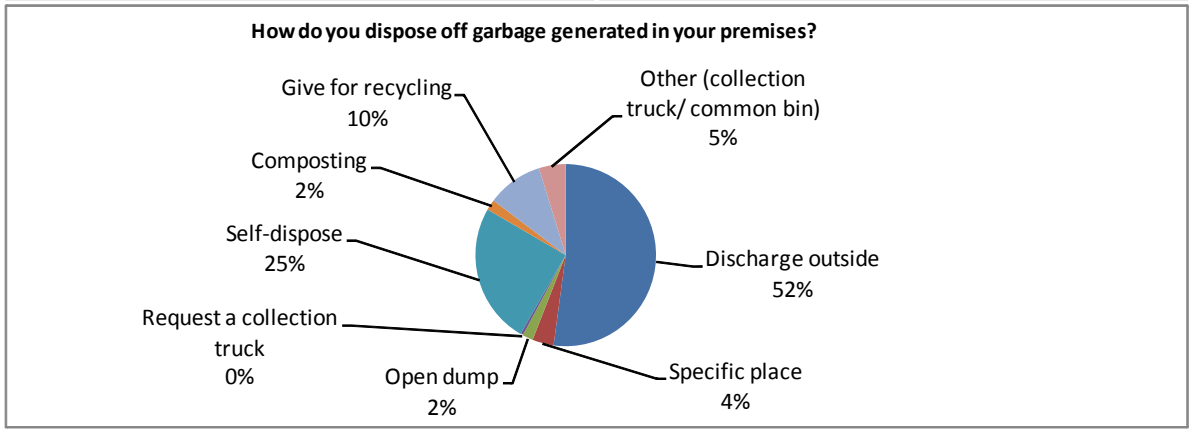

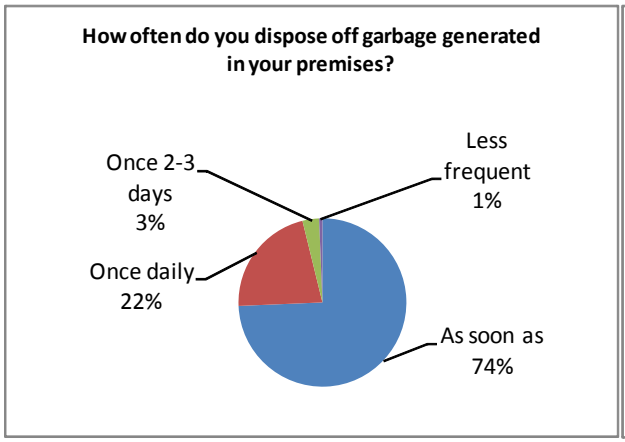

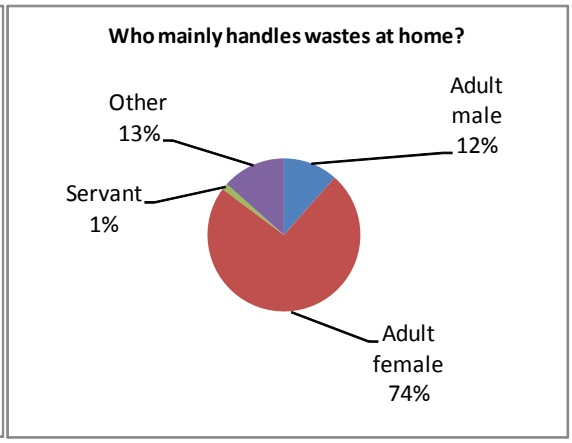

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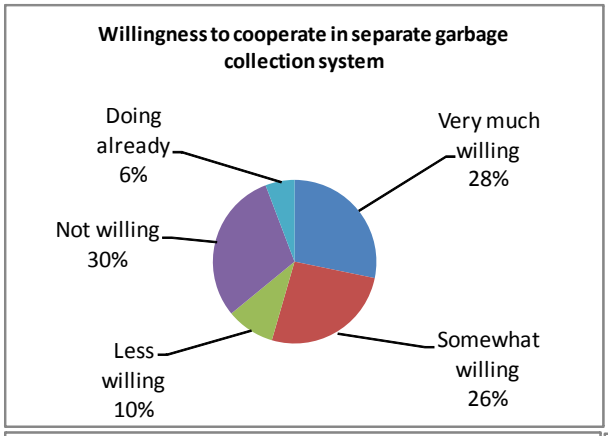

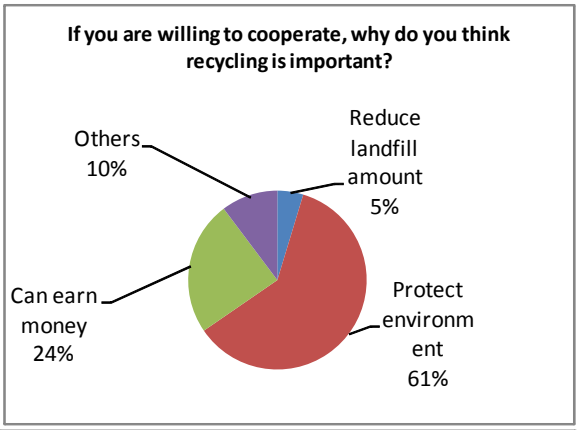

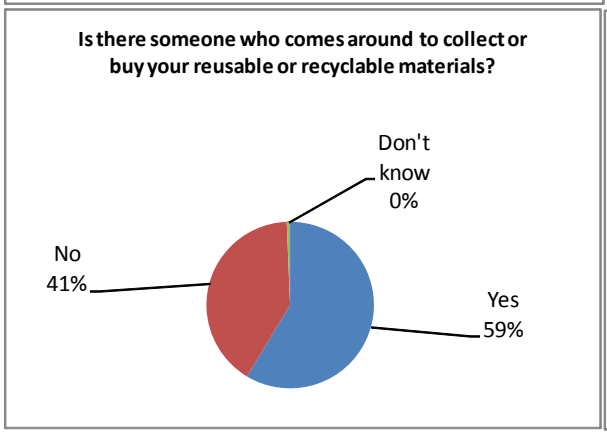

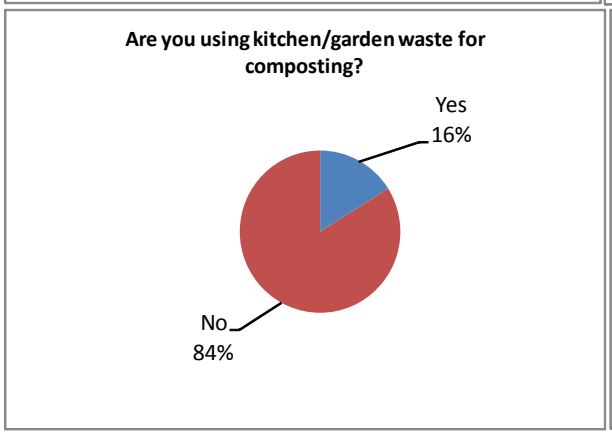

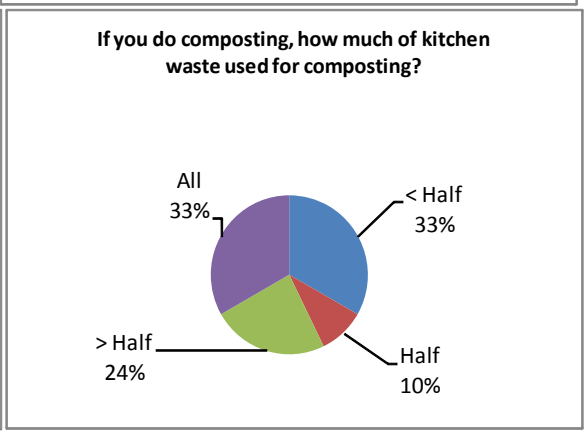

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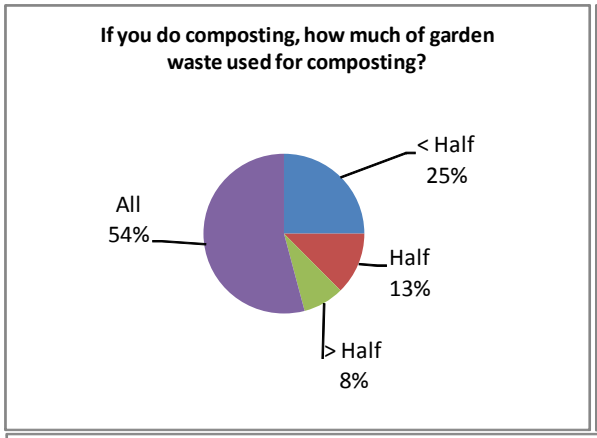

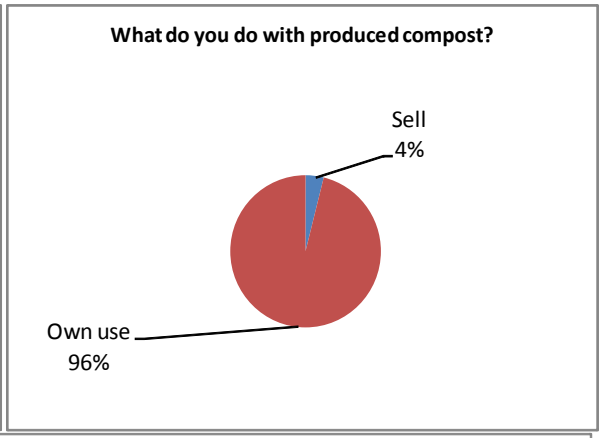

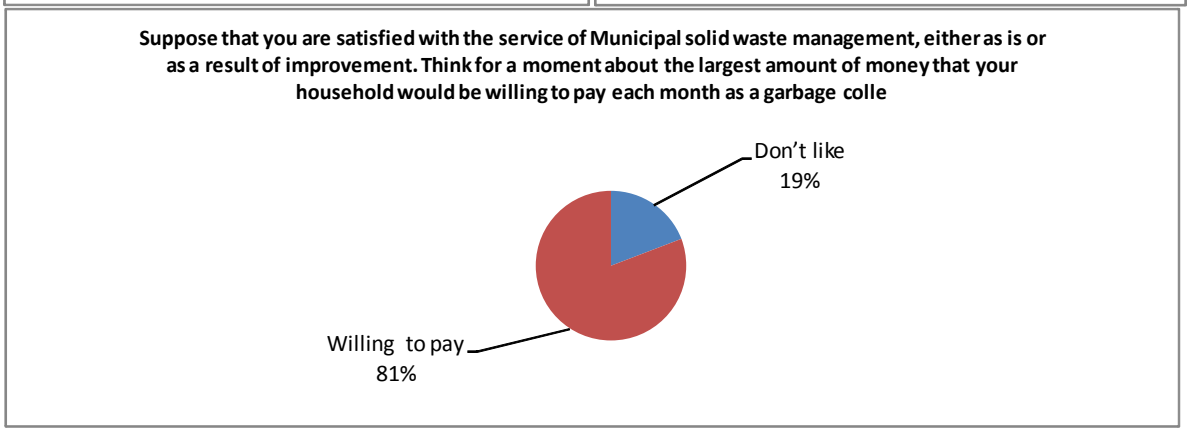

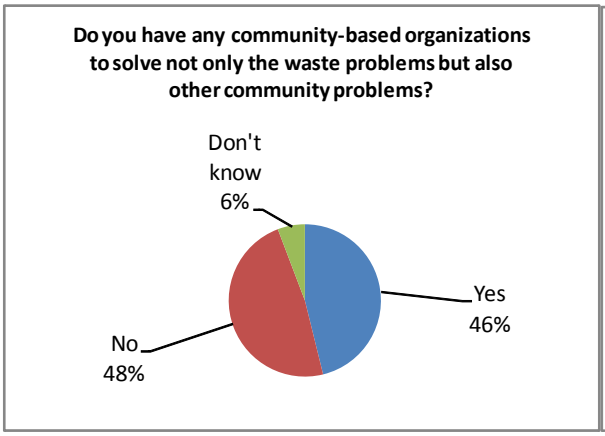

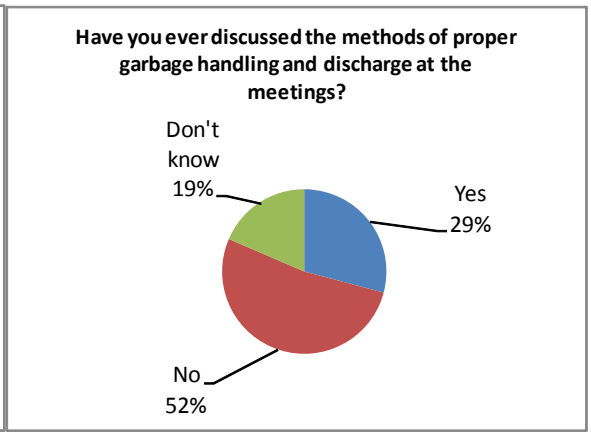

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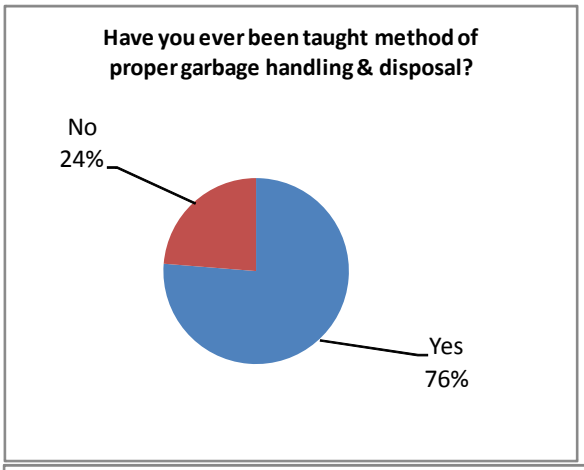

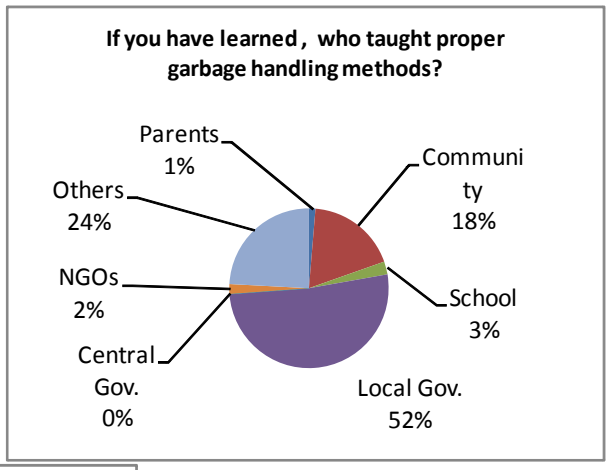

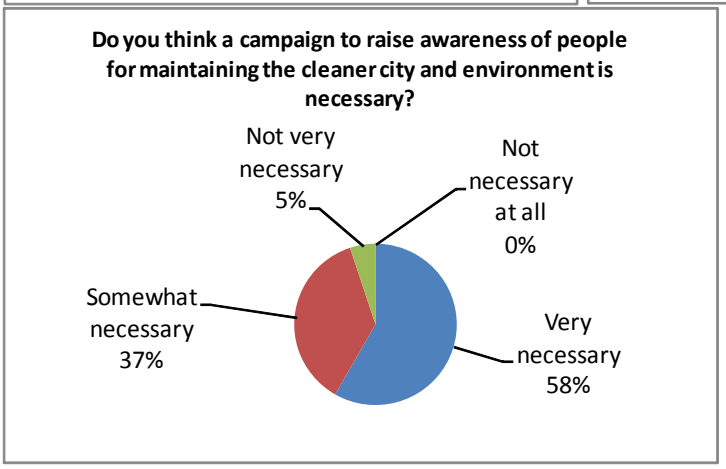

1.4 Trincomalee UC

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1 Introduction

The purpose of this survey is to obtain the current data regarding Solid Waste Management (SWM) at Trincomalee Urban Council (TUC). The data collection survey was conducted from 26th October to 30th October, 2015 by a team of expert dispatched by Waste To Energy Technologies Limited.

This report consists of brief summaries of survey methods and results. The additional primary data and records are available as soft copies. The preliminary data collection was conducted through four comprehensive surveys which are;

i. **Waste Generation Survey (WGS)** is to gather information on waste generation sources at TUC based on secondary data available at TUC and other relevant organizations.
ii. **Public Opinion Survey (POS)** is to gather information on public opinion on current waste management in TUC. The POS was conducted through a questionnaire survey that covers different types of waste generators in the TUC area.
iii. **Final Disposal Site Survey (FDSS)** is to collection data on final MSW disposal site of TUC based on secondary data as well as field recordings & visits to the site.

1.1 Background conditions of Trincomalee Urban Council

Trincomalee was administered by a Local Board between 1884 and 1933. Then between 1933 and 1939, the city administered by a Local Development Board. Thereafter city was promoted to an Urban Council on 1st January 1940. However, Trincomalee is one of the largest cities in Sri Lanka without municipality status although UC was established 75 years ago.

The Trincomalee Town lies in the Eastern part of the Trincomalee District. It is the District Head Quarters for Trincomalee District. The area of the Town is about 7.5 km^2 and the town is mainly surrounded by sea and bay except from North and North-west. The Urban Council is part of the Trincomalee Town & Gravets DS division.

In general the topography is almost flat; the highest elevation is the Koneshwaram Temple area which is one of the famous tourist attractions in Trincomalee city.

Trincomalee district has typical tropical climate with two rainy seasons occur; major during the North East monsoons (October to January) and the minor rainy season occurs during the South West monsoon (April and May). The period between the South West Monsoon and the North East Monsoon is the dry season extending from June to September. The average rainfall is 1569 mm with mean annual air temperature of 28.5 °C.

There are 18 GN divisions in the city with 14, 538 families (Figure 1-1). The total residential population in the TUC is 53, 550. Majority of residence are Tamil and Muslims comes at second. The Sinhalese group restricted to 3 villages on around the Kandy-Trincomalee main road.

The city has been divided into 12 wards; however the health administration has defined its own warding system restricting the number of wards to 9 wards.

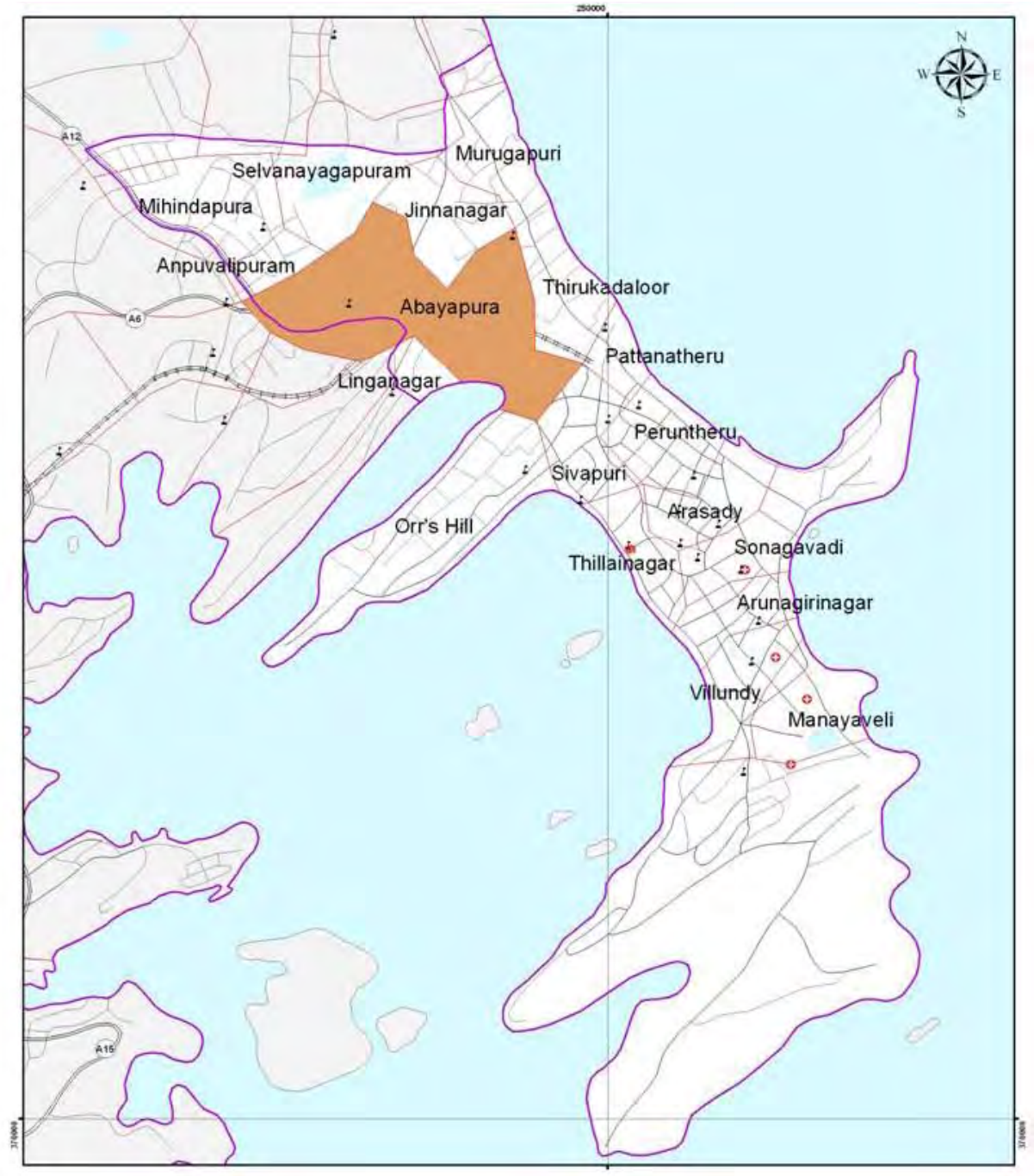


Figure 1-1 City map of Trincomalee Urban Council

2 Waste Generation Survey (WGS)

In order to obtain general information on waste generation amounts, the data available at waste management section of the Health Department, Works Department and Revenue Department of TUC was used. Some of the data was available in the form of formal records and reports which were treated as the most precise secondary data while the data collected from official interviews with TUC officers was treated as verification data. Thus, the survey data was collected through different methods;

a) Recording and compiling of published and verified data by TUC,
b) Reading and recording of unpublished & non-confidential data available at TUC,
c) Recording and official statistics available at Divisional Secretariat offices, and
d) Official person-to-person interview with relevant officers at TUC for verification of data.

The numerical data was collected as specified in following Table 2-1.

Table 2-1 Type of data collected for WGS in Trincomalee UC

Source	Description
Household	Each number of following category households was surveyed; 1) High income level, 2) Middle income level and 3) Low income level.
Commercial	Each number of following category restaurants was surveyed; 1) Large size restaurants, 2) Middle size restaurants and 3) Small size restaurants. Each number of following category shops was surveyed; 1)Organic shops (large) 2)Organic shops (middle) 3)Organic shops (small) 4)Non-Organic shops (large) 5)Non-Organic shops (middle) 6)Non-Organic shops (small)
Hotels	Each number of following category hotels was surveyed; 1) Large size hotels 2) Middle size hotels and 3) Small size hotels.
Markets	Number of stalls and types
Institutions	Each number of following institute was surveyed; 1) Schools 2) Hospitals (government) 3) Hospitals (private) 4) Public office 5) Bank/private office 6) Buddhist temples 7) Hindu temples 8) Mosques 9) Churches 10) Navy/Police/ Army bases 11) Others
Industries	Wastes from any industries.

Source	Description
Other	Public parks and other public facilities
Construction and demolition	Wastes originating from construction, rehabilitation and demolition activities, etc.
Hazardous (Special)	Management and collection of hazardous wastes originating from various sources, including household items

2.1 Waste Generation Survey Results

The records indicate that the total residential population within TUC is 53, 550 (Source: Divisional Secretariat, Trincomalee. 2015). The Trincomalee UC area consists of 18 Grama Niladari (GN) divisions as shown in below Table 2-2.

Table 2-2 Household population (GN level) within Trincomalee UC area

GN division	Population
Abayapura	4124
Anpuvalipuram	4266
Arasadi	2022
Arunagirinagar	1705
Jinnanagar	2936
Linganagar	3359
Manayaveli	3630
Mihindupura	1369
Murugapuri	3343
Orr's Hill	4778
Pattanatheru	1160
Peruntheru	2549
Selvanayahapuram	2628
Sivapuri	4060
Sonagavadi	2629
Thillainagar	2210
Thirukadaloor	3554
Villundy	3228
Total	**53550**

As shown in following, Trincomalee UC own and control a larger number of public properties and institutes.

Table 2-3 Type and number of municipal establishment own by Trincomalee UC

Public property	No. of units
Town Hall	1

Public property	No. of units
Libraries	1
Reading centres	3
Children's parks	3
Play grounds	4
Market complexes	2
Cemetery	3
Bus stand complexes	2
Office/ sub-office	42
Slaughter house	1
Fish markets	2
Meat stall/ markets	17 stall/ 1 market
Public toilets	61
Community centres	19
Gymnasiums	1
Staff Quarters	45
Public wells	30
Three wheeler parks	50
pavillion	2
Quarters- staff	33
Quarters - labour lines	49
Stadium	2

Trincomalee city host most of the government and privet sector institutes in the Trincomalee District. Following table shows the number of government and privet/non-government establishments within Trincomalee UC.

Table 2-4 Number of government and privet institutions within Trincomalee UC

Institute	No. of units
Schools	75
Other education institutes	61
General Hospital	1
Hospitals - Clinics	1
Medical clinics	43
District Secretariat office	1
Divisional secretary offices	1
Banks	12
Post office	6
Other Government offices	14
Police stations	1
Military (Army/ Navy/ Air-force)	1
International NGO	10

Institute	No. of units
Local NGO	12
Cultural & Religious school	51
Sports clubs	32
Community based organizations	47
Buddhist temples	3
Hindu Kovils	52
Mosques	9
Churches	20

A major portion of MSW is generated from commercial sector in the city. Following Table 2-5 shows the number of different commercial (business) establishments in TUC area.

Table 2-5 Number of business establishments in TUC area

Business establishments	No of units	Business establishments	No of units
Large hotels	6	Iron welding	35
Large size restaurants	49	Plastic shop	20
Middle size restaurants and	52	Mobile phone shop	30
Small size restaurants.	60	Fried fish shop	5
Vegetable(middle)	45	Sweet shop	35
Fruit shops (middle)	20	Shoe palaces	30
Glossary shops	15	Roof tiles sales	15
General wholesale shops (large)	110	Coconut business	6
General wholesale shops (small)	205	Egg business	10
Textile trading shops (large)	140	Temple festival goods	12
Hardware shops	25	Printers	10
Vehicle spare parts shops	22	Gas cylinder sales	20
Timber/furniture shops	25	Tyre tube sales	8
Vegetable sales shops	116	Milk powder sales	10
Fish sales stalls	47	Old iron sale shop	13
Meat sales stalls	17	Cement shop	13
Barber shops	25	Recording place	17
Beauty salon	12	Net café- E-mail	25
Pharmacy	22	coffin box sale	2
Transport providers	8	Saw mills	1
Contractors	28	Stone quarry	1
Foreign visa	8	Dairy production	1
Pawning centres	27	Processing fish	1
Computer literacy	6	Gingerly coconut oil	1
Driving learners	2	Bakery products	1
Foreign money exchangers	10	Sugar factory and Palmyra	1
Stationary shops	40	Chocolates & sugar confectionaries	1

Business establishments	No of units	Business establishments	No of units
Tailor shops	42	Food products (papadam)	1
wine shops	16	Palmyra Juggery	1
Ice –chicken shops	15	Soft drink manufacture	1
Fashion shop	70	Aerated water	1
Grinding mills	25	Coir and rope	1
small shops	40	Metal Industries	1
Electronic equipment repairs shop	12	Other	2

3 Public Opinion Survey (POS)

This Public Opinion Survey (POS) was commissioned to identify a range of household waste management matters in relation to the household sector. Information on household waste management practices and information on householders' experiences with waste collection delivery services was collected for the purpose of improving our understanding of householder's experiences and attitudes and also to better understand prevailing situation in householder's point of view. The purpose of this survey research included;

a. To collect information on public attitudes to the waste management and environment in broader,
b. To value aspects of environmental health and protection,
c. To provide information on experiences with Local Authority's waste management service and,
d. To provide information on household waste management practices.

3.1 Public opinion survey methodology

The number of samples from Trincomalee identified as 200 households, but size of the sample increased to 202 during the implementation to increase the accuracy. The selection of households and areas within Trincomalee UC was done after a consultative discussion with Municipal commissioner, MSW section officers at TUC and JICA expert team members. Trincomalee UC has 9 zones as SWM areas. Samples were selected from each zone representing approximately equal numbers.

The survey was executed by a team of university students who were trained about the questionnaire, survey methodology and the data entering before dispatched to their respective fields. A senior expertise took the leadership and continuously supervised the field survey. The selected households were first educated about the survey, its main objectives and asked their cooperation before starting the field survey. In addition business and institutes, large waste generators, hospitals recycling shops and large public markets were also surveyed using appropriate questionnaires prepared in consultation with JICA experts.

Table 3-1 Category and number of samples for Public Opinion Survey

Category	Survey area	Number of samples
High-income households	Orr's Hill, Linganagar, Moor Street, Arunakiri St	51
Middle-income Households	Lower St Orr's Hill, 2nd Lane Linganagar, Takkiya Lane Moor Street, Arunakiri St	42
Low-income Households	Orr's Hill, Linganagar, Sirimapura, Thirugnanasampanthar street	58
Businesses /Service organization	Kandy Rd, Main Street, Thirugnanasampantar street, Dockyard street, Mosque Rd	40
Large waste generators		6
Markets		2
Hospitals		2

Category	Survey area	Number of samples
NGO		1
Total		**202**

The questionnaires were available in all languages (English/Sinhala/Tamil); however the questionnaire form was filled by the interviewer based on interviewees' response. The collected information was recorded in digital form using Microsoft Excel and reviewed for accuracy. The data was analyzed in detail for different objectives that generate an overview of the survey.

3.2 Results of Public Opinion Survey

- ✓ 60 % of the surveyed households are Tamil, 26 % Sinhalese and 14 % Muslims. Data on the average number of people per household and monthly income is set out in below Table 3-2.

Table 3-2 Average and standard deviation values of income and family size

Category	Family size	Income (Rs/month)
High	4.7 ± 1.5	58, 863 ± 31, 438
Middle	4.5 ± 1.7	31, 524 ± 5, 518
Low	4.5 ± 1.9	14, 569 ± 6, 432
	No of workers	**Income (Rs/month)**
Business	3.3 ± 3.5	99, 789 ± 241, 313

- ✓ In Trincomalee UC, 99 % of surveyed households are provided with a garbage collection service, of which 99 % stated they use this service. Only 34 % of surveyed households are "very satisfied" with present SWM service provision, while 46 % are "somewhat satisfied".

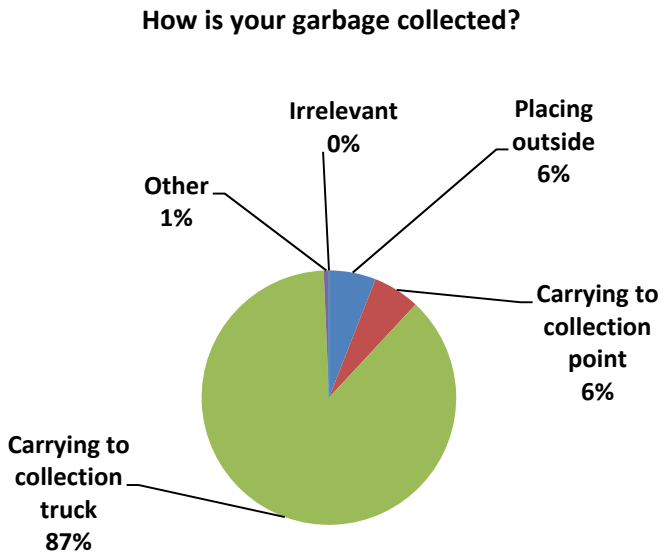


Figure 3-1 Method of garbage discharge by residence in TUC area

- ✓ Households' main methods of waste discharge are shown in Figure 3-1. The most common method is carrying garbage to collection truck (87 %). 6% of residence discharges waste outside their premises for house to house collection while another 6 % caring waste to waste collection points.
- ✓ 78% of surveyed households receive the garbage collection service once in a week while 15% stated that they received the service less frequent than once/week. However, 61% discharge their garbage as soon as it is generated and 34 % discharge their garbage daily. The discrepancy between these figures explains the large amount of discarded garbage present on many streets around Trincomalee.
- ✓ In general, adult females handle waste in about 79 % of surveyed households.
- ✓ As shown in Figure 3-2, only 20 % of surveyed households are not willing to cooperate with source separation for recycling while majority (69 %) very much willing for separate garbage collection system.
- ✓ Ando also, 69 % of surveyed households stated that there are recyclable collectors or someone who comes to collect their reusable or recyclable materials.

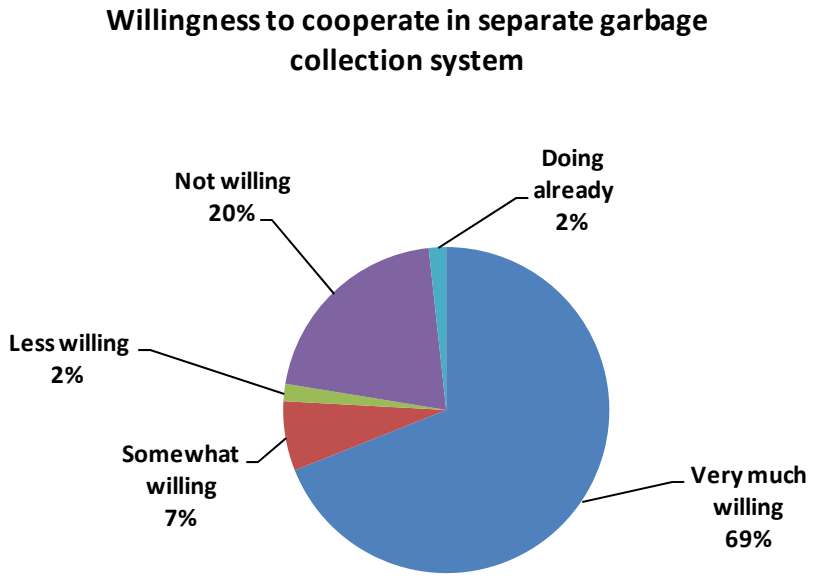


Figure 3-2 Willingness of residence for a source separated garbage collection system in Trincomalee UC

- ✓ Only 21 % of surveyed households use kitchen/garden waste for composting and used the finished compost for their own garden.
- ✓ Many surveyed households (60 %) have ever discussed proper garbage discharge methods at the community level.
- ✓ 72 % households stated that SWM awareness programmes are very necessary while 24 % stated "somewhat necessary".
- ✓ The average WTP (willingness to pay) for improved SWM services is 37 ± 57 Rs/month per household. However 23 % of household do not like to pay for SWM service.
- ✓ Out of all surveyed households, only 9 % stated that they sale/give-off metal for recycling and 2 % of residence sale/give-off tins & cans for recycling. The glass and bottle recycling is

only practiced by 1 % of households while the plastic recycling is 11 %. Percentage of household who involved in paper recycling (sale or given-off) was low (2 %).

4 Final disposal site survey (FDS)

4.1 Introduction the FDS at Trincomalee UC's dumpsite

4.1.1 Survey Method

The data and information in this report were collected from various sources including published reports, verified data from Trincomalee Urban Council, and direct interview with responsible Privet authority (CGL International Eco Pvt Ltd) at disposal site.

4.1.2 Target of Survey

The survey is focus on obtaining general information on waste receiving, handling, disposal, facility management, environmental monitoring and legal adherences.

4.1.3 Data Sampling

The numerical data was collected as specified in following **Table 4-1**.

Table 4-1 Data collected during the final disposal site survey

	Survey Items	Method
1	Current condition of final disposal site and its surroundings	
	✓ Disposal method and structure	Records, visual observation
	✓ Soil-covering	Records, visual observation
	✓ Land owner	Records
	✓ Residual area	Records, visual observation
	✓ Leachate water	Records, visual observation
	✓ Waste picker	Records, visual observation, interview
	✓ Scattering waste, smoke, fire, offensive odour, animals and so on	Records, visual observation
2	Operation and Management of final disposal site	
	✓ Environmental Protect License and Environmental Clearance	Record
	✓ Personnel	Records, interview
	✓ Operation vehicles, their maintenances and drivers	Records, interview
	✓ Weighbridge	Records, interview
	✓ Waste collection data	Records, interview
	✓ Supervisory method	Records, interview
3	Waste amount to final disposal site (24 hours, 7 days)	Records, Survey
4	Adverse impact near by residences	Records, Survey
5	Implementation status of geological, topographic and EIA survey for new final disposal site	Records, interview
6	Progress situation for new final disposal site	Records, interview
7	Court case	Records, interview

4.2 Current condition of final disposal site and its surroundings

4.2.1 Final Disposal Site of Trincomalee UC

The final disposal site is situated in a forest reserve near Kannia village, at about 9 km away from the city center of Trincomalee on the left of Trincomalee-Anuradhapura (A 12) main road. The final disposal site is situated inside the western boarder of Naval Headquarters Sanctuary which is administrated by Department of Forestry and District Secretariat of Trincomalee.

Figure 4-1 Location of Trincomalee UC's MSW dumpsite in Trincomalee peninsula

4.2.2 History and evolution of the dumpsite

The dumpsite was first started in year 2005. From the beginning, the site was commonly shared by Trincomalee Urban Council and Trincomalee Four Gravets PS. The historical evolution of the dumpsite is illustrated in Figure 4-2.

The west side of the dump extend up to the Trincomalee lagoon, approximately 600 m away from the present dumping area. The north of the dumpsite extend up to an flood water regulation channel that originate from an anicut built to regulate flood waters on the right side of the road coming through the paddy fields.

As shown in the Figure 4-3, the nearest residential area is on the opposite site of the main road which is 700 m away from the dumpsite.

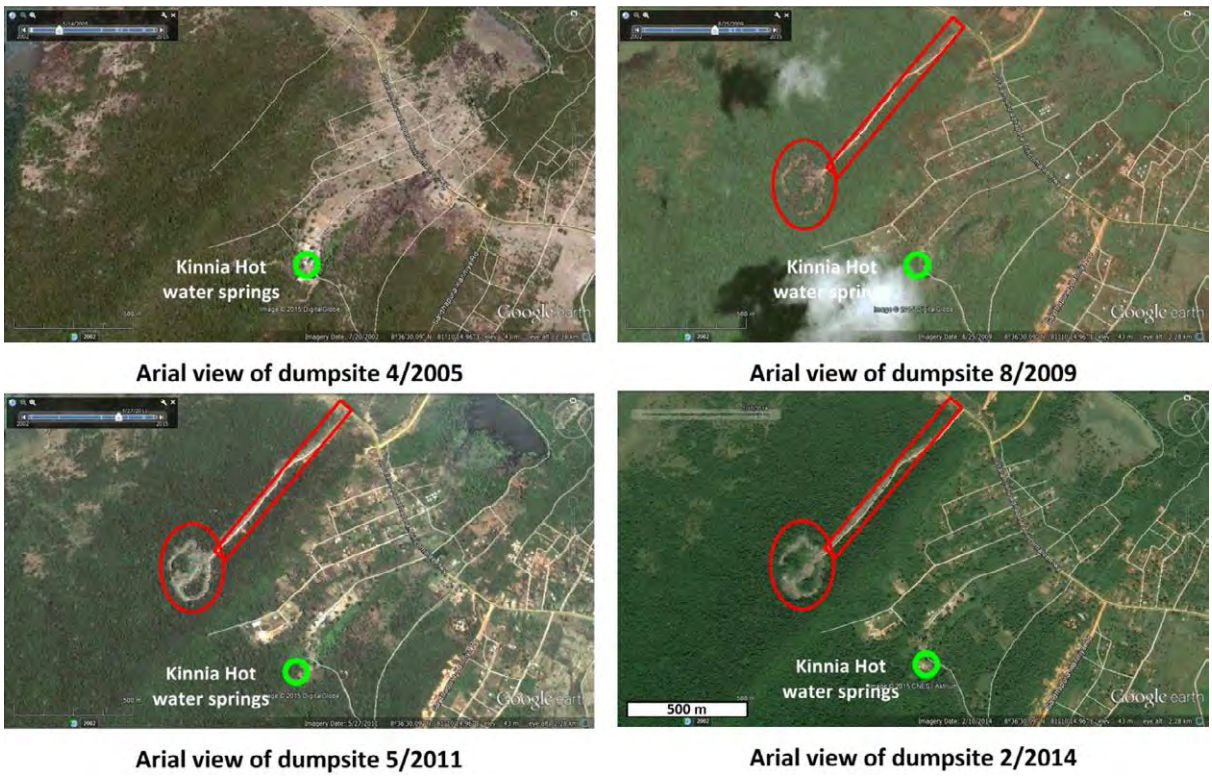


Figure 4-2 Historical evolution of Trincomalee MSW dumpsite from year 2005 to 2014

Figure 4-3 Environment around the Trincomalee UC's dumpsite

4.2.3 Extend and landform

At present, a 5 hectare land has been allocated for the dumpsite by Department of forestry and District Secretariat of Trincomalee which has been planned to expand up to 25 hectares during the future development.

As shown in Figure 4-4, the area is covered with thick forest with abundant wildlife. Especially, folk of elephants frequently visit the site for scavenging. The landform is a flat-undulated terrain with a mild slope towards North. However, there are several seasonal streams crossing the access road to the dumpsite.

Figure 4-4 Elephants scavenge in the dumpsite

Although the main dumping area is situated about 1 km inside the forest, waste has been dumped either sides of the road. This practice is very common during the rainy season when vehicles could not travel on the unpaved muddy access road.

4.2.4 Waste receiving and disposal

Very recently, starting from 1st of October, 2015, the overall management and maintenance of the dumpsite was handed over to a privet company called **CGL International Eco Pvt Ltd.** The intension of Privet Company is to establish plastic recycling center and a waste to energy facility at the dumpsite after preliminary site rehabilitation. The site rehabilitation works have already been started. The company has dispatched several workers to work at the site (watchmen and record keeper). In addition, access road has been cleared and partly paved with concrete (approximately 150 m). At present, the Company does not collect a tipping fee for vehicle entry and disposal.

The existing dumpsite is commonly shared by two Local Authorities and few Government and Privet sector organizations in Trincomalee District.

The available records show that dumpsite receive 10 to 30 loads of MSW from different organizations. The estimated waste quantities disposed at the dumpsite is shown Table 4-2. In addition, 2-6 loads of toilet waste is also transported in gully bowser and disposed at the dumpsite.

Table 4-2 Estimated waste disposal quantities at Kannia dumpsite

Survey date	TUC	UPS	PRIMA	NAVY	POLICE	OTHER	Gully waste
			Tonnes/day				m^3/day
18/10/2015	23.5	7.1	0.0	2.4	7.1	2.4	24.0
19/10/2015	17.0	9.4	0.0	2.4	9.4	2.4	8.0
20/10/2015	45.4	7.1	7.1	0.0	11.8	7.1	20.0
21/10/2015	10.9	9.4	0.0	4.7	18.8	4.7	0.0
22/10/2015	37.9	2.4	0.0	0.0	21.2	4.7	20.0
23/10/2015	4.7	2.4	0.0	2.4	7.1	2.4	4.0
24/10/2015	31.3	0.0	0.0	4.7	14.1	14.1	24.0
25/10/2015	7.6	0.0	0.0	4.7	11.8	0.0	8.0
27/10/2015	10.0	9.4	0.0	2.4	7.1	0.0	8.0

TUC: Trincomalee Urban Council
UPS: Uppuveli Pradeshiya Sabha
PRIMA: Prima Mills Pvt Ltd
NAVY: Sri Lanka navy camp- Trincomalee
POLICE: Sri Lanka Police Headquarters- Trincomalee
Other: Town & Gravet PS and indiviaduals

4.3 Site infrastructure facilities

There is an entrance to the site from the Trincomalee-Anuradhapura (A12) highway. The access road has not been paved and there is no gate or office building near the entrance.

There was an electric fence around the dumping area which was constructed in 2013. However, the fence was damaged by elephants soon after the construction.

In addition, there is a partly constructed toilet waste treatment facility at the middle of dumping ground. Some of the installation at the toilet waste disposal facility was also damaged by elephants in year 2013.

Figure 4-5 Few notable features at Kannia dumpsite in Trincomalee

4.3.1 Current condition of final disposal site and its surroundings

1	Current condition of final disposal site and its surroundings	
1.1	Disposal method and structure	✓ Incoming waste loads (tractors, compactors and gully bowsers) are recorded at the entrance gate (starting from 2nd week of October). ✓ All other MSW collection vehicles emptied its waste at the dumpsite. No specific control measures apply for selection of dumping area. Thus, **Open Dumping** is practiced. ✓ All other wastes are dumped on the ground and no compaction or spreading ✓ No machineries are employed at the site. However, site management explained that they will employ bulldozer when there is a requirement for leveling the waste. ✓ Sewage is discharged to temporally streams near culverts
1.2	Soil-covering	✓ Covering of waste by soil is not practiced
1.3	Land owner	✓ Trincomalee Divisional Secretariat and Department of Wildlife possesses the ownership of the land and surrounding area. ✓ However, Trincomalee UC and the Company are in the process of obtaining 25 acres of land for future development
1.4	Residual area	✓ Approximately 10 ha area has already been covered with waste
1.5	Leachate water	✓ No leachate collection and treatment system ✓ Leachate and surface water flow towards the down slope and into the forest
1.6	Waste picker	✓ Admission of waste pickers has been restricted by the Company
1.7	Scattering waste, smoke, fire, offensive odor, animals	✓ Waste is dumped everywhere on the dumping site, especially along the access road ✓ There is evidence that at least half of the dumpsite (approximately 2 hectares) has been recently burned out by intentional or unintentional fires. ✓ There are more than 25 stray dogs reside in the dump site

4.3.2 Operation and Management of final disposal site

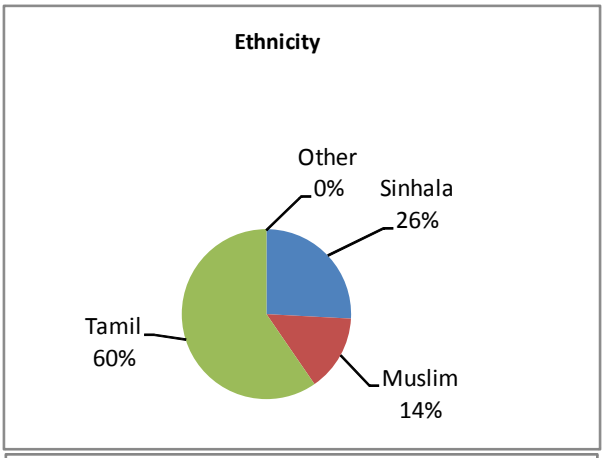
2	Operation and Management of final disposal site	
2.1	Environmental Protect License and Environmental Clearance	✓ None
2.2	Personnel	✓ 1-Supervisor – visit in the morning (employ by the Company) ✓ 1-Labors-works during daytime and keep vehicle entry records (employ by the Company) ✓ 1-Labors-works during daytime and keep vehicle entry records (employ by the TUC)
2.3	Operation vehicles, their maintenances and drivers	✓ None
2.4	Weighbridge	✓ None
2.5	Waste collection data	✓ A record book is available from 1st October 2015
2.6	Supervisory method	✓ Company manager and site supervisor frequently visit the site
3.0	Waste amount to final disposal site (24 hours, 7 days)	✓ A summary is shown in Table 4-2
4.0	Adverse impact nearby residences	✓ Residences are at least 500 m away from the dumping area. And the forest act as a cover for dour and waste blowing.
5.0	Implementation status of geological, topographic and EIA survey for new final disposal site	✓ None
6.0	Progress situation for new final disposal site	✓ None

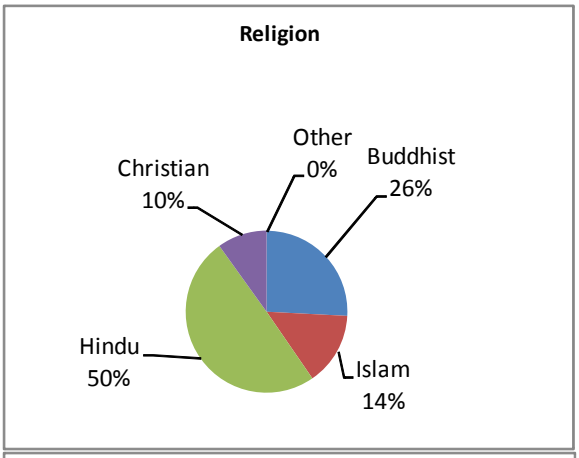
2	**Operation and Management of final disposal site**	
7.0	Court case	✓ None

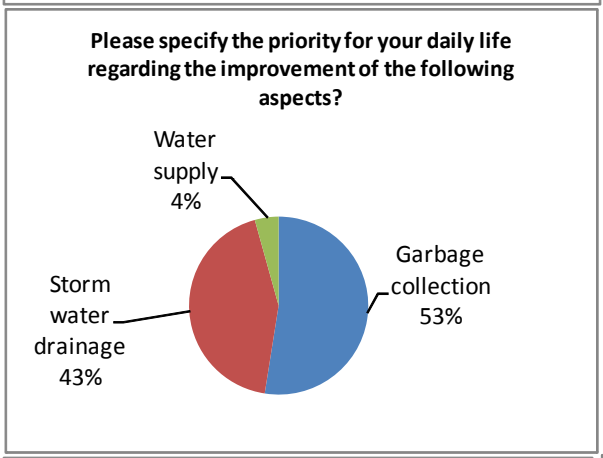
Annex

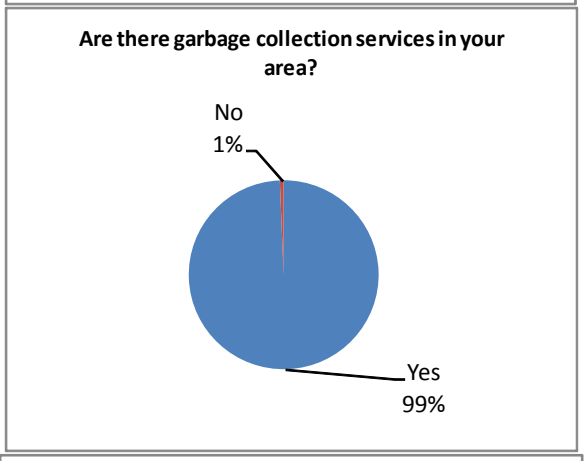
TRINCOMALEE URBAN COUNCIL

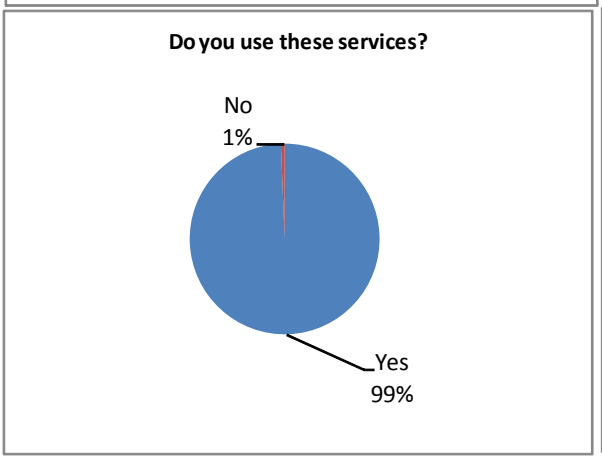
Response to Public Opinion Survey for Household

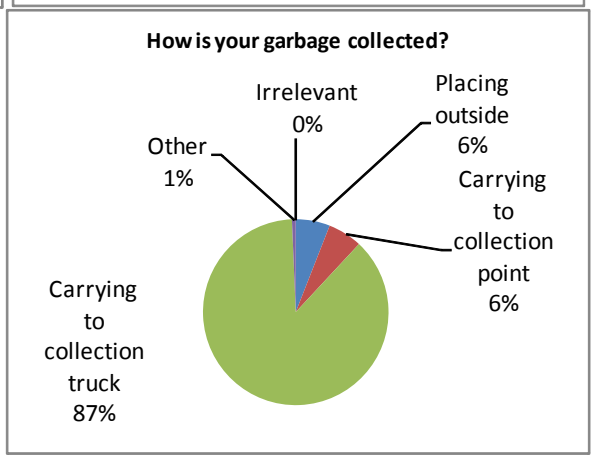




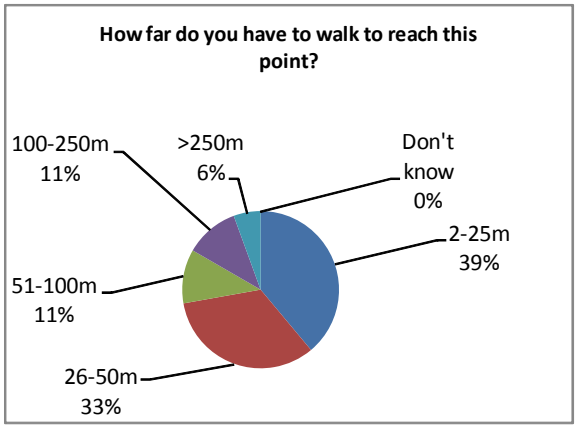


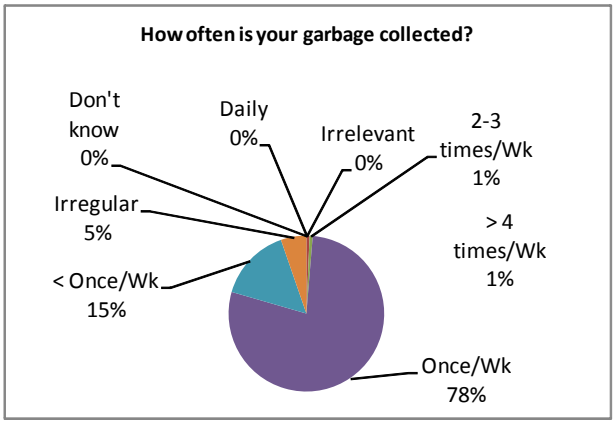


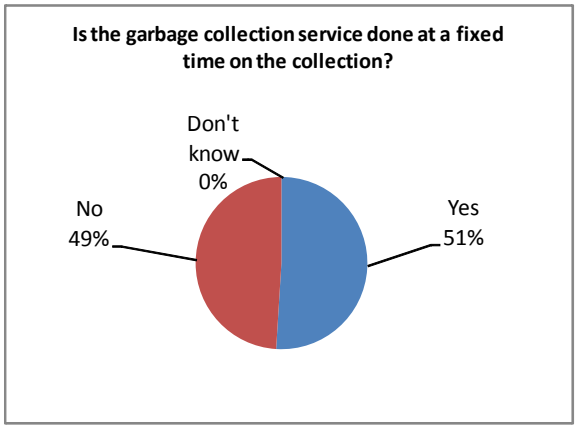


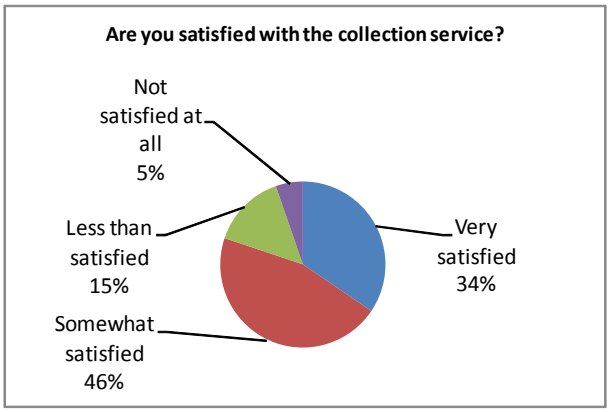


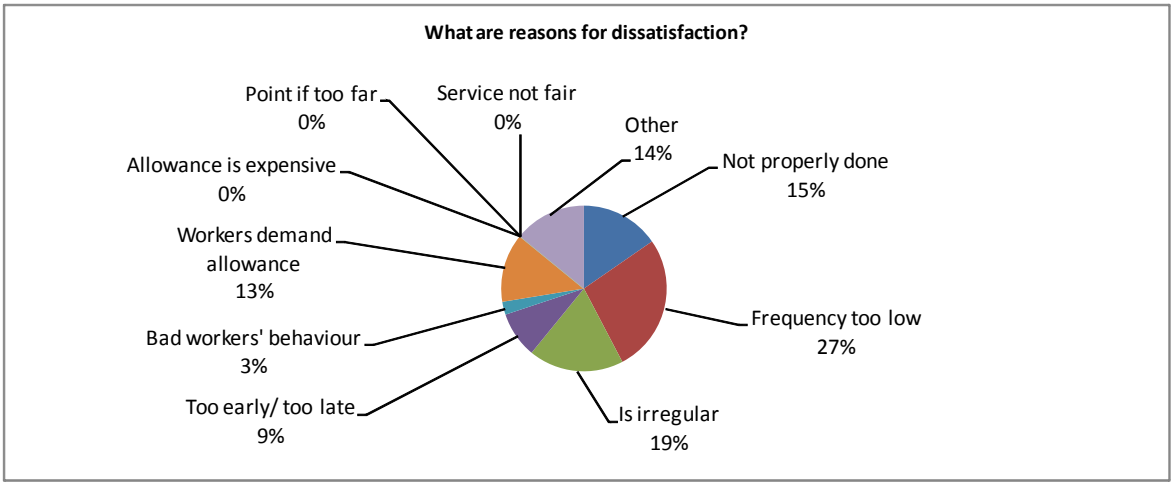
Response to Public Opinion Survey for Household











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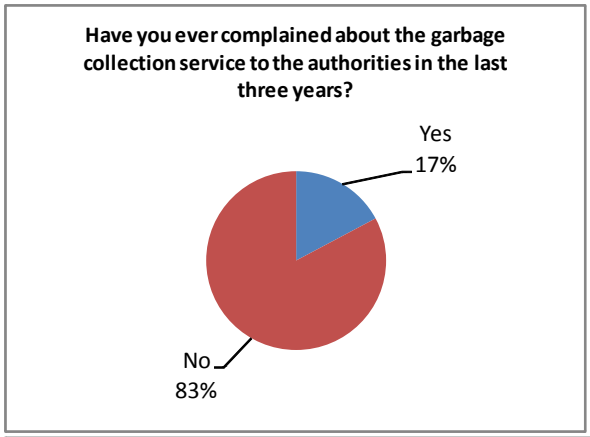

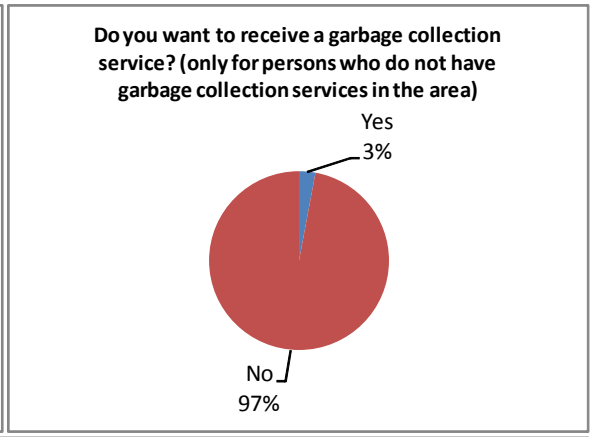

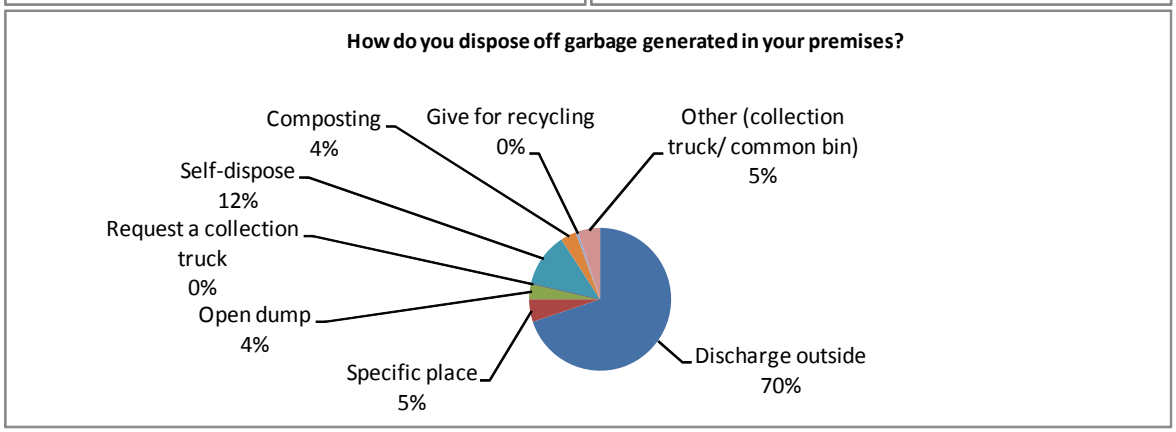

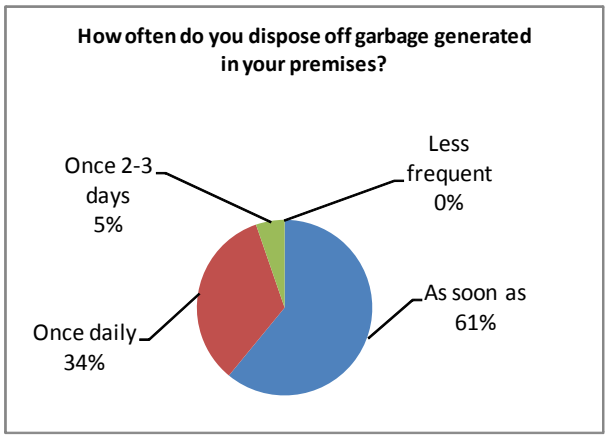

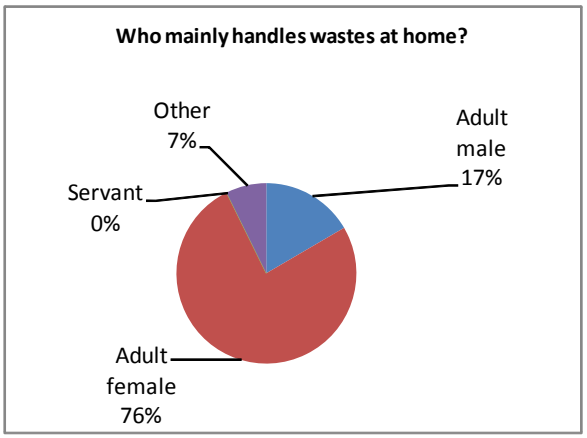

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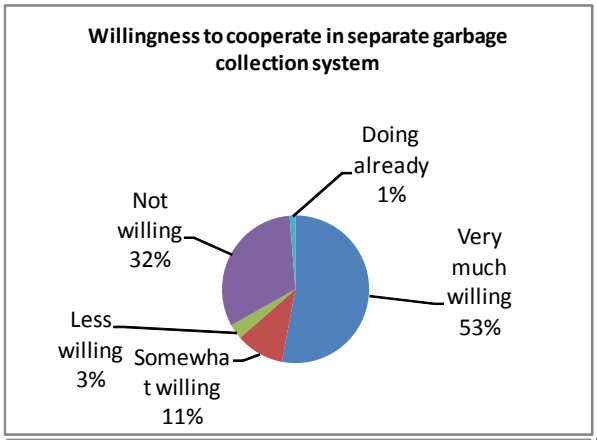

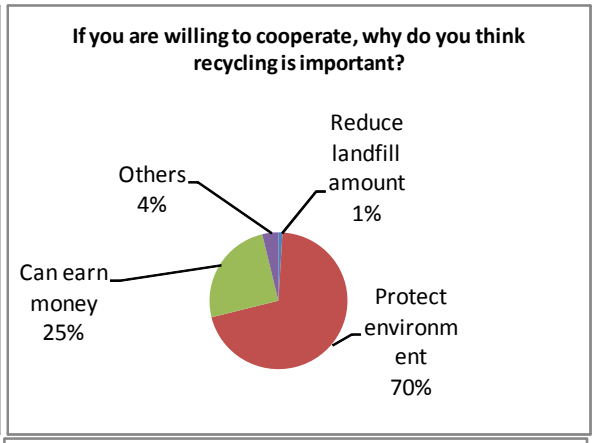

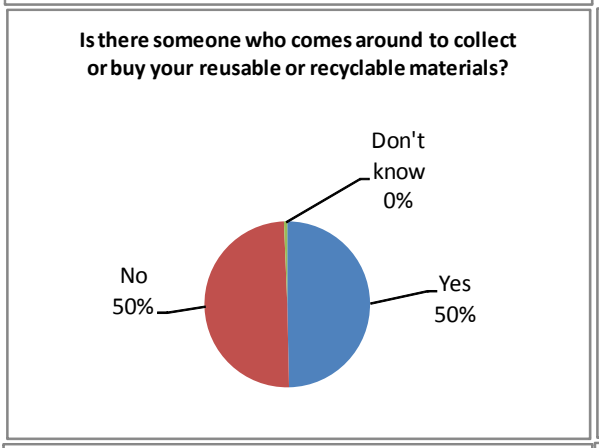

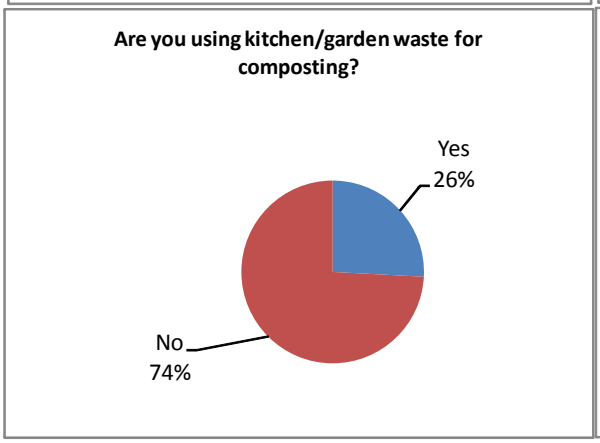

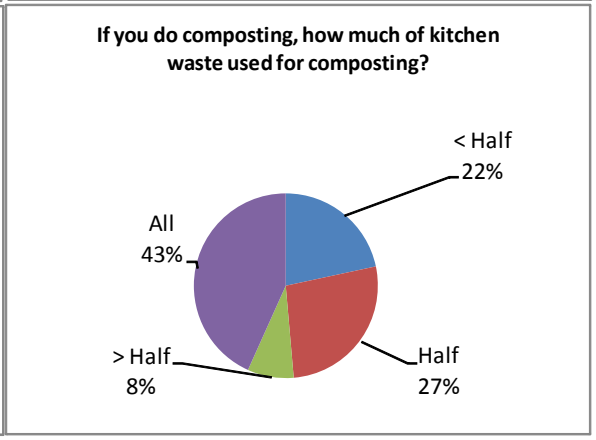

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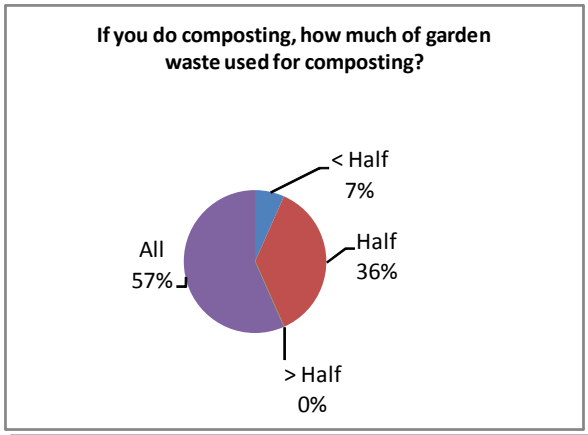

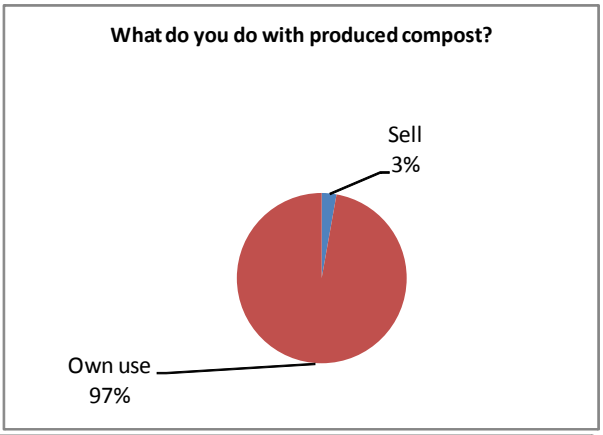

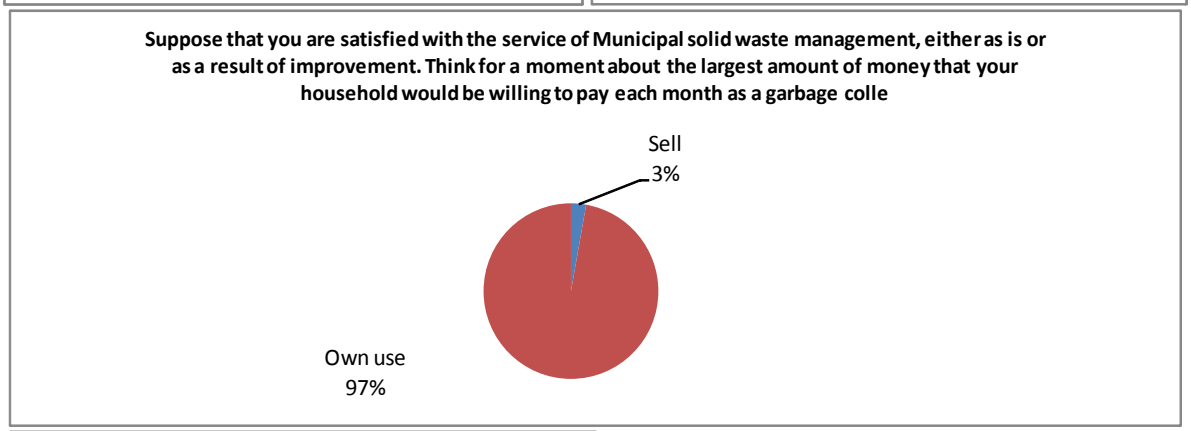

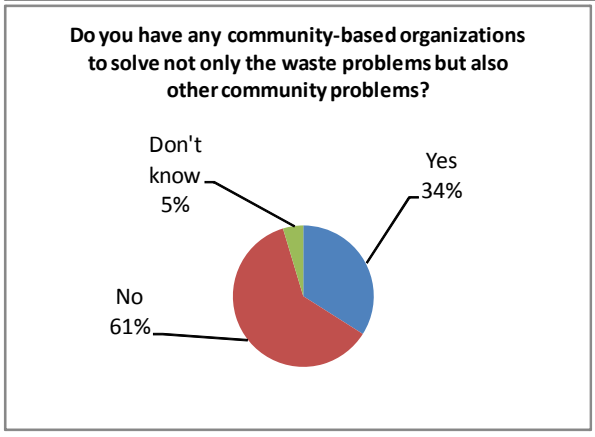

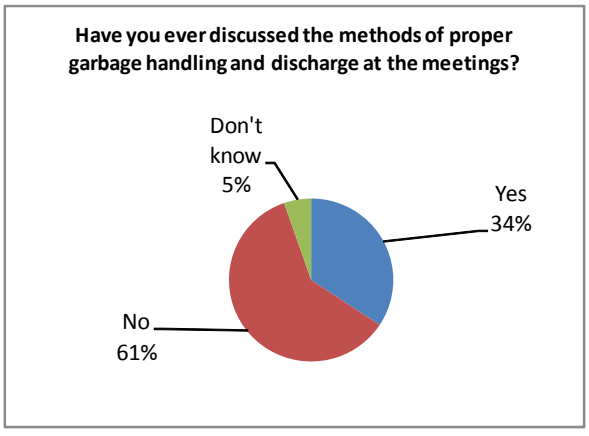

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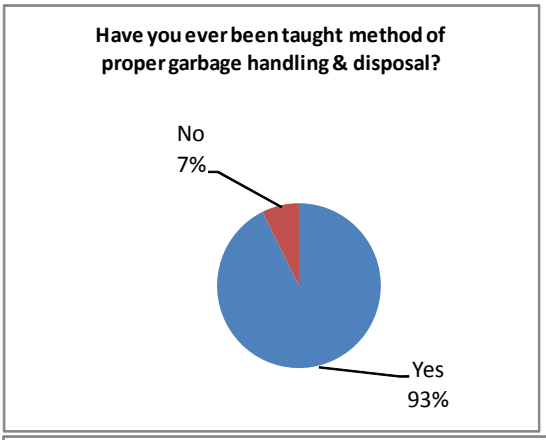

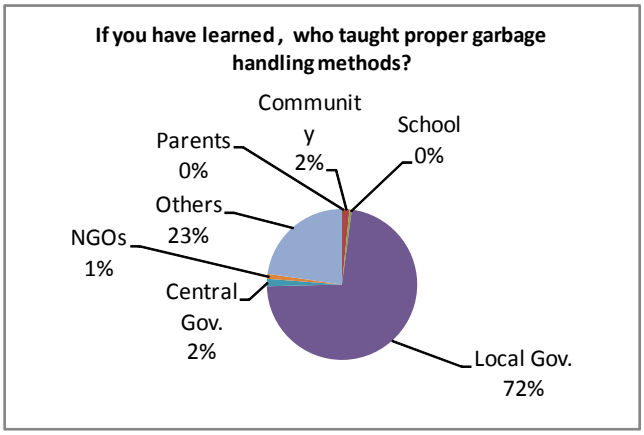

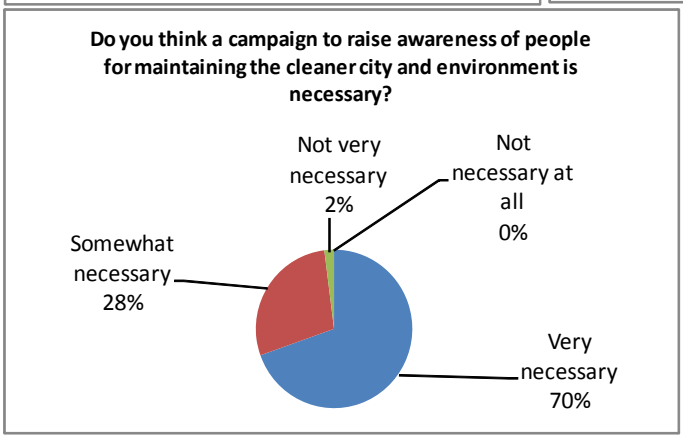

1.5 Kurunegala MC

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1 Introduction

The purpose of this survey is to obtain the current data regarding Solid Waste Management (SWM) at Kurunegala Municipal Council (KMC). The data collection survey was conducted from 30th October to 4th November, 2015 by a team of expert dispatched by Waste To Energy Technologies Limited.

This report consists of brief summaries of survey methods and results. The additional primary data and records are available as soft copies. The preliminary data collection was conducted through four comprehensive surveys which are;

i. **Waste Generation Survey (WGS)** is to gather information on waste generation sources at KMC based on secondary data available at KMC and other relevant organizations.
ii. **Public Opinion Survey (POS)** is gather information on public opinion on current waste management in KMC. The POS was conducted through a questionnaire survey that covers different types of waste generators in the KMC area.
iii. **Final Disposal Site Survey (FDSS)** is to collection data on final MSW disposal site of KMC based on secondary data as well as field recordings & visits to the site.

1.1 Background conditions of Kurunegala Municipal Council

Kurunegala city is the capital of the North Western Province of Sri Lanka. It is situated about 94 km from Colombo, and 42 km from Kandy. Kurunegala Municipal Council is bordering to Kurunegala Pradeshiya Sabha on all directions (Figure 1-1). KMC is the major commercial and service hub of the Kurunegala District as well as the only Local Authority with Municipal status in North Western Province of Sri Lanka. The city is well renounced for education, especially for popular schools and tuition centers. And, Kurunegala city is a major transit center in the country connecting north and south.

Table 1-1 Basic fact sheet of Kurunegala Municipal Council

Item	Description
Province	North Western Province of Sri Lanka
District	Kurunegala
Local Authority Status	Municipal Council
Location in Relation to	Kurunegala is situated about 94 km from Colombo, and 42 km from Kandy
Extent of the Authority Area	11. 34 sq.km
No. of Council Wards	12
No. of Council Members	22
No. of Dwellings	6, 049
Population MC record (2012 statistics)	26, 903 (~ 100,000 daily floating population)
Average Population Density	23.72 p/ha
Major economic activities	Commerce, services, & light scale industry (Light industries such as vehicle repairs, vehicle service stations, printing presses, textile garments, small scale mechanical workshops, etc.)

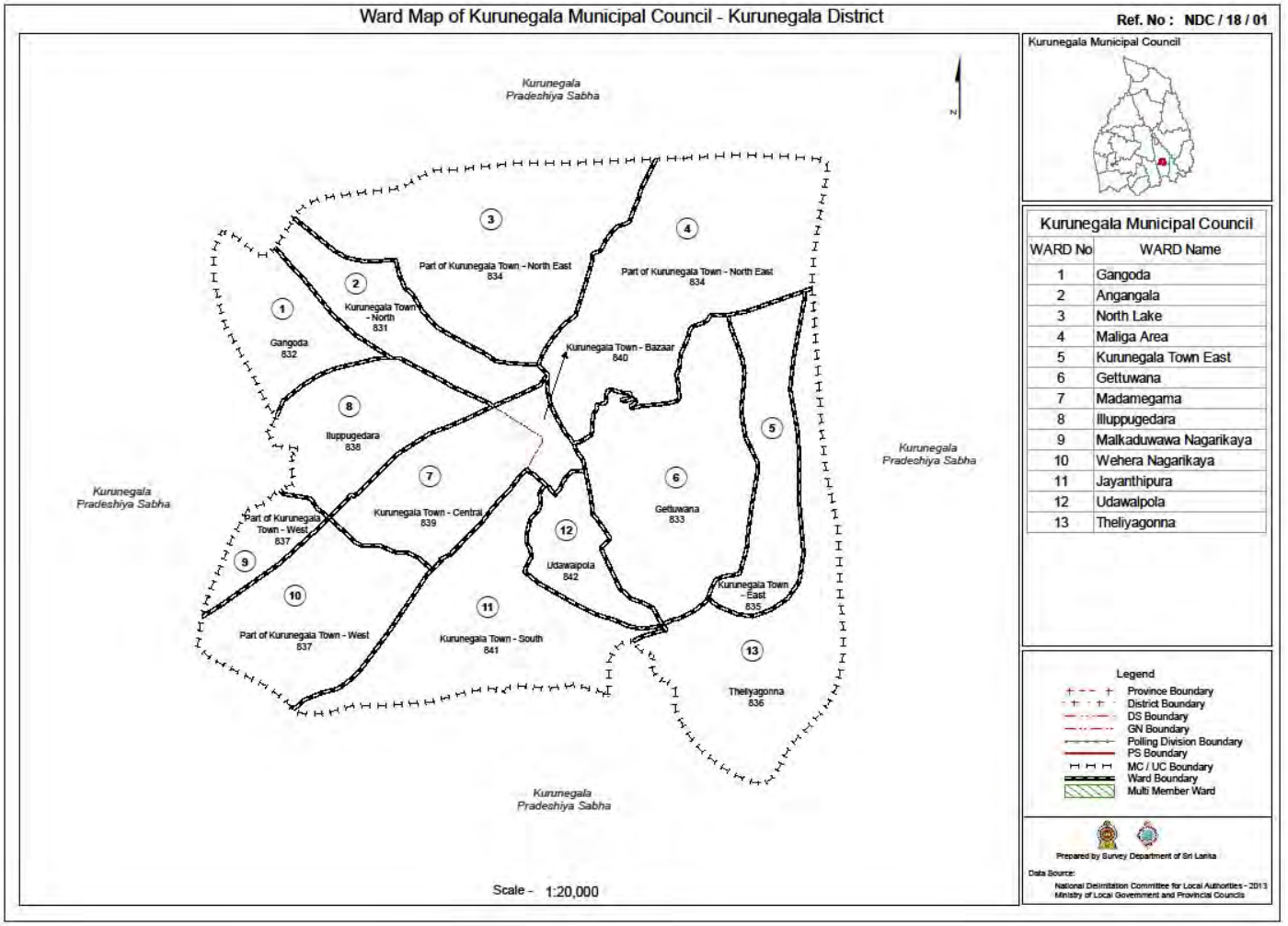


Figure 1-1 City map of Kurunegala MC

2 Waste Generation Survey (WGS)

In order to obtain general information on waste generation amounts, the data available at waste management section of the Health Department, Works Department and Revenue Department of KMC was used. Some of the data was available in the form of formal records and reports which were treated as the most precise secondary data while the data collected from official interviews with KMC officers was treated as verification data. Thus, the survey data was collected through different methods;

a) Recording and compiling of published and verified data by KMC,
b) Reading and recording of unpublished & non-confidential data available at KMC,
c) Recording and official statistics available at Kurunegala Divisional Secretariat office, and
d) Official person-to-person interview with relevant officers at KMC for verification of data.

The numerical data was collected as specified in following Table 2-1.

Table 2-1 Type of data collected for WGS in Kurunegala MC

Source	Description
Household	Each number of following category households was surveyed; 1) High income level, 2) Middle income level and 3) Low income level.
Commercial	Each number of following category restaurants was surveyed; 1) Large size restaurants, 2) Middle size restaurants and 3) Small size restaurants. Each number of following category shops was surveyed; 1)Organic shops (large) 2)Organic shops (middle) 3)Organic shops (small) 4)Non-Organic shops (large) 5)Non-Organic shops (middle) 6)Non-Organic shops (small)
Hotels	Each number of following category hotels was surveyed; 1) Large size hotels 2) Middle size hotels and 3) Small size hotels.
Markets	Number of stalls and types
Institutions	Each number of following institute was surveyed; 1) Schools 2) Hospitals (government) 3) Hospitals (private) 4) Public office 5) Bank/private office 6) Buddhist temples 7) Hindu temples 8) Mosques 9) Churches 10) Navy/Police/ Army bases 11) Others
Industries	Wastes from any industries.

Source	Description
Other	Public parks and other public facilities
Construction and demolition	Wastes originating from construction, rehabilitation and demolition activities, etc.
Hazardous (Special)	Management and collection of hazardous wastes originating from various sources, including household items

2.1 Waste Generation Survey Results

The records indicate that the total residential population within KMC is 26, 903 (Source: Divisional Secretariat, Kurunegala 2015). The Kurunegala MC area consists of 12 Grama Niladari (GN) divisions as shown in below Table 2-2 .

Table 2-2 Population statistics of GN divisions in KMC area

GN Division Name	No of Houses	Population
Kurunagala Town North	352	1,265
Gangoda	475	2,108
Gattuwana	420	1,843
Kurunagala Town North East	828	3,319
Kurunagala Town East	378	1,710
Theliyagonna	648	3,072
Kurunagala Town Western	988	5,664
Illuppugedara	751	3,136
Kurunagala Town Central	338	1,298
Kurunagala Town Bazaar	43	228
Kurunagala Town South	513	1,920
Udawalpola	315	1,340
Total	**6,049**	**26,903**

As shown in following Table 2-3, Kurunegala MC own and control a larger number of public properties and institutes.

Table 2-3 Type and number of municipal establishment own by Kurunegala MC

Public property	No of units	Public property	No of units
Libraries	1	Pola premises	1 (sun & Wed)
Reading centres	1	Community centres	9
Municipal parks	1	Gymnasiums	1
Play grounds	7	Swimming pools	1
Market complexes	1 (151 shops)	Common wells	23
Cemetery	2	Town hall	1
Vehicle parking complexes	72 (4 main)	Crematoriums	1

Public property	No of units	Public property	No of units
Bus stand complexes	3 (1 main)	Preschools	35
Slaughter house	1	Rest Houses	2
Meat stall/ markets	2	No of shop rooms rent out	670
Public toilets	7		

Following Table 2-4 shows the number of government and privet/non-government establishments within Kurunegala MC.

Table 2-4 Number of government and privet institutions within Kurunegala MC

Type of institute/ organization	No of units	Type of institute/ organization	No of units
Schools	14	Lanka Fertilizer Cooperation	1
Higher education institutes	3	Sri Lanka Fisheries Cooperation	1
General Hospitals	1	Lanka Petroleum Cooperation	1
Arurvedic hospitals	1	Railway Station	1
Dispensaries	3	Coconut Development Authority	1
Clinics	17	Office of Educational Workers	1
Government Banks	5	Meteorological Department office	1
Rural Banks	1	Government Analyst's Office	1
Main Post office	1	Foreign Employment Services Office	1
Sub Post office	1	Regional Engineer's Office	1
Police stations	1	Provincial Revenue Office	1
Veterinary service center	1	District Land Rehabilitation Office	1
National Youth Services Council office	1	Department of Transport and Motor	1
Co-op City	1	Sura Bahdu Adhikari Office	1
Registrar General Office	1	Sura Bahdu Station Office	1
Environmental & Natural Resources	1	Wayama Special Operations Office	1
Agricultural and Agrarian	1	Schools (privet)	3
Land ownership resolving Department	1	Hospitals and health homes (privet)	4
Main Electrical Engineer's Office	1	Dispensaries	38
Office of Zonal Irrigation Director's	1	Aruvedic dispensaries (privet)	5
Labor Department	1	Banks privet	15
Sri Lanka Telecom Local Office	1	Society oriented Banks	3
Institute of Small instructress	1	Veterinary service centres	1
South Depot	1	NGOs	11
Industrial Services office	1	INGOS	2
Cloth weaving Institute	1	Insurance Cooperation	5
Educational Department	1	Buddhist temples	13
National Timber Cooperation	1	Hindu Kovils	6
National Water Supply and Drainage Board	1	Mosques	5
Kurunagala Cultivation Board	1	Churches	6
Employee Provident	1	Dharma schools	7

Type of institute/ organization	No of units	Type of institute/ organization	No of units
Guiders headquarters	1	Nun Monasteries	4
Probationary and Child Care	1	Devala	1
Election Department office	1	Youth Societies	13
District Disaster Management Centre	1	Village Development societies	8
Consumer Affairs Authority	1	Women Societies	8
Provincial Ministry of Agriculture	1	Farmers Organizations	4
District Secretariat Office	1	Samurdhi Societies	12
Wayamba Provincial Council Complex	1	Funeral Aiding Societies	2
Land Registration Office	1		

A major portion of MSW is generated from commercial sector in the city. Following Table 2-5 shows the number of different commercial (business) establishments in KMC area.

Table 2-5 Types and number of business establishments in KMC area

Type of business	No of units	Type of business	No of units
Middle size restaurants and	140	Rice mills	1
Vegetable shops (large)	43	Cloth weaving	1
Fruit sales shops	9	Coir products	1
Glossary shops	228	Leather products	7
Textile trading shops (large)	243	Constructions	12
Furniture sales shops	10	Fruit processing	4
Vehicle spare parts shops	65	Agricultural tools and equipment	1
Fish sales stalls	9	Gold and silver	7
Meat /fish sales stalls	26	Sweets	36
Barber shops	31	Welding smithies	25
Pharmacy	21	Saw mills	5
Ornamental plant nursery	9	Cement products	7
Ornamental fish	3	Ornamental goods	19
Bakery	12	Stationary production	6
Paints	34	Tailoring	80
Building materials sales	47	Floor mat production	30
God, silver and Gem shops	25	Mushrooms	2
Cooperatives	6	Joss sticks	6
Metal goods	29	Paper production	12
Local materials buying centres	4	Granite	1
Bars	11	Poultry farms	25
Laundry	4	Broiler farms	3
Middle size hotels	40	Buffalo farms	1
Tourist hotels (approved by Tourist Board)	8	Goat farms	10
Garments	3		

3 Public Opinion Survey (POS)

This Public Opinion Survey (POS) was commissioned to identify a range of household waste management matters in relation to the household sector. Information on household waste management practices and information on householders' experiences with waste collection delivery services was collected for the purpose of improving our understanding of householder's experiences and attitudes and also to better understand prevailing situation in householder's point of view. The purpose of this survey research included;

a. To collect information on public attitudes to the waste management and environment in broader,
b. To value aspects of environmental health and protection,
c. To provide information on experiences with Local Authority's waste management service and,
d. To provide information on household waste management practices.

3.1 Public opinion survey methodology

The number of samples from Kurunegala identified as 200 households, but size of the sample increased to 210 during the implementation to increase the accuracy. The selection of households and areas within Kurunegala MC was done after a consultative discussion with MSW section officers at KMC and JICA expert team members.

The survey was executed by a team of university students who were trained about the questionnaire, survey methodology and the data entering before dispatched to their respective fields. A senior expertise took the leadership and continuously supervised the field survey. The selected households were first educated about the survey, its main objectives and asked their cooperation before starting the field survey. In addition business and institutes, large waste generators, hospitals recycling shops and large public markets were also surveyed using appropriate questionnaires prepared in consultation with JICA experts.

Table 3-1 Category and number of samples for Public Opinion Survey

Category	Survey area	Number of samples
High-income households	Yanthampalawa, Jayanthipura, Araliya uyana, Gemunu Mw, Perakum Mw, Wilegoda Rd	48
Middle-income Households	Gangoda Rd, Yanthampalawa, Gattuwana, Jayanthipura	52
Low-income Households	Ammon Kovil Rd, Gattuwana, Wilegoda, Elugala	50
Businesses /Service organization	Central Market, Yanthampalawa, Kachcheri Rd	41
Large waste generators		10
Markets		3
Hospitals		2
Recycling shops		3
NGO		1

Category	Survey area	Number of samples
Total		**210**

The questionnaires were available in all languages (English/Sinhala/Tamil); however the questionnaire form was filled by the interviewer based on interviewees' response. The collected information was recorded in digital form using Microsoft Excel and reviewed for accuracy. The data was analyzed in detail for different objectives that generate an overview of the survey.

3.2 Results of Public Opinion Survey

- ✓ 81% of the surveyed households are Sinhalese, with 17 % of Tamils and 2 % Muslims. The ethnicity could be further classified into 100% Sinhalese in high income group, 98 % of Sinhalese in middle income group and 50 % of low income families were Tamils. The data on the average number of people per household and monthly income is set out in below Table 3-2.

Table 3-2 Average and standard deviation values of income and family size

Category	Family size	Income (Rs/month)
High	4.3 ± 1.3	63,521 ± 30,130
Middle	4.4 ± 1.0	34,865 ± 12,041
Low	4.8 ± 1.6	16,100 ± 5,164
	No of workers	**Income (Rs/month)**
Business	6.2 ± 13.0	371,243 ± 353,581

- ✓ In Kurunegala MC, 98 % of surveyed households are provided with a garbage collection service, of which 98% stated they use this service. 68 % of surveyed households are "very satisfied" with present SWM service provision, while 26 % are "somewhat satisfied".

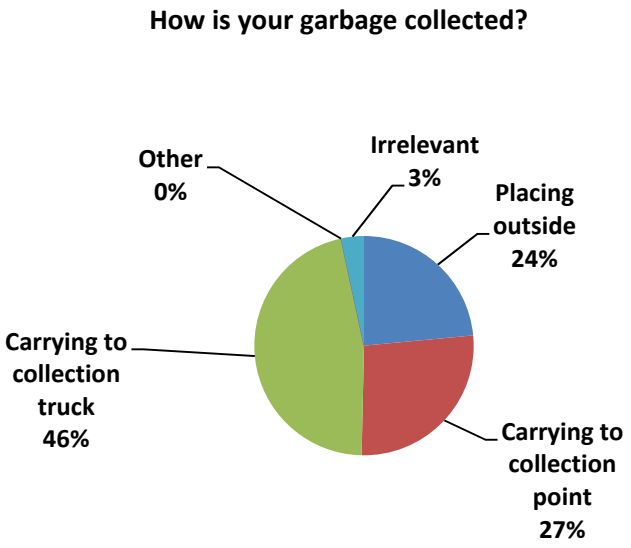


Figure 3-1 Method of garbage discharge by residence in KMC area

- ✓ Households' main methods of waste discharge are shown in Figure 3-1. The most common methods are carrying garbage to collection truck (46%) and carrying to garbage collection point (27%) and discharging it outside their premises for house to house collection (24%).
- ✓ Only 34% of surveyed households receive a daily garbage collection service while 44 % stated that they received the service 2-3 times/week.
- ✓ 69% discharge their garbage as soon as it is generated and 27 % discharge their garbage daily. Only 4% discharge their garbage 2-3 times per week.
- ✓ In general, adult females handle waste in about 67 % of surveyed households.
- ✓ As shown in Figure 3-2, 65 % of households separate their garbage into organic and inorganic waste at the source of generation. Only 5 % of surveyed households are not/less willing to cooperate with source separation for recycling. Rests of the household are very much willing (23 %) and somewhat willing (7 %) to cooperate in source separated garbage collection system.
- ✓ Further, 73 % of surveyed households stated that there are recyclable collectors or someone who comes to collect their reusable or recyclable materials. Hence, informal recycling system is well established in Kurunegala MC area.

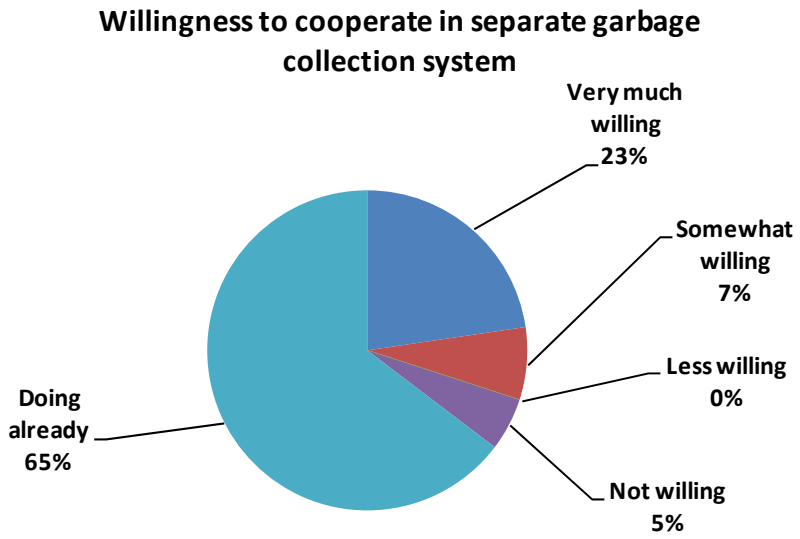


Figure 3-2 Willingness of residence for a source separated garbage collection system in Kurunegala MC

- ✓ 20 % of surveyed households use kitchen/garden waste for composting and 97% of them used the finished compost for their own garden.
- ✓ Not many surveyed households (48 %) have ever discussed proper garbage discharge methods at the community level, but 35% said that they discussed the garbage issue at community meetings.
- ✓ 92 % households stated that SWM awareness programmes are very necessary while 7 % stated "somewhat necessary". Only 1% of surveyed households stated that awareness campaigns are not necessary or not needed at all.
- ✓ 49 % of household do not like to pay for SWM service mainly because of the revenue tax they paid for KMC. The average WTP (willingness to pay) for improved SWM services is 68 ± 94 Rs/month per household.
- ✓ Out of all surveyed households, 11 % stated that they sale/give-off Glass & Bottle for recycling and 6 % of residence sale/give-off Plastics for recycling. Also, 1-8 % of households sale/ give-off can & metal for recycling. Cardboard and paper recycling were 0 % and 10 % respectively.

4 Final disposal site survey (FDS)

4.1 Introduction the FDS of Kurunegala MC

4.1.1 Survey Method

The data and information in this report were collected from various sources including published reports, verified data from Kurunegala Municipal Council, Supervisor of Sundarapola Waste Disposal site and direct interview with other officers & workers at disposal site.

4.1.2 Target of Survey

The survey is focus on obtaining general information on waste receiving, handling, disposal, facility management, environmental monitoring and legal adherences.

4.1.3 Data Sampling

The numerical data was collected as specified in following Table 4-1.

Table 4-1 Data collected during the final disposal site survey

	Survey Items	Method
1	Current condition of final disposal site and its surroundings	
	✓ Disposal method and structure	Records, visual observation
	✓ Soil-covering	Records, visual observation
	✓ Land owner	Records
	✓ Residual area	Records, visual observation
	✓ Leachate water	Records, visual observation
	✓ Waste picker	Records, visual observation, interview
	✓ Scattering waste, smoke, fire, offensive odour, animals and so on	Records, visual observation
2	Operation and Management of final disposal site	
	✓ Environmental Protect License and Environmental Clearance	Record
	✓ Personnel	Records, interview
	✓ Operation vehicles, their maintenances and drivers	Records, interview
	✓ Weighbridge	Records, interview
	✓ Waste collection data	Records, interview
	✓ Supervisory method	Records, interview
3	Waste amount to final disposal site (24 hours, 7 days)	Records, Survey
4	Adverse impact near by residences	Records, Survey
5	Implementation status of geological, topographic and EIA survey for new final disposal site	Records, interview
6	Progress situation for new final disposal site	Records, interview
7	Court case	Records, interview

4.2 Current condition of final disposal site and its surroundings

4.2.1 Sundarapola waste disposal site

Final disposal site is located at Sundarapola, at about 3.9 km away from the Kurunegala town (Figure 4-1). The dumpsite lies within Kalawegedara GN division of Maspotha Divisional Secretariat and also comes under Kurunegala PS administration limits. Sundarapola waste disposal site is one of the largest MSW dumpsite in North Western Province of Sri Lanka and one of the oldest MSW dumpsite in Sri Lanka. The site is commonly shared by KMC and Kurunegala PS for MSW and toilet waste disposal since late 1920s. In addition, several government and privet organizations also use the site for MSW and non-hazardous solid waste disposal.

Figure 4-1 Location of Sundarapola dumpsite

The available records showed the dumpsite was first started in year 1921. At that time, the surrounding land use was mainly coconut plantations and scrub lands. However, during the recent years, there are more than 200 families reside very close to the dumpsite on west side over the access road. The dumpsite is boarded to Wawagedara forest reserve on East and North sides and to a small cemetery on south. The forest reserve extends over 1000 acres on West side of the dump.

4.2.2 Extend and landform

Final disposal site is located at Sundarapola, at about 1 km away from Wariyapola-Kurunegala highway (A10). The extent of the final waste disposal site is 12.5 acres. The closet proximity to residence is around 10 m from the site boundary on the western side across the 3 m wide public road. The land is having mild slope toward the road on the left. The storm water drain on right side of the road has been concreted which carry storm water from the site area during the rainy season and well as leachate water throughout the year.

Figure 4-2 Sundarapola dumpsite and environment within 500 m radius from center

As shown in Figure 4-3, there is an entrance to the site from the Sundarapoa road. The entrance road divided to three sub-access roads running toward composting facility, and two active filling areas. Internal access roads up to composting facility and recycling center are tarmac paved, all other internal access roads are temporally constructed once with soil and C&D waste.

The landform is a flat terrain with gentle slope towards the road (East-West direction) except the areas where the waste has been dumped.

Figure 4-3 Access road and basic site infrastructure facilities at Sundarapola dumpsite

4.2.3 Waste receiving and disposal

The existing dumpsite is commonly shared by KMC, kurunegala PS, an Army Camp, and small textile garment in Kurunegala city. The monthly disposal amounts of MSW and toilet waste are shown in following Table 4-2 .

Table 4-2 Sources and quantities of waste disposed at Sundarapola MSW dumpsite

Origin & type of waste	Units	Amount
Kurunegala Municipal Council (MSW)	Tonnes/month	1, 150
Kurunegala Pradeshiya Sabha (MSW)	Tonnes/month	300
Army Camp (Domestic waste)	Tonnes/month	19

Origin & type of waste	Units	Amount
Industry (Textile waste)	Tonnes/month	9
Toilet waste (Gully waste from KMC)	m^3/month	380

Waste collected and received from KMC at the dumpsite is recorded but there is no weighbridge facility. Thus, the site office maintains only a record of receiving waste from KMC but not from other sources.

The management of the dumpsite has a pre-schedule plan for waste disposal. The site supervisor instructs the waste collection vehicles and waste handling machineries for disposal area.

One of the biggest challenges in management is to get dumping vehicle access to the active filling area during the heavy rainy season. Therefore, site management uses a crawler excavator for waste handling during.

Figure 4-4 Landfilling machineries at Sundarapola dumpsite

Site facilities include two machineries; an excavator (primarily for dumpsite) and a skid-steer loader (primarily for compost facility).

4.2.4 Management of Sundarapola Dumpsite

The dumpsite lies within the Kurunegala PS limits; however the ownership of the land lies with KMC (taken on 99 year lease from Department of Wildlife and Government Agent of Kurunegala).

The integrated site includes a composting facility, plastic recycling facility and night soil treatment facility. Three tractor loads of waste containing high amount of biodegradables from Market places and day-fair are used for composting every day. The compostable waste is unloaded on the open concrete floor and sorted for large non-degradable particles. Window piles are built with Skid-steer loader. Rest of the general MSW is unloaded in the dumping area and heaps are made by the Excavator (type 120). Sorted plastics collected through recyclable collection system of are received to the recycling facility. Plastics and other recyclables from the composting process are also sent to

the recycling factory. Rejected materials from sorting such as contaminated Polythene, textile, Styrofoam are collected by the Holcim Pvt LTD to use as RDF in the cement factory. However, KMC does not pay or charge from Holcim Pvt Ltd.

Figure 4-5 Waste unloading and dumping area of Sundarapola dumpsite

Sewage is directly discharged to the treatment facility.

At present, the dumpsite management is well established with human resources and considerable amount of facilities and machineries. Following table show the management structure and human resources at the Sundarapola dumpsite.

Table 4-3 Administration structure and human resources available at Sundarapola site

Human resources	Number of persons
Municipal Commissioner (Administration)	1
Medical Officer of Health (Administration)	1
Public Health Inspector (Administration)	1
Resident site officers	
Site supervisors –(Permanent position)	2
Labours & Machine/Tractor operators	1
Men labours–(Permanent position)	18
Women Labour - (Permanent position)	2
Men labours–(Casual position)	6
Security guard -Day time (Permanent positions)	1
Security guards –Night (Permanent position)	2

The daily machine and labor operation records are available at the site office. The records showed that the site operation cost nearly Rs. 200,000 per month, excluding direct wages for workforce.

Item	Excavator (SH 130)	Skid-Steer Loader	Tractor	Monthly Total
		RS/ Month		
Fuel	38,000	13,607	13,580	65,187
Insurance/Revenue	38,000	3,961	1,325	43,287
Repair/Service	10,775	11,668	2,071	24,514
Operators Salary	32,040	16,962	16,962	65,964
Monthly Amount(Rs)	118,815	46,198	33,940	178,152
Total Cost	**118,815**	**46,198**	**32,243**	**197,257**
(Working factor at final disposal site)	*100%*	*100%*	*95%*	

4.2.5 Major site infrastructure and auxiliary facilities

The Sundarapola dumpsite has few of the typical management infrastructure facilities available at a landfill. Recently, the site has been developed to an integrated solid waste disposal site with composting, toilet waste treatment and recycling facilities. These auxiliary were built through the support from Central Government under Pilisaru project and Ministry of Local Government & Provincial Councils (NSWMSC) funds and technical assistance.

4.2.5.1 Common site infrastructure facilities

Site office, workers rest facility, security hut, entrance gate, chain-link fence around the site, three phase electricity connection, water well and pumping system, domestic water supply from NWS&DB.

4.2.5.2 Composting facility

The composting facility consists of waste unloading and piling area (open-concrete floor), sorting facility (designed for belt conveyer operations but conveying systems has not been installed yet), compost maturing sheds, sieving area (2 mechanical sieving machines), bagging area, finished compost storage. The facility has been designed for large scale operations that process up to 25 tonnes of MSW per day. However, the facility was operated by a private party at the beginning and discontinued of the operation on from 18th June 2014. Thereafter, KMC took over the operation of composting plant and now in the process of gradually starting up the composting operation since October 2014.

Figure 4-6 Composting facility at Sundarapola dumpsite

4.2.5.3 Toilet waste treatment facility

The facility was constructed from central Government fund allocation.

Figure 4-7 Toilet waste treatment facility at Sundarapola dumpsite

4.2.5.4 Plastic recycling facility

The plastic recycling facility was constructed from Pilisary funds as the central recycling facility for Kurunegala District. The facility has plastic sorting area, material store, crushing machines, Agglomerator, washing tanks and finished plastic store area.

Figure 4-8 Recycling center at Sundarapola dumpsite

4.2.6 Current condition of final disposal site and its surroundings

1	Current condition of final disposal site and its surroundings	
1.1	Disposal method and structure	✓ Incoming waste loads from KMC (tractors, compactors and trucks) are recorded at the entrance gate. No records on other waste collection vehicle. ✓ Trucks and tractors are directed to active unloading area (during rain) and directly to filling area (during dry season). ✓ All other MSW collection vehicles emptied its waste at the dumpsite. No specific control measures apply for selection of dumping area. Thus, **Open Dumping** is practiced. ✓ All other wastes are dumped on the ground and heaped up using an excavator. The skid steer loader is occasionally used to assist the excavator
1.2	Soil-covering	✓ In general, daily covering of waste by soil is not practiced ✓ However, soil and construction wastes are used to make temporally access/roads on the dump
1.3	Land owner	✓ Ownership lies with a Kurunegala MC under 99 year lease agreement with Department of Wildlife and Government Agent of Kurunegala
1.4	Residual area	✓ Approximately 12.5 acres (~ 5 hectares) has already been allocated for the site. Nearly 60 % of the site is filled with waste.
1.5	Leachate water	✓ No proper leachate collection system; however there is a properly constructed leachate drain along the roadside to diver the leachate flow to storm water drain without flowing on the road ✓ Leachate and surface water flow towards the stream flow downstream of dumpsite
1.6	Waste picker	✓ None
1.7	Scattering waste, smoke, fire, offensive odor, animals	✓ Waste is dumped on designated areas on the dumping site ✓ Scattering and blowing out of waste is a problem during the dry season because soil covering is not practiced ✓ No fire and smoke witness at the dumpsite during the observation ✓ Occasionally, offensive odors come out from active dumping area ✓ Dogs are frequent in the dump site

4.2.7 Operation and Management of final disposal site

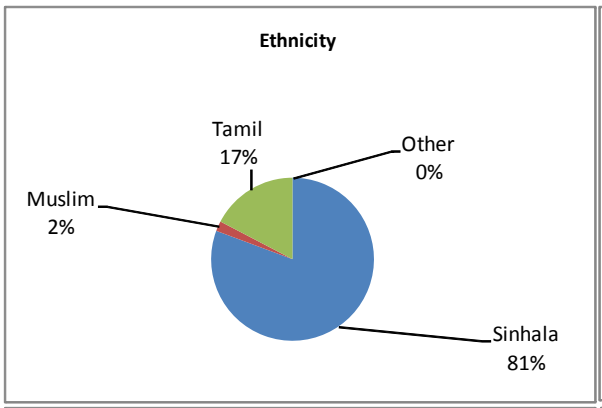
2	**Operation and Management of final disposal site**	
2.1	Environmental Protect License and Environmental Clearance	✓ None
2.2	Personnel	✓ 2-Supervisors –(Permanent position) ✓ 18-Men labors–(Permanent position) ✓ 2-Women Labor - (Permanent position) ✓ 6-Men labors–(Casual position) ✓ 1-Security guard -daytime (Permanent position) ✓ 2-Security guards –Night (Permanent position)
2.3	Operation vehicles, their maintenances and drivers	✓ 1 excavator ✓ 1 skid steer loader ✓ 1 four wheel tractors
2.4	Weighbridge	✓ None
2.5	Waste collection data	✓ Daily record is available only for KMC vehicles
2.6	Supervisory method	✓ General planning and supervision come under Major/commissioner and MOH of KMC. Those three officers are regularly inspecting the site and instruct the site Chief PHI for necessary actions. Site supervisors are responsible for coordinating with KMC for solving daily management issues as well as other contingency matters. ✓ Site supervisor is responsible for daily operations of all facilities

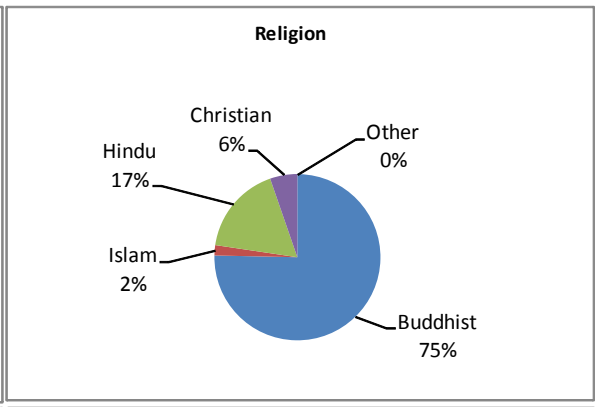
2	**Operation and Management of final disposal site**	
3.0	Waste amount to final disposal site (24 hours, 7 days)	✓ A summary is shown in Table 4-2
4.0	Adverse impact nearby residences	✓ Odor is the man nuisance for residence around the dumpsite ✓ Residence also complain about fly and insect problems ✓ Dust emission during the dry season is a problem for residence around the dumpsite
5.0	Implementation status of geological, topographic and EIA survey for new final disposal site	✓ None
6.0	Progress situation for new final disposal site	✓ None
7.0	Court case	✓ None

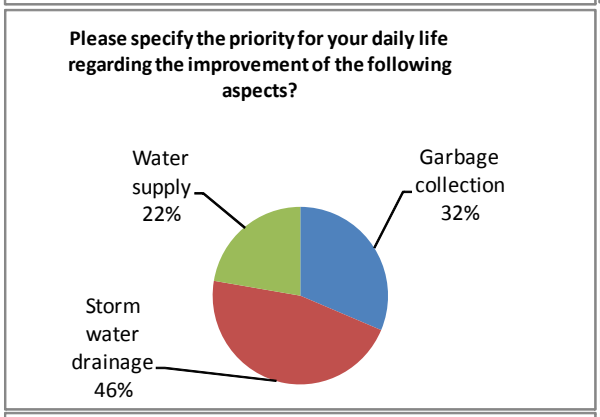
Annex

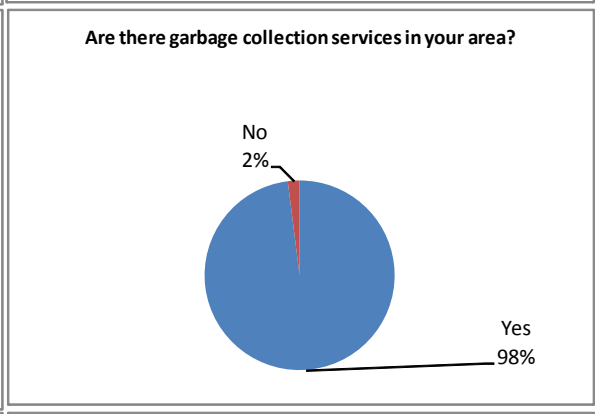
KURUNEGALA MUNICIPAL COUNCIL

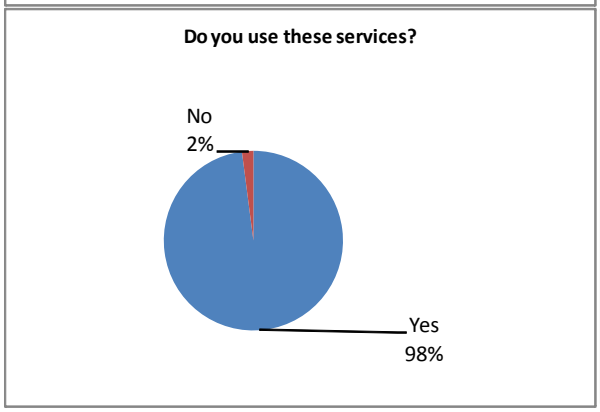
Response to Public Opinion Survey for Household

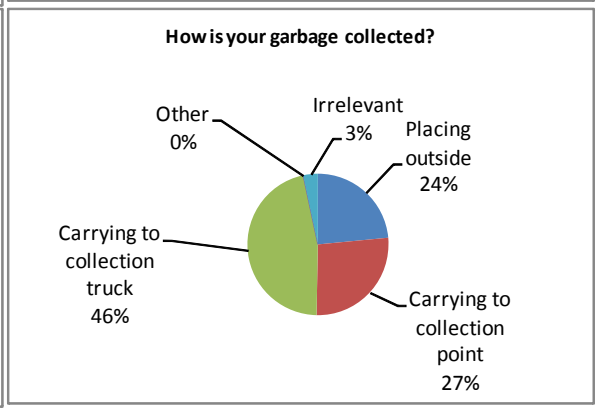












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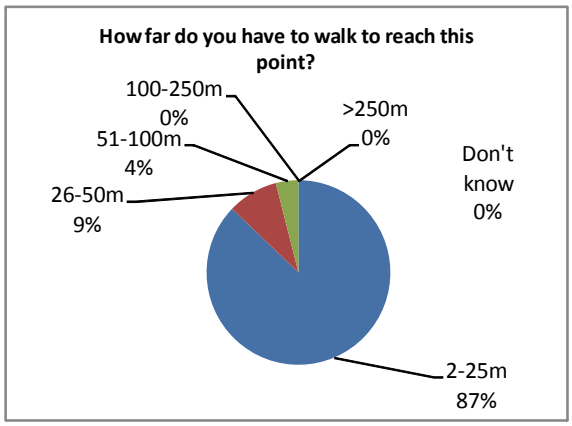

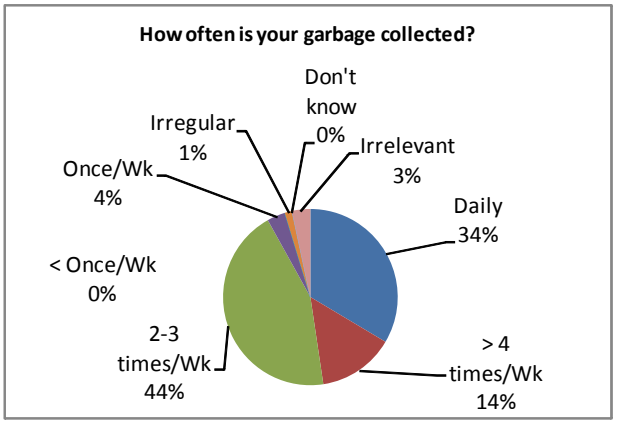

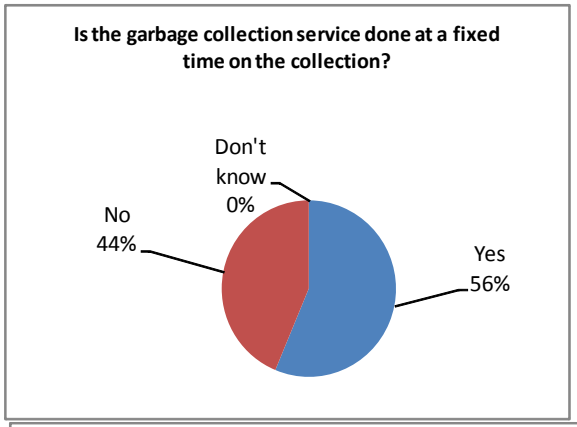

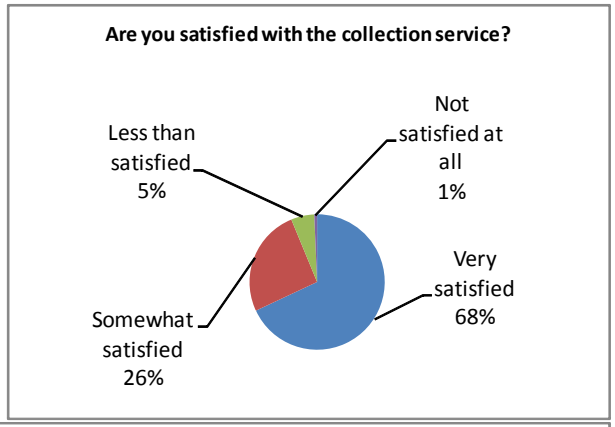

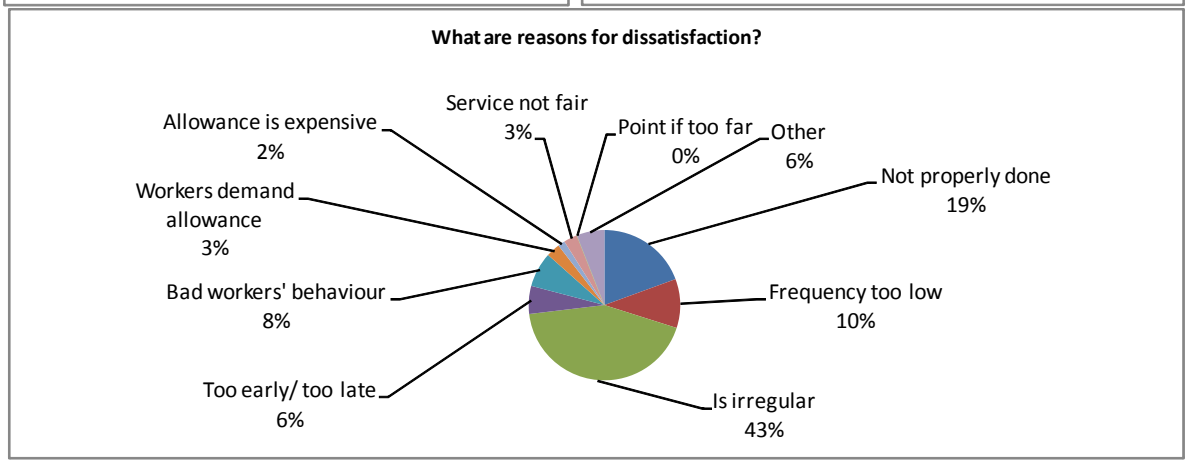

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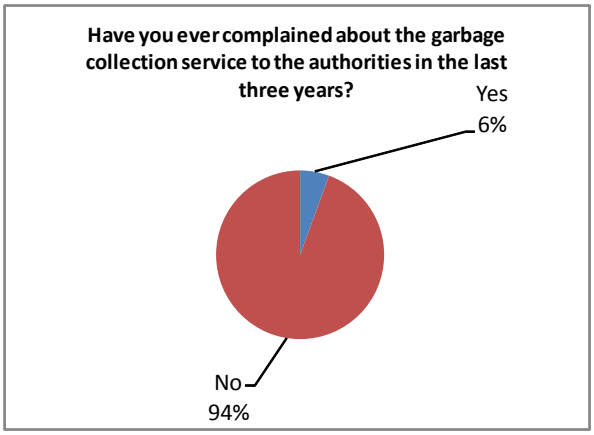

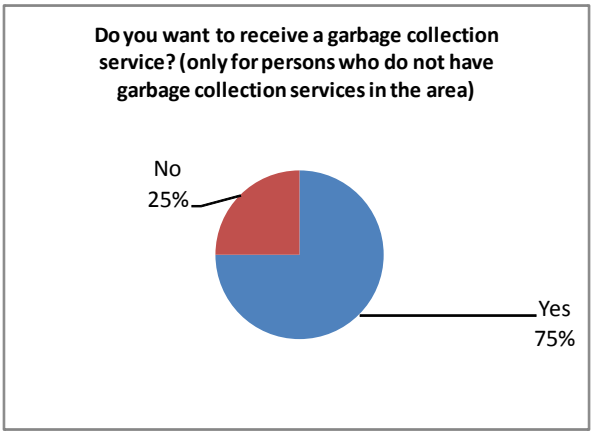

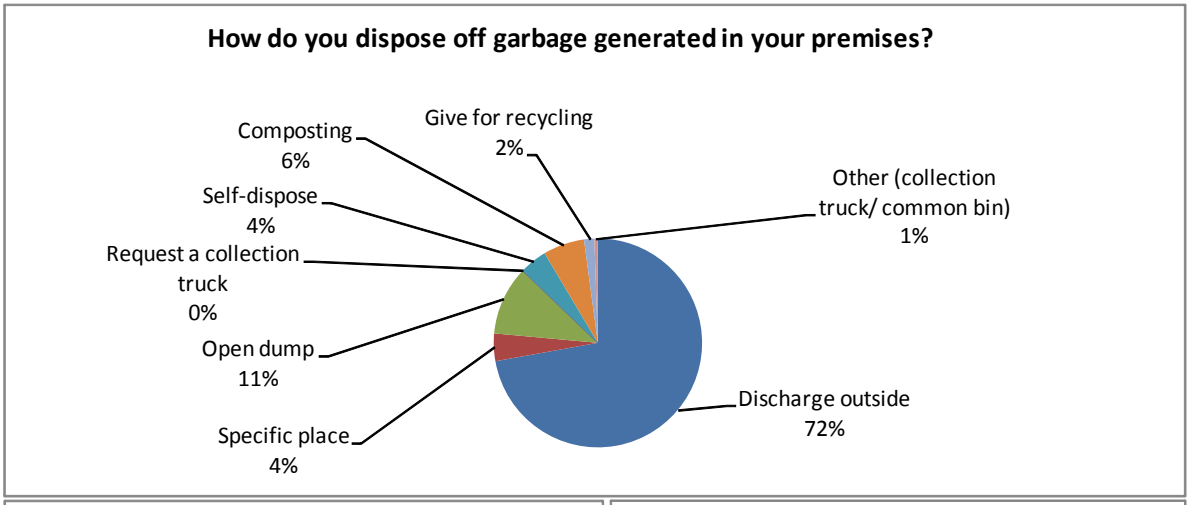

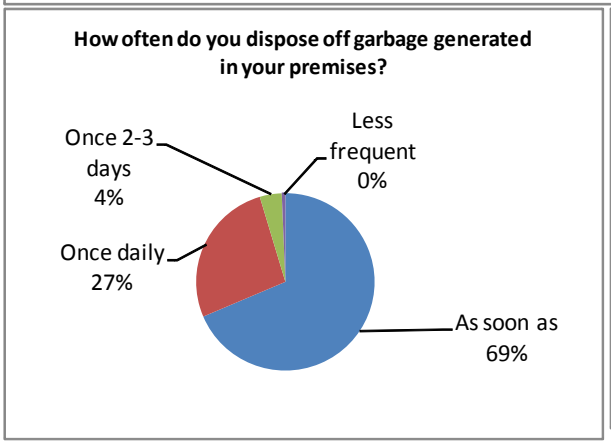

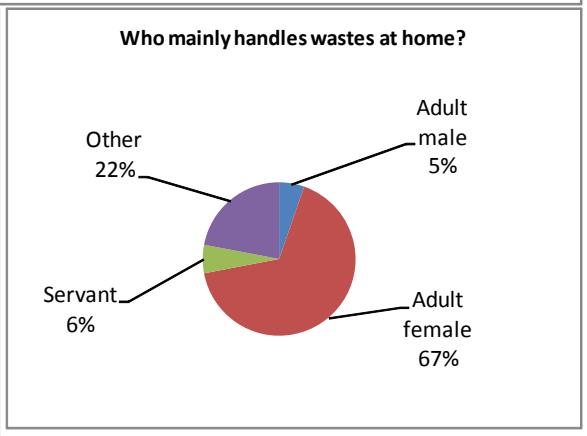

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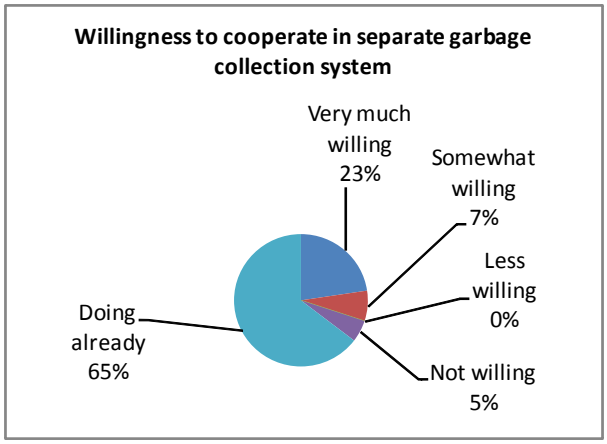
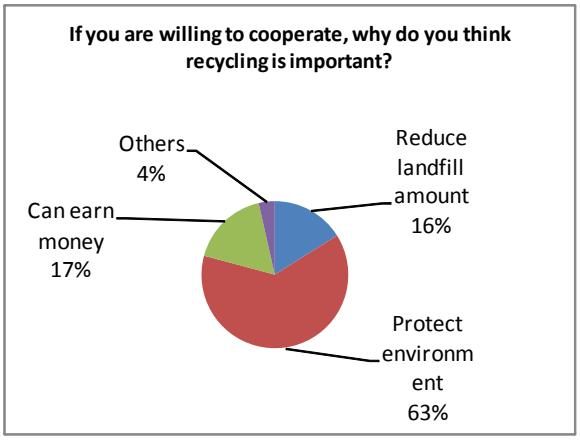
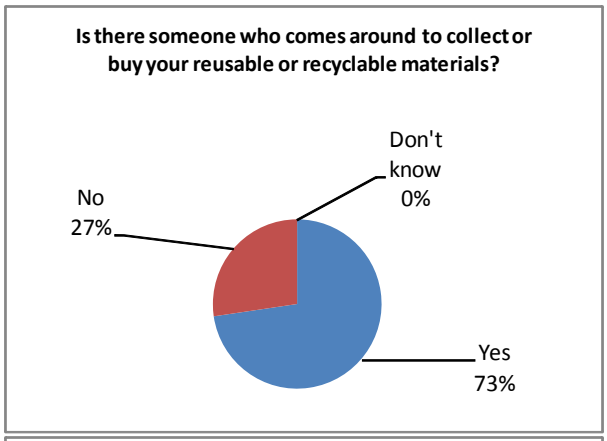
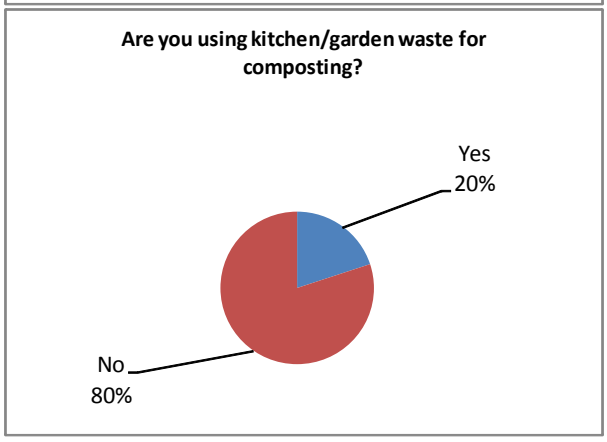
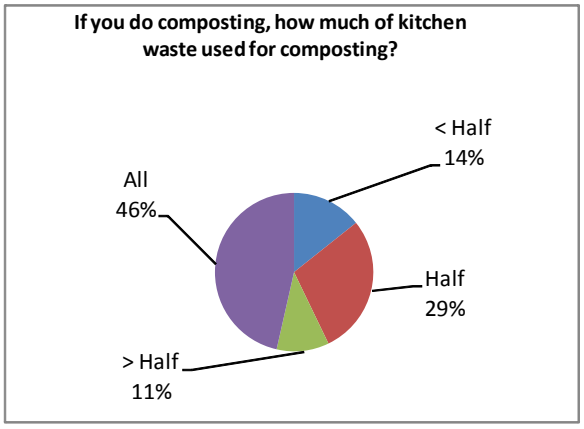




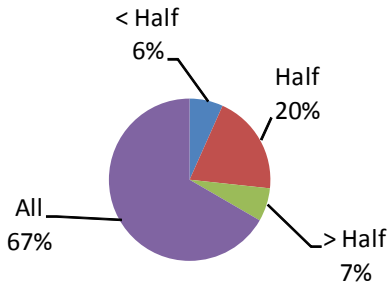




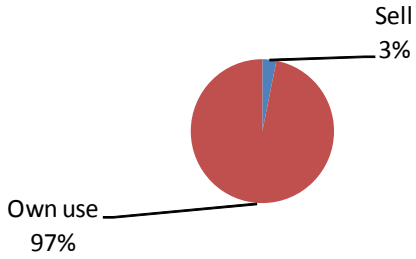


Response to Public Opinion Survey for Household

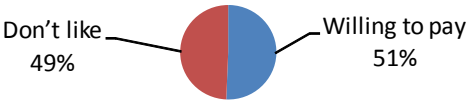
If you do composting, how much of garden waste used for composting?



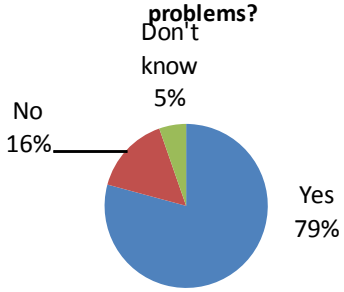
What do you do with produced compost?



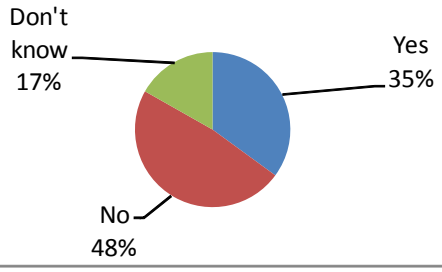
Suppose that you are satisfied with the service of Municipal solid waste management, either as is or as a result of improvement. Think for a moment about the largest amount of money that your household would be willing to pay each month as a garbage colle



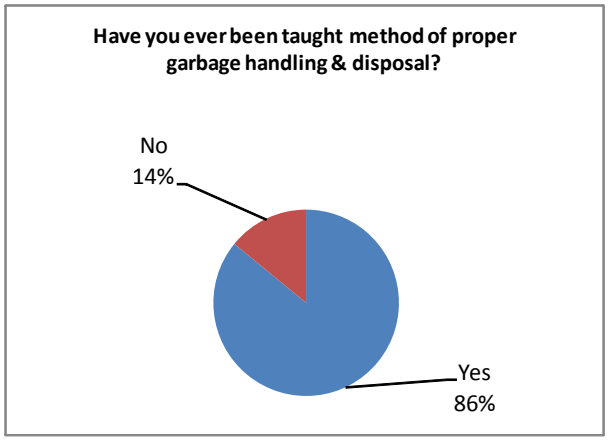
Do you have any community-based organizations to solve not only the waste problems but also other community problems?

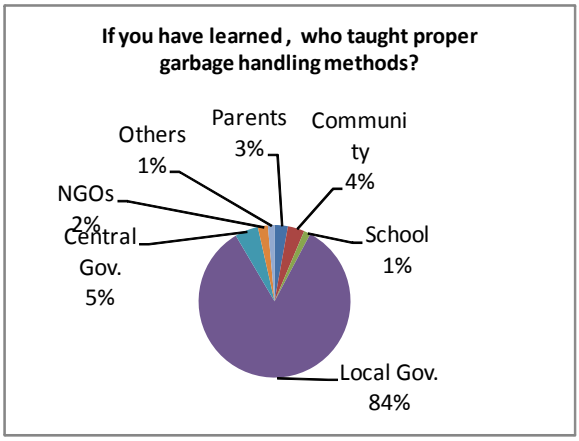


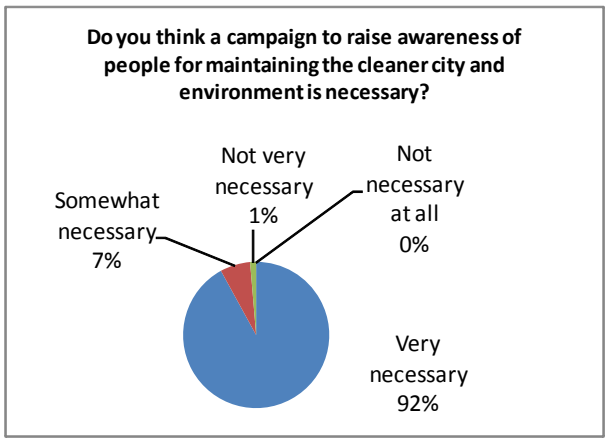
Have you ever discussed the methods of proper garbage handling and discharge at the meetings?



Response to Public Opinion Survey for Household







1.6 Nuwara Eliya MC

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1 Introduction

The purpose of this survey is to obtain the current data regarding Solid Waste Management (SWM) at Nuwara Eliya Municipal Council (NEMC). The data collection survey was conducted from 4th November to 8th November, 2015 by a team of expert dispatched by Waste To Energy Technologies Limited.

This report consists of brief summaries of survey methods and results. The additional primary data and records are available as soft copies. The preliminary data collection was conducted through four comprehensive surveys which are;

i. **Waste Generation Survey (WGS)** is to gather information on waste generation sources at NEMC based on secondary data available at NEMC and other relevant organizations.
ii. **Public Opinion Survey (POS)** is gather information on public opinion on current waste management in NEMC. The POS was conducted through a questionnaire survey that covers different types of waste generators in the NEMC area.
iii. **Final Disposal Site Survey (FDSS)** is to collection data on final MSW disposal site of NEMC based on secondary data as well as field recordings & visits to the site.

1.1 Background conditions of Nuwara Eliya Municipal Council

Nuwara Eliya city is the capital of the Nuwara Eliya District of Central Province of Sri Lanka. Nuwara Eliya serves as the major capital city of the upcountry for commercial and services. It is situated about 160 km from Colombo via Peradeniya. The Nuwara Eliya city is an important location for local as well as foreign tourism, agriculture especially for upcountry vegetable production and sales, and for tea industry.

Nuwara Eliya Municipal Council was established in 1949 to handle all aspects of development within the city. In recent years, there is a boost in tourism industry in the city with latest infrastructure development activities. The reconstruction that had been done in and around the area of the famous Lake Gregory has become a tourist attraction not only to foreigners but also for those within the country. The jogging and cycling areas, recreational activities at the lake side, and new and renovated accommodation facilities are notable features of recent city infrastructure development.

Table 1-1 Basic fact sheet of Nuwara Eliya Municipal Council

Item	Description
Province	Central Province of Sri Lanka
District	Nuwara Eliya
Local Authority Status	Municipal Council
Year of establishment	1949
Location in Relation to	Nuwara Eliya is situated about 160 km from Colombo
Extent of the Authority Area	15. 1 sq.km
No. of Council Wards	10
No. of Council Members	10
No. of Dwellings	6, 799
Population MC record (2012 statistics)	53, 670 (~ 20,000 daily floating population that may increase by 10

	times during festive season in April & long vacations)
Average Population Density	35.5 p/ha
Major economic activities	Tourism, commerce, services, & light scale industry (agro-processing, textile garments etc.)

Due to its highland location, Nuwara Eliya has a subtropical highland climate with a mean annual temperature of 16 °C).In the winter months it is quite cold at night, and there can even be frost. However, it rapidly warms up as the tropical sun climbs higher during the day.

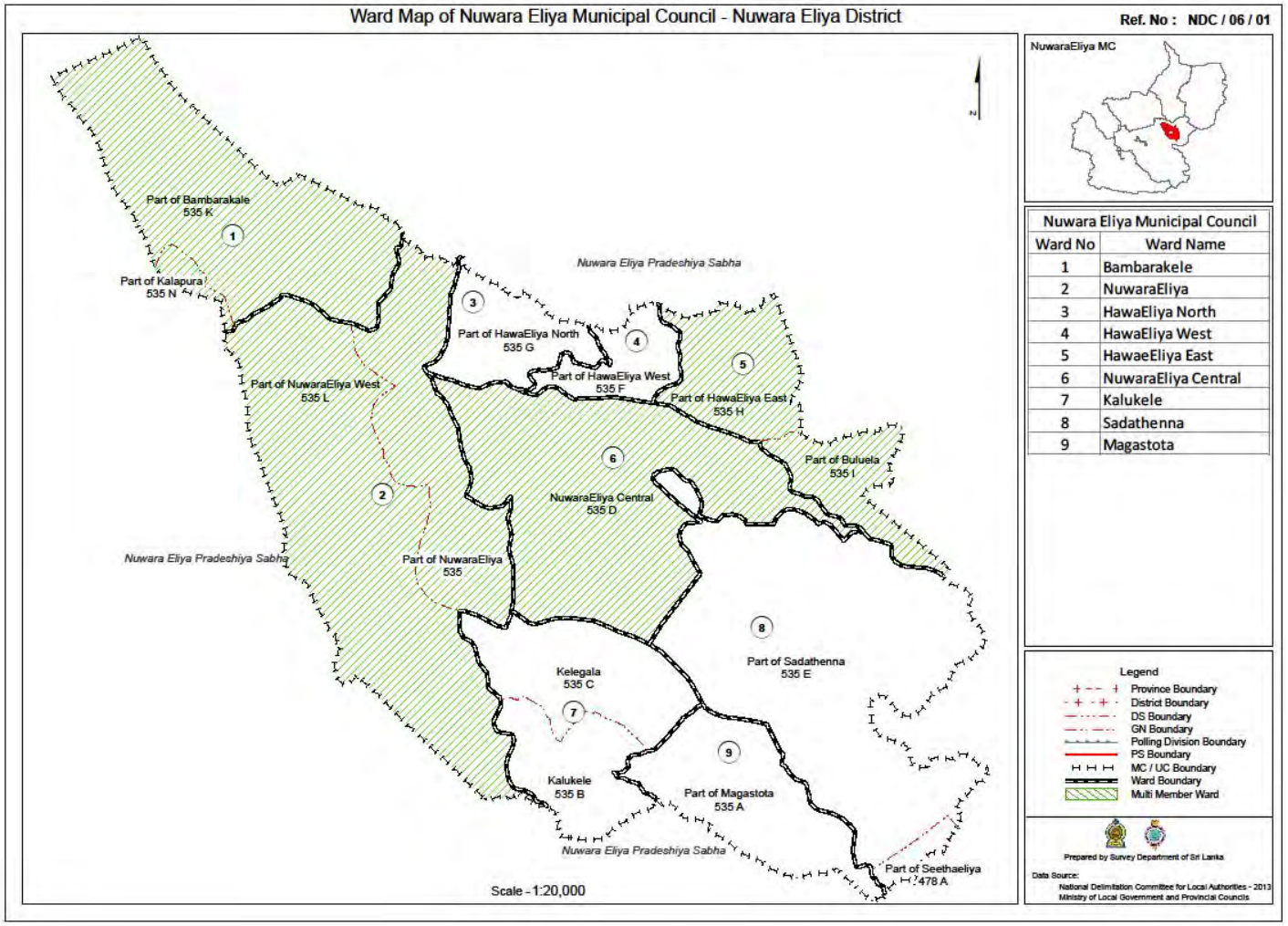


Figure 1-1 City map of Nuwara Eliya MC

2 Waste Generation Survey (WGS)

In order to obtain general information on waste generation amounts, the data available at waste management section of the Health Department, Engineering Department and Revenue Department of NEMC was used. Some of the data was available in the form of formal records and reports which were treated as the most precise secondary data while the data collected from official interviews with NEMC officers was treated as verification data. Thus, the survey data was collected through different methods;

a) Recording and compiling of published and verified data by NEMC,
b) Reading and recording of unpublished & non-confidential data available at NEMC,
c) Recording and official statistics available at Nuwara Eliya Divisional Secretariat office, and
d) Official person-to-person interview with relevant officers at NEMC for verification of data.

The numerical data was collected as specified in following Table 2-1.

Table 2-1 Type of data collected for WGS in Nuwara Eliya MC

Source	Description
Household	Each number of following category households was surveyed; 1) High income level, 2) Middle income level and 3) Low income level.
Commercial	Each number of following category restaurants was surveyed; 1) Large size restaurants, 2) Middle size restaurants and 3) Small size restaurants. Each number of following category shops was surveyed; 1)Organic shops (large) 2)Organic shops (middle) 3)Organic shops (small) 4)Non-Organic shops (large) 5)Non-Organic shops (middle) 6)Non-Organic shops (small)
Hotels	Each number of following category hotels was surveyed; 1) Large size hotels 2) Middle size hotels and 3) Small size hotels.
Markets	Number of stalls and types
Institutions	Each number of following institute was surveyed; 1) Schools 2) Hospitals (government) 3) Hospitals (private) 4) Public office 5) Bank/private office 6) Buddhist temples 7) Hindu temples 8) Mosques 9) Churches 10) Navy/Police/ Army bases 11) Others
Industries	Wastes from any industries.

Source	Description
Other	Public parks and other public facilities
Construction and demolition	Wastes originating from construction, rehabilitation and demolition activities, etc.
Hazardous (Special)	Management and collection of hazardous wastes originating from various sources, including household items

2.1 Waste Generation Survey Results

The records indicate that the total residential population within NEMC is 49, 505 (Source: Divisional Secretariat, Nuwara Eliya 2015). The Nuwara Eliya MC area consists of 15 Grama Niladari (GN) divisions as shown in below Table 2-2 .

Table 2-2 Population statistics of GN divisions in NEMC area

GN Name	GN Number	Total population	No of dwellings
Nuwaraeliya	535	1341	248
Magastota	535A	1464	374
Kalukele	535B	1136	210
Kelegala	535C	1902	399
Nuwaraeliya Central	535D	4463	896
Sandathenna	535E	136	228
Hawaeliya West	535F	2154	492
Hawaeliya North	535G	2305	421
Hawaeliya East	535H	2364	499
Bulu Ela	535I	1408	307
Bambarakele	535K	3268	690
Nuwaraeliya West	535L	2580	618
Kalapura	535N	232	491
Topass	535J	2757	278
Shanthipura	535M	1408	648

As shown in following Table 2-3, Nuwara Eliya MC own and control a larger number of public properties and institutes.

Table 2-3 Type and number of municipal establishment own by Nuwara Eliya MC

Public property	No of units
Libraries	1
Municipal parks	4
Play grounds	2
Market complexes	1
Cemetery	4

Public property	No of units
Vehicle parking complexes	1
Bus stand complexes	1
Office/ sub-office	14
Fish markets	4
Meat stall/ markets	2
Public toilets	12
Pola premises	1
Community centres	8
Gymnasiums	1
Market shops (rent out)	583

Following Table 2-4 shows the number of government and privet/non-government establishments within Nuwara Eliya MC.

Table 2-4 Number of government and privet institutions within Nuwara Eliya MC

Type of institute/organization	No of units	Type of institute/organization	No of units
Government/public		*Institutes (Privet)*	
Schools	18	Schools	5
Higher education institutes	1	Higher education institutes	5
Hospitals	1	Hospitals	1
Hospitals - Clinics	2	Hospitals - Clinics	10
District Secretariat office	1	Banks	8
Divisional secretary offices	1	Insurance companies	10
Banks	4	Financial Institutes	17
Post office	1	Audit firms	7
Police stations	2	Learners	1
Military (Army/ Navy/ Air-force)	1	Health service centres	2
Buddhist temples	10	Private telephone services centres	7
Hindu Kovils	10	Foreign employment agencies	1
Mosques	2	Employment agencies	1
Churches	9	Currier Services	3

A major portion of MSW is generated from commercial sector in the city. Following Table 2-5 shows the number of different commercial (business) establishments in NEMC area.

Table 2-5 Types and number of business establishments in NEMC area

Type of business	No of units	Tyepe of business	No of units
Tea shops	49	Industries	
Restaurants (Bojana shala)	51	Textile and other products	2
Snak bars	2	Diamond cutting	4

Type of business	No of units	Tyepe of business	No of units
Ice-cream	2	Artificial eye lasses production	1
Vegetable/ Fruit shops (large)	29	Jam Production	1
Vegetable and fruits retail shops	38	Other Businesses (trade)	
Vegetable whole sale and potato whole sale	36	Bakery products	7
Retail shops	102	Sweets	7
Chick pea and nut sales	2	Jewelry manufacturing	8
Betel leaves sales	2	Handi crafts	1
Tea sales	13	Gas wholesale	3
Glossary shops	2	Super markets	3
General wholesale shops (large)	80	Whole sale goods distribution centers	7
Ready made garments sales	9	Chillie mills	2
Warm clothes	17	Iron mill (kamhala)	1
Textile trading shops (large)	17	Welding, (paasum, liyawana pattal)	5
Jewelry sales	9	Balances and repair	1
Shoes sales	7	Jewelry pawing centers	14
Electronic equipment sales shop	15	Tailor shops	21
Furniture sales shops	6	phone repair	8
mechanical carpentry items	3	Mobile phone cards and telecommunication services	9
Shop items (sappu Bhanda)	30	Printing	5
Seed potatoes	7	Electrical equipment repair and sales	26
Vegetable seeds and agricultural tools and equipment	11	Computer services	4
Agrochemicals, pesticides, inorganic fertilizer	18	milk collecting centers	1
Stationary	8	Funeral services	4
News papers	2	Colleting of recyclable items	4
Offerings items sales	1	Astrological offices	2
Hardware shops	13	Photographic centers	7
Vehicle sales	4	Fitness centers	1
Vehicle spare parts shops	15	Spa centers	1
Bicycle Spare parts shops	1	Cigarette Agency	1
Tyre and tubes	4	Temporary sale stalls during April season	66
Fish sales stalls	8	Bicycle repair	2
Egg stall	2	Water pums and equipment repair	1
Meat sales stalls	4	Three wheel repair	4
Barber shops	23	Vehicle repair garages	17
Beauty salon	18	Motor cycle repair	2
Pharmacy	10	Vehicle service stations	4
Arduredic and Sinhala medicines sales	10	Fuel filling stations	2
Spectacles	2	Transport services	3
Lottery selling stalls	2	Building blocks and concrete products	4

Type of business	No of units	Tyepe of business	No of units
CD and Video DVD sales	13	Building materials	7
Computer items sales	3	Flower sales	8
Musical instrument sales	1	Miscellaneous	14
Tourist Hotels	18	Betting centers	9
Rest Houses	176		

3 Public Opinion Survey (POS)

This Public Opinion Survey (POS) was commissioned to identify a range of household waste management matters in relation to the household sector. Information on household waste management practices and information on householders' experiences with waste collection delivery services was collected for the purpose of improving our understanding of householder's experiences and attitudes and also to better understand prevailing situation in householder's point of view. The purpose of this survey research included;

a. To collect information on public attitudes to the waste management and environment in broader,
b. To value aspects of environmental health and protection,
c. To provide information on experiences with Local Authority's waste management service and,
d. To provide information on household waste management practices.

3.1 Public opinion survey methodology

The number of samples from Nuwara Eliya identified as 200 households, but size of the sample increased to 204 during the implementation to increase the accuracy. The selection of households and areas within Nuwara Eliya MC was done after a consultative discussion with MSW section officers at NEMC and JICA expert team members.

The survey was executed by a team of university students who were trained about the questionnaire, survey methodology and the data entering before dispatched to their respective fields. A senior expertise took the leadership and continuously supervised the field survey. The selected households were first educated about the survey, its main objectives and asked their cooperation before starting the field survey. In addition business and institutes, large waste generators, hospitals recycling shops and large public markets were also surveyed using appropriate questionnaires prepared in consultation with JICA experts.

Table 3-1 Category and number of samples for Public Opinion Survey

Category	Survey area	Number of samples
High-income households	Unique View, Grand Hotel Rd, Bonavista, Wedaban Rd, Kalukale Rd, Edirisinghe Rd	47
Middle-income Households	Hawaeliya Mahinda Rd, Hawaeliya Vajira Rd, Kalukale Rd, Hawaeliya Rd	53
Low-income Households	Magastota Estate, Bambarakale, Unique View, Lady Mclum Rd, PWD Line	50
Businesses /Service organization	City Center, Badulla Rd, Market complex, Kandy Rd	37
Large waste generators		11
Markets		2
Hospitals		1
Recycling shops		2
NGO		1

Category	Survey area	Number of samples
Total		**204**

The questionnaires were available in all languages (English/Sinhala/Tamil); however the questionnaire form was filled by the interviewer based on interviewees' response. The collected information was recorded in digital form using Microsoft Excel and reviewed for accuracy. The data was analyzed in detail for different objectives that generate an overview of the survey.

3.2 Results of Public Opinion Survey

- ✓ 48% of the surveyed households are Sinhalese, with 47 % of Tamils and 5 % Muslims. The ethnicity could be further classified into 60% Sinhalese in high income group, 68 % of Sinhalese in middle income group and 82 % of low income families were Tamils. The data on the average number of people per household and monthly income is set out in below Table 3-2.

Table 3-2 Average and standard deviation values of income and family size

Category	Family size	Income (Rs/month)
High	4.3 ± 1.1	60,383 ± 19,533
Middle	5.2 ± 2.3	27,340 ± 7,000
Low	5.2 ± 2.0	16,900 ± 8,817
	No of workers	**Income (Rs/month)**
Business	3.4 ± 2.7	349,083 ± 681,795

- ✓ In Nuwara Eliya MC, 97 % of surveyed households are provided with a garbage collection service, of which 95% stated they use this service. 55 % of surveyed households are "very satisfied" with present SWM service provision, while 27 % are "somewhat satisfied".

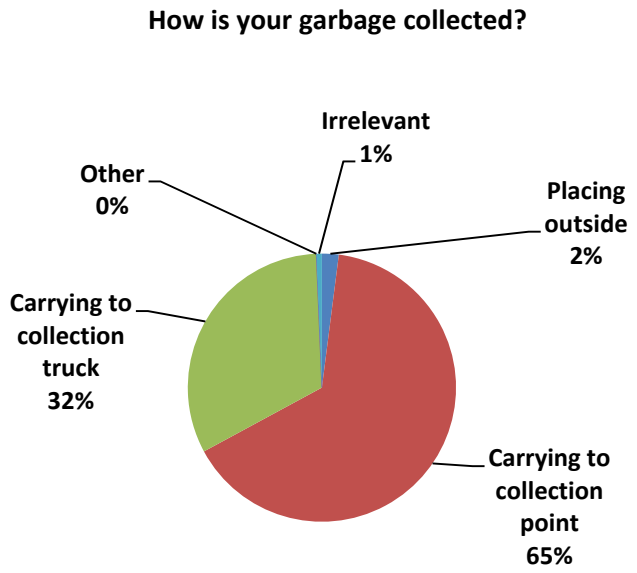


Figure 3-1 Method of garbage discharge by residence in NEMC area

- ✓ Households' main methods of waste discharge are shown in Figure 3-1. The most common methods are carrying garbage to collection point (65%) and carrying to garbage collection truck (32%) and discharging it outside their premises for house to house collection (2%).
- ✓ Only 40% of surveyed households receive a daily garbage collection service while 36 % stated that they received the service 2-3 times/week.
- ✓ 59% discharge their garbage as soon as it is generated and 32 % discharge their garbage daily. Only 9% discharge their garbage 2-3 times per week.
- ✓ In general, adult females handle waste in about 53 % of surveyed households.
- ✓ As shown in Figure 3-2, 35 % of households separate their garbage into organic and inorganic waste at the source of generation. Only 6 % of surveyed households are not/less willing to cooperate with source separation for recycling. Rests of the household are very much willing (50 %) and somewhat willing (4 %) to cooperate in source separated garbage collection system.
- ✓ Further, 72 % of surveyed households stated that there are recyclable collectors or someone who comes to collect their reusable or recyclable materials. Hence, informal recycling system is well established in Nuwara Eliya MC area.

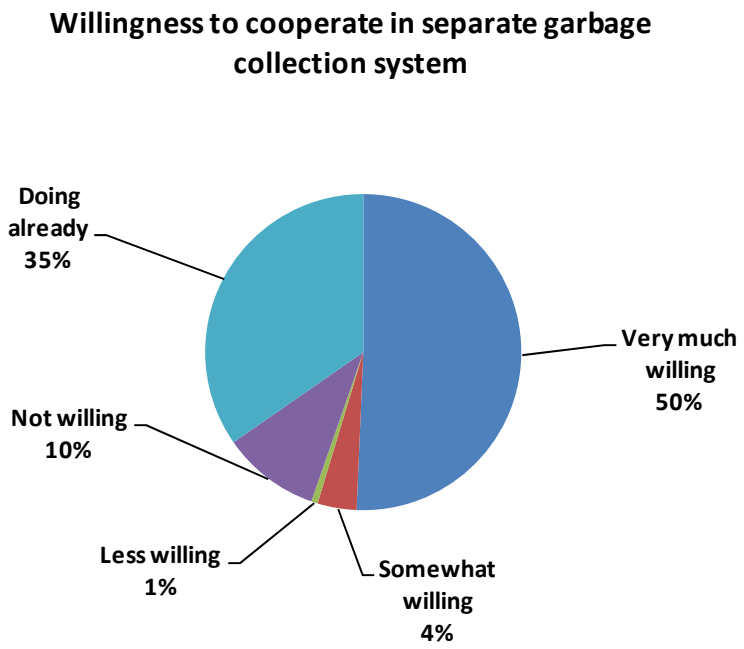


Figure 3-2 Willingness of residence for a source separated garbage collection system in Nuwara Eliya MC

- ✓ Only 17 % of surveyed households use kitchen/garden waste for composting and 100% of them used the finished compost for their own garden.
- ✓ Not many surveyed households (53 %) have ever discussed proper garbage discharge methods at the community level, but 26% said that they discussed the garbage issue at community meetings.
- ✓ 88 % households stated that SWM awareness programmes are very necessary while 11 % stated "somewhat necessary". Only 1% of surveyed households stated that awareness campaigns are not necessary or not needed at all.
- ✓ 51 % of household do not like to pay for SWM service mainly because of the revenue tax they paid for NEMC. The average WTP (willingness to pay) for improved SWM services is 68 ± 125 Rs/month per household.
- ✓ Out of all surveyed households, 19 % stated that they sale/give-off Glass & Bottle for recycling and 2 % of residence sale/give-off Plastics for recycling. Also, 7-10 % of households sale/ give-off can & metal for recycling. Cardboard and paper recycling were 0 % and 4 % respectively.

4 Final disposal site survey (FDS)

4.1 Introduction the FDS of Nuwara Eliya MC

4.1.1 Survey Method

The data and information in this report were collected from various sources including published reports, verified data from Nuwara Eliya Municipal Council, Supervisor of Moonplains Waste Disposal site and direct interview with other officers & workers at disposal site.

4.1.2 Target of Survey

The survey is focus on obtaining general information on waste receiving, handling, disposal, facility management, environmental monitoring and legal adherences.

4.1.3 Data Sampling

The numerical data was collected as specified in following Table 4-1.

Table 4-1 Data collected during the final disposal site survey

	Survey Items	Method
1	Current condition of final disposal site and its surroundings	
	✓ Disposal method and structure	Records, visual observation
	✓ Soil-covering	Records, visual observation
	✓ Land owner	Records
	✓ Residual area	Records, visual observation
	✓ Leachate water	Records, visual observation
	✓ Waste picker	Records, visual observation, interview
	✓ Scattering waste, smoke, fire, offensive odour, animals and so on	Records, visual observation
2	Operation and Management of final disposal site	
	✓ Environmental Protect License and Environmental Clearance	Record
	✓ Personnel	Records, interview
	✓ Operation vehicles, their maintenances and drivers	Records, interview
	✓ Weighbridge	Records, interview
	✓ Waste collection data	Records, interview
	✓ Supervisory method	Records, interview
3	Waste amount to final disposal site (24 hours, 7 days)	Records, Survey
4	Adverse impact near by residences	Records, Survey
5	Implementation status of geological, topographic and EIA survey for new final disposal site	Records, interview
6	Progress situation for new final disposal site	Records, interview
7	Court case	Records, interview

4.2 Current condition of final disposal site and its surroundings

4.2.1 Moonplains waste disposal site

Final disposal site is located in Moonplains, about 6.0 km away from the Nuwara Eliya city center. The area lies within Moonplians GN division in Nuwara Eliya Divisional Secretariat Division.

Moonplains waste disposal facility was upgraded to a model semi-engineered sanitary landfill in year 2003 with JICA assistant. This disposal facility was the first model sanitary landfill in Sri Lanka and is still continue to be a model landfill.

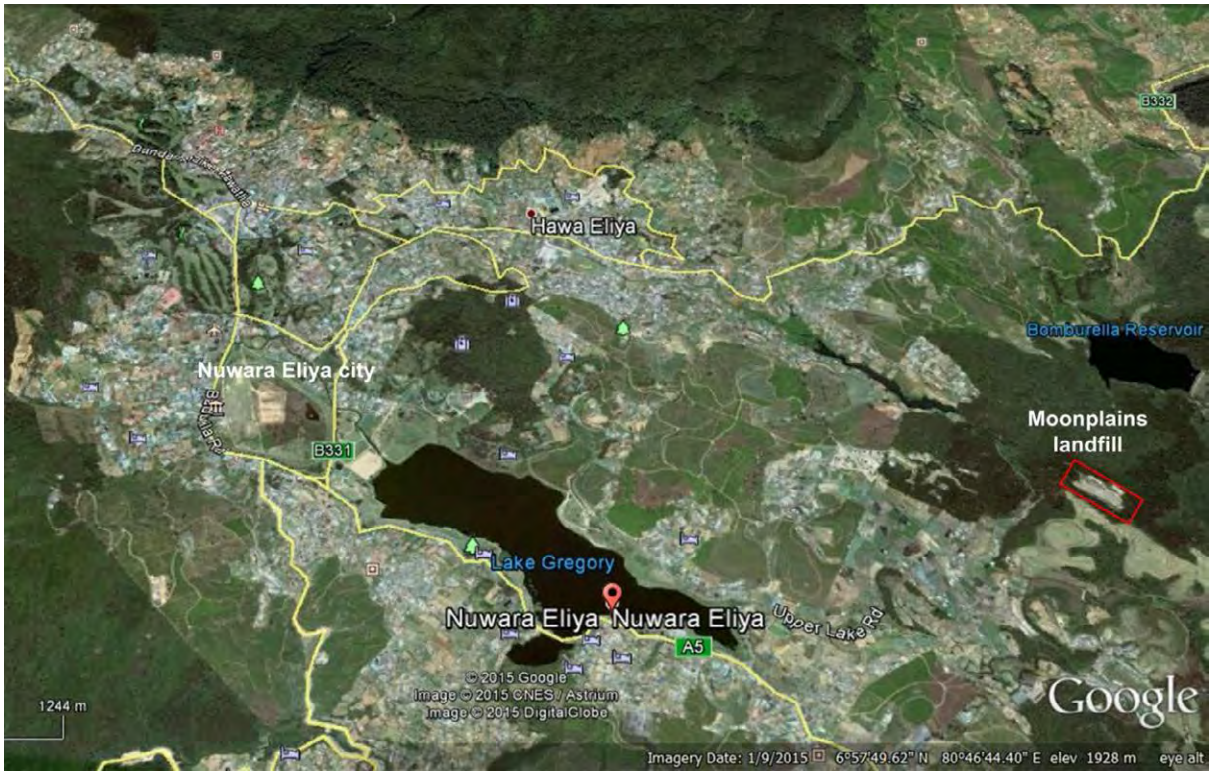


Figure 4-1 Location of Moonplains dumpsite

4.2.2 Extend and landform

Final disposal site is located at Moonplains, at about 1 km inside the forest reservation. At present, the area covering the dumpsite and access road to the dumpsite are belonging to NEMC which was transferred during the landfill development in 2003. Currently the site is having valley landform on a middle slope of a small mountain. The site is surrounded by the plantation forest and there are two accesses to the site from the top of the slope as well as from the bottom of the landfill via Bomuruella reservoir road. The closets proximity to a residence is about 1 km from the active filling area. There is a small perennial stream at the bottom of the valley which used to discharge the treated effluent from landfill and toilet waste treatment facility.

Figure 4-2 Moonplains dumpsite and environment within 500 m radius from center

As shown in Figure 4-2 and Figure 4-3, there is an entrance to the site from the Moonplains road. The entrance road has been developed with tarmac up to the main entrance of the dumpsite. Internal access roads up to waste discharging area and toilet waste disposal facility are also tarmac paved; all other internal access roads on the dump are temporally constructed by compacted soil.

Figure 4-3 Landfill facilities at Moonplains Landfill site

4.2.3 Waste receiving and disposal

The existing dumpsite is receiving 26 tonnes of waste per day (Table 4-2). At present, there is no source segregated waste collection in NEMC, therefore all the waste are disposed at the dump, except for small amount of recyclable waste received through normal waste collection system.

Table 4-2 Average quantities of MSW disposed at Moonplains MSW dumpsite for 11 days

Date	Tonnes/ day
21-Oct	25.6
22-Oct	29.6
23-Oct	21.5
24-Oct	19.0
25-Oct	11.5
26-Oct	45.6
27-Oct	20.6
28-Oct	34.9
29-Oct	25.6
31-Oct	30.6
1-Nov	21.5
Average	**26.0**

The site office maintains a record of receiving waste from NEMC and also maintains written record on day-to-day activities and including a visitor's book.

Figure 4-4 Landfilling machineries at Moonplains dumpsite

4.2.4 Management of Moonplains Dumpsite

The management of the dumpsite has a pre-schedule plan for waste disposal. The site supervisor instructs the waste collection vehicles and waste handling machineries for disposal area.

One of the biggest challenges in management is to get dumping vehicle access to the active filling area during the heavy rainy season. Therefore, site management unloads the waste from the internal access road to the dumping area and the bulldozer is used to move and compact the waste.

Figure 4-5 Waste unloading and dumping area of Moonplains dumpsite

At present, the dumpsite management is well established with human resources and considerable amount of facilities and machineries. Following table show the management structure and human resources at the Moonplains dumpsite.

Table 4-3 Administration structure and human resources available at Moonplains site

Human resources	Number of persons
Municipal Commissioner (Administration)	1
Medical Officer of Health (Administration)	1
Chief Public Health Inspector (Administration)	1
Resident site officers	
Site supervisors –(Permanent position)	1
Labours & Machine/Tractor operators	1
Men labours–(Permanent position)	3
Security guard -Day time (Permanent positions)	1
Security guards –Night (Permanent position)	1

The daily machine and labor operation records are available at the site office. The records showed that the site operation cost is mainly for Bulldozer operation and maintenance which is nearly Rs. 1.1 million per year.

Table 4-4 Annual machinery cost (bulldozer) at Moonplains landfill

Item	Annual cost (Rs)
Fuel	434,158
Repair/Service	282,700
Operators Salary	384,000
Total annual cost	1,100,858

4.2.5 Major site infrastructure and auxiliary facilities

The integrated site includes a small incinerator for paper waste, toilet waste treatment facility, medical waste disposal facility, e-waste disposal facility, leachate treatment facility, workers rest and site office, education & training facility, and plastic recycling facility (under construction).

The toilet waste treatment facility has been renovated with new coir biobrush application and extension of primary clarification tank. Those renovations were done during 2010-2014. The leachate treatment facility was also renovated with application of coir biobrush and charcoal filtering system. A plastic net has placed on the open tank to prevent plant letter fall on the tank.

In addition, electricity and domestic waste supply are also available at the site.

The plastic recycling facility is the new addition to integrated landfill facility which was partially funded by Pilisaru project (Rs. 5.5 million) and NEMC (Rs. 2.5 million).

Figure 4-6 Plastic recycling center under construction

Entrance and site office

Garage for bulldozer

Land filled area

Waste filled area without soil cover

Leachate treatment facility

Toilet waste treatment facility

Medical waste disposal facility

E-waste disposal

Paper incinerator

Figure 4-7 Land filling area and auxiliary facilities at Moonplains landfill

4.2.6 Current condition of final disposal site and its surroundings

1	Current condition of final disposal site and its surroundings	
1.1	Disposal method and structure	✓ Incoming waste loads from NEMC (tractors, compactors and trucks) are recorded at the entrance gate. ✓ Trucks and tractors are directed to active unloading area (during rain) and directly to filling area (during dry season). ✓ All other MSW collection vehicles emptied its waste at the dumpsite. Site is managed with designated pattern and waste is dumped only on selected areas. ✓ Waste is covered with soil. Daily soil cover is applied during dry season and covering by soil during heavy rainy season is limited due to difficulties in access on waste by Bulldozer/ trucks. Thus, **controlled tipping** is practiced.
1.2	Soil-covering	✓ 15 cm thick soil layer applied daily on disposed waste. The availability of soil at the site is limited, therefore municipality collects and import soil from city and other areas whenever necessary ✓ In general, daily covering of waste by soil is practiced except during heavy rainy season ✓ Soil and construction wastes are used to make temporally access/roads on the dump
1.3	Land owner	✓ Ownership lies with a Nuwara Eliya MC
1.4	Residual area	✓ Approximately 2.5 hectares (~5.2 5 acres) has already been allocated for the site. Nearly 60 % of the site is filled with waste.
1.5	Leachate water	✓ There is leachate collection pipe network beneath the dump and several open drains on the dump. The open drains are connected to gas venting systems (vertical structures filled with gravel). However, the gas vents have already clogged with soil and debris. Therefore, leachate contaminated rain water runs over the waste fill and overflow to leachate treatment facility. ✓ Treated effluent from toilet waste treatment facility is also diverted to leachate treatment facility ✓ Treated leachate and surface water flow towards the stream flow downstream of dumpsite
1.6	Waste picker	✓ None

1	**Current condition of final disposal site and its surroundings**	
1.7	Scattering waste, smoke, fire, offensive odor, animals	✓ Waste is dumped on designated areas on the dumping site ✓ Scattering and blowing out of waste is minimum due to covering by soil during dry season ✓ No fire and smoke witness at the dumpsite during the observation ✓ Occasionally, offensive odors come out from active dumping area ✓ There are about 10 dogs in the site ✓ Entering of wildlife (wild boar and stags) during the nighttime has been observed

4.2.7 Operation and Management of final disposal site

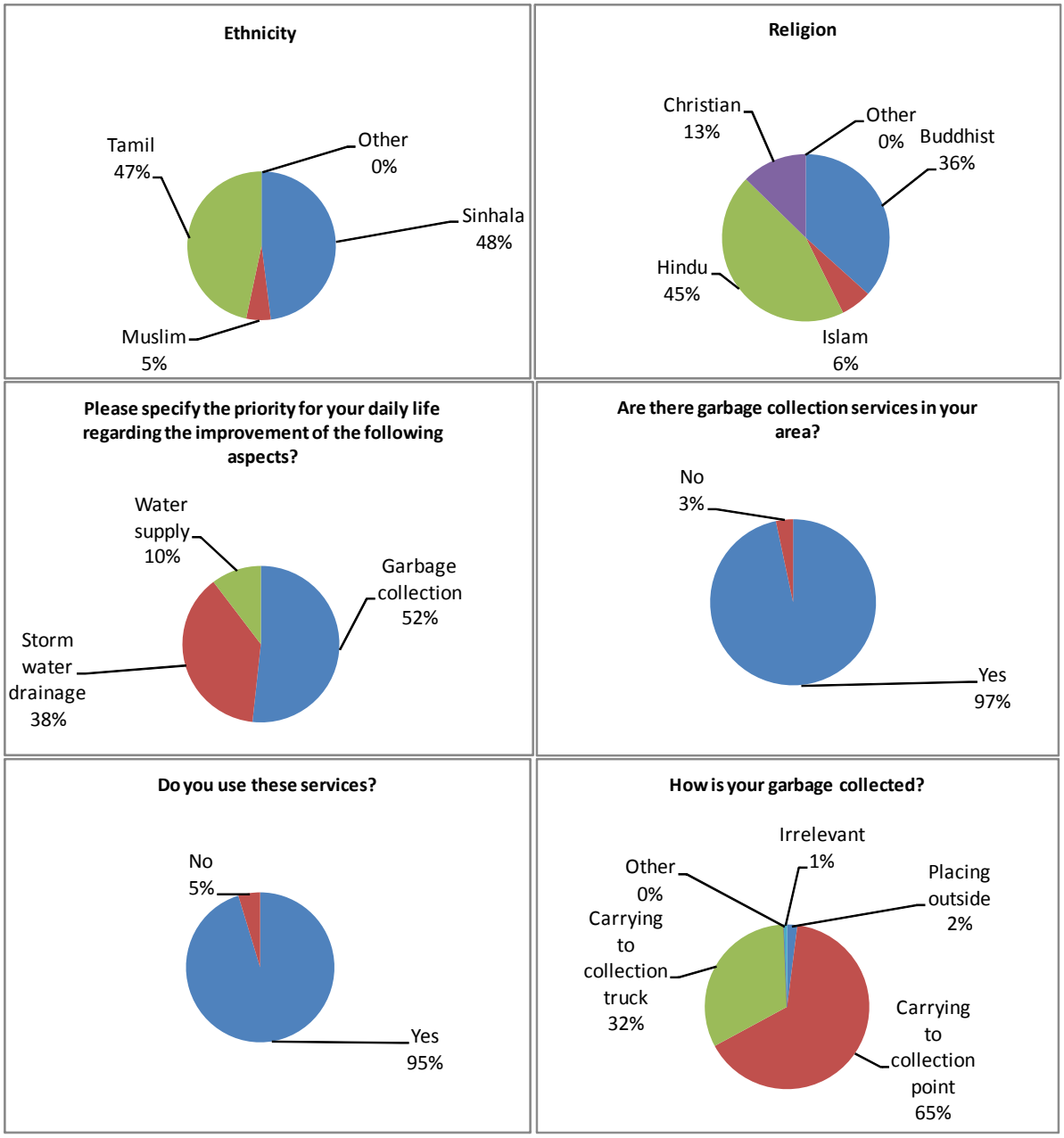
2	**Operation and Management of final disposal site**	
2.1	Environmental Protect License and Environmental Clearance	✓ Regular inspections are done by CEA ✓ The irrigation department analyze the quality of downstream waters
2.2	Personnel	✓ 1-Supervisors –(Permanent position) ✓ 3-Men labors–(Permanent position) ✓ 1-Machine operator - (Permanent position) ✓ 1-Security guard -daytime (Permanent position) ✓ 1-Security guards –Night (Permanent position)
2.3	Operation vehicles, their maintenances and drivers	✓ 1 Bulldozer (CAT D4)
2.4	Weighbridge	✓ None

2	**Operation and Management of final disposal site**	
2.5	Waste collection data	✓ Daily record is available for vehicle and visitors entry. And also records are available for daily routine works including repair and maintenance of facilities
2.6	Supervisory method	✓ General planning and supervision come under Major/commissioner/ Engineer and MOH of NEMC. Those three officers are regularly inspecting the site and instruct the site supervisor and Chief PHI for necessary actions. Site supervisors are responsible for coordinating with NEMC for solving daily management issues as well as other contingency matters. ✓ Site supervisor is responsible for daily operations of all facilities
3.0	Waste amount to final disposal site (24 hours, 7 days)	✓ A summary is shown in Table 4-2
4.0	Adverse impact nearby residences	✓ No records and objections from nearby residence ✓ Department of irrigation has made verbal communication on treated water quality
5.0	Implementation status of geological, topographic and EIA survey for new final disposal site	✓ None
6.0	Progress situation for new final disposal site	✓ None
7.0	Court case	✓ None

Annex

NUWARA ELIYA MUNICIPAL COUNCIL

Response to Public Opinion Survey for Household



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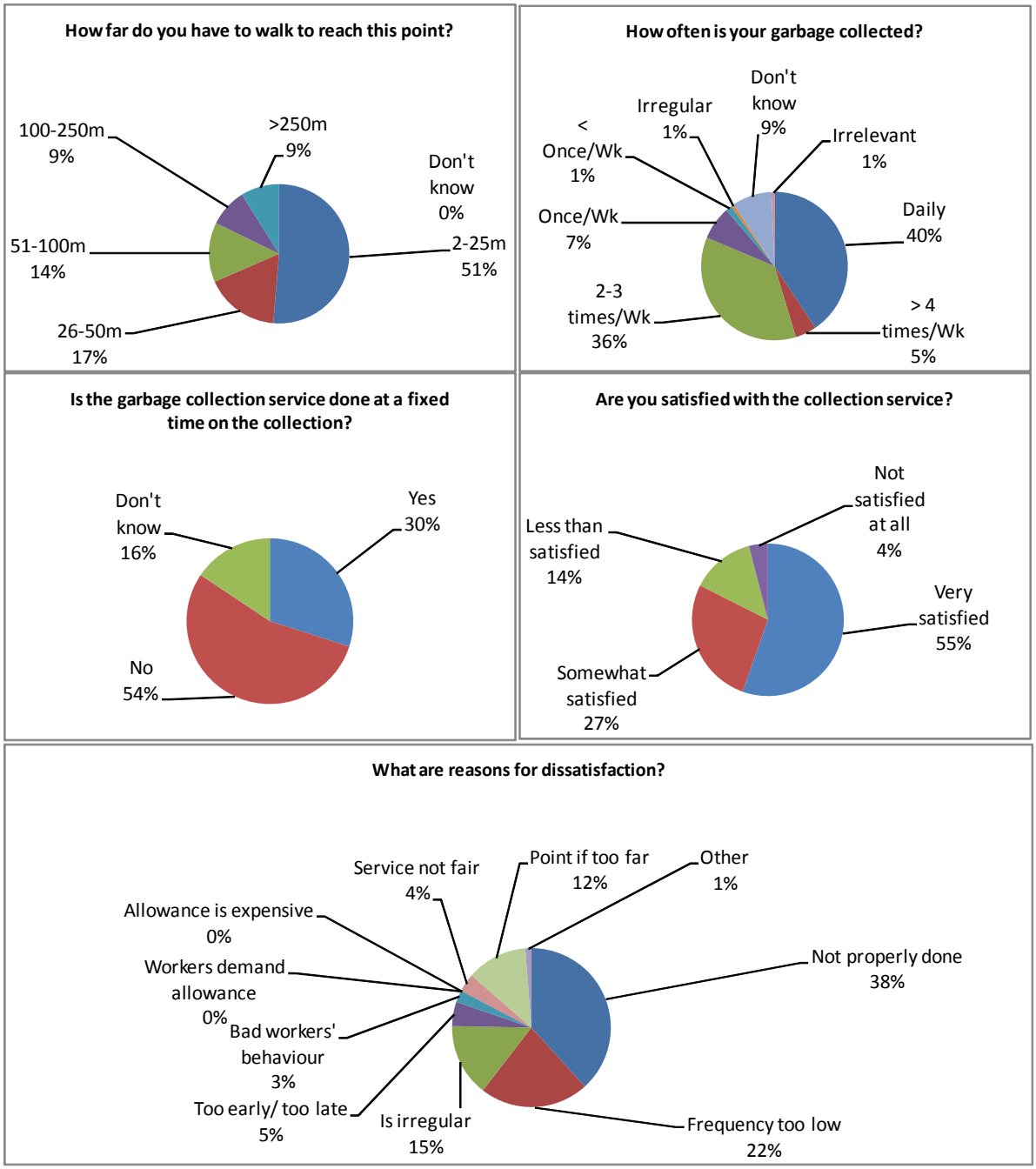

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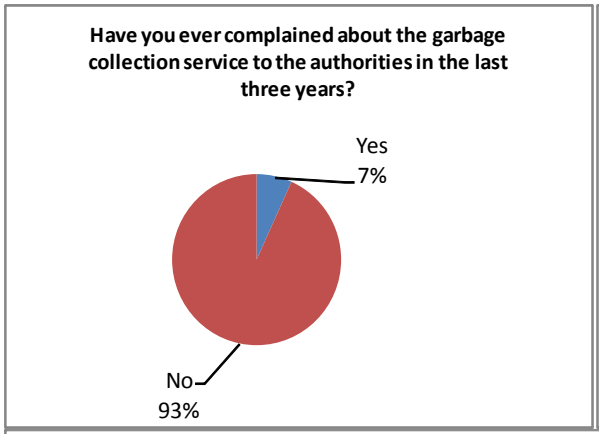

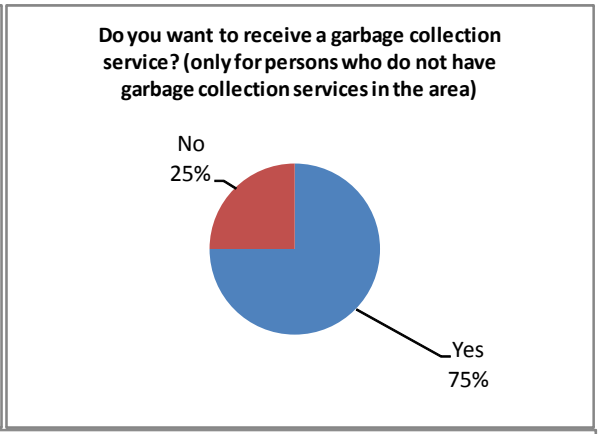

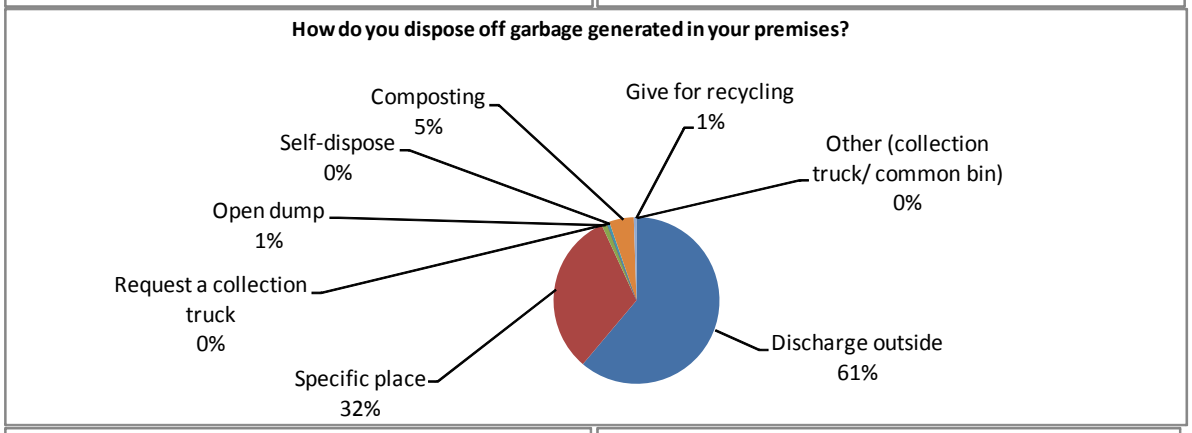

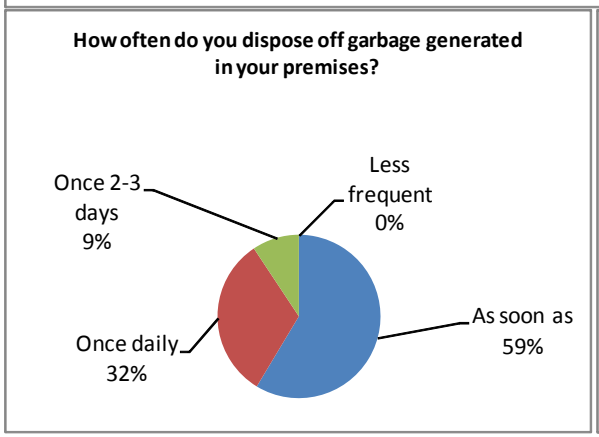

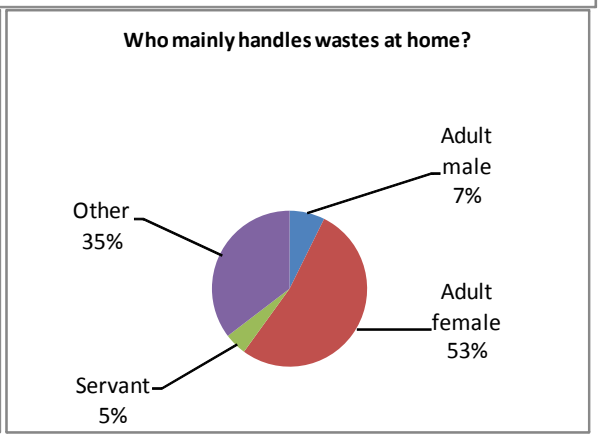

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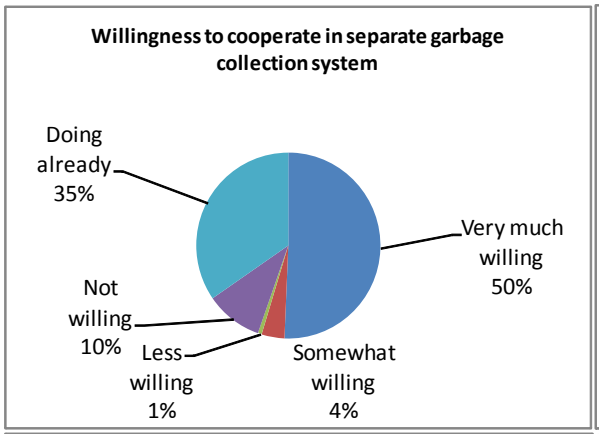
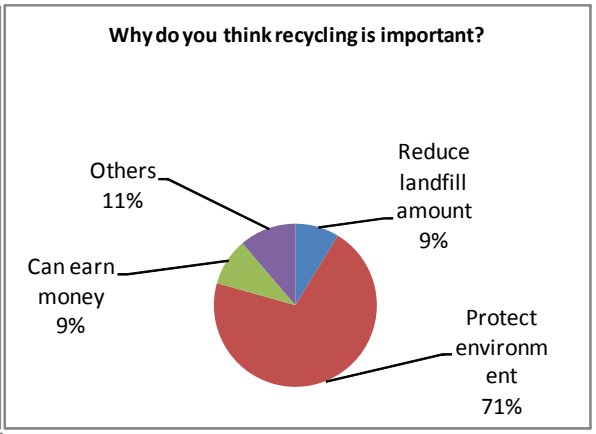
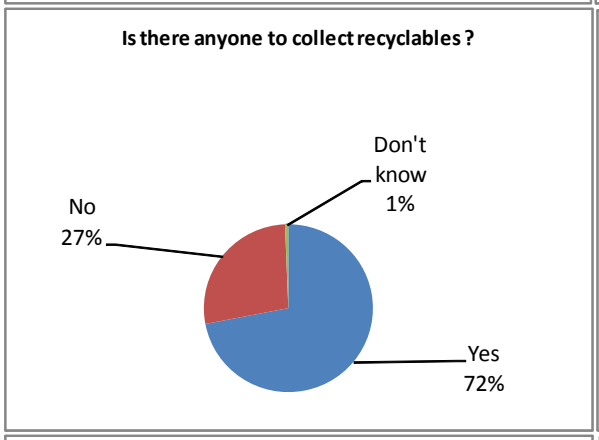
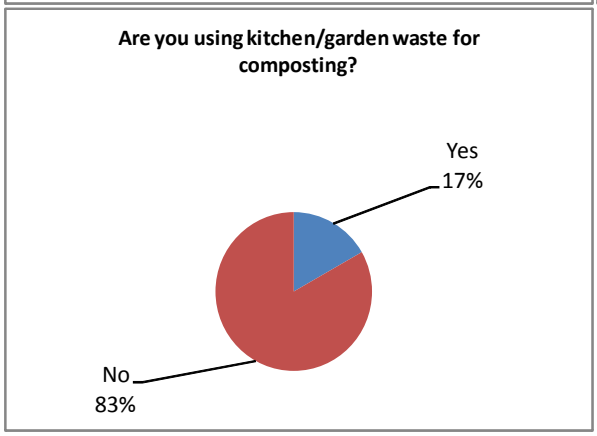
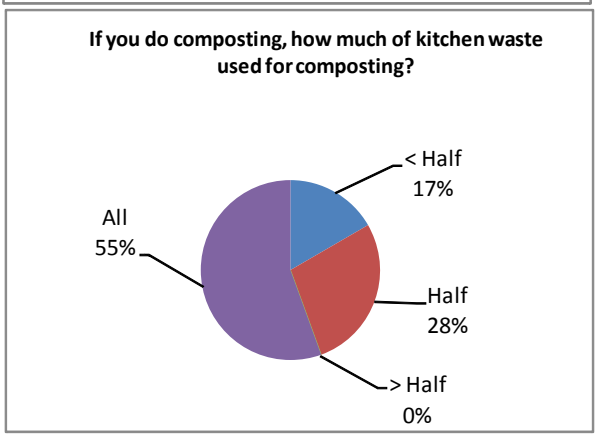




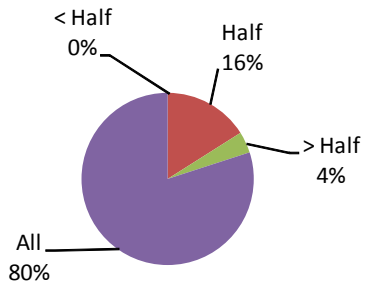




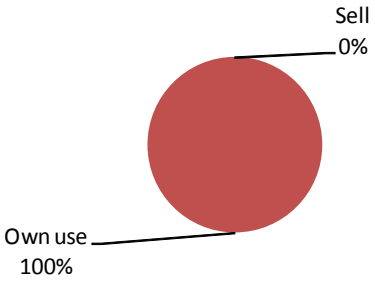


Response to Public Opinion Survey for Household

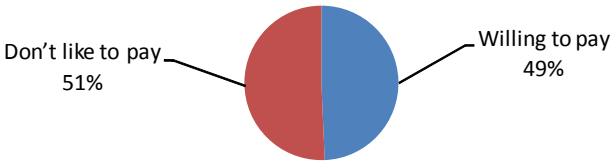
If you do composting, how much of garden waste used for composting?



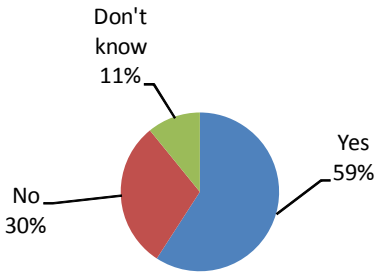
What do you do with produced compost?



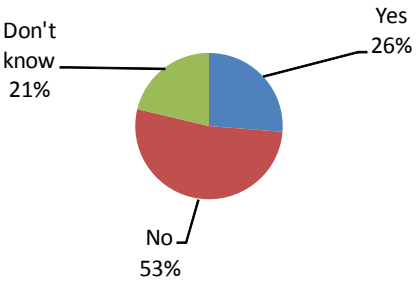
Suppose that you are satisfied with the service of Municipal solid waste management, either as is or as a result of improvement. Think for a moment about the largest amount of money that your household would be willing to pay each month as a garbage colle



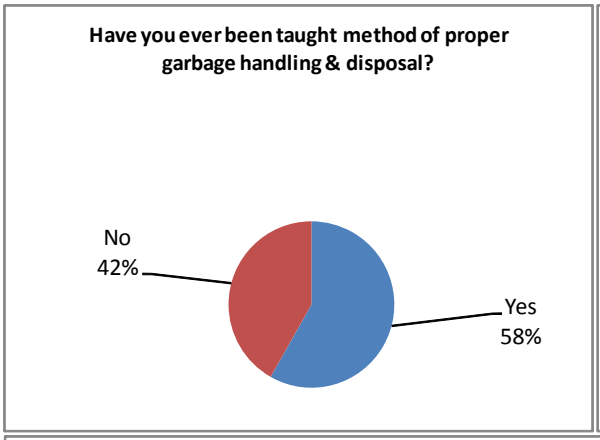
Do you have any community-based organizations to solve not only the waste problems but also other community problems?

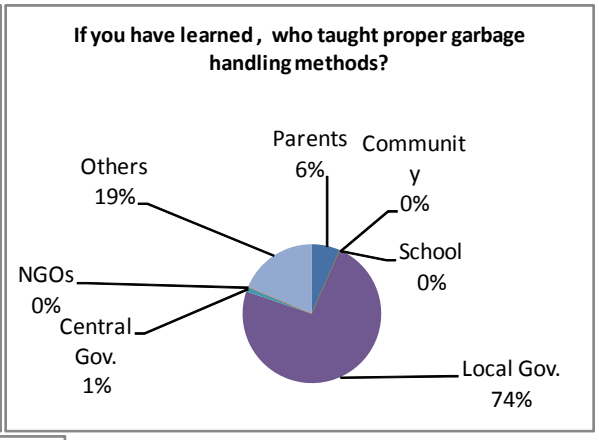


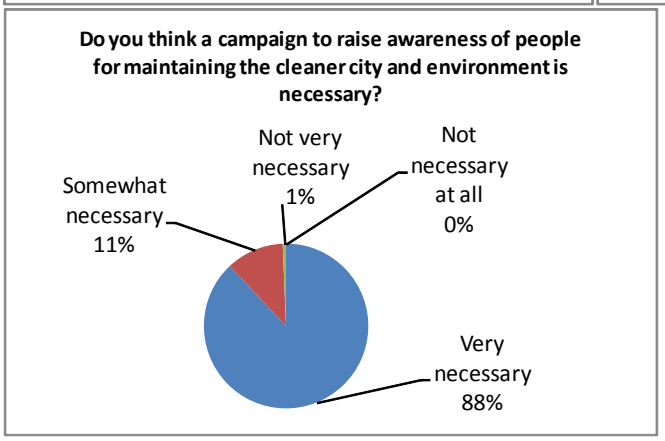
Have you ever discussed the methods of proper garbage handling and discharge at the meetings?



Response to Public Opinion Survey for Household







1.7 Moratuwa MC

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1 Introduction

The purpose of this survey is to obtain the current data regarding Solid Waste Management (SWM) at Moratuwa Municipal Council (MMC). The data collection survey was conducted from 13th October to 19th October, 2015 by a team of expert dispatched by Waste To Energy Technologies Limited.

This report consists of brief summaries of survey methods and results. The additional primary data and records are available as soft copies. The preliminary data collection was conducted through four comprehensive surveys which are;

i. **Waste Generation Survey (WGS)** is to gather information on waste generation sources at MMC based on secondary data available at MMC and other relevant organizations.
ii. **Public Opinion Survey (POS)** is gather information on public opinion on current waste management in MMC. The POS was conducted through a questionnaire survey that covers different types of waste generators in the MMC area.
iii. **Final Disposal Site Survey (FDSS)** is to collection data on final MSW disposal site of MMC based on secondary data as well as field recordings & visits to the site.

1.1 Background conditions of Moratuwa Municipal Council

Moratuwa town is located in the Colombo District of the Western Province on the Southern direction of City of Colombo. It is bounded by Dehiwala-Mt. Lavinia Municipal Council to the North, Indian Ocean to the West and Bolgoda river to the South and to the East.

From 1908 to 1930 Moratuwa town had been administered by a Local Board. It received Urban Council status on 1st January 1930. It was elevated to the level of a Municipal Council on 8th January 1998.

It is one of those towns, which came under the impact of industrialization move, which took place in Colombo during the 1970s. It forms part of the Ratmalana industrial area, which has a wide variety of modern industries providing employment for the population of its hinterland areas. The Western coastal belt of this town had been traditionally a fishing settlement although its character is presently under going change particularly after the construction of the new coastal road parallel to the railway line. The location of one of the premier technical universities in the country namely the University of Moratuwa and the Arthur C. Clark Centre at Katubedda provide a new dimension to the modernization and technical advancement for this area as well as for the country. Moratuwa is one of the nearest urban centres of Colombo city where the impact of Colombo's development was felt strongly.

Moratuwa is one of the five Municipal Councils coming within the Colombo Metropolitan Area. Its importance lies mainly due to the following factors.

- ✓ A town with some modern industrial activities
- ✓ Traditional carpentry workshops and timber industry

- ✓ Fisheries activities
- ✓ Educational and religious centres of a higher order
- ✓ Service activities particularly related to tourists industry
- ✓ Residential suburbs of Colombo

In view of its demographic, social and economic importance, Moratuwa has been identified as a sub-regional center in the Regional Structure Plan prepared for the Colombo Metropolitan Region by the Urban Development Authority in 1998.

Table 1-1 Basic fact sheet of Moratuwa Municipal Council

Item	Description
Province	Western Province of Sri Lanka
District	Colombo
Local Authority Status	Municipal Council
Year of Establishment	January 1998 (Formerly an Urban Council since January 1930)
Location in Relation to	Moratuwa is located Colombo City on the Southern direction about 24 km away from Colombo City
Extent of the Authority Area	23.6 sq.km
No. of Council Wards	17
No. of Council Members	29
No. of Villages	42
No. of Dwellings	41, 459
Population MC record (2012 statistics)	166, 857 (132, 795)
Average Population Density	56.26 p/ha

2 Waste Generation Survey (WGS)

In order to obtain general information on waste generation amounts, the data available at waste management section of the Health Department, Works Department and Revenue Department of MMC was used. Some of the data was available in the form of formal records and reports which were treated as the most precise secondary data while the data collected from official interviews with MMC officers was treated as verification data. Thus, the survey data was collected through different methods;

a) Recording and compiling of published and verified data by MMC,
b) Reading and recording of unpublished & non-confidential data available at MMC,
c) Recording and official statistics available at Moratuwa Divisional Secretariat office, and
d) Official person-to-person interview with relevant officers at MMC for verification of data.

The numerical data was collected as specified in following Table 2-1.

Table 2-1 Type of data collected for WGS in Moratuwa MC

Source	Description
Household	Each number of following category households was surveyed; 1) High income level, 2) Middle income level and 3) Low income level.
Commercial	Each number of following category restaurants was surveyed; 1) Large size restaurants, 2) Middle size restaurants and 3) Small size restaurants. Each number of following category shops was surveyed; 1)Organic shops (large) 2)Organic shops (middle) 3)Organic shops (small) 4)Non-Organic shops (large) 5)Non-Organic shops (middle) 6)Non-Organic shops (small)
Hotels	Each number of following category hotels was surveyed; 1) Large size hotels 2) Middle size hotels and 3) Small size hotels.
Markets	Number of stalls and types
Institutions	Each number of following institute was surveyed; 1) Schools 2) Hospitals (government) 3) Hospitals (private) 4) Public office 5) Bank/private office 6) Buddhist temples 7) Hindu temples 8) Mosques 9) Churches 10) Navy/Police/ Army bases 11) Others
Industries	Wastes from any industries.

Source	Description
Other	Public parks and other public facilities
Construction and demolition	Wastes originating from construction, rehabilitation and demolition activities, etc.
Hazardous (Special)	Management and collection of hazardous wastes originating from various sources, including household items

2.1 Waste Generation Survey Results

The records indicate that the total residential population within MMC is 132, 795 (Source: Divisional Secretariat, Moratuwa & Divisional Secretariat, Nallur, 2015). The Moratuwa MC area consists of 42 Grama Niladari (GN) divisions as shown in below Table 2-2 .

Table 2-2 Population statistics of villages in MMC area

Village Name	Total Population	Village Name	Total Population
Angulana North	3,146	Rawathawatta West	2,754
Kaldemulla	3,939	Idama	2,371
Soysapura North	2,499	Uswatta	1,713
Soysapura South	2,276	Moratuwella South	3,594
Dahampura	2,217	Indibedda West	3,416
Thelawala North	4,346	Moratumulla East	3,023
Borupana	4,875	Moratumulla West	2,791
Thelawala South	3,305	Villorawatta East	2,833
Lakshapathiya North	3,667	Villorawatta West	3,575
Lakshapathiya Central	2,355	Indibedda East	2,756
Angulana South	2,443	Moratuwella North	1,814
Uyana South	3,476	Moratuwella West	1,797
Uyana North	2,824	Koralawella North	4,321
Rawathawatta South	1,667	Koralawella East	1,705
Rawathawatta East	3,225	Koralawella West	2,621
Lakshapathiya South	4,289	Koralawella South	2,781
Kuduwamulla	2,544	Katukurunda North	2,769
Katubedda	8,751	Katukurunda South	3,371
Molpe	6,062	EgodaUyana North	3,529
Moratumulla North	2,537	EgodaUyana Central	2,237
Kadalana	2,808	EgodaUyana South	3,773

As shown in following Table 2-3, Moratuwa MC own and control a larger number of public properties and institutes.

Table 2-3 Type and number of municipal establishment own by Moratuwa MC

MC properties	No. of units
Libraries	8
Municipal parks	5
Play grounds	7
Market buildings	8
Cemetery	4
Vehicle parking complexes	5
Bus stand complexes	1
Slaughter house	8
Meat stall/ markets	8

Following Table 2-4 shows the number of government and privet/non-government establishments within Moratuwa MC.

Table 2-4 Number of government and privet institutions within Moratuwa MC

Institutes (Governments)	No. of units	Institutes (Privet)	No. of units
Schools	33	Schools	6
Hospitals	10	Hospitals	2
Government Office (AG, post office, bank etc)	20	Clinic/ dispensary	80
Public office	142	Other education institutes	72
Buddhist temples	47	Bank/Finance office	48
Hindu temples	3		
Mosques	2		
Churches	23		
Navy/Police/ Army bases	4		

A major portion of MSW is generated from commercial sector in the city. Following Table 2-5 shows the number of different commercial (business) establishments in MMC area.

Table 2-5 Types and number of business establishments in MMC area

Type of Business	No. of units	Type of Business	No. of units
Food & household goods		**General trading**	
Large/Middle size hotels	99	Textile trading shops (large)	106
Small size hotels	83	Electronic equipment sales shop	14
Restaurants	32	Electrical equipment sales shop	87
General wholesale shops (large)	12	Furniture sales shops	123
Glossary shops	510	Hardware shops	143
Vegetable sales shops	32	Vehicle spare parts shops	45
Fruit sales shops	18	Vehicle repair garages	101
Fish sales stalls	27	Barber shops	132

Type of Business	No. of units	Type of Business	No. of units
Meat sales stalls	54	Beauty salon	38
Vine stores	16	Pharmacy	68
Medical laboratory	38	Plastic sales	37
Industries		Communication	126
Saw mills	40	Watch repair & sell	18
Garments/ Tailoring	120	Optical center	21
Furniture	1509		
Factory & product	44		

In addition, Moratuwa MC own fleet of vehicles used for MSW service as well as other general functions. Following Table 2-6 shows a list of vehicles own by MMC.

Table 2-6 Type and number of vehicles own by MMC

Type of vehicle	In-use	Not in-use	Total
Tractor	18	7	25
Gully bowser	2	2	4
Tipper (dump) truck	8		8
Truck	1		1
Two wheel tractor	5	1	6
Tar-cab	1		1
Compact bowser	4		4
Garbage buggy	2		2
Cart	2		2
Loader buggy	3		3
Wheel loader		1	1
Water bowser	2		2
Boom truck	1		1
Sky lift	2		2
Chain (Crawler) dozer		1	1
Road Roller compactor	3		3
Fire engines	2		2
Ambulance	1		1
Three wheeler	8		8
Jet bowser	1		1
Motorcycles	3	1	4
Wheel excavator	3		3
Dumper	2		2
Cab car	7		7
Total	**81**	**13**	**94**

3 Public Opinion Survey (POS)

This Public Opinion Survey (POS) was commissioned to identify a range of household waste management matters in relation to the household sector. Information on household waste management practices and information on householders' experiences with waste collection delivery services was collected for the purpose of improving our understanding of householder's experiences and attitudes and also to better understand prevailing situation in householder's point of view. The purpose of this survey research included;

a. To collect information on public attitudes to the waste management and environment in broader,
b. To value aspects of environmental health and protection,
c. To provide information on experiences with Local Authority's waste management service and,
d. To provide information on household waste management practices.

3.1 Public opinion survey methodology

The number of samples from Moratuwa identified as 200 households, but size of the sample increased to 202 during the implementation to increase the accuracy. The selection of households and areas within Moratuwa MC was done after a consultative discussion with MSW section officers at MMC and JICA expert team members.

The survey was executed by a team of university students who were trained about the questionnaire, survey methodology and the data entering before dispatched to their respective fields. A senior expertise took the leadership and continuously supervised the field survey. The selected households were first educated about the survey, its main objectives and asked their cooperation before starting the field survey. In addition business and institutes, large waste generators, hospitals recycling shops and large public markets were also surveyed using appropriate questionnaires prepared in consultation with JICA experts.

Table 3-1 Category and number of samples for Public Opinion Survey

Category	Survey Area	Number of samples
High-income households	Koranelis Place, Anglican Church Rd, JMC Fernando Rd, Galpotta Mw, Rely Fernando Rd	50
Middle-income Households	1st Lane Katubedda, Galpotta Mw, Kridangana Mw, Mendis Rd, C.P. de Silva,	50
Low-income Households	Samajawadi Niwasa-Pura, Covious rd, Kovila Rd, Usawi Watta, Podu Jana Mw	50
Businesses /Service organization	New Galle Rd, Galle Rd, Rawtawatta, Galle Rd, New Galle Rd	37
Large waste generators		11
Markets		1
Recycling shops		1
NGO		1

Category	Survey Area	Number of samples
Total		**202**

The questionnaires were available in all languages (English/Sinhala/Tamil); however the questionnaire form was filled by the interviewer based on interviewees' response. The collected information was recorded in digital form using Microsoft Excel and reviewed for accuracy. The data was analyzed in detail for different objectives that generate an overview of the survey.

3.2 Results of Public Opinion Survey

- ✓ 97% of the surveyed households are Sinhalese, with 1 % of Muslims, 1% Tamils and 1 % other. Data on the average number of people per household and monthly income is set out in below Table 3-2.

Table 3-2 Average and standard deviation values of income and family size

Category	Family size	Income (Rs/month)
High	4.5 ± 1.7	85, 200 ± 32, 607
Middle	4.1 ± 1.2	48, 375 ± 10, 226
Low	4.0 ± 1.3	27, 140 ± 9,553
	No of workers	**Income (Rs/month)**
Business	3.9 ± 3.4	602, 200 ± 940, 534

- ✓ In Moratuwa MC, 100 % of surveyed households are provided with a garbage collection service, of which 97% stated they use this service. Only 44 % of surveyed households are "very satisfied" with present SWM service provision, while 34 % are "somewhat satisfied".

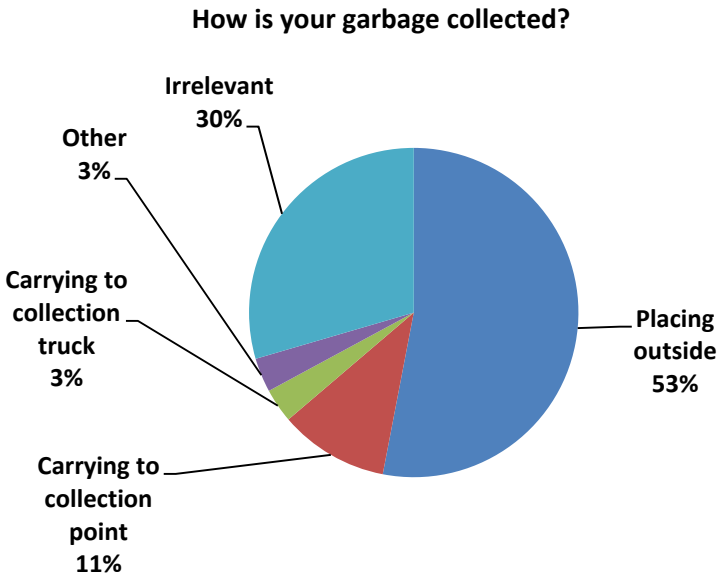


Figure 3-1 Method of garbage discharge by residence in MMC area

- ✓ Households' main methods of waste discharge are shown in Figure 3-1. The most common methods are discharging it outside their premises for house to house collection (53 %) and carrying garbage to collection truck (11%).
- ✓ Only 08% of surveyed households receive a daily garbage collection service while 62 % stated that they received the service 2-3 times/week. Similarly, 49% discharge their garbage 2-3 times per week, 22 % as soon as it is generated and 28 % discharge their garbage daily.
- ✓ In general, adult females handle waste in about 73 % of surveyed households.
- ✓ As shown in Figure 3-2, 33 % of households separate their garbage into organic and inorganic waste at the source of generation. Only 2 % of surveyed households are not/less willing to cooperate with source separation for recycling. Rests of the household are very much willing (55 %) and somewhat willing (10 %) to cooperate in source separated garbage collection system.
- ✓ Further, 84 % of surveyed households stated that there are recyclable collectors or someone who comes to collect their reusable or recyclable materials. Hence, informal recycling system is well established in Moratuwa MC area.

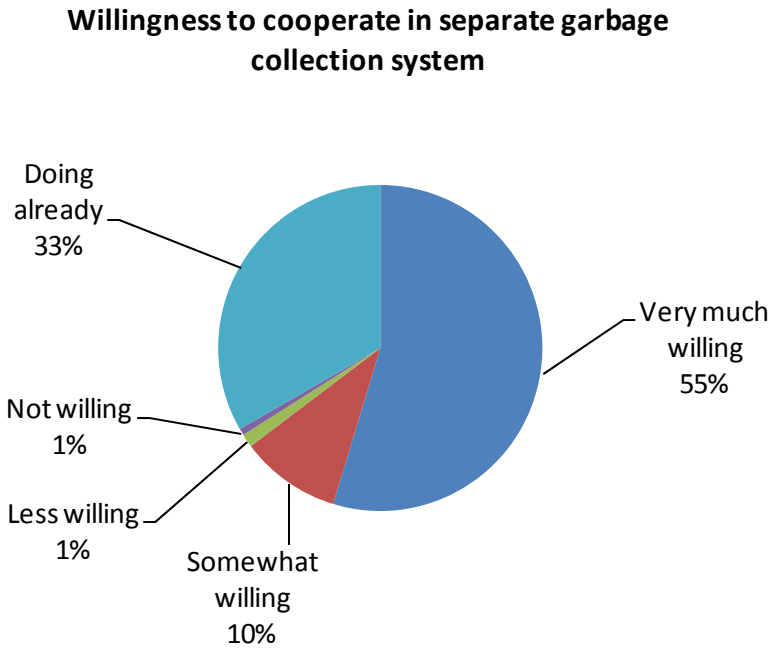


Figure 3-2 Willingness of residence for a source separated garbage collection system in Moratuwa MC

- ✓ Only 11 % of surveyed households use kitchen/garden waste for composting and used the finished compost for their own garden.
- ✓ Not many surveyed households (70 %) have ever discussed proper garbage discharge methods at the community level.
- ✓ 80 % households stated that SWM awareness programmes are very necessary while 13 % stated "somewhat necessary". Only 7% of surveyed households stated that awareness campaigns are not necessary or not needed at all.
- ✓ 61 % of household do not like to pay for SWM service mainly because of the revenue tax they paid for MMC. The average WTP (willingness to pay) for improved SWM services is 50 ± 97 Rs/month per household.

- ✓ Out of all surveyed households, 31 % stated that they sale/give-off Glass & Bottle for recycling and 30 % of residence sale/give-off Plastics for recycling. Also, 14 % of households sale/ give-off can & metal for recycling. Cardboard and paper recycling were 4 % and 11 % respectively.

4 Final disposal site survey (FDS)

4.1 Introduction the FDS of Moratuwa MC

4.1.1 Survey Method

The data and information in this report were collected from various sources including published reports, verified data from Moratuwa Municipal Council, Manager of Karadiyana Waste Disposal site and direct interview with officers & workers at disposal site.

4.1.2 Target of Survey

The survey is focus on obtaining general information on waste receiving, handling, disposal, facility management, environmental monitoring and legal adherences.

4.1.3 Data Sampling

The numerical data was collected as specified in following Table 4-1.

Table 4-1 Data collected during the final disposal site survey

	Survey Items	Method
1	Current condition of final disposal site and its surroundings	
	✓ Disposal method and structure	Records, visual observation
	✓ Soil-covering	Records, visual observation
	✓ Land owner	Records
	✓ Residual area	Records, visual observation
	✓ Leachate water	Records, visual observation
	✓ Waste picker	Records, visual observation, interview
	✓ Scattering waste, smoke, fire, offensive odour, animals and so on	Records, visual observation
2	Operation and Management of final disposal site	
	✓ Environmental Protect License and Environmental Clearance	Record
	✓ Personnel	Records, interview
	✓ Operation vehicles, their maintenances and drivers	Records, interview
	✓ Weighbridge	Records, interview
	✓ Waste collection data	Records, interview
	✓ Supervisory method	Records, interview
3	Waste amount to final disposal site (24 hours, 7 days)	Records, Survey
4	Adverse impact near by residences	Records, Survey
5	Implementation status of geological, topographic and EIA survey for new final disposal site	Records, interview
6	Progress situation for new final disposal site	Records, interview
7	Court case	Records, interview

4.2 Current condition of final disposal site and its surroundings

4.2.1 Karadiyana waste disposal site

Karadiyana waste disposal site is one of the largest MSW dumpsite in the country. The Karadiyana dumpsite second only to the Meethotumulla dumpsite for its waste disposal amounts.

The Karadiyana site is situated approximately 6.5 km away from Moratuwa city center. The site boarded to Weras Ganga (upper catchment river of Bolgoda Lake) on the west and abandoned paddy field and marshy lands on other sides (Figure 4-1).

Figure 4-1 Location of Karadiyana dumpsite

4.2.2 History and evolution of the dumpsite

The available records showed the dumpsite was first started in year 1996. Prior to this, Moratuwa MC disposed collected MSW at a dumpsite in Thalahena on the west side Weras Ganga. Starting from 1996, the site was commonly shared by few municipal and local authorities for waste disposal. The historical evolution of the dumpsite is illustrated in Figure 4-2.

During the late 90's, there were several dumping grounds other right bank of the Weras Ganga. The residence residing around the area stated there were three main dumping areas during late 90's and early 2000's. However, by the mid of 2000's, the dumping was limited two large areas separated by a small stream, runs perpendicular to the Weras Ganga. It has been reported that, during the mid 2000's the small river was heavily contaminated by leachate (Esakku et al., 2007).

The Weras Ganga, a stream flowing adjacent to the dumpsite on west direction, finally connected to the Bolgoda lake which is considered as very sensitive coastal lagoon in western province of Sri Lanka. Therefore, Karadiyana dump site has been a hot topic in the country due to protests from public and environmentalist throughout the history.

Figure 4-2 Historical evolution of Karadiyana dumpsite

4.2.3 Management and authority of Karadiyana Dumpsite

At first the dump site at Karadiyana has been used by a Private Sector Company to dispose the waste collected from Dehiwala Mt Lavinia MC, Moratuwa MC and Kesbewa MC since 1996. In view of the huge environmental & health impacts caused by open dumping of waste over a period of long time, and due public objections, a Cabinet Sub Committee directed relevant ministries (ministry of Local Government, Ministry of Environment, Pilisaru Project and Western Provincial Council) to provide a temporary solution to manage the incoming waste in collaboration with the Western Province Waste Management Authority (WMA-WP). During the time, the private sector company agreed to design and construct a feasible solution, but could not accomplish by themselves. Consequently, the Privet Company and the WMA-WP jointly prepared a project proposal and approval of the Cabinet of Ministers was obtained on 16th December 2009 to implement the proposal with funding from the General treasury. However, as the private company has not followed conditions laid out by the Central Environment Authority, the site was handed over to the Western Province Waste Management Authority (WMA) in 2010.

4.2.4 Extend and landform

Final disposal site is located at Karadiyana, at about 5 km away from the Galle road. The extent of the final waste disposal site is 37 acres (site A =12 acres, site B = 13 acres, reservation for Waste energy project = 12 acres). The closet proximity to residence is around 100 m from the site B and 800 m from site A on the western side across the Weras Ganga. The Weras ganga runs approximately 5 km south to meet Bolgoda Lake and Lunawa Lagoon.

Figure 4-3 Karadiyana dumpsite and environment within 500 m radius from center

There are two entrances to the site; main entrance (A) has gate and security office. The site B has only security office. The site A and B are separated with a stream which has been widen and dredged recently by Sri Lanka Land Reclamation & Development Corporation (SLLR & DC). The access road to

the site is either from North or South via the Karadiyana Road which is a public road maintain by Western Provincial Council.

Except the active dumping areas, surrounding area is covered with shrubs and wetland flora with extensive growth of wetland plants on the vicinity. The landform is a flat terrain except the areas where the waste has been dumped. However, the area is almost entirely surrounded by flowing waters in streams around the site.

4.2.5 Waste receiving and disposal

The existing dumpsite is commonly shared by several Local Authorities in Colombo District of the Western Province. They are shown in following Table 4-2 .

Table 4-2 Sources and quantities of waste disposed at Karadiyana MSW dumpsite

Sources of waste	MSW (mixed)	MSW (sorted organic)	All waste
	Average tonnage per day (TPD)		
Boralesgamuwa UC	30.7	0.0	30.7
Dehiwala Mt. Lavinia MC	172.6	0.5	187.5
Homagama PS	26.9	0.5	27.5
Kesbewa UC	57.8	0.1	58.5
Maharagama UC	75.7	0.0	78.6
Moratuwa MC	57.7	32.6	96.9
Sri Jayawardenapua Kotte MC	36.7	2.7	41.7
Kotalawala Defence University			2.5
Other sources			108.0

All the waste received at the dumpsite is weighted by a weighbridge. Thus, the site office maintains a record of receiving waste quantities which have been categorized based on origin and type of waste.

The management of the dumpsite has a pre-schedule plan for waste disposal. The site A and site B are alternatively used for waste disposal. The rotation of dumpsite is done every six month on average with some exceptions due to environmental and management issues.

One of the biggest challenge in management is to get dumping vehicle access to the active filling area (Active cell) during the heavy rainy season. Consequently, management increases the fleet of earth moving machine (Bulldozer & Excavator) during the heavy rainy season.

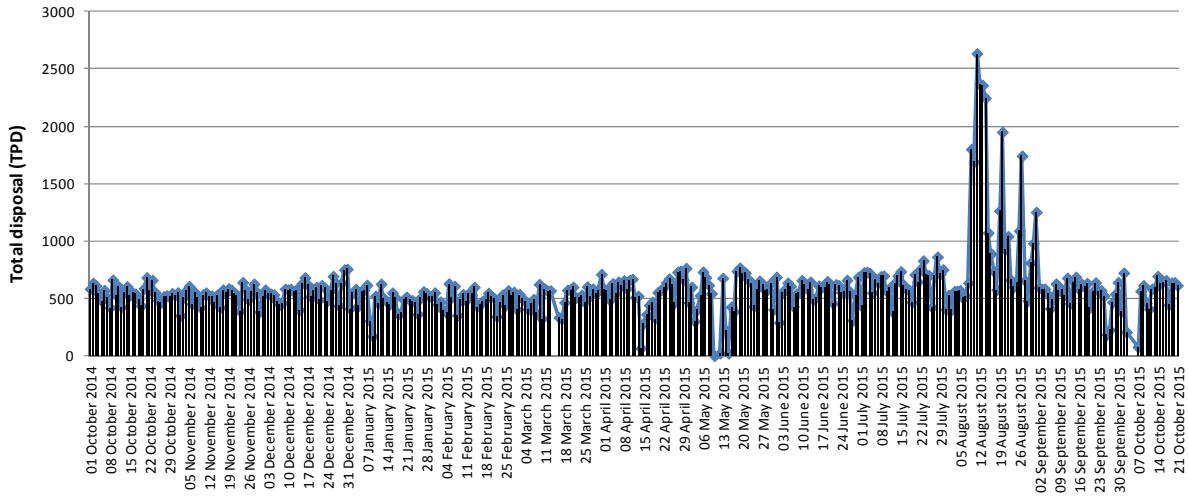


Figure 4-4 Daily waste disposal amount at Karadiyana dumpsite for a year (The peaks in August 2015 is due to discharge of soil/dredged waste)

As shown in Figure 4-4 and Table 4-3, in addition approximately about 500 tonnes of MSW waste, dumpsite management accepts different types of other waste receiving from government and privet organization.

Table 4-3 Different types of waste disposed at the Karadiyana dumpsite

Type of waste	Disposal amount (TPD)
Mixed municipal solid waste	471.71
Sorted organic (municipal) waste	32.02
Construction and demolition waste	17.32
Soil	15.39
Soil mixed with waste	10.62
Bulky Waste	9.92
Slaughterhouse waste	6.88
Industrial waste	4.31
Saw dust	0.77
Industrial sludge waste	0.52
Sanitary waste	0.17
Polythene & Styrofoam	0.15
Wood trunk	0.09
Special waste	0.03
Non toxic bulk waste	0.02

The management of Karadiyana dumpsite charged a fee to dispose waste at the dumpsite. The tiping fee structure is shown in.

Type of waste	Tipping Fee (Rs/ Tonne)
MSW waste	500
Bulky waste	650
Soil with waste	650
Wood trunk	650

Type of waste	Tipping Fee (Rs/ Tonne)
Slaughter house waste	1550
Industrial waste	1550
Polythene & Styrofoam waste	1550
Sorted organic waste	225

4.3 Site infrastructure facilities

The Karadiyana dumpsite has most of the typical management infrastructure facilities available at a landfill (Figure 4-5). Those were purchased and installed by Waste Management Authority of Western Province during the site rehabilitation works from year 2010.

Site infrastructure buildings

Weighbridge

Access on the dump

Access on the dump made by railway slippers

Figure 4-5 Major site infrastructure facilities at Karadiyana Dumpsite

Additional, there is a facility for organic waste composting (Windrow Composting). The composting plant was built through the fund allocated by Western Provincial Council (Rs. 80 million) and the Pilisaru program of the Environment Ministry (Rs. 27 million). The composting plant will is still under construction and modification although the major components are already been made available. After completion of the composting project infrastructure, WMA-WP expect to process 100 tonnes of organic waste per day for composting.

As shown in Figure 4-6 , Site management has employed a fleet of machineries for waste handling at the site.

Figure 4-6 Fleet of machineries work at Karadiyana dumpsite

4.3.1 Current condition of final disposal site and its surroundings

1	Current condition of final disposal site and its surroundings	
1.1	Disposal method and structure	✓ Incoming waste loads (tractors, compactors and trucks) are weighted and recorded at the entrance gate. Each vehicle has been issued a ticket from the weighbridge which will be reported back to relevant municipality/ organization ✓ Selected vehicles which contain soil and construction waste are unloaded on a separate area. Rest of the waste trucks are directed to active filling area/ cell. ✓ All other MSW collection vehicles emptied its waste at the dumpsite. No specific control measures apply for selection of dumping area. Thus, **Open Dumping** is practiced. ✓ All other wastes are dumped on the ground and spread using bulldozer and excavators ✓ Waste pickers are allowed to pickup recyclable material during the unloading and spreading of waste
1.2	Soil-covering	✓ In general, daily covering of waste by soil is not practiced ✓ However, soil and construction wastes are used to make temporally access/roads on the dump
1.3	Land owner	✓ Ownership lies with a privet owner but the and has been leased out (for 33 years) to WMA-WP
1.4	Residual area	✓ Approximately 25 ha area has already been covered with waste out the total land area (37 hectares).
1.5	Leachate water	✓ No leachate collection and treatment system ✓ Leachate and surface water flow towards the stream flow around the dumpsite
1.6	Waste picker	✓ At present, 9 people including 1 women pick materials for selling ✓ Plastic, Metal, Cardboard, wires, beer cans, and arrack bottles are collected. Collected materials are sold by management of Karadiyana (WMA-WP) and a share is allocated for collectors. Collectors income is approximately Rs. 10, 000 per month
1.7	Scattering waste, smoke,	✓ Waste is dumped on designated areas on the dumping site ✓ Scattering and blowing out of waste were not observed due to proper disposal and covering practices ✓ No fire and smoke witness at the dumpsite during the observation

1	**Current condition of final disposal site and its surroundings**	
	fire, offensive odor, animals	✓ Occasionally, offensive odors come out from active dumping area. Then authority uses odor control chemicals ✓ Dogs, cattle are frequent in the dump site. However, authority take maximum effort to control the entry of animals but face difficulties due to lack of fencing around the dumpsite

4.3.2 Operation and Management of final disposal site

2	**Operation and Management of final disposal site**	
2.1	Environmental Protect License and Environmental Clearance	✓ None
2.2	Personnel	✓ 1-Project Manager –Permanent position (project manager is working under the Zone Manager of WMA-WP. The overall management is done by Chairmen and Director f WMA-WP) ✓ 1-Human Resources Manager –Permanent position ✓ 1-Accountant – permanent position but vacant at present ✓ 2- Human resource management assistants- Permanent positions ✓ 1- Site supervisor–Permanent position ✓ 2- Machine operators–Permanent position ✓ 9-Labors- Permanent position ✓ 43-Contract/ Casual labors- but only 17-24 of them are employed daily
2.3	Operation vehicles, their maintenances and drivers	✓ 3 bulldozers (2 bulldozers on rent) ✓ 2 excavators (both excavators on rent basis) ✓ 1 backhoe loader ✓ 1 four wheel tractors ✓ 1 dump truck ✓ 1 double-cab for office use and 1 van has been hired for general purposes

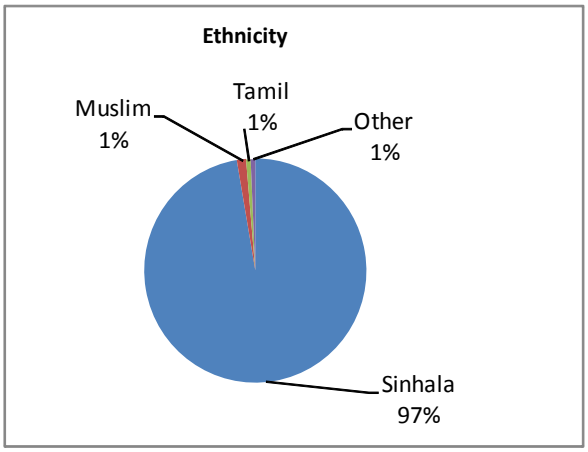
2	**Operation and Management of final disposal site**	
2.4	Weighbridge	✓ Available and functioning properly
2.5	Waste collection data	✓ Daily record is available in digital form
2.6	Supervisory method	✓ General planning and supervision come under WMA-WP (Chairman & director). Those three officers are regularly inspecting the site and instruct the site Manager for necessary actions. Manager is responsible for coordinating with Authority and municipalities for solving daily management issues as well as other contingency matters. ✓ Site Manager is responsible for daily operations and long term planning
3.0	Waste amount to final disposal site (24 hours, 7 days)	✓ A summary is shown in Table 4-2 and Table 4-3
4.0	Adverse impact nearby residences	✓ Odor is the man nuisance for residence around the dumpsite ✓ Then, the irritation caused by waste collection vehicles is also a problem for nearby residence ✓ Dust emission during the dry season is a problem for vehicles/people who use the Karadiyana road
5.0	Implementation status of geological, topographic and EIA survey for new final disposal site	✓ There are several proposals for establishment of Waste to Energy project at the site. The WMA-WP has come into an agreement with a privet investment company. ✓ The EIA has been submitted in 2012, but the approval has not been granted yet. ✓ A sample project report on Karadiyana WtoE is attached as Annex i
6.0	Progress situation for new final disposal site	✓ None
7.0	Court case	✓ Residence around the dumpsite has taken legal actions against the Karadiyana Dumpsite Management at Magistrate Court, and the legal order has been issued to WMA-Wp to rectify the issues

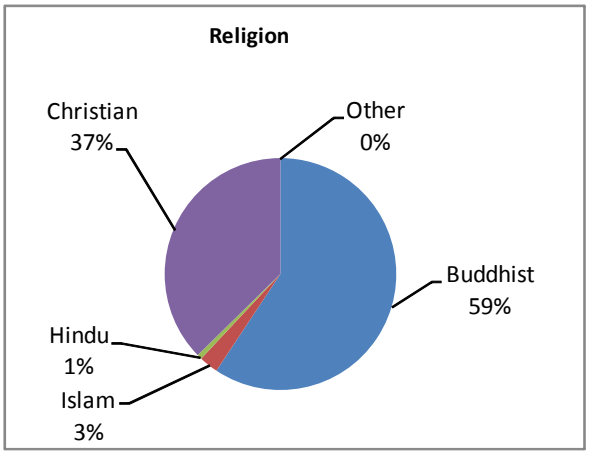
2	**Operation and Management of final disposal site**	
		✓ No official records are available up to date since the court case is still going on

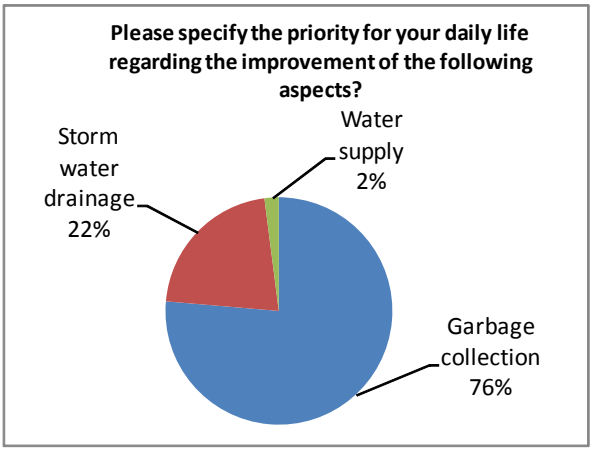
Annex

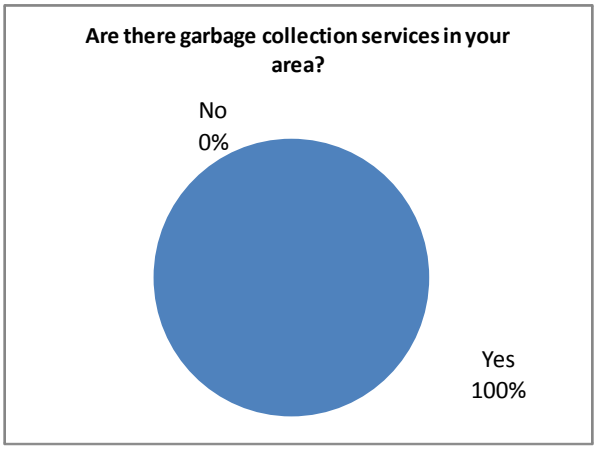
MORATUWA MUNICIPAL COUNCIL

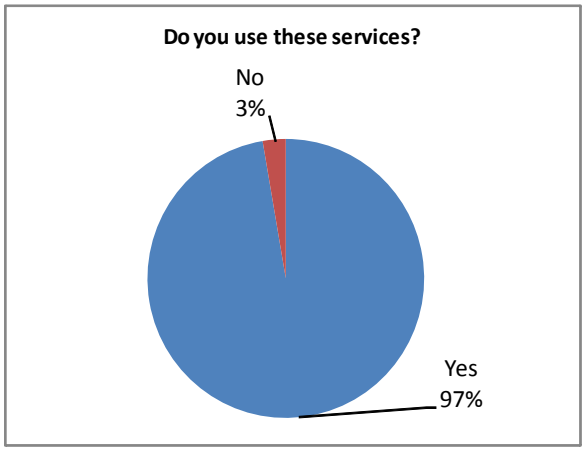
Response to Public Opinion Survey for Household

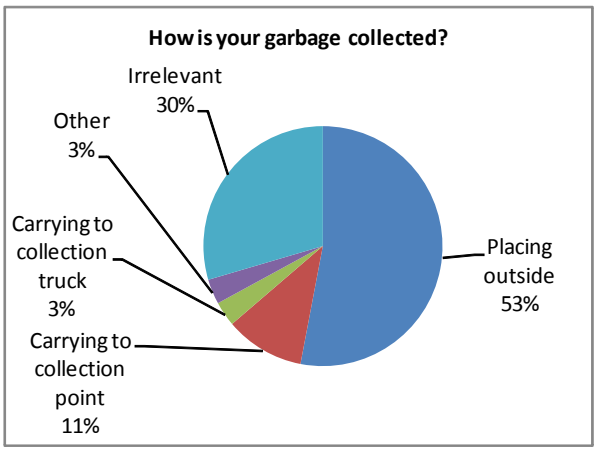












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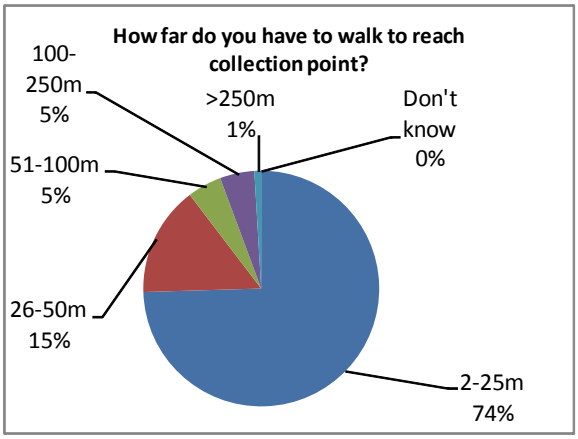

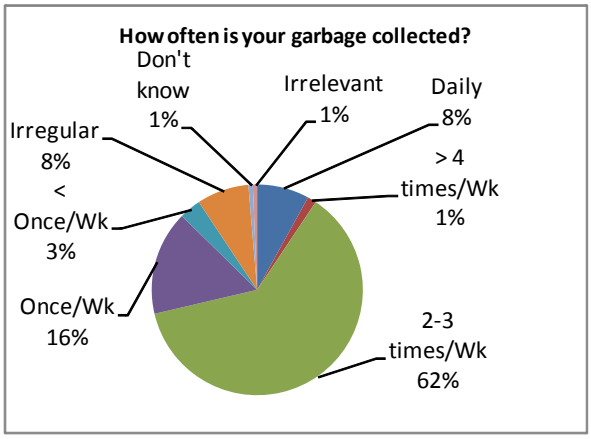

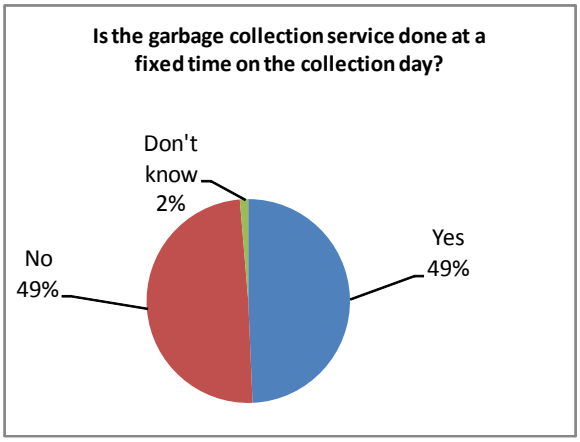

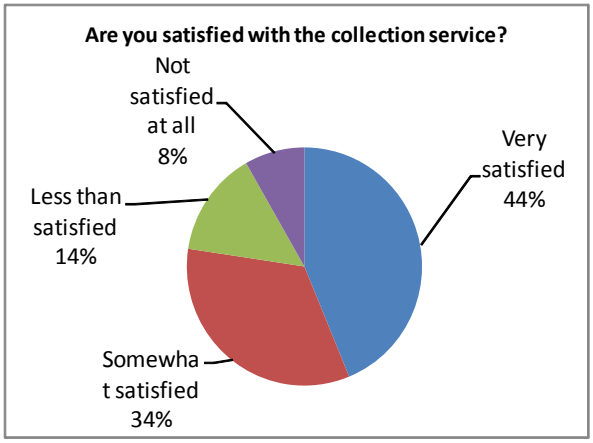

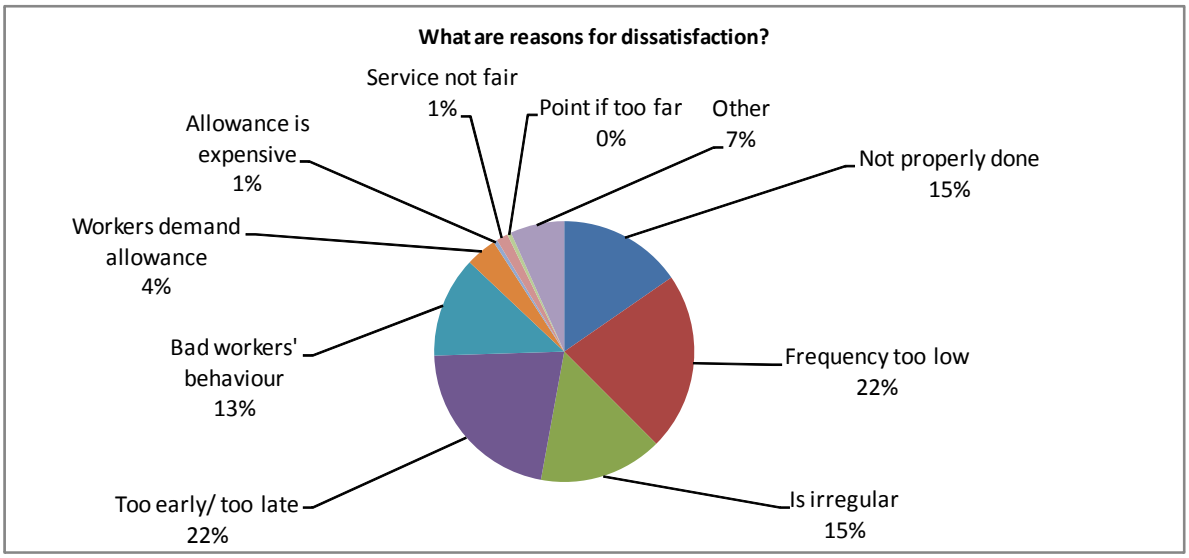

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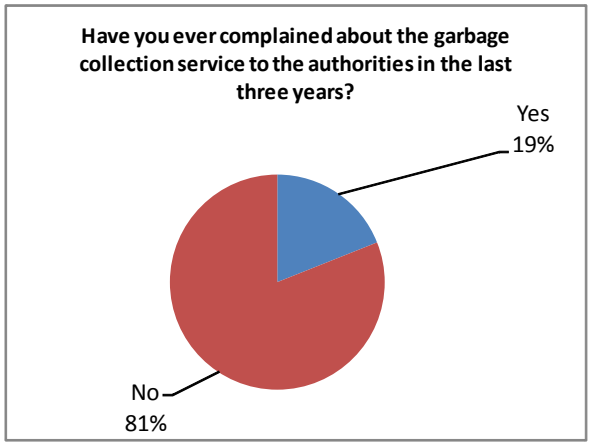

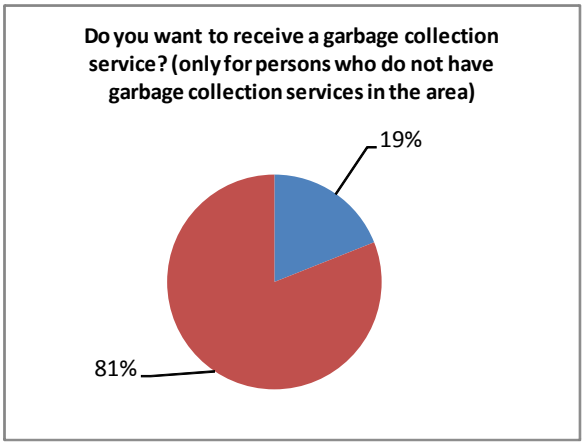

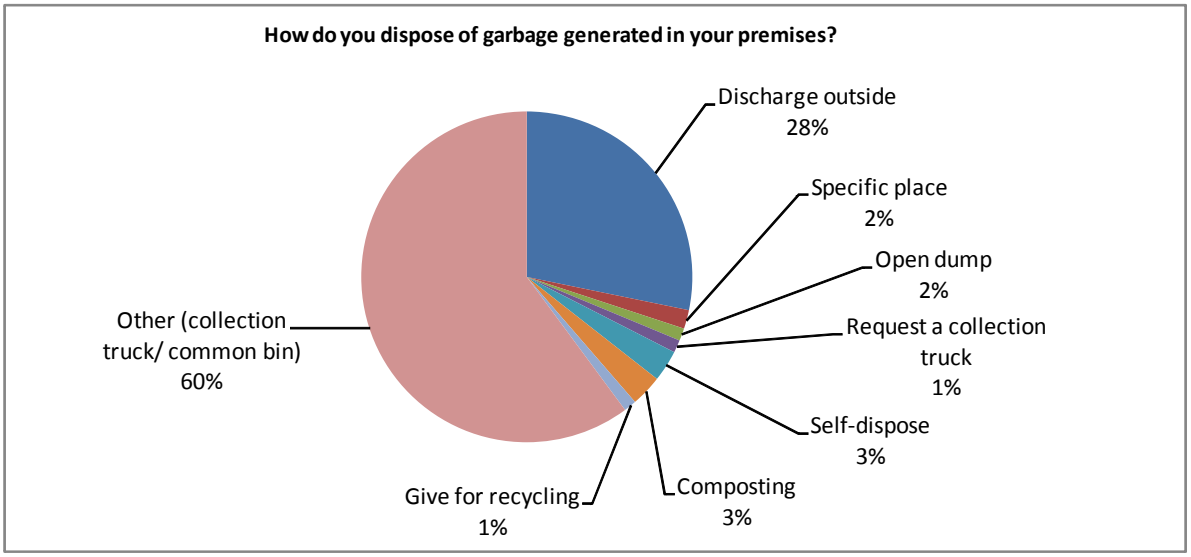

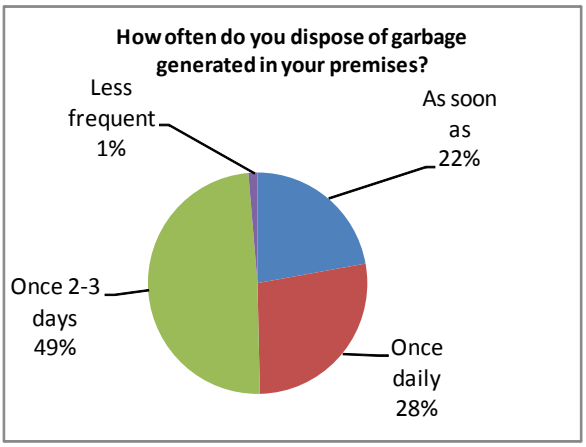

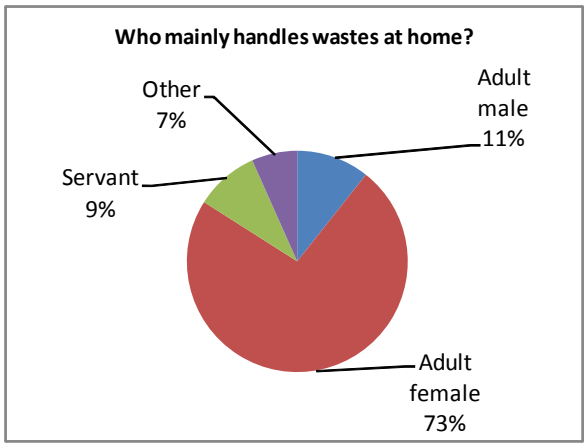

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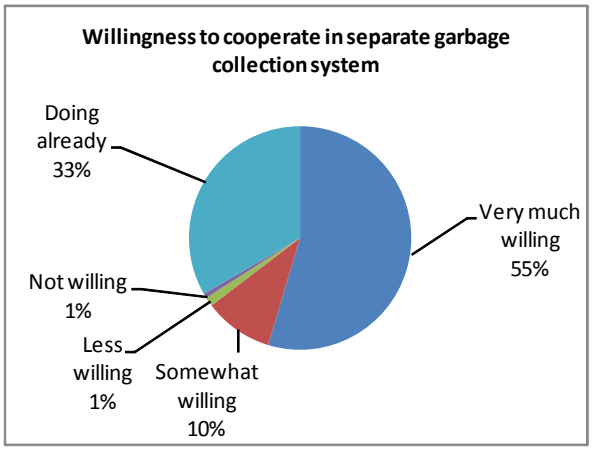

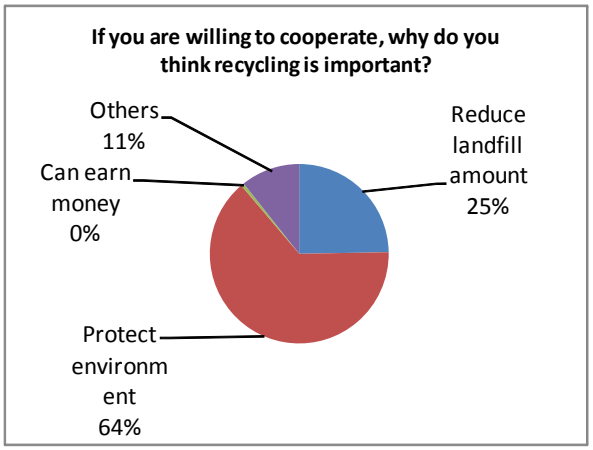

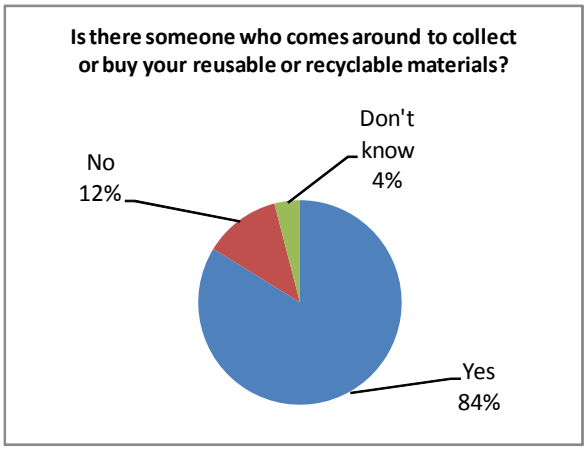

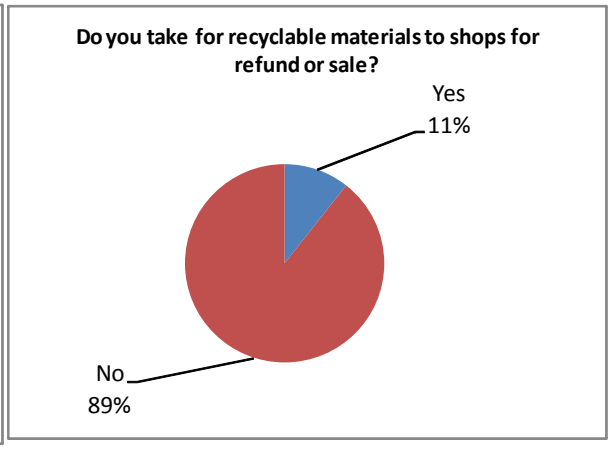

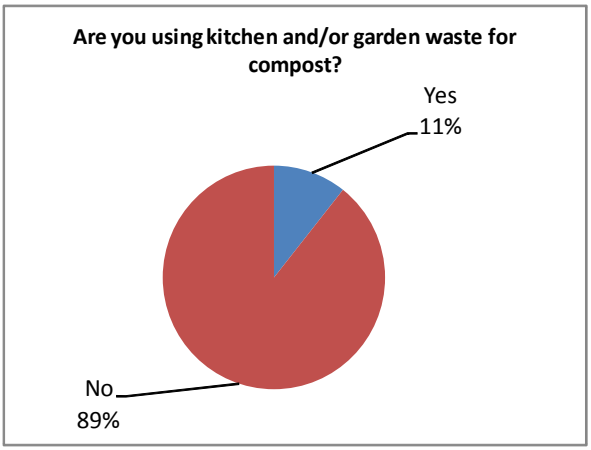

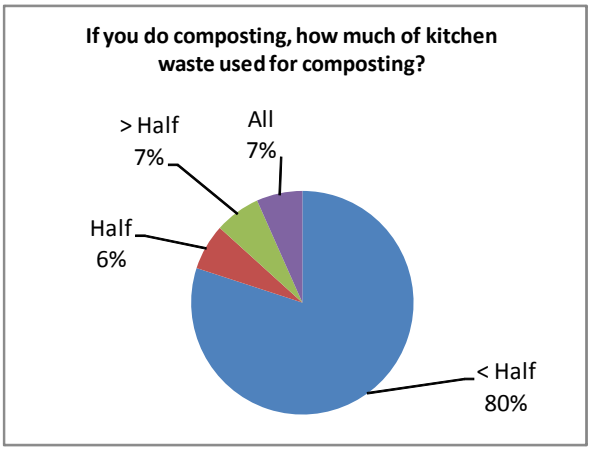

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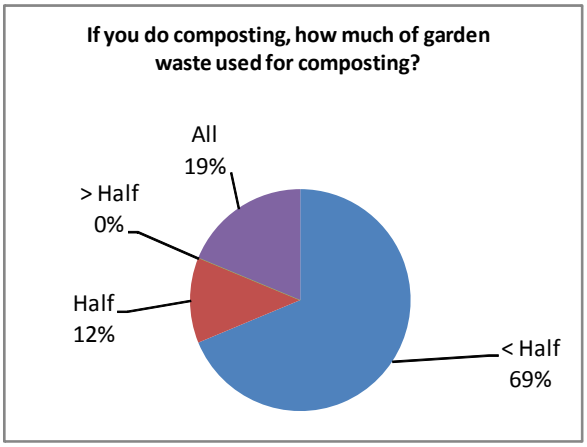

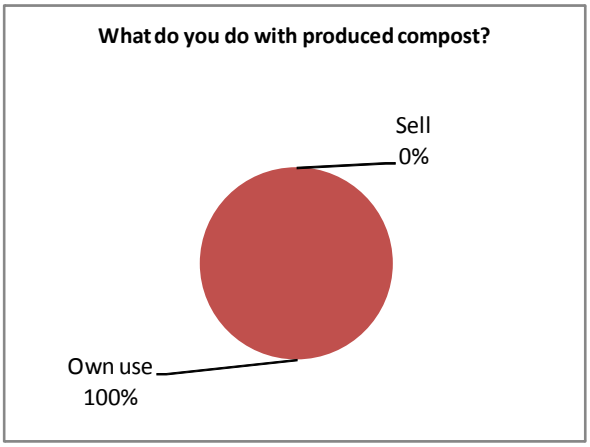

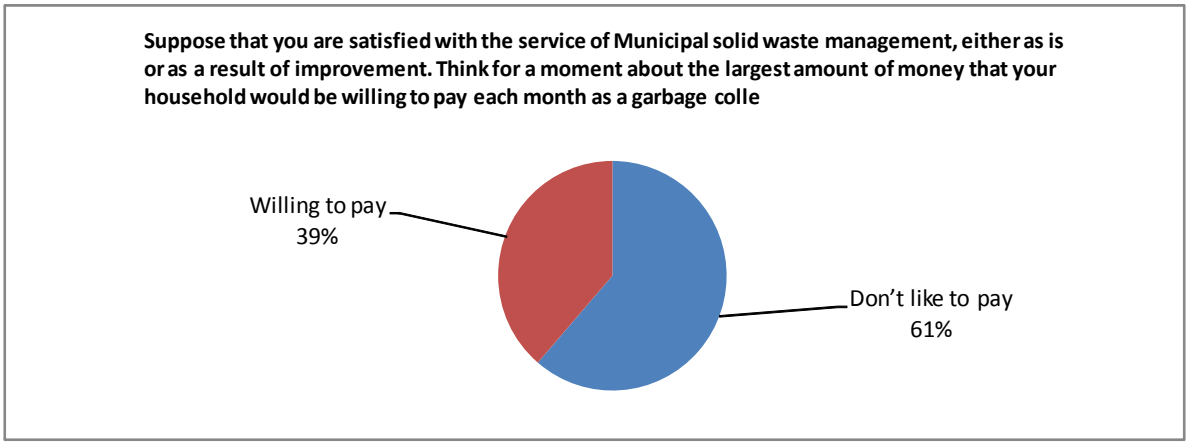

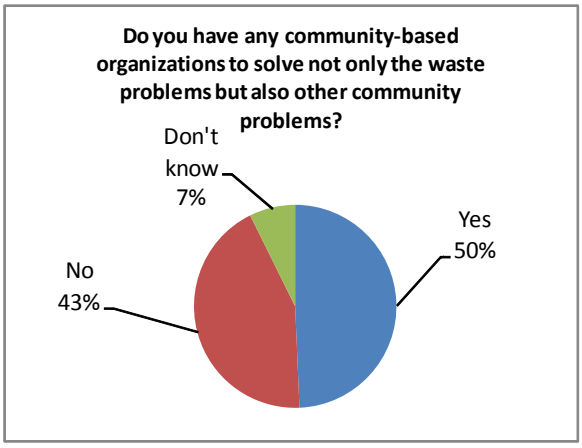

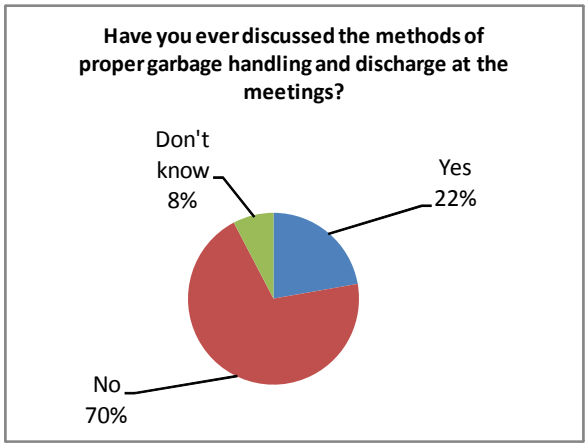

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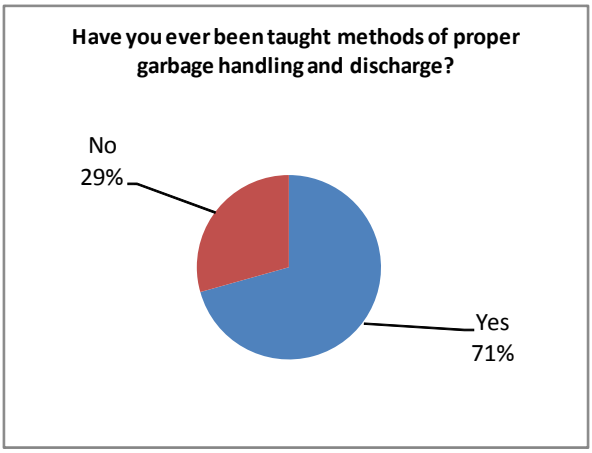

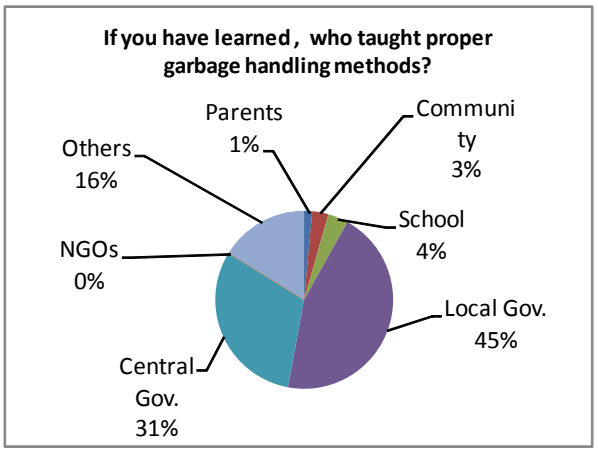

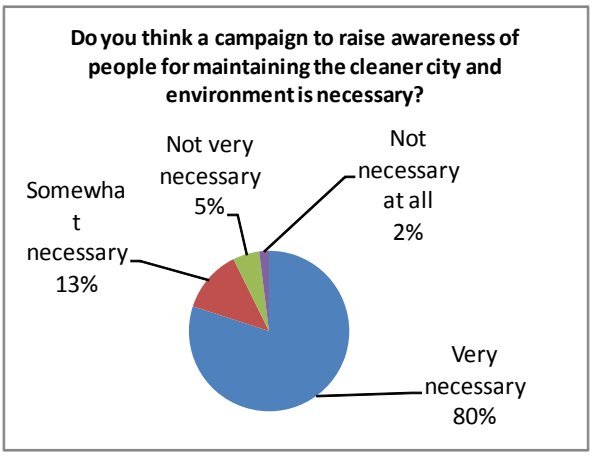

1.8 Kesbewa UC

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1 Introduction

The purpose of this survey is to obtain the current data regarding Solid Waste Management (SWM) at Kesbewa Urban Council (KUC). The data collection survey was conducted from 23th October to 29th October, 2015 by a team of expert dispatched by Waste To Energy Technologies Limited.

This report consists of brief summaries of survey methods and results. The additional primary data and records are available as soft copies. The preliminary data collection was conducted through three comprehensive surveys which are;

i. **Waste Generation Survey (WGS)** is to gather information on waste generation sources at KUC based on secondary data available at KUC and other relevant organizations.
ii. **Public Opinion Survey (POS)** is gather information on public opinion on current waste management in KUC. The POS was conducted through a questionnaire survey that covers different types of waste generators in the KUC area.
iii. **Final Disposal Site Survey (FDSS)** is to collection data on final MSW disposal site of KUC based on secondary data as well as field recordings & visits to the site. ***DMUC commonly shares Karadiyana final disposal facility which is discussed in "Data collection Survey Report- Moratuwa UC".***

1.1 Background conditions of Kesbewa Urban Council

Kesbewa Urban Council (KUC) encompasses 50.39 km^2 in the Colombo district located in the Western province in Sri Lanka. KUC lies on the Colombo-Horana main road about 20 km away from the commercial capital of Sri Lanka and is part of the Colombo urban fringe that has been rapidly increasing in population. It is also characterized by high and rapid conversion of agricultural to urban uses.

The KUC is located in the Low country Wet zone which is classified based on the altitude from the mean sea level and annual rainfall. The KUC area is characterized by four rainy seasons; the first Inter-monsoon period from March to April, the Southwest Monsoon period from May to September, the Second inter-monsoon period from October and November and the Northeast monsoon period from December to February. During the Southwest monsoon period, the area receives more than 500 mm rainfall, while during the second inter-monsoon and the northeast monsoon periods the area receives more than 200 mm average rainfall in some months.

The average air temperature of the KUC area for last 5 years (2008 to 2013) is 28.05 °C, ranging from 31.33 °C (Maximum) temperature to 24.50 °C (Minimum) with some significant deviations. During the Southwest Monsoon period (May to September) average temperature is relatively low when compared with the 1st inter monsoon period and the northeast monsoon period. The hottest season of the KUC is January to March.

Table 1-1 Basic fact sheet of Kesbewa Urban Council

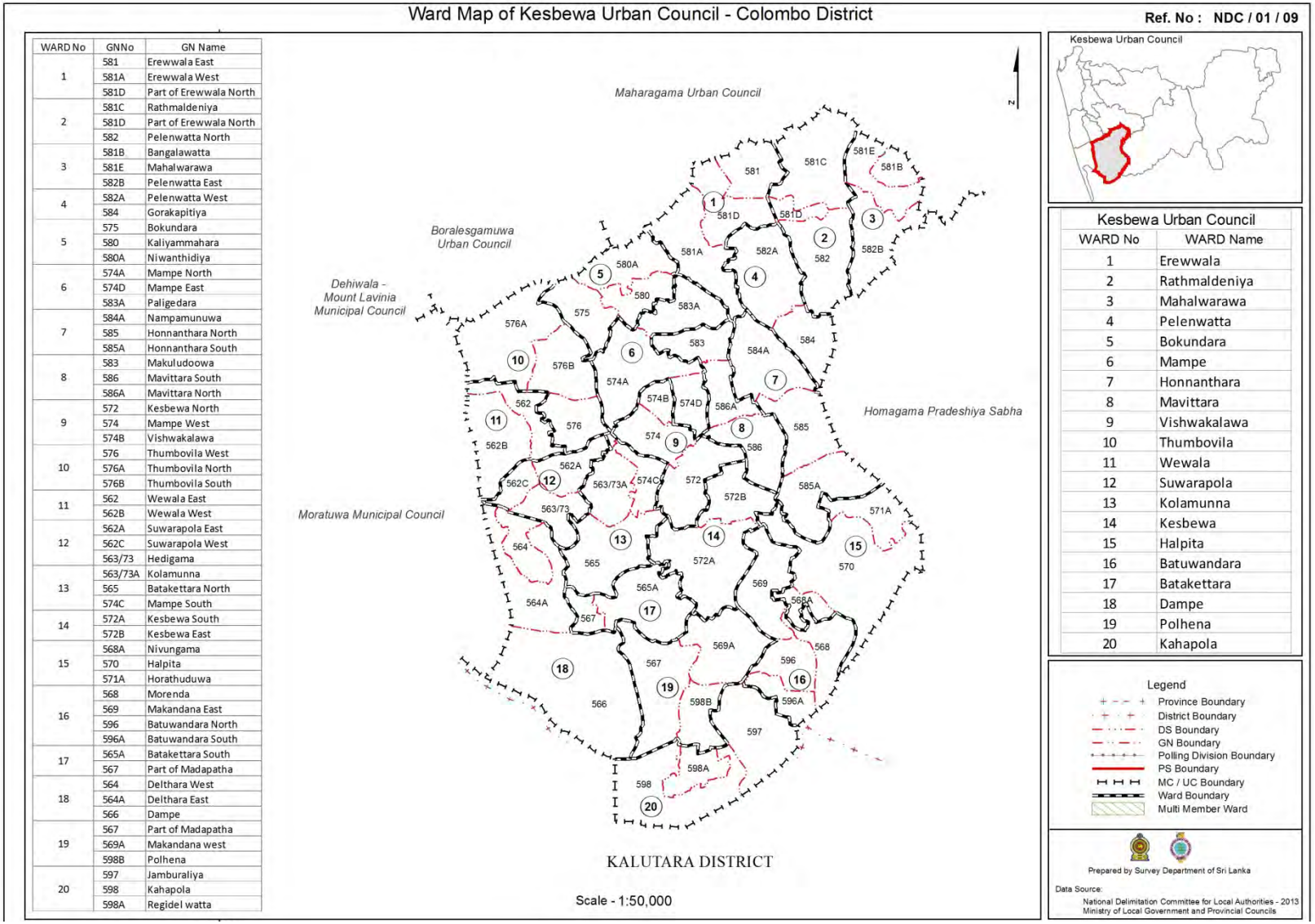
Item	Description
Province	Western Province of Sri Lanka

Item	Description
District	Colombo
Local Authority Status	Urban Council
Location in Relation to	Kesbewa lies in Colombo-Horana main road about 20 km away from Colombo
Extent of the Authority Area	50.39 sq.km
No. of Council Wards	20
No. of Council Members	17
No. of Villages	55
No. of Dwellings	52, 783
Population UC record (2012 statistics)	191, 764
Average Population Density	38 p/ha

The 2012 population of the KUC area was 191,764 while population density stood at 3,806 inhabitants per square kilometer. There were 52, 783 housing units and average housing density was 1, 047 per square kilometer. The KUC has emerged as an attractive residential area for commuters from many parts of Sri Lanka, and as a result, many of its agricultural areas, especially former rubber plantations were gradually converted to non-agricultural areas, resulting in 2012 in about 60% of the land area being used for residential and 30% still being used for agriculture.

Table 1-2 Land use pattern of Kesbewa UC area (UDA-2012)

Land use	Area (km^2)	Percentage
Residential	30.171	59.9%
Government	0.001	0.0%
Other Land	0.085	0.2%
Playground	0.095	0.2%
Cemeteries	0.107	0.2%
Hotels	0.129	0.3%
Commercial	0.164	0.3%
Build-up	0.218	0.4%
Religious	0.421	0.8%
Public	0.452	0.9%
Industrial	0.725	1.4%
Road	1.404	2.8%
Coconut	0.398	0.8%
Paddy	10.115	20.1%
Other Agriculture	2.38	4.7%
Water bodies	3.06	6.1%
Marshy Land	0.429	0.9%
Total	**50.353**	**100.0%**



WARD No	GNNo	GN Name
1	581	Erewwala East
	581A	Erewwala West
	581D	Part of Erewwala North
2	581C	Rathmaldeniya
	581D	Part of Erewwala North
	582	Pelenwatta North
3	581B	Bangalawatta
	581E	Mahalwarawa
	582B	Pelenwatta East
4	582A	Pelenwatta West
	584	Gorakapitiya
5	575	Bokundara
	580	Kaliyammahara
	580A	Niwanthidiya
6	574A	Mampe North
	574D	Mampe East
	583A	Paligedara
7	584A	Nampamunuwa
	585	Honnanthara North
	585A	Honnanthara South
8	583	Makuludoowa
	586	Mavittara South
	586A	Mavittara North
9	572	Kesbewa North
	574	Mampe West
	574B	Vishwakalawa
10	576	Thumbovila West
	576A	Thumbovila North
	576B	Thumbovila South
11	562	Wewala East
	562B	Wewala West
12	562A	Suwarapola East
	562C	Suwarapola West
	563/73	Hedigama
13	563/73A	Kolamunna
	565	Batakettara North
	574C	Mampe South
14	572A	Kesbewa South
	572B	Kesbewa East
15	568A	Nivungama
	570	Halpita
	571A	Horathuduwa
16	568	Morenda
	569	Makandana East
	596	Batuwandara North
	596A	Batuwandara South
17	565A	Batakettara South
	567	Part of Madapatha
18	564	Delthara West
	564A	Delthara East
	566	Dampe
19	567	Part of Madapatha
	569A	Makandana west
	598B	Polhena
20	597	Jamburaliya
	598	Kahapola
	598A	Regidel watta

Kesbewa Urban Council	
WARD No	WARD Name
1	Erewwala
2	Rathmaldeniya
3	Mahalwarawa
4	Pelenwatta
5	Bokundara
6	Mampe
7	Honnanthara
8	Mavittara
9	Vishwakalawa
10	Thumbovila
11	Wewala
12	Suwarapola
13	Kolamunna
14	Kesbewa
15	Halpita
16	Batuwandara
17	Batakettara
18	Dampe
19	Polhena
20	Kahapola

Figure 1-1 Ward and GN map of Kesbewa UC area

2 Waste Generation Survey (WGS)

In order to obtain general information on waste generation amounts, the data available at waste management section of the Health Department, Works Department and Revenue Department of KUC was used. Some of the data was available in the form of formal records and reports which were treated as the most precise secondary data while the data collected from official interviews with KUC officers was treated as verification data. Thus, the survey data was collected through different methods;

a) Recording and compiling of published and verified data by KUC,
b) Reading and recording of unpublished & non-confidential data available at KUC,
c) Recording and official statistics available at Kesbewa Divisional Secretariat office, and
d) Official person-to-person interview with relevant officers at KUC for verification of data.

The numerical data was collected as specified in following Table 2-1.

Table 2-1 Type of data collected for WGS in Kesbewa UC

Source	Description
Household	Each number of following category households was surveyed; 1) High income level, 2) Middle income level and 3) Low income level.
Commercial	Each number of following category restaurants was surveyed; 1) Large size restaurants, 2) Middle size restaurants and 3) Small size restaurants. Each number of following category shops was surveyed; 1)Organic shops (large) 2)Organic shops (middle) 3)Organic shops (small) 4)Non-Organic shops (large) 5)Non-Organic shops (middle) 6)Non-Organic shops (small)
Hotels	Each number of following category hotels was surveyed; 1) Large size hotels 2) Middle size hotels and 3) Small size hotels.
Markets	Number of stalls and types
Institutions	Each number of following institute was surveyed; 1) Schools 2) Hospitals (government) 3) Hospitals (private) 4) Public office 5) Bank/private office 6) Buddhist temples 7) Hindu temples 8) Mosques 9) Churches 10) Navy/Police/ Army bases 11) Others
Industries	Wastes from any industries.

Source	Description
Other	Public parks and other public facilities
Construction and demolition	Wastes originating from construction, rehabilitation and demolition activities, etc.
Hazardous (Special)	Management and collection of hazardous wastes originating from various sources, including household items

2.1 Waste Generation Survey Results

The records indicate that the total residential population within Kesbewa Divisional Secretariat Division is 245, 232. However, KUC covers only part of DS area therefore the Urban Council population has been estimated as 191,764 persons. The Kesbewa UC area consists of 55 Grama Niladari (GN) divisions but some of the villages (GNs) are partly shared by neighboring local authorities.

Table 2-2 Population statistics of villages in KUC area

GN name		Code	Population	GN name		Code	Population
Bangalawatta		581B	2,194	Madapatha		567	3,799
Batakettara	North	565	5,847	Mahalwarawa		581E	2,773
Batakettara	South	565A	6,628	Makandana	East	569	4,947
Batuwandara	North	596	1,545	Makandana	West	569A	4,434
Batuwandara	South	596A	1,481	Makuludoowa		583	3,257
Bellanvila		535A	3,413	Mampe	North	574A	4,690
Bodhirajapura		577B	2,303	Mampe	East	574D	2,040
Bokundara		575	3,633	Mampe	West	574	3,055
Boralesgamuwa	West A	533B	4,466	Mampe	South	574C	2,070
Boralesgamuwa	West C	533F	1,485	Mavittara	North	586A	2,761
Boralesgamuwa	East A	533	4,842	Mavittara	South	586	1,880
Boralesgamuwa	West B	533E	2,822	Morenda		568	1,300
Boralesgamuwa	East B	533D	5,204	Nampamunuwa		584A	3,385
Dampe		566	4,165	Neelammahara		579	3,358
Delthara	West	564	2,084	Nivungama		568A	2,196
Delthara	East	564A	1,524	Niwanthidiya		580A	3,435
Divulpitiya	East	535D	2,328	Paligedara		583A	3,050
Divulpitiya	West	535B	2,631	Pelenwatta	East	582B	4,032
Egodawatta		533C	3,310	Pelenwatta	North	582	4,703
Erewwala	West	581A	6,544	Pelenwatta	West	582A	5,503
Erewwala	North	581D	4,373	Pepiliyana	West	535	5,039
Erewwala	East	581	2,542	Pepiliyana	East	535C	1,765
Gorakapitiya		584	1,749	Polhena		598B	2,339
Halpita		570/571	5,487	Rathmaldeniya		581C	5,440
Hedigama		563/73	4,294	Rattanapitiya		533A	4,768

GN name		Code	Population	GN name		Code	Population
Honnanthara	North	585	3,522	Regidel	Watta	598A	1,270
Honnanthara	South	585A	3,939	Suwarapola	East	562A	2,779
Horathuduwa		570/71A	1,604	Suwarapola	West	562C	1,387
Jamburaliya		597	3,184	Thumbovila	South	576B	3,303
Kahapola		598	3,283	Thumbovila	North	576A	4,037
Kaliyammahara		580	3,042	Thumbovila	West	576	2,697
Katuwawala	North	578	3,697	Vishwakalawa		574B	2,045
Katuwawala	South	578A	1,489	Werahera	North	577	1,977
Kesbewa	North	572	4,279	Werahera	South	577A	5,213
Kesbewa	East	572B	2,019	Wewala	West	562B	4,949
Kesbewa	South	572A	6,316	Wewala	East	562	2,655
Kolamunna		563/73A	3,633	**Total**			**245,232**

Following Table 2-3 shows the number of government and privet/non-government establishments within Kesbewa UC.

Table 2-3 Number of government and privet institutions within Kesbewa UC

Type of institute	No. of units
Schools	20
Hospitals	1
Medical Clinics	57
District Secretariat office	1
Divisional secretary offices	1
Post office	8
Police stations	1
Higher education institutes	63

A major portion of MSW is generated from commercial sector in the city. Following Table 2-4 shows the number of different commercial (business) establishments in KUC area.

Table 2-4 Types and number of business establishments in KUC area

Type of business	No. of units	Type of business	No. of units
Large restaurants	37	Press/printing	34
Small restaurants	46	Guest House	28
Vegetable/ Fruit shops	289	Building equipment	27
Glossary shops	606	factory	72
General wholesale shops	30	Food production	13
Textile trading shops	87	Chemical production	7
Electronic equipment shop	99	Reception Hall	8
Electrical equipment shop	52	Communications	74

Type of business	No. of units	Type of business	No. of units
Furniture sales shops	24	Education Center	63
Hardware shops	140	Wholesale	30
Vehicle spare parts shops	13	Financial Center	32
Vehicle repair garages	134	Pawn Center	18
Saw mills	120	bar	7
Vegetable sales shops	289	Office	177
Fish sales stalls	40	Book/Paper Shop	90
Barber shops	40	Oil Station	12
Beauty salon	83	Jewellery	20
Pharmacy	44	Optical Center	9
Large hotels	74	Studio	17
Garments	57	Show room	2
Furniture	3	Metal	19
Saw mills	120	Factories (Bag etc)	69
Bakery	58	Cab service	19
Ice cream shops	14	Learners	3
Chemical Fertilizer	3	Ceramic Shops	15
Laundry	5	Plastic Shop	6
Vehicle Service	17	Flower shop	15
Mills	86	Battery Service	8
Gas Station	25	Funeral Directors	3
Farm	6	Day care Center	8
Welding /lath	73	Food city	5

3 Public Opinion Survey (POS)

This Public Opinion Survey (POS) was commissioned to identify a range of household waste management matters in relation to the household sector. Information on household waste management practices and information on householders' experiences with waste collection delivery services was collected for the purpose of improving our understanding of householder's experiences and attitudes and also to better understand prevailing situation in householder's point of view. The purpose of this survey research included;

a. To collect information on public attitudes to the waste management and environment in broader,
b. To value aspects of environmental health and protection,
c. To provide information on experiences with Local Authority's waste management service and,
d. To provide information on household waste management practices.

3.1 Public opinion survey methodology

The number of samples from Kesbewa identified as 200 households, but size of the sample increased to 211 during the implementation to increase the accuracy. The selection of households and areas within Kesbewa UC was done after a consultative discussion with MSW section officers at KUC and JICA expert team members.

The survey was executed by a team of university students who were trained about the questionnaire, survey methodology and the data entering before dispatched to their respective fields. A senior expertise took the leadership and continuously supervised the field survey. The selected households were first educated about the survey, its main objectives and asked their cooperation before starting the field survey. In addition business and institutes, large waste generators, hospitals recycling shops and large public markets were also surveyed using appropriate questionnaires prepared in consultation with JICA experts.

Table 3-1 Category and number of samples for Public Opinion Survey

Category	Survey area	Number of samples
High-income households	ICC Gardens, Karadiyana Watta, Mithreepura, High Way terrace, Sarabhumi	51
Middle-income Households	Samagipura, Bangalawatta, Vijithapura, High Way terrace, Mithreepura, Sarabhumi, Isuru Pedesa	67
Low-income Households	Rejilel Watta Kahapola, Hillcrest Watta, Marrodha Rd, ICC garden	33
Businesses /Service organization	Kahapola, Horana Rd Piliyandala, Colombo Rd	39
Large waste generators		17
Hospitals		1
Markets		1
Recycling shops		1
NGO		1

Category	Survey area	Number of samples
Total		**211**

The questionnaires were available in all languages (English/Sinhala/Tamil); however the questionnaire form was filled by the interviewer based on interviewees' response. The collected information was recorded in digital form using Microsoft Excel and reviewed for accuracy. The data was analyzed in detail for different objectives that generate an overview of the survey.

3.2 Results of Public Opinion Survey

- ✓ 95% of the surveyed households are Sinhalese, with 5 % of Muslims. Data on the average number of people per household and monthly income is set out in below Table 3-2.

Table 3-2 Average and standard deviation values of income and family size

Category	Family size	Income (Rs/month)
High	4.1 ± 1.0	219. 314 ± 285, 156
Middle	4.4 ± 1.2	45, 224 ± 11, 650
Low	4.6 ± 1.6	26, 167 ± 9,358
	No of workers	**Income (Rs/month)**
Business	2.4 ± 2.9	893, 590 ± 1, 527, 887

- ✓ In Kesbewa UC, 100 % of surveyed households are provided with a garbage collection service, and all of them use this service. Moreever, 64 % of surveyed households are "very satisfied" with present SWM service provision, while 28 % are "somewhat satisfied".

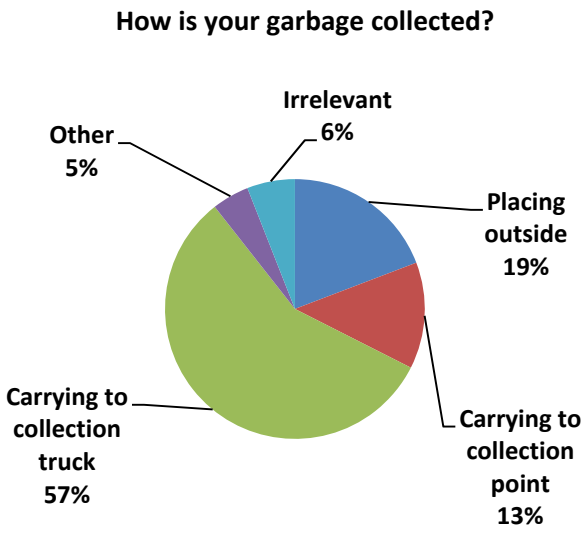


Figure 3-1 Method of garbage discharge by residence in KUC area

- ✓ Households' main methods of waste discharge are shown in Figure 3-1. The most common methods are carrying garbage to collection truck (77%) and discharging it outside their premises for house to house collection (23 %).
- ✓ Only 33 % of surveyed households receive a daily garbage collection service and 26 % stated received the service 2-3 times/week while 36 % revived the service once in a week. However, 23 % discharge waste as soon as it generates, while 59% discharge their garbage daily and 18 % discharge 2-3 times per week.
- ✓ In general, adult male is responsible for waste discharge in 54 % surveyed households with 31 % adult female share from the rest.
- ✓ As shown in Figure 3-2, only 8 % of households separate their garbage into organic and inorganic waste at the source of generation. Furthermore, 38 % of surveyed households are not/less willing to cooperate with source separation for recycling. Rests of the household are either very much willing (26 %) or somewhat willing (28 %) to cooperate in source separated garbage collection system.
- ✓ Further, 82 % of surveyed households stated that there are recyclable collectors or someone who comes to collect their reusable or recyclable materials. Hence, informal recycling system is well established in Kesbewa UC area.

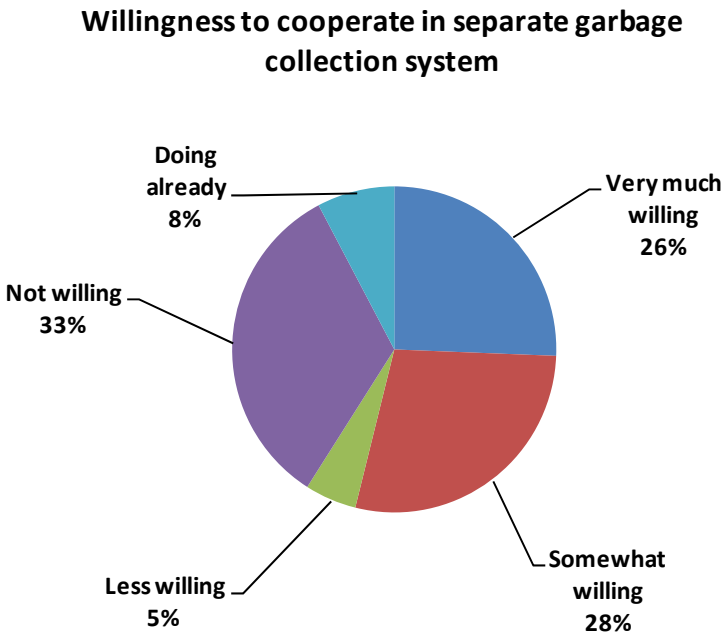


Figure 3-2 Willingness of residence for a source separated garbage collection system in Kesbewa UC

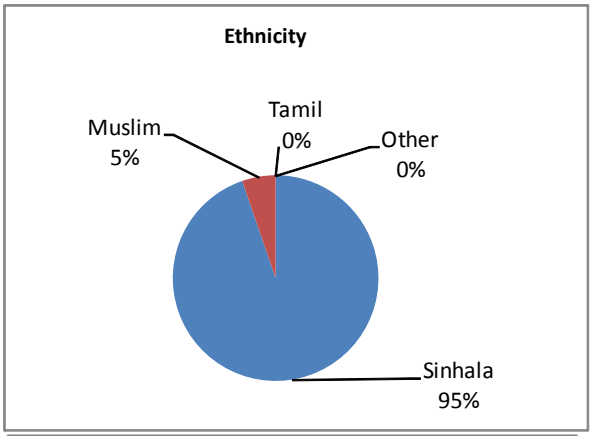
- ✓ None of the surveyed households use kitchen/garden waste for composting.
- ✓ Not many surveyed households (10 %) have ever discussed proper garbage discharge methods at the community level.
- ✓ 62 % households stated that SWM awareness programmes are very necessary while 38 % stated "somewhat necessary". None of surveyed households stated that awareness campaigns are not necessary or not needed at all.
- ✓ Only 15 % of household do not like to pay for an improved SWM service. The average WTP (willingness to pay) for improved SWM services is 38 ± 52 Rs/month per household.

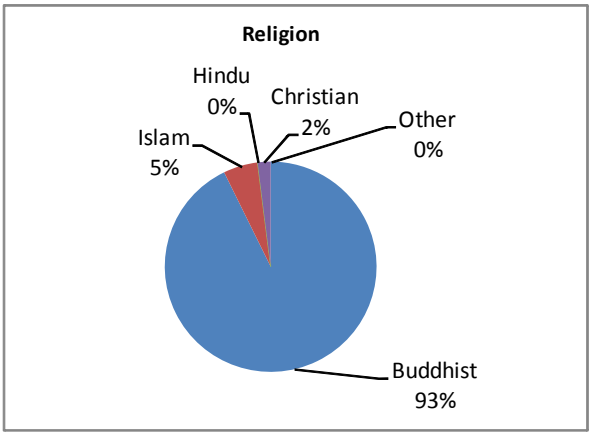
- ✓ Out of all surveyed households, 38 % stated that they sale/give-off Glass & Bottle for recycling and 68 % of residence sale/give-off Plastics for recycling. Also, 11 % of households sale/ give-off Tin/can for recycling. Cardboard and paper recycling were as high as 84 % and 35 % respectively.

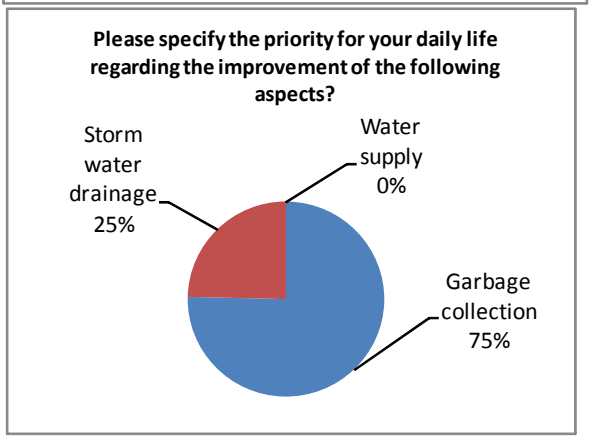
Annex

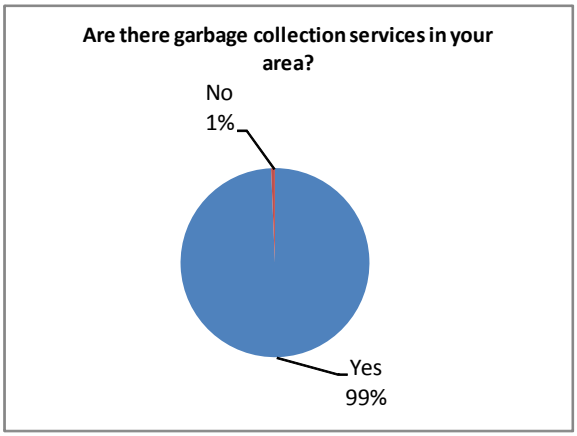
KESBEWA URBAN COUNCIL

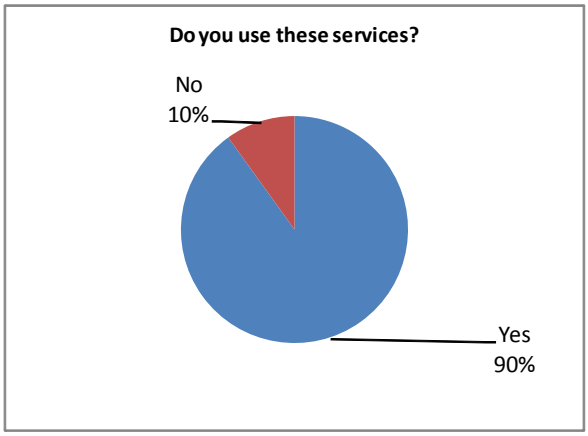
Response to Public Opinion Survey for Household

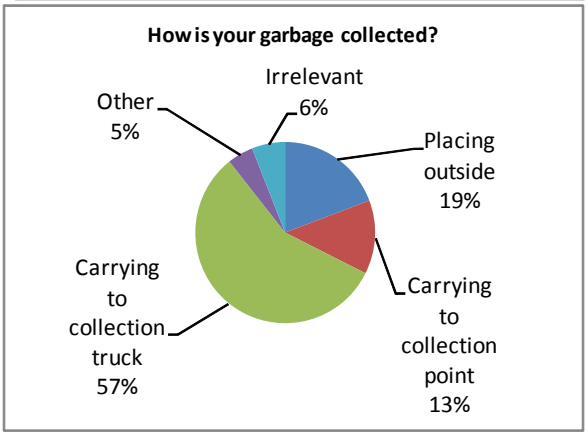












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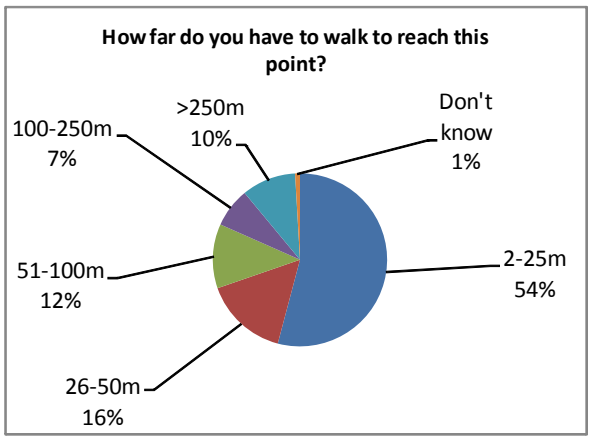

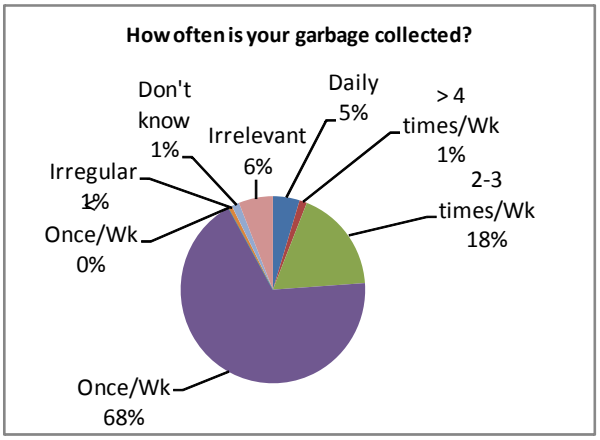

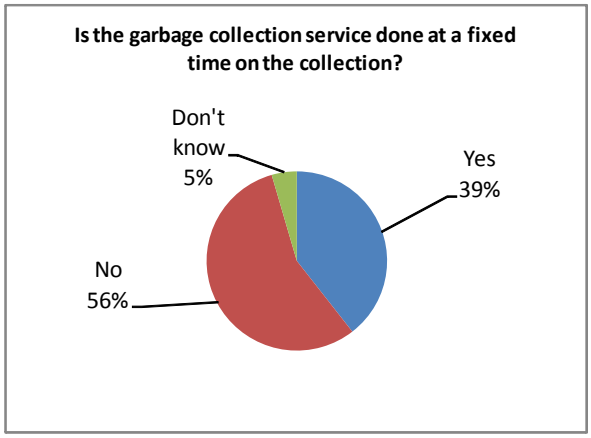

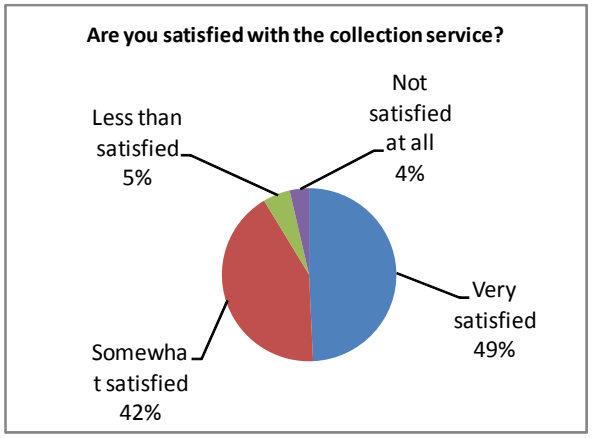

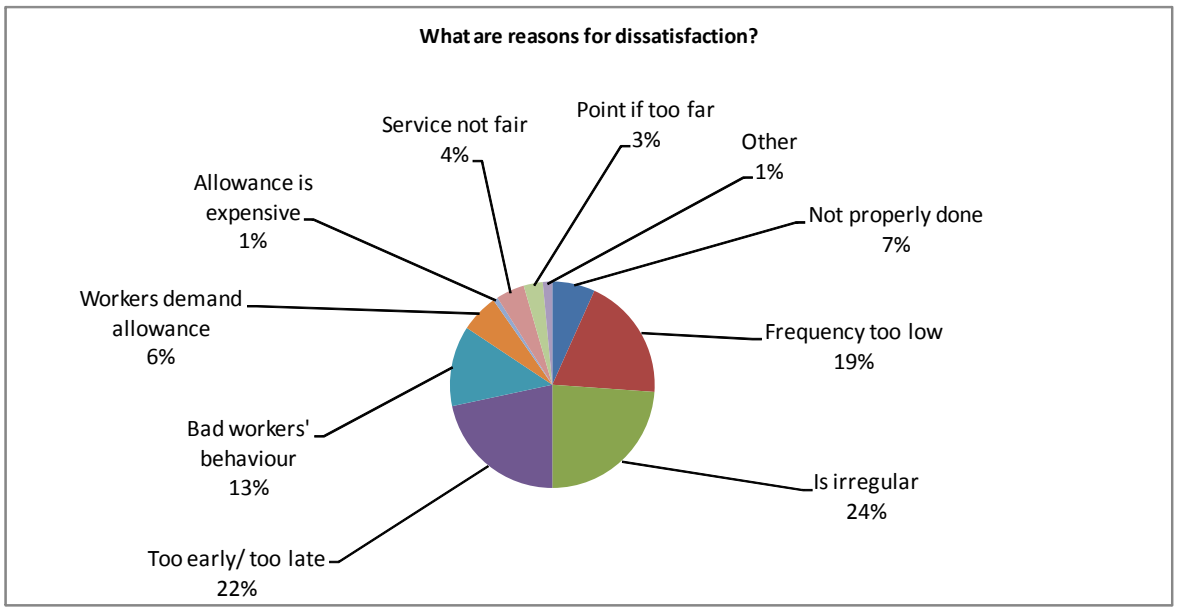

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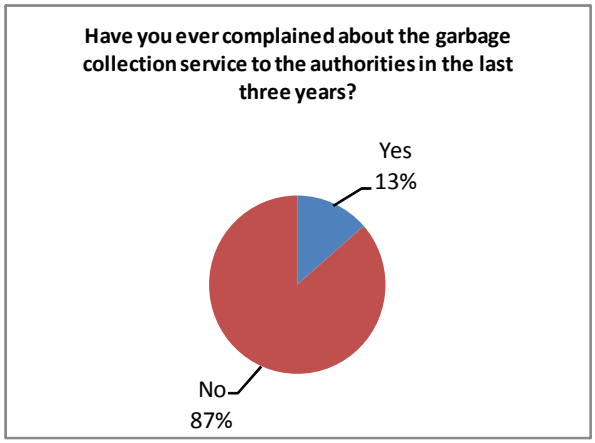

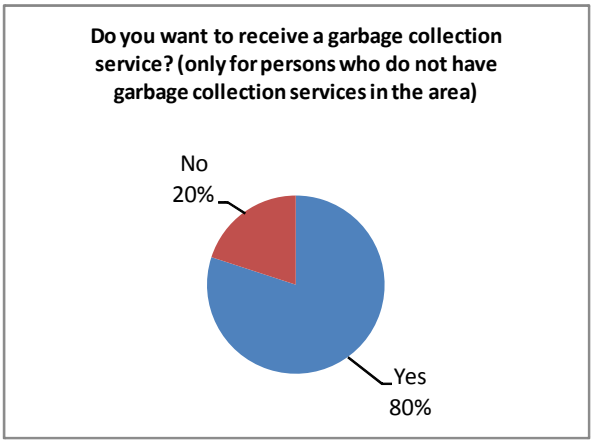

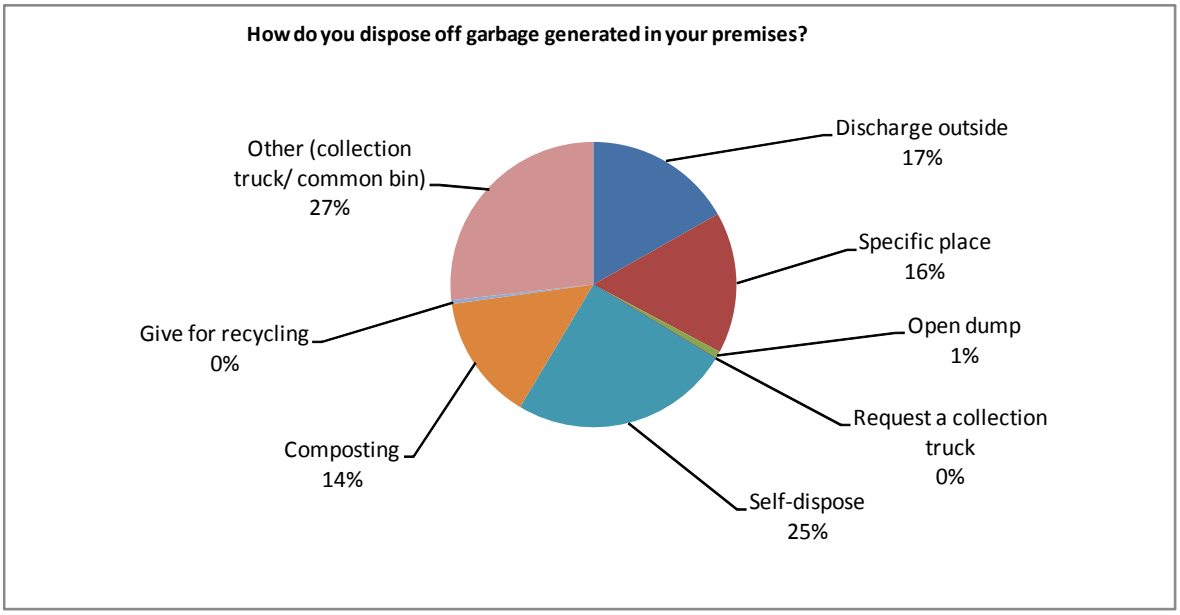

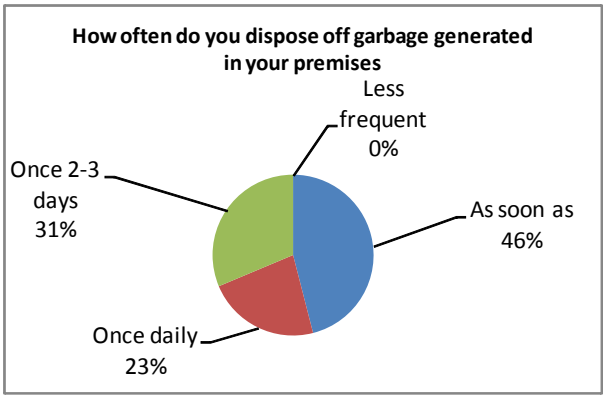

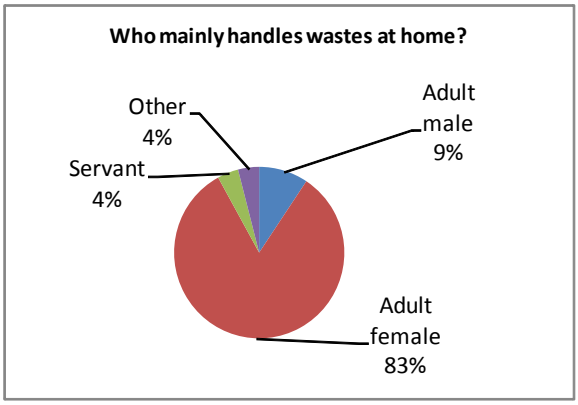

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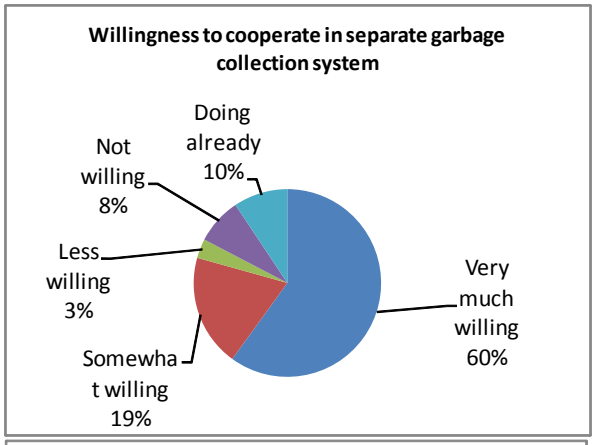
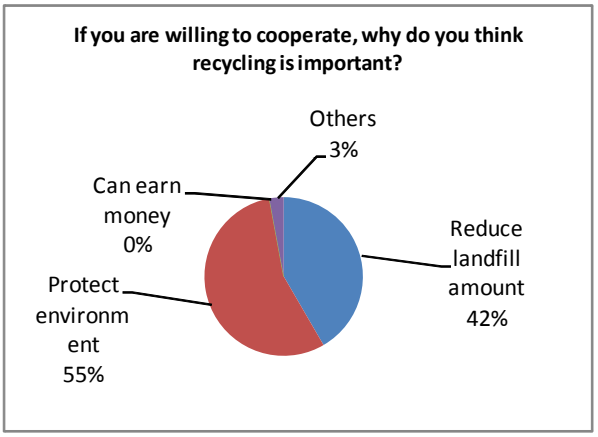
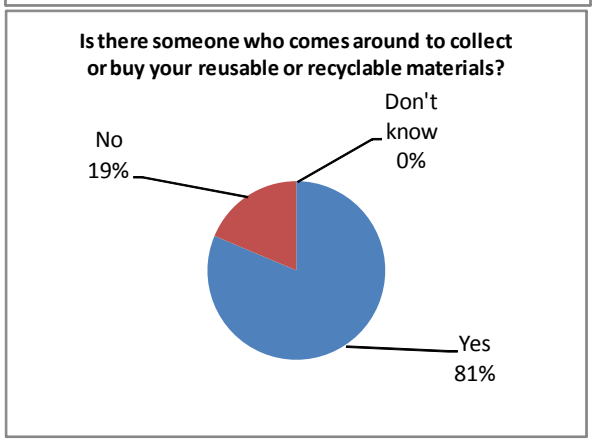
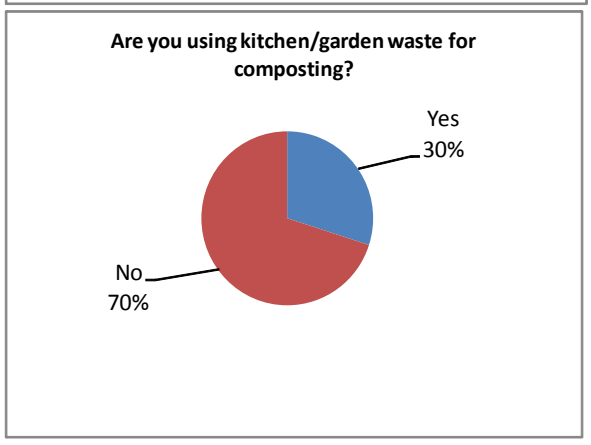
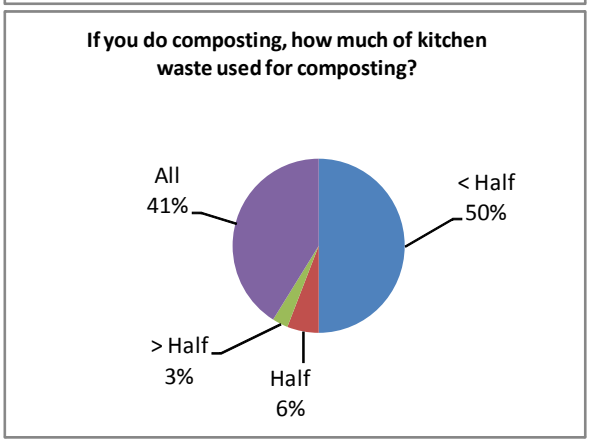




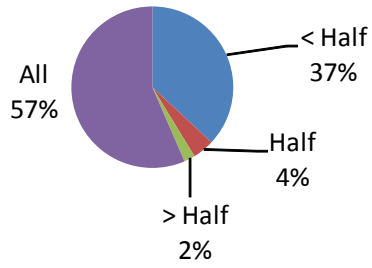




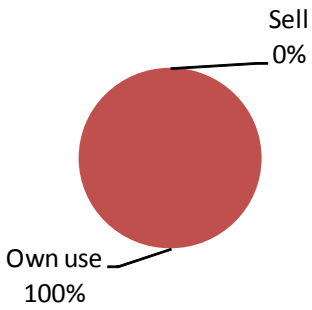


Response to Public Opinion Survey for Household

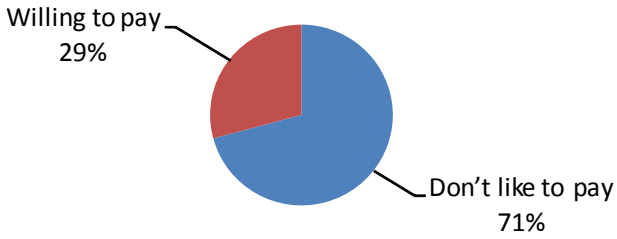
If you do composting, how much of garden waste used for composting?



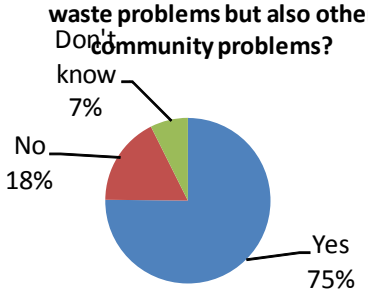
What do you do with produced compost?



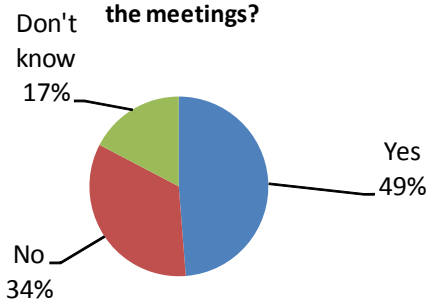
Suppose that you are satisfied with the service of Municipal solid waste management, either as is or as a result of improvement. Think for a moment about the largest amount of money that your household would be willing to pay each month as a garbage collection fee



Do you have any community-based organizations to solve not only the waste problems but also other community problems?



Have you ever discussed the methods of proper garbage handling and discharge at the meetings?



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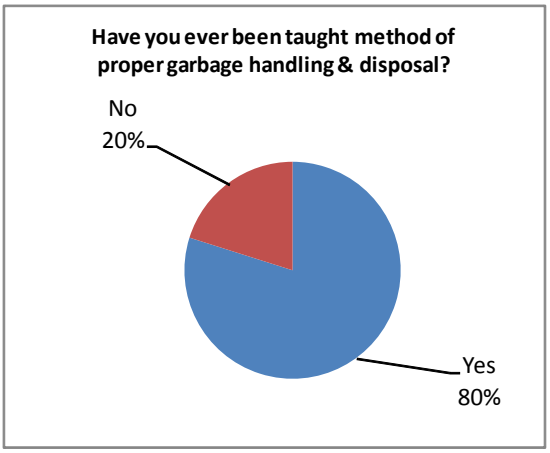

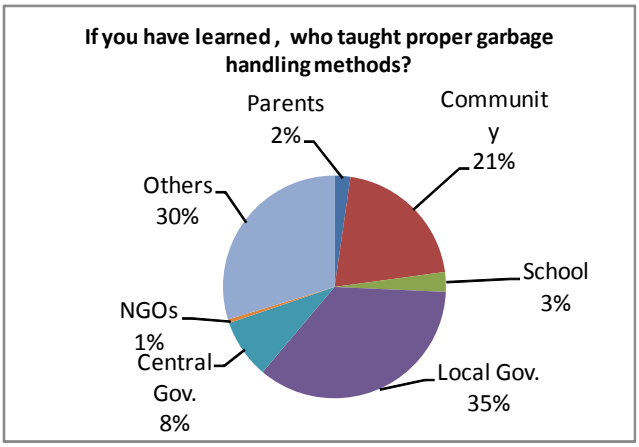

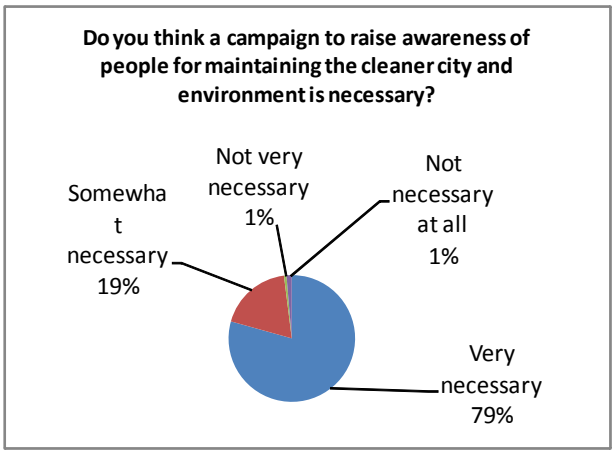

1.9 Katunayake Seeduwa UC

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1 Introduction

The purpose of this survey is to obtain the current data regarding Solid Waste Management (SWM) at Katunayake-Seeduwa Urban Council (KSUC). The data collection survey was conducted from 30th October to 04th November, 2015 by a team of expert dispatched by Waste To Energy Technologies Limited.

This report consists of brief summaries of survey methods and results. The additional primary data and records are available as soft copies. The preliminary data collection was conducted through three comprehensive surveys which are;

i. **Waste Generation Survey (WGS)** is to gather information on waste generation sources at KSUC based on secondary data available at KSUC and other relevant organizations.
ii. **Public Opinion Survey (POS)** is gather information on public opinion on current waste management in KSUC. The POS was conducted through a questionnaire survey that covers different types of waste generators in the KSUC area.
iii. **Final Disposal Site Survey (FDSS)** is to collection data on final MSW disposal site of KSUC based on secondary data as well as field recordings & visits to the site.

1.1 Background conditions of Katunayake-Seeduwa Urban Council

Katunayake-Seeduwa town is located in the Gampaha District of the Western Province on the Northern direction of City of Colombo. It is bounded by Negombo Municipal Council to the North, Katana Pradeshiya Sabha to East, Ja-Ela and Wattala Pradeshiya Sabhas on south. Indian Ocean lies on the West.

Table 1-1 Basic fact sheet of Katunayake-Seeduwa Urban Council

Item	Description
Province	Western Province of Sri Lanka
District	Gampaha
Local Authority Status	Urban Council
Location in Relation to	Katunayake-Seeduwa is located North of Colombo City along the Colombo- Puttlam (A3) Highway
No. of Council Wards	12
No. of Council Members	9
No. of Villages	16
No. of Dwellings	8, 156
Population UC record (2012 statistics)	59, 281

2 Waste Generation Survey (WGS)

In order to obtain general information on waste generation amounts, the data available at waste management section of the Health Department, Works Department and Revenue Department of KSUC was used. Some of the data was available in the form of formal records and reports which were treated as the most precise secondary data while the data collected from official interviews with KSUC officers was treated as verification data. Thus, the survey data was collected through different methods;

a) Recording and compiling of published and verified data by KSUC,
b) Reading and recording of unpublished & non-confidential data available at KSUC,
c) Recording and official statistics available at Katunayake-Seeduwa Divisional Secretariat office, and
d) Official person-to-person interview with relevant officers at KSUC for verification of data.

The numerical data was collected as specified in following Table 2-1.

Table 2-1 Type of data collected for WGS in Katunayake-Seeduwa UC

Source	Description
Household	Each number of following category households was surveyed; 1) High income level, 2) Middle income level and 3) Low income level.
Commercial	Each number of following category restaurants was surveyed; 1) Large size restaurants, 2) Middle size restaurants and 3) Small size restaurants. Each number of following category shops was surveyed; 1)Organic shops (large) 2)Organic shops (middle) 3)Organic shops (small) 4)Non-Organic shops (large) 5)Non-Organic shops (middle) 6)Non-Organic shops (small)
Hotels	Each number of following category hotels was surveyed; 1) Large size hotels 2) Middle size hotels and 3) Small size hotels.
Markets	Number of stalls and types
Institutions	Each number of following institute was surveyed; 1) Schools 2) Hospitals (government) 3) Hospitals (private) 4) Public office 5) Bank/private office 6) Buddhist temples 7) Hindu temples 8) Mosques 9) Churches 10) Navy/Police/ Army bases

Source	Description
	11) Others
Industries	Wastes from any industries.
Other	Public parks and other public facilities
Construction and demolition	Wastes originating from construction, rehabilitation and demolition activities, etc.
Hazardous (Special)	Management and collection of hazardous wastes originating from various sources, including household items

2.1 Waste Generation Survey Results

The records indicate that the total residential population within KSUC is 59, 281. The Katunayake-Seeduwa UC area consists of 16 Grama Niladari (GN) divisions as shown in below Table 2-2 .

Table 2-2 Population statistics of villages in KSUC area (Source: Census and statistics 2012)

GN name	GN code	Total population
Air Force Camp	150	2,733
Evariwatta	149	6,804
Kurana-Katunayake West	142B	3,138
Kurana-Katunayake North	142	2,701
Kurana-Katunayake South	142A	1,814
Katunayaka North	143	2,177
Katunayaka Suth	143A	5,738
Liyanagemulla North	144A	5,898
Liyanagemulla South	144	4,824
Amandoluwa	148	8,538
Seeduwa	147	5,210
Mookalangamuwa West	145B	3,041
Mookalangamuwa East	145A	2,402
Bandarawatta East	145C	1,915
Bandarawatta West	145	4,127
Ambalammulla	146	2,400

As shown in following Table 2-3, Katunayake-Seeduwa UC own and control a number of public properties and institutes.

Table 2-3 Type and number of municipal establishment own by Katunayake-Seeduwa UC

Type of public property	No. of units
Libraries	3
Municipal parks	1
Play grounds	5

Type of public property	No. of units
Cemetery	5
Fish markets	1
Meat stall/ markets	6
Pola premises	4
Community centres	3

Following Table 2-4 shows the number of government and privet/non-government establishments within Katunayake-Seeduwa UC.

Table 2-4 Number of government and privet institutions within Katunayake-Seeduwa UC

Type of institute	No. of units
Schools	11
Hospitals	4
Privet Hospitals	2
Medical clinics	3
District Secretariat office	1
Divisional secretary offices	1
Post office	6
Other Government offices	44
Police stations	1
Higher education institutes	4
Banks	9
Buddhist temples	9
Hindu Kovils	15

A major portion of MSW is generated from commercial sector in the city. Following Table 2-5 shows the number of different commercial (business) establishments in KSUC area.

Table 2-5 Types and number of business establishments in KSUC area

Type of business	No of units	Type of business	No of units
Large size restaurants	14	Bakery	11
Middle size restaurants and	9	Lerner	3
Vegetable/ Fruit shops	31	Education center	4
Glossary shops	140	Filling station	2
Textile trading shops	15	Communications	22
Electrical equipment shops	25	Vehicle service stations	11
Furniture shops	13	Printing/press	3
Hardware shops	30	Office	31
Vehicle spare parts shops	23	Hostel	20
Vehicle repair garages	14	Funeral service	2

Type of business	No of units	Type of business	No of units
Saw mills	7	Food Production	21
Vegetable sales shops	17	Guest house	9
Fruit sales shops	14	Lath works	13
Fish sales stalls	3	Auto A/C Repair	4
Meat sales stalls	4	Super market	6
Barber shops	18	Chemical Production	4
Pharmacy	10	Gas	7
Large size hotels	7	Grinding mills	5
Small size hotels	12	Production	8
Garments/ Tailoring	20	Plastic Factory	3
Furniture	13	Jewellery	5
Saw mills	7	Plastic sales Shops	25
Medical center	2	Book Shop	14
Farm shop	2	Studio	10
Bar	5	Optical	3
Engineering service	8	Cab Service	7
Race Spots	3		

In addition, Katunayake-Seeduwa UC own fleet of vehicles used for MSW service. Following Table 2-6 shows a list of vehicles own by KSUC.

Table 2-6 Type and number of vehicles own by KSUC

Type of vehicle	Total
Four wheel Tractor & Trailers	09
Three-wheel trucks	2
Handcarts	10

3 Public Opinion Survey (POS)

This Public Opinion Survey (POS) was commissioned to identify a range of household waste management matters in relation to the household sector. Information on household waste management practices and information on householders' experiences with waste collection delivery services was collected for the purpose of improving our understanding of householder's experiences and attitudes and also to better understand prevailing situation in householder's point of view. The purpose of this survey research included;

a. To collect information on public attitudes to the waste management and environment in broader,
b. To value aspects of environmental health and protection,
c. To provide information on experiences with Local Authority's waste management service and,
d. To provide information on household waste management practices.

3.1 Public opinion survey methodology

The number of samples from Katunayake-Seeduwa identified as 200 households, but size of the sample increased to 202 during the implementation to increase the accuracy. The selection of households and areas within Katunayake-Seeduwa UC was done after a consultative discussion with MSW section officers at KSUC and JICA expert team members.

The survey was executed by a team of university students who were trained about the questionnaire, survey methodology and the data entering before dispatched to their respective fields. A senior expertise took the leadership and continuously supervised the field survey. The selected households were first educated about the survey, its main objectives and asked their cooperation before starting the field survey. In addition business and institutes, large waste generators, hospitals recycling shops and large public markets were also surveyed using appropriate questionnaires prepared in consultation with JICA experts.

Table 3-1 Category and number of samples for Public Opinion Survey

Category	Survey Area	Number of samples
High-income households	Liyanagemulla, Main Rd, Gama Meda Rd, Welabada Rd	46
Middle-income Households	Liyanagemulla, Mukalangamuwa, St. Joseph St, Seeduwa South, Ambalanmulla, Main Rd	59
Low-income Households	Bandarawatta, Mukalangamuwa, Main Road, Ambalanmulla, St. Joseph St	46
Businesses /Service organization	Seeduwa, Ambalanmulla, Main Rd	42
Large waste generators		9
Markets		1
Recycling shops		1
Total		**204**

The questionnaires were available in all languages (English/Sinhala/Tamil); however the questionnaire form was filled by the interviewer based on interviewees' response. The collected information was recorded in digital form using Microsoft Excel and reviewed for accuracy. The data was analyzed in detail for different objectives that generate an overview of the survey.

3.2 Results of Public Opinion Survey

- ✓ 99% of the surveyed households are Sinhalese, with 1 % of Muslims. Data on the average number of people per household and monthly income is set out in below Table 3-2.

Table 3-2 Average and standard deviation values of income and family size

Category	Family size	Income (Rs/month)
High	5.5 ± 5.0	184, 348 ± 151, 623
Middle	4.0 ± 1.2	75, 237 ± 125, 615
Low	4.5 ± 1.7	33, 957 ± 10, 681
	No of workers	**Income (Rs/month)**
Business	2.3 ± 1.3	927, 619 ± 733, 335

- ✓ In Katunayake-Seeduwa UC, 99 % of surveyed households are provided with a garbage collection service, of which 93 % stated they use this service. Only 48 % of surveyed households are "very satisfied" with present SWM service provision, while 33 % are "somewhat satisfied". About 19 % of surveyed households are either "not satisfied at all" or "less than satisfied".

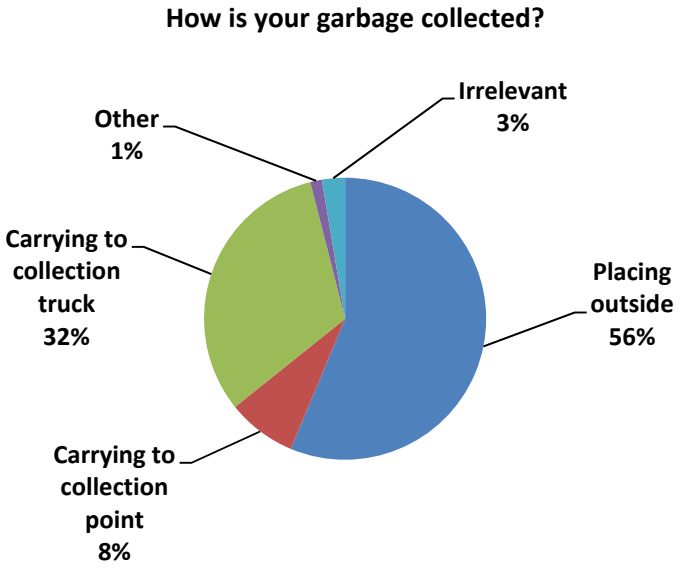


Figure 3-1 Method of garbage discharge by residence in KSUC area

- ✓ Households' main methods of waste discharge are shown in Figure 3-1. The most common methods are discharging it outside their premises for house to house collection (56 %) and carrying garbage to collection truck (32 %).
- ✓ Only 26 % of surveyed households receive a daily garbage collection service, 30 % stated that they received the service 2-3 times/week and 20 % receive the service once in a week. Similarly, 48% discharge their garbage daily, 12 % discharge their garbage 2-3 times per week, and 23 % as soon as it is generated.
- ✓ In general, adult females handle waste in about 77 % of surveyed households.
- ✓ As shown in Figure 3-2, only 8 % of households separate their garbage into organic and inorganic waste at the source of generation. Only 7 % of surveyed households are not/less willing to cooperate with source separation for recycling. Rests of the household are very much willing (74 %) and somewhat willing (11 %) to cooperate in source separated garbage collection system.
- ✓ Further, 70 % of surveyed households stated that there are recyclable collectors or someone who comes to collect their reusable or recyclable materials. Hence, informal recycling system is well established in Katunayake-Seeduwa UC area.

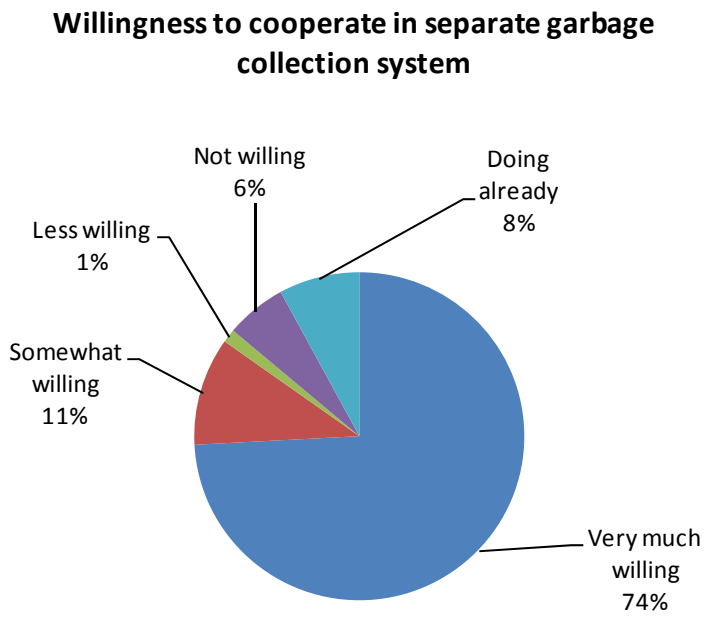


Figure 3-2 Willingness of residence for a source separated garbage collection system in Katunayake-Seeduwa UC

- ✓ Only 22 % of surveyed households use kitchen/garden waste for composting and used the finished compost for their own garden.
- ✓ Not many surveyed households (79 %) have ever discussed proper garbage discharge methods at the community level.
- ✓ 85 % households stated that SWM awareness programmes are very necessary while 12 % stated "somewhat necessary". Only 3 % of surveyed households stated that awareness campaigns are not necessary or not needed at all.

- ✓ 66 % of household do not like to pay for SWM service mainly because of the revenue tax they paid for KSUC. The average WTP (willingness to pay) for improved SWM services is 64 ± 127 Rs/month per household.
- ✓ Out of all surveyed households, 42 % stated that they sale/give-off Glass & Bottle for recycling and 56 % of residence sale/give-off Plastics for recycling. Also, 28 % of household sale/ give-off can & metal for recycling. Cardboard and paper recycling were 28 % and 41 % respectively.

4 Final disposal site survey (FDS)

4.1 Introduction the FDS of Katunayake-Seeduwa UC

4.1.1 Survey Method

The data and information in this report were collected from various sources including published reports, verified data from Katunayake-Seeduwa Urban Council, Supervisor of Katunayake-Seeduwa Waste Disposal site and direct interview with workers at disposal site.

4.1.2 Target of Survey

The survey is focus on obtaining general information on waste receiving, handling, disposal, facility management, environmental monitoring and legal adherences.

4.1.3 Data Sampling

The numerical data was collected as specified in following Table 4-1.

Table 4-1 Data collected during the final disposal site survey

	Survey Items	Method
1	Current condition of final disposal site and its surroundings	
	✓ Disposal method and structure	Records, visual observation
	✓ Soil-covering	Records, visual observation
	✓ Land owner	Records
	✓ Residual area	Records, visual observation
	✓ Leachate water	Records, visual observation
	✓ Waste picker	Records, visual observation, interview
	✓ Scattering waste, smoke, fire, offensive odour, animals and so on	Records, visual observation
2	Operation and Management of final disposal site	
	✓ Environmental Protect License and Environmental Clearance	Record
	✓ Personnel	Records, interview
	✓ Operation vehicles, their maintenances and drivers	Records, interview
	✓ Weighbridge	Records, interview
	✓ Waste collection data	Records, interview
	✓ Supervisory method	Records, interview
3	Waste amount to final disposal site (24 hours, 7 days)	Records, Survey
4	Adverse impact near by residences	Records, Survey
5	Implementation status of geological, topographic and EIA survey for new final disposal site	Records, interview
6	Progress situation for new final disposal site	Records, interview
7	Court case	Records, interview

4.2 Current condition of final disposal site and its surroundings

4.2.1 Katunayake-Seeduwa waste disposal site

Katunayake-Seeduwa waste disposal site is one of the MSW dumpsite locate in a very sensitive environmental setup which is at the edge of Negombo Lagoon. The Katunayake-Seeduwa site is situated approximately 2.5 km away from Katunayake-Seeduwa city center. The site boarded to Negombo Lagoon on the East and Colombo-Katunayake Expressway on the West (Figure 4-1 and Figure 4-2).

Figure 4-1 Location of Katunayake-Seeduwa dumpsite

Figure 4-2 Katunayake-Seeduwa dumpsite and environment around the dumpsite

4.2.2 History and evolution of the dumpsite

The available records showed the dumpsite was first started in early 90's. Starting from 90's, the site was commonly shared by KSUC and few privet organizations such as Sri Lanka Airline catering Service tec. The historical evolution of the dumpsite is illustrated in Figure 4-3. As evident of historical aria views and interviews with site workers, there was a large area covered with waste. At the beginning, there were no roads into the site, therefore garbage was dumped along the access road and temporarily service roads build during the expressway construction.

Historically, the area was paddy fields; however the agricultural practices were abundant due to flood waters (induced by soil filling for expressway) and saltwater intrusion. The major portion of the land belongs to Sri Lanka Land Reclamation & Development Corporation (SLLR&DC) with privately own a minor portion.

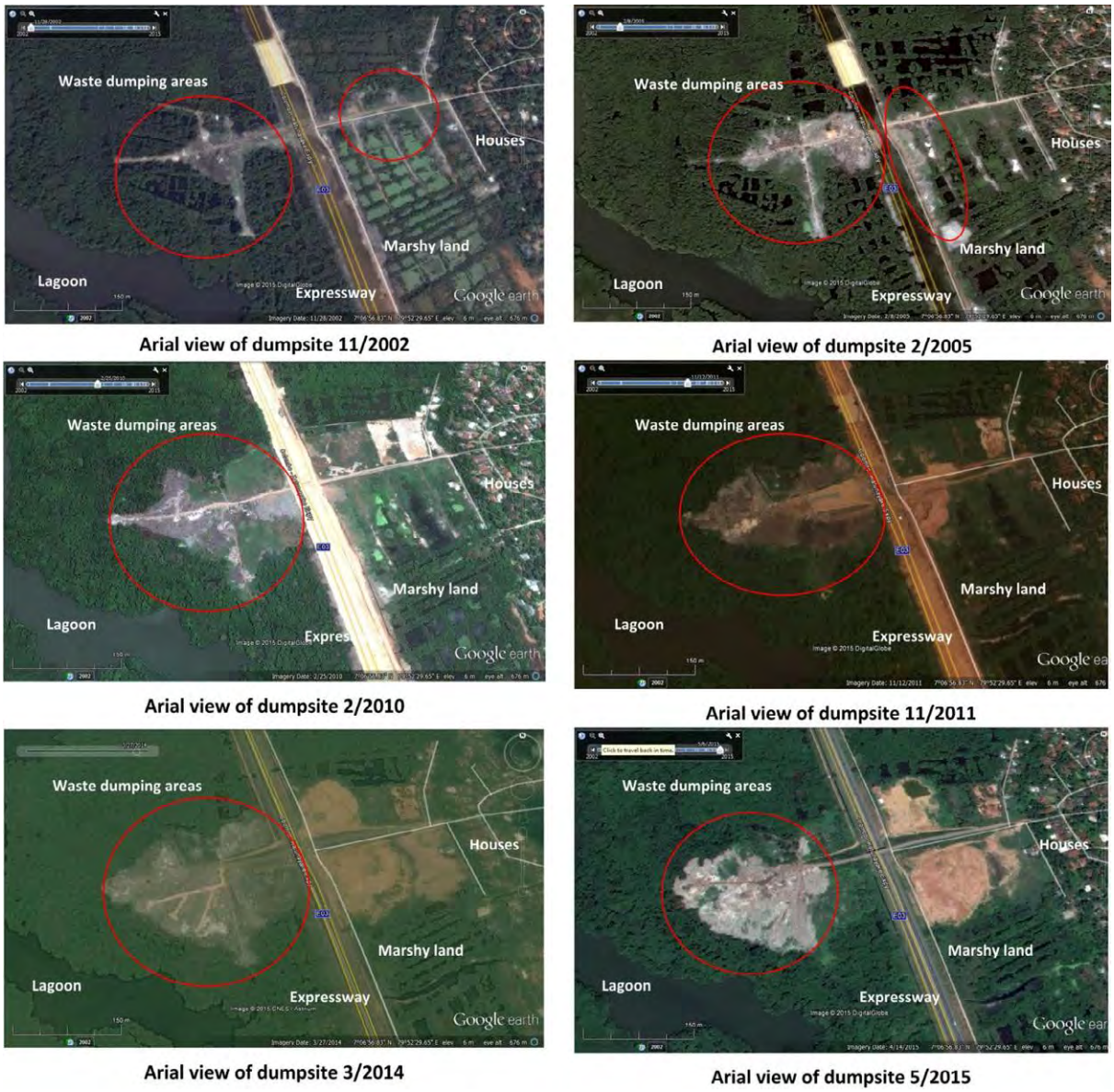


Figure 4-3 Historical evolution of Katunayake-Seeduwa dumpsite

The access to the dumpsite was repaired and rebuilt during the expressway construction. This include a overhead bridge on the Expressway and a temporally screen facing the expressway.

4.2.3 Management and authority of Katunayake-Seeduwa Dumpsite

The dumpsite is operated and managed by the KSUC. The site has minimum infrastructure facilities, therefore the dumping and control supervision of dumpsite are at minimal level.

4.2.4 Extend and landform

Final disposal site is located at Ambalanmulla, within Katunayake-Seeduwa UC, at about 1 km away from the A3 highway on its west. The extent of the final waste disposal site is 20 acres including a small portion of privately own land. The closet proximity to residence is around 600 m from the site except the single dwelling lies at the edge of the dumpsite. The Negombo Lagoon is approximately 500 m west to the site.

Figure 4-4 Katunayake-Seeduwa dumpsite and environment within 500 m radius from center

Except the active dumping areas, surrounding area is covered with shrubs and wetland flora with extensive growth of wetland plants (mangroves) on the vicinity. The landform is a flat terrain except the areas where the waste has been dumped. However, the area is almost entirely surrounded by standing waters in streams around the site.

4.2.5 Waste receiving and disposal

The existing dumpsite is commonly shared by several Local Authority and few privet organizations as shown in following Table 4-2 .

Table 4-2 Sources and quantities of waste disposed at Katunayake-Seeduwa MSW dumpsite

Date	4-wheel tractor	3-wheel truck	MSW disposal	Food waste picked up
	(Loads)	(Loads)	(tonnes/day)	(kg/day)
2/11/2015	23	6	58	
3/11/2015	23	6	58	
4/11/2015	21	4	53	250
5/11/2015	21	5	53	400
6/11/2015	23	6	58	400
7/11/2015	22	5	56	400
8/11/2015	9	4	23	

The MSW disposal is approximately 53-58 tonnes per day which is delivered by 9 tractors with 20-23 trips. In addition, three-wheeler trucks also deliver 4-6 loads of waste per day.

A notable feature is that part of food & kitchen waste delivered to site is sorted out and picked up by waste pickers as animal feed. The Katunayake-Seeduwa area is popular for pig farming, and the waste pickers collect approximately 400 kg of food waste per day.

4.3 Site infrastructure facilities

The Katunayake-Seeduwa dumpsite has minimum site infrastructure facilities. Figure 4-6 shows dumpsite and environment around the dumpsite. A privately hired bulldozer is employed at the site for waste handling (spreading).

Figure 4-5 Bulldozer is employed for waste handling at KSUC dumpsite

View of dumping site

Access road

Machinery (broken down)

Waste unloading

Mangrove growth at the edge

Food waste pickers

Collecting recyclable plastics

Figure 4-6 Activities and environment around KSUC dumpsite

4.3.1 Current condition of final disposal site and its surroundings

1	Current condition of final disposal site and its surroundings	
1.1	Disposal method and structure	✓ Incoming waste loads (tractors, three wheel trucks) are recorded manually by site supervisor at the entrance. ✓ All other MSW collection vehicles emptied its waste at the dumpsite. No specific control measures apply for selection of dumping area. Thus, **Open Dumping** is practiced. ✓ Waste pickers are allowed to pickup recyclable material during the unloading of waste
1.2	Soil-covering	✓ In general, daily covering of waste by soil is not practiced ✓ However, soil and construction wastes are used to make temporally access/roads on the dump. The soil application is practiced when need arise (when vehicle access is limited due to rain/ waste filling)
1.3	Land owner	✓ Ownership lies with a Sri Lanka Land Reclamation & Development Corporation (SLLR&DC) and a privet owner
1.4	Residual area	✓ Approximately 8 ha area has already been allocated, and approximately 3 hectares have already been covered by waste
1.5	Leachate water	✓ No leachate collection and treatment system ✓ Leachate and surface water flow towards the lagoon
1.6	Waste picker	✓ At present, 10-12 waste pickers including 3-4 persons who collect food & kitchen waste ✓ Plastic, Metal, Cardboard, beer cans, and arrack bottles are collected in addition to food waste
1.7	Scattering waste, smoke, fire, offensive odor, animals	✓ Scattering and blowing out of waste are frequent. Thus Expressway authority has made temporally screening (~ 150 m long and 2 m high) with galvanize sheet to the east side that face to expressway ✓ Workers set fire on waste to reduce waste amount and recover area ✓ Frequently offensive odors come out from active dumping area ✓ Dogs, cattle are frequent in the dump site

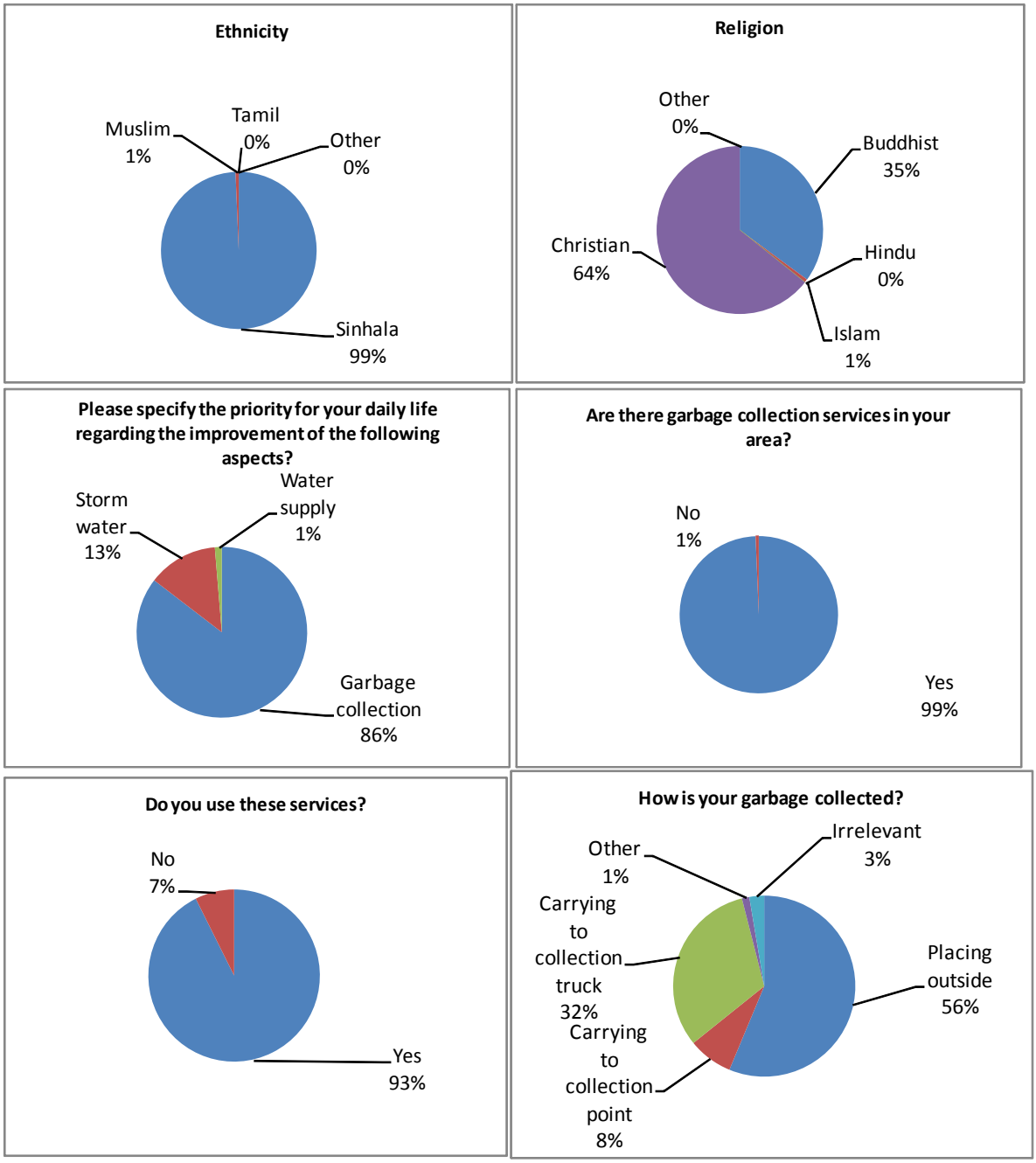
4.3.2 Operation and Management of final disposal site

2	Operation and Management of final disposal site	
2.1	Environmental Protect License and Environmental Clearance	✓ None
2.2	Personnel	✓ 1-Site supervisor
2.3	Operation vehicles, their maintenances and drivers	✓ 1 bulldozer (CAT D4) is hired and dispatched by KSUC for waste spreading. The bulldozer works 6 hours per day on average
2.4	Weighbridge	✓ None
2.5	Waste collection data	✓ Daily record is available (manual recording of vehicle number)
2.6	Supervisory method	✓ General planning and supervision come under Chief-PHI of KSUC. ✓ Site supervisor is responsible for daily operations and vehicle entry recording
3.0	Waste amount to final disposal site (24 hours, 7 days)	✓ A summary is shown in Table 4-2
4.0	Adverse impact nearby residences	✓ Odor and smoke are the man nuisance for residence around the dumpsite ✓ Then, the irritation caused by waste collection vehicles is also a problem for nearby residence along the road
5.0	Implementation status of geological, topographic and EIA survey for new final disposal site	✓ There is a proposal to construct a compost plant at the site by a privet company; Holcim Cement Pvt Ltd. However the proposal was abundant due to unsuitable soil formation/ ground condition beneath the dumpsite.
6.0	Progress situation for new final disposal site	✓ None
7.0	Court case	✓ None

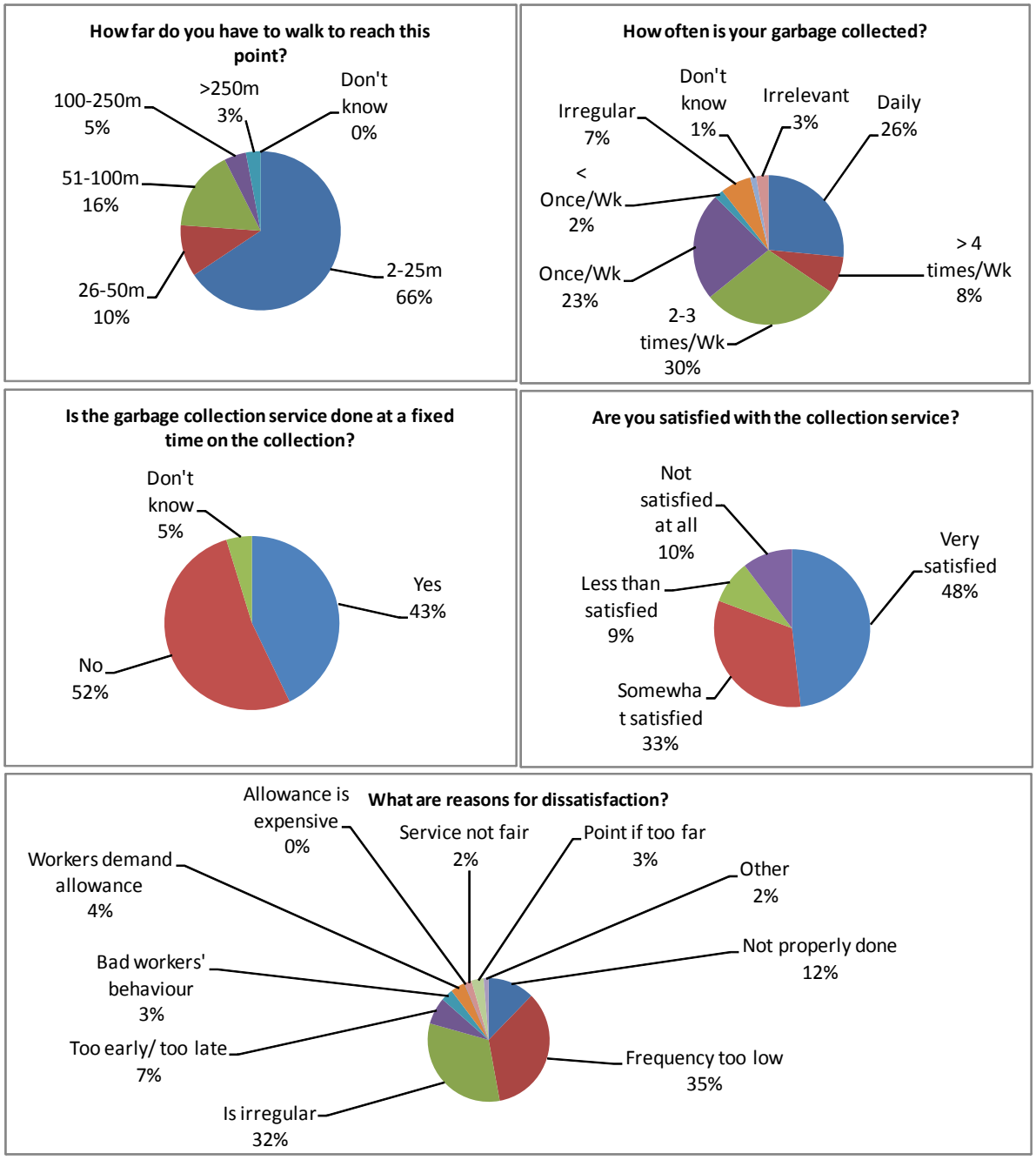
Annex

KATUNAYAKE SEEDUWA URBAN COUNCIL

Response to Public Opinion Survey for Household



Response to Public Opinion Survey for Household



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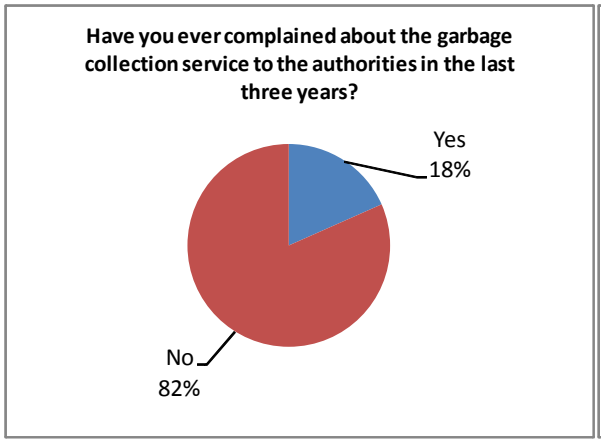

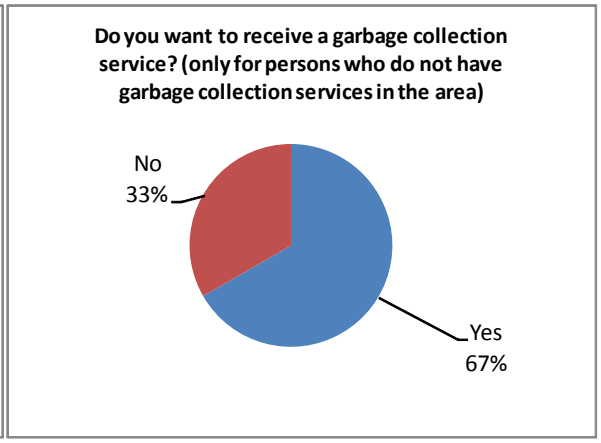

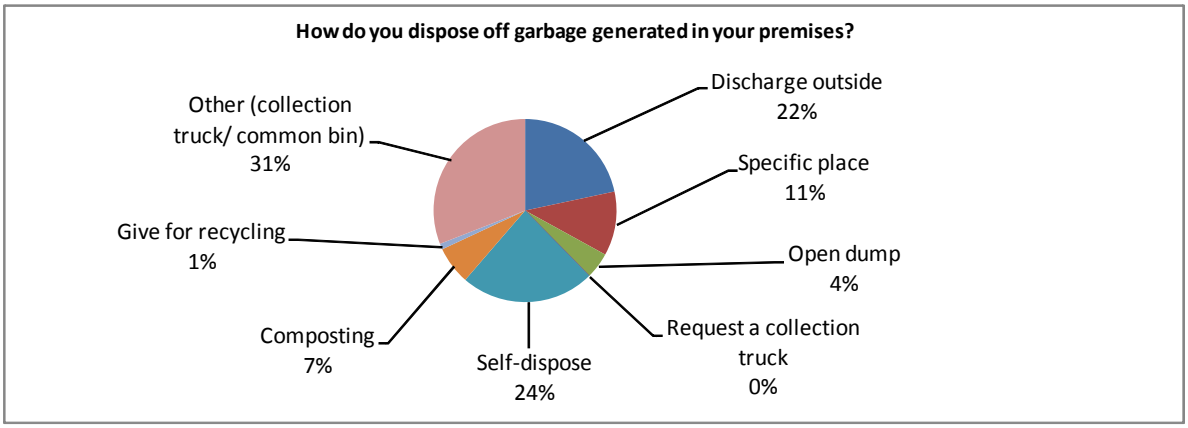

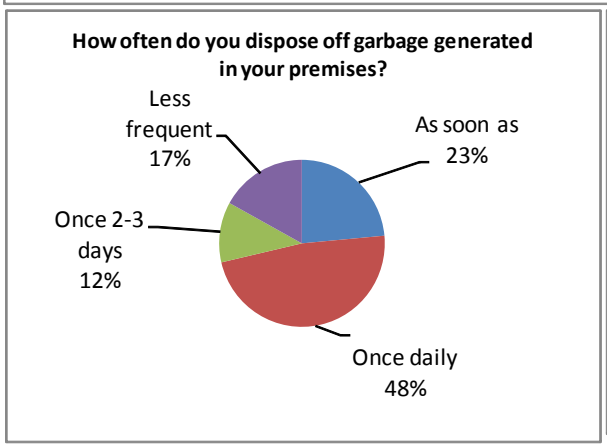

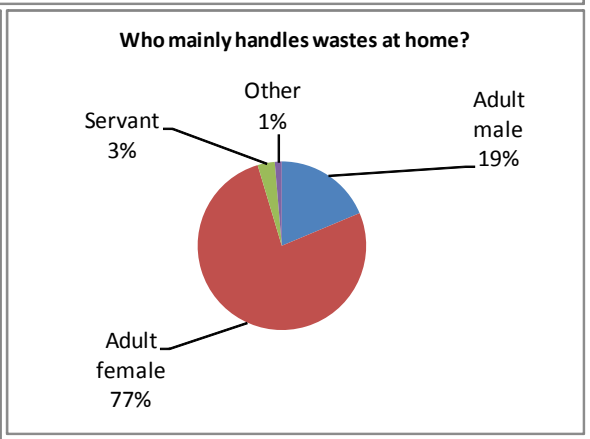

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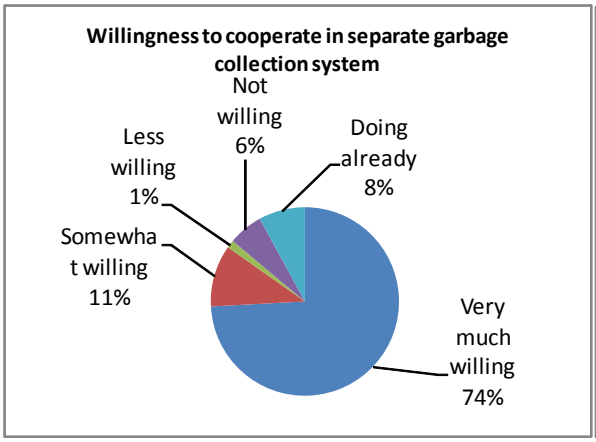
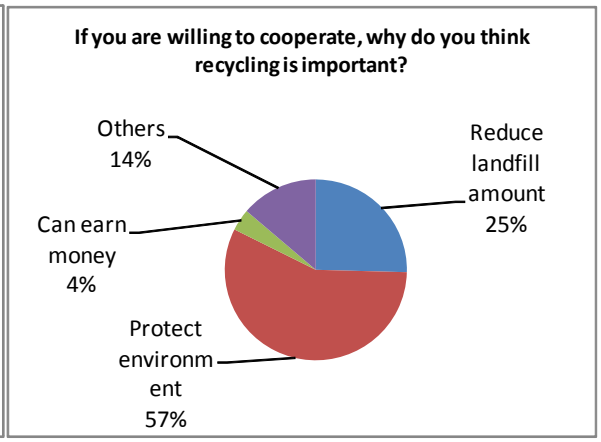
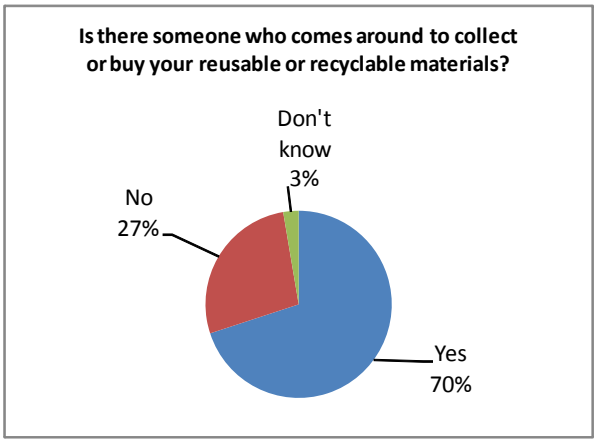
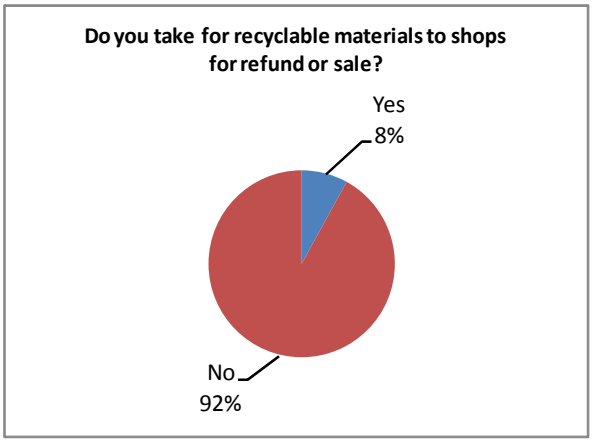
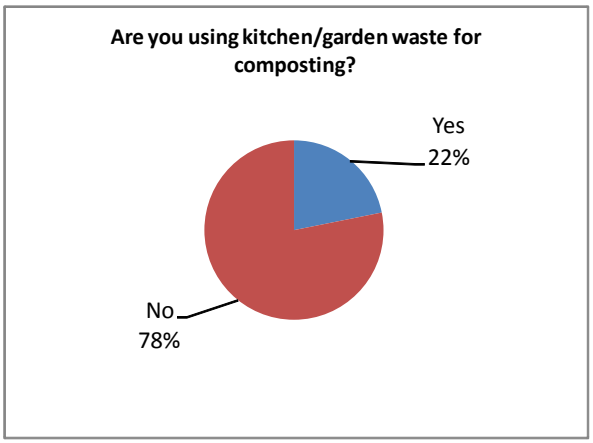
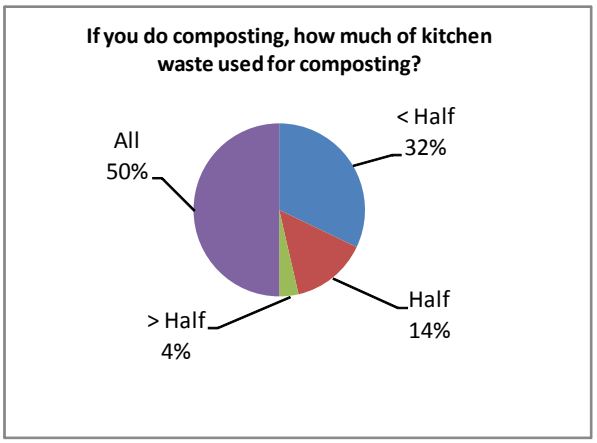






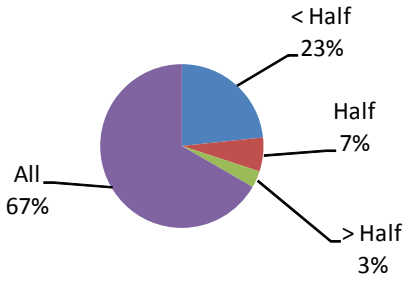




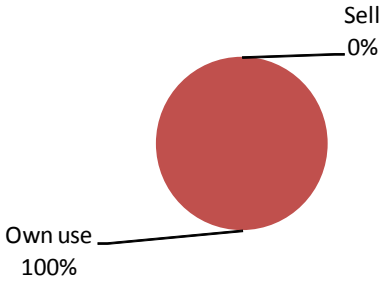


Response to Public Opinion Survey for Household

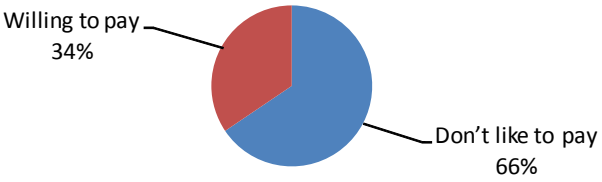
If you do composting, how much of garden waste used for composting?



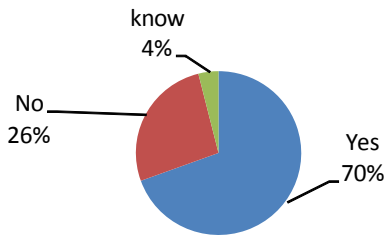
What do you do with produced compost?



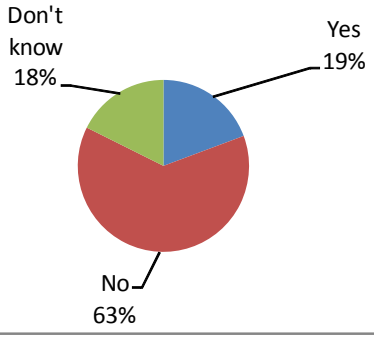
Suppose that you are satisfied with the service of Municipal solid waste management, either as is or as a result of improvement. Think for a moment about the largest amount of money that your household would be willing to pay each month as a garbage colle



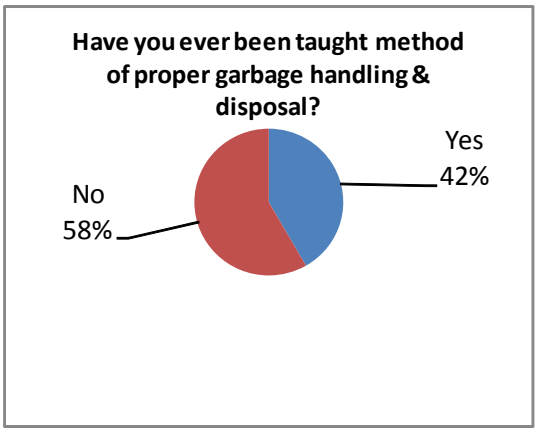
Do you have any community-based organizations to solve not only the waste problems but also other community problems?

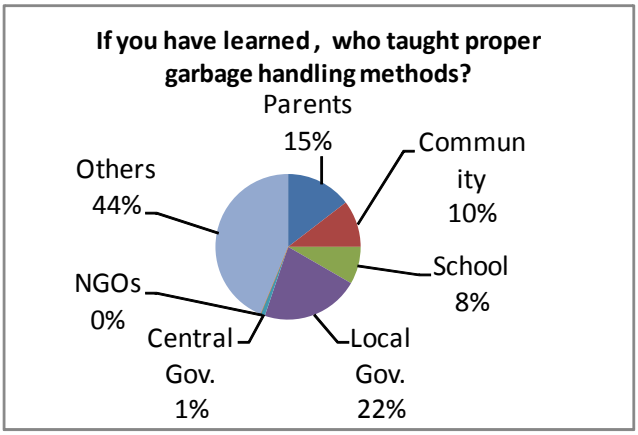


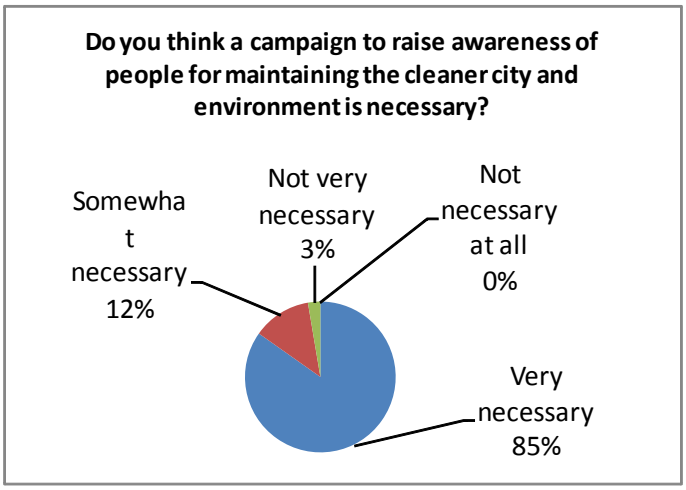
Have you ever discussed the methods of proper garbage handling and discharge at the meetings?



Response to Public Opinion Survey for Household







1.10 Dehiwala Mt. Lavinia MC

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1 Introduction

The purpose of this survey is to obtain the current data regarding Solid Waste Management (SWM) at Dehiwala Mt. Lavinia Municipal Council (DMMC). The data collection survey was conducted from 19th October to 23rd October, 2015 by a team of expert dispatched by Waste To Energy Technologies Limited.

This report consists of brief summaries of survey methods and results. The additional primary data and records are available as soft copies. The preliminary data collection was conducted through four comprehensive surveys which are;

i. **Waste Composition Survey (WCS)** is to gather information on Physical Composition of MSW collected by DMMC.
ii. **Waste Generation Survey (WGS)** is to gather information on waste generation sources at DMMC based on secondary data available at DMMC and other relevant organizations.
iii. **Public Opinion Survey (POS)** is gather information on public opinion on current waste management in DMMC. The POS was conducted through a questionnaire survey that covers different types of waste generators in the DMMC area.
iv. **Final Disposal Site Survey (FDSS)** is to collection data on final MSW disposal site of MMC based on secondary data as well as field recordings & visits to the site. ***DMMC commonly shares Karadiyana final disposal facility which is discussed in "Data collection Survey Report- Moratuwa MC".***

1.1 Background conditions of Dehiwala Mt. Lavinia Municipal Council

Dehiwala Mount Lavinia Municipal (DMMC) is the second largest Municipality in Sri Lanka, and covers an extent of 2, 109 hectaretares. It lies south of the Colombo Municipal Council area and separated from it by the Dehiwala canal which forms the northern boundary of DMMC. Its southern limits lie in Borupana Road and the eastern boundary is Weras Ganga with its canal system and including some areas to its east (Pepiliyana, Gangodawila and Kohuwala).

As shown in Figure 1-1, DMMC is composed of 29 wards whose extents vary from 29 hectares (Galkissa) the smallest and the largest 305.6 hectares (Kandawala).

Dehiwela, Mount Lavinia attained Municipal status in December 1959. An area map of 1937 shows Dehiwela Mount Lavinia as a Local body of 6 wards extending over a land extent of only 16.3 sq. Km (1, 630 hectares). Due to rapid urban growth and for administrative reasons this area was extended and divided into 19 wards in 1959 and given Municipal status. Later in 1967, the Municipal area of approximately 2, 109 hectare was apportioned into 29 wards as it exists today.

As the DMMC area lies on the coastal plain the land is mostly flat and undulating towards the inland areas to MSL 30. Soils are made of red yellow podozols (Laterite) and Regosols with low Humic Gleys in valleys and stream beds. A significant feature is the large extent of wet lands around the Weras Ganga (river) and Bolgoda Lake the two major water bodies. The Bellanwila and Attidiya marshes are noteworthy for their bio-diversity and as such are considered as an Ecological protected zone. Lying

in the wet zone, the DMMC area receives an average annual rainfall between 2000 to 3000 mm mainly during the south west monsoon and the inter-monsoon periods. Mean average day temperature is around 28°c and average maximum between 30.5 to 31°c Minimum night temperature varies from 26°c to 27°c.

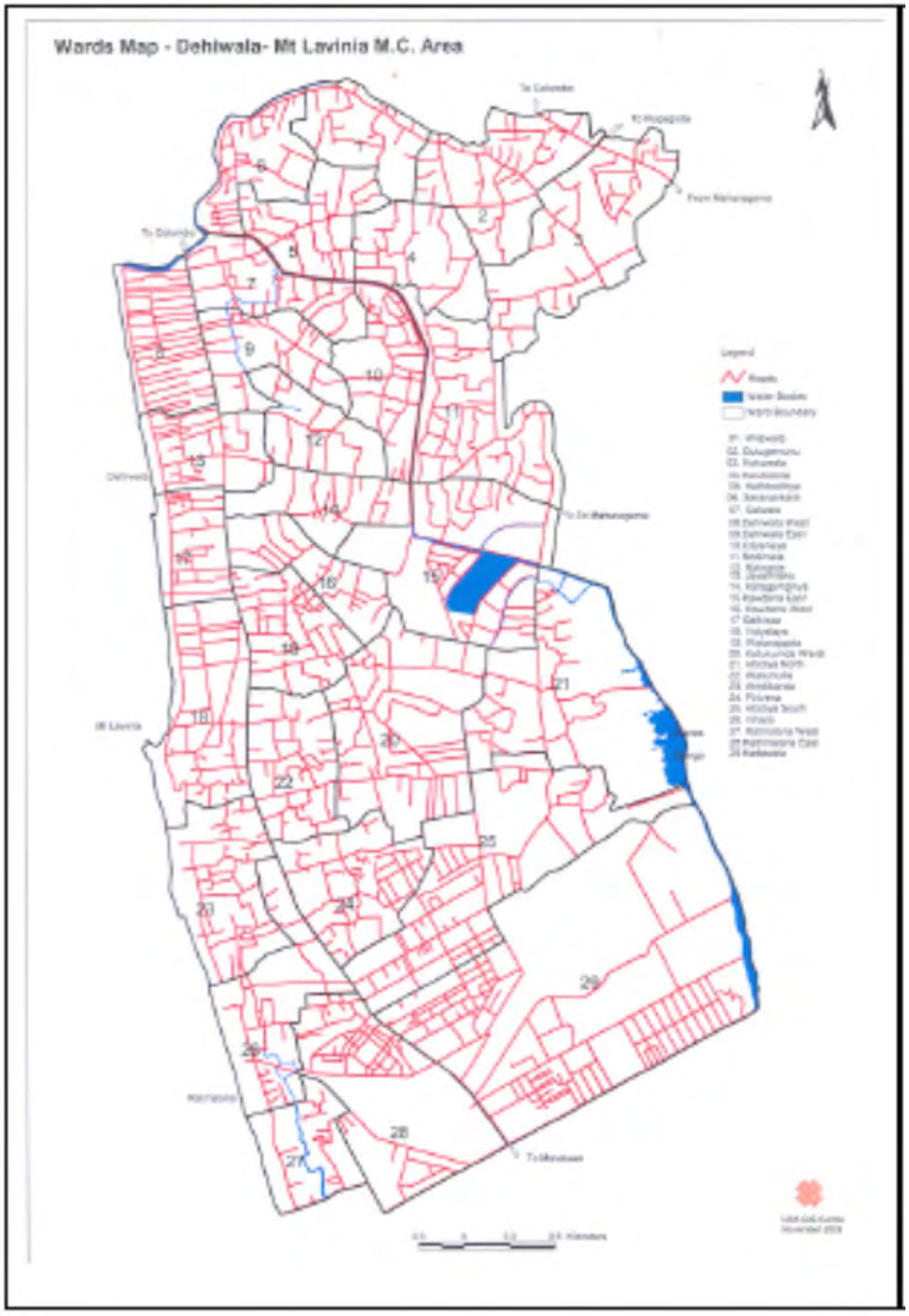


Figure 1-1 A map of Dehiwala Mt Lavinia Municipality area

Dehiwela Mount Lavinia and Sri Jayawardenapura Kotte being two large suburban centers of the city of Colombo function together as one large urban agglomeration in the Region (Western Province).

The overspill from the City in residential and commercial uses of land has rapidly urbanized these suburban centers. Dehiwela Mount Lavinia MC (DMMC) and Sri Jayawardenpaura MC (SDMMC) along with Colombo MC (CMC) form the most urbanized part of the core area of the Colombo Metropolitan Region (CMR). In the hierarchy of towns in the CMR, DMMC ranks 2nd next to the capital city (CMC). This is an indication of the status of the MC in terms of its service functions in the region. A good road network and transport system links it to the rest of the region and other parts the country.

The lands in the city of Dehiwela Mount Lavinia are predominantly in mixed residential uses. The properties along main highways (Galle Road) and Dehiwela - Nugegoda roads are almost entirely used for commercial activities. A few public institutions and industries are interspersed in the ribbon development as characteristic of the urban places in Sri Lanka.

Dehiwela Mt. Lavinia MC area is a place where a great deal of commercial and trade activities take place. The town, being part of the large urban agglomeration, the Greater Colombo Area, it has accommodated the expansion of commercial activities of the country's capital city. Many large scale industries are also found in Ratmalana/Attidiya areas to the South of the town. Tourism and the Hotel Trade are other significant economic activities.

2 Waste Composition Survey (WCS)

The primary purpose of this survey is to ensure a standard approach to waste physical composition analysis for the purposes of understanding the composition of waste delivered to final disposal facility which was collected from DMMC area. Information generated by WCAs will be useful to DMMC as well as administrators/policy makers to improve the efficiency and overall effectiveness of waste management systems.

All the MSW collected within DMMC is disposed off at the Karadiyama MSW dumpsite. Thus, the WCS survey was conducted at Karadiyana dumpsite.

2.1 Methods of waste composition Survey

2.1.1 Classification of Wastes at Disposal Facility

This study was conducted to assess the physical composition of MSW samples collected from DMMC and delivered to the final disposal facility by collection vehicles.

2.1.2 Sampling frequency

The WCA was carried out for a full waste collection cycle starting from Monday (15th October 2015) to Sunday (21st October 2015).

2.1.3 Bulk-Sampling for WCS

An effective WCA programme must be based on waste samples that are representative of the target area as a whole (usually a whole local authority), be sufficient to take account of variation in waste arising whilst also being affordable within the project budget. A good sampling strategy is essential to achieving this difficult balance. Thus it is needed to ensure that a 'good' sample is obtained within the constraints of time and cost.

Figure 2-1 Sampling for WCS at DMMC, (a) manually unloading the profile sample and (b) unloaded sample

Waste collection vehicles, especially four wheel tractors trailers (4-wheel tractors) are filled from bottom to the top of the trailer, thus making a distinguished vertical stratification in the tractor. The filling pattern becomes more complex when the garbage is discharged in bags. Therefore, as shown in Figure 2-1, profile sampling from collection vehicles was adapted in this study. The profile sample was taken from the back of the trailer, measuring at least 1/8 of the length of the trailer. Therefore, the size of the composite sample was found to be varied from 100 and 150 kg.

Thereafter, all the large and over sized waste particles were manually shredded into smaller particles. At the first round of shredding, larger particles were cut in to small the size particles with knife and scissors (Figure 2-2).

Figure 2-2 Particle size reduction, mixing and preparation of working sample by coning & quartering technique

The size of the bulk sample was reduced to a workable size by Coning and Quartering technique. Finally the sample was reduced to a more manageable size as the actual classification of materials was carried out by hand. The Coning and Quartering technique involved the following:

a) The sample was placed on the floor and thoroughly mixed by shovel, manually.
b) The sample was then placed in a uniform pile of approximately 0.8 m high.
c) The pile was divided into four quarters using straight lines perpendicular to each other.
d) Either pair of opposite corners was removed to leave half the original sample.

e) The process was repeated three times until the desired sample was obtained.

2.1.4 Measurement of physical composition

2.1.4.1 Specific gravity of waste

To measure the bulk density of a sample, the following procedure was followed:

a) Weighed and recorded a volumetrically celebrated bucket of known volume (50 L)
b) Poured the sample into the bucket until it was overflowing
c) Settled the contents of the bucket by dropping it three times from a height of 10 cm
d) After settling the waste, waste-filled bucket volume was measured
e) Weight the bucket and its contents was recorded
f) The bulk density was estimated by dividing the waste weight by filled volume, as kg/ m^3.

Figure 2-3 Procedure of analysis of physical composition

2.1.4.2 Physical composition analysis procedure

Once the sample size was determined and a reduced or workable sample was obtained, the following procedure was carried out.

a) Sorted reduced sample and pick out larger items first e.g. glass, paper, plastics.

b) Separated waste into following categories,
   i. Kitchen waste
   ii. Paper
   iii. Textiles
   iv. Grass & Wood
   v. Soft Plastic
   vi. Hard Plastic
   vii. Rubber & leather
   viii. Metals
   ix. Glass
   x. Stones & Ceramics
   xi. Others
c) Weighed the separated waste using an accurate top loading balance and recorded on standard form
d) Any remaining material which did not fall into any of prescribed categories was passed through a 4 mm mesh sieve and classified as 'components smaller than 4 mm mesh'.

2.1.4.3 Chemical Waste Composition analysis procedure

Three components analysis for the category from I to VII shown above was carried out in two steps. First fresh samples were immediately transported to Environmental Engineering Laboratory at University of Dehiwala Mt. Lavinia which was a 10 minutes drive from the Karadiyana site. Then samples were immediately placed in an oven and dried at 80 -100 °C for 48 hours to estimate water content.

Figure 2-4 Dried waste samples at laboratory is ready for sealed packing after water content analysis

Thereafter, dried samples were transported to Solid Waste Management Research Unit of University of Peradeniya for analysis of;

- ✓ Ash content
- ✓ Volatile solid content
- ✓ C/N ratio analysis (only for category from I and IV)

2.2 Waste composition survey results

A summary of the results of the waste composition survey conducted in DMMC are tabulated below.

Table 2-1 Summary results of MSW physical composition survey in Dehiwala Mt. Lavinia MC

Sample		BD	KW	PP	TEX	GR	S-PL	H-PL	R&L	ME	GL	ST	OTH
Date		Percentage (%)											
15/10	Sam-1	404.8	35.7	8.5	7.6	22.7	12.0	3.5	0.3	1.4	2.5	5.9	0.2
	Sam-2	335.2	52.2	19.4	4.7	8.6	9.4	0.5	1.7	0.4	0.8	2.2	0.1
16/10	Sam-1	366.3	45.4	17.3	4.4	14.3	12.4	1.6	0.1	0.7	2.7	0.9	0.1
	Sam-2	371.8	65.6	7.6	0.8	16.2	8.0	1.1	0.1	0.2	0.4	0.0	0.0
17/10	Sam-1	414.5	44.5	11.5	5.7	26.9	8.6	0.8	0.3	0.5	0.4	0.8	0.0
	Sam-2	436.0	65.0	7.3	3.0	7.2	10.4	0.6	0.1	0.7	1.9	3.6	0.2
18/10	Sam-1	353.7	77.6	5.6	4.9	8.7	3.0	0.0	0.0	0.1	0.1	0.0	0.0
	Sam-2	403.4	55.4	9.8	2.5	20.8	7.9	0.9	1.5	0.4	0.8	0.0	0.1
	Sam-3	443.8	70.0	10.3	0.7	3.6	13.6	0.6	0.0	0.5	0.3	0.4	0.0
19/10	Sam-1	366.3	35.5	21.7	11.7	11.8	10.7	2.5	1.8	1.3	0.5	1.9	0.6
	Sam-2	440.8	41.0	10.5	2.1	22.6	6.1	1.8	1.4	0.3	0.5	13.6	0.0
20/10	Sam-1	588.9	62.2	13.1	3.4	8.3	8.7	1.4	0.7	0.6	1.1	0.5	0.1
	Sam-2	366.3	53.3	11.8	1.5	21.7	4.6	1.2	0.3	0.8	0.9	3.9	0.0
21/10	Sam-1	261.6	53.3	14.5	6.4	6.2	11.8	1.3	0.4	1.8	4.0	0.0	0.3
	Sam-2	326.1	31.5	34.6	5.4	11.4	10.1	2.6	0.1	0.8	1.7	1.5	0.3
Average		392.0	52.5	13.6	4.3	14.1	9.1	1.4	0.6	0.7	1.2	2.3	0.1
Stranded Deviation		73.2	13.7	7.4	2.9	7.3	2.9	0.9	0.7	0.5	1.1	3.6	0.2
Mean Error		18.9	3.5	1.9	0.8	1.9	0.8	0.2	0.2	0.1	0.3	0.9	0.0
Median		371.8	53.3	11.5	4.4	11.8	9.4	1.2	0.3	0.6	0.8	0.9	0.1

BD- Bulk density (kg m^{-3}), KW- Kitchen waste, PP- Paper, TEX- Textile, GR-Grass & wood, S-Pl- Soft plastics, H-PL- Hard plastics, R&L- Rubber & leather, ME- Metal, GL- Blass & bottles, ST- Stones & ceramics, OTH- Other

The analysis showed that the amount of food & kitchen waste is the highest portion (31.5- 77.6 %). However, the amount of garden waste in the collection is comparatively low which ranged from 3.6 % to 26.9 %. Another notable feature is the very low amount of stones & ceramics (0.0 – 13.6 %). The average waste composition derived from the 15 samples is shown in Figure 2-5.

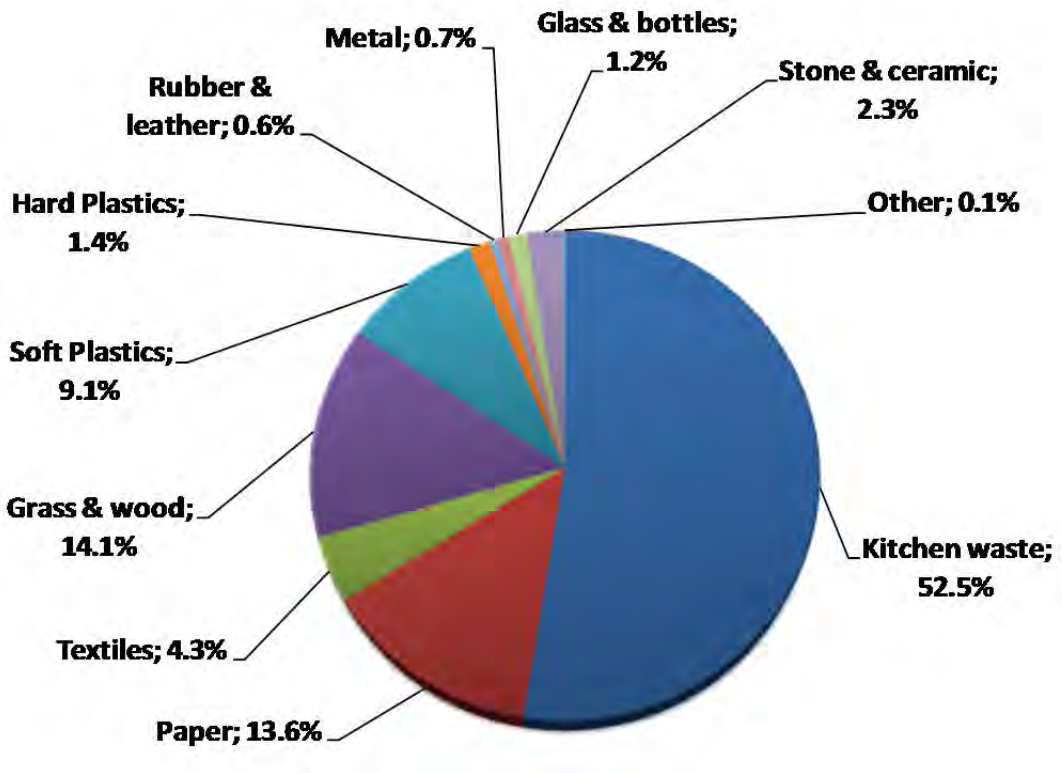


Figure 2-5 Average physical composition of MSW in Dehiwala Mt. Lavinia MC

The above figures shows that collected waste are suitable for composting. However, it is noted that mixed waste collected from commercial areas contain some industrial (ink, paints, electronic waste etc.) as well as hazardous waste (medical waste, chemicals etc.) in small quantities. Therefore, precautions should be made to segregate such types of hazardous waste at the source.

It also showed that the percentages of more profitable recyclable materials (hard plastic, metal, and glass) are reasonably low (0.7 – 1.4 %), while the percentages of less profitable materials (paper, soft plastic, textile) are much higher (9.1 – 13.6 %).

2.2.1 Results of chemical composition survey

A summary of chemical composition survey is shown in following table.

Date	Type	MC	VS	C	N	C:N
			Percentage (%)			Ratio
16/10/2015	Mixed waste- S1	52.2%				
19/10/2015	Mixed waste- S2	55.8%				
20/10/2015	Mixed waste- S3	43.5%				
	Average	***50.5%***				
16/10/2015	Kitchen waste-S1	61.2%	72.3%	40.2%	2.4%	16.8
19/10/2015	Kitchen waste-S2	68.9%	74.6%	41.4%	1.6%	26.4
20/10/2015	Kitchen waste-S3	64.6%	82.0%	45.6%	1.4%	32.7
	Average	***64.9%***	***76.3%***	***42.4%***	***1.8%***	***25.3***

Date	Type	MC	VS	C	N	C:N
16/10/2015	Grass & wood-S1	47.5%	93.2%	51.8%	0.9%	56.3
19/10/2015	Grass & wood-S2	50.8%	87.4%	48.5%	0.9%	55.0
20/10/2015	Grass & wood-S3	39.0%	90.6%	50.4%	1.4%	35.0
	Average	***45.8%***	***90.4%***	***50.2%***	***1.1%***	***48.8***
16/10/2015	Paper- S1	54.4%	86.2%	47.9%	0.7%	69.8
19/10/2015	Paper- S2	45.7%	88.6%	49.2%	0.3%	148.5
20/10/2015	Paper- S3	57.3%	72.1%	40.0%	0.7%	61.3
	Average	***52.5%***	***82.3%***	***45.7%***	***0.6%***	***93.2***
16/10/2015	Textile-S1	44.4%	93.1%	51.7%	0.4%	115.4
19/10/2015	Textile-S2	38.5%	98.8%	54.9%	0.4%	125.1
20/10/2015	Textile-S3	40.2%	94.3%	52.4%	0.5%	97.7
	Average	***41.1%***	***95.4%***	***53.0%***	***0.5%***	***112.7***
16/10/2015	Soft plastics-S1	36.6%	72.2%			
19/10/2015	Soft plastics-S2	25.9%	73.8%			
20/10/2015	Soft plastics-S3	27.3%	79.9%			
	Average	***29.9%***	***75.3%***			
16/10/2015	Hard plastics-S1	6.1%	97.0%			
19/10/2015	Hard plastics-S2	4.8%	98.3%			
20/10/2015	Hard plastics-S3	5.0%	97.9%			
	Average	***5.3%***	***97.8%***			
16/10/2015	Rubber & leather-S1	31.4%	83.1%			
19/10/2015	Rubber & leather-S2	10.6%	70.4%			
20/10/2015	Rubber & leather-S3	14.1%	71.5%			
	Average	***18.7%***	***75.0%***			

3 Waste Generation Survey (WGS)

In order to obtain general information on waste generation amounts, the data available at Waste Management Section, Works Department and Revenue Department of DMMC was used. Some of the data was available in the form of formal records and reports which were treated as the most precise secondary data while the data collected from official interviews with DMMC officers was treated as verification data. Thus, the survey data was collected through different methods;

a) Recording and compiling of published and verified data by DMMC,
b) Reading and recording of unpublished & non-confidential data available at DMMC,
c) Recording and official statistics available at District Secretariat, Dehiwala Mt. Lavinia, and
d) Official person-to-person interview with relevant officers at DMMC for verification of data.

The numerical data was collected as specified in following Table 3-1.

Table 3-1 Type of data collected for WGS in Dehiwala Mt. Lavinia MC

Source	Description
Household	Each number of following category households was surveyed; 1) High income level, 2) Middle income level and 3) Low income level.
Commercial	Each number of following category restaurants was surveyed; 1) Large size restaurants, 2) Middle size restaurants and 3) Small size restaurants. Each number of following category shops was surveyed; 1)Organic shops (large) 2)Organic shops (middle) 3)Organic shops (small) 4)Non-Organic shops (large) 5)Non-Organic shops (middle) 6)Non-Organic shops (small)
Hotels	Each number of following category hotels was surveyed; 1) Large size hotels 2) Middle size hotels and 3) Small size hotels.
Markets	Number of stalls and types
Institutions	Each number of following institute was surveyed; 1) Schools 2) Hospitals (government) 3) Hospitals (private) 4) Public office 5) Bank/private office 6) Buddhist temples 7) Hindu temples 8) Mosques 9) Churches 10) Navy/Police/ Army bases 11) Others
Industries	Wastes from any industries.

Source	Description
Other	Public parks and other public facilities
Construction and demolition	Wastes originating from construction, rehabilitation and demolition activities, etc.
Hazardous (Special)	Management and collection of hazardous wastes originating from various sources, including household items

3.1 Waste Generation Survey Results

The records indicate that the total residential population within DMMC is 176, 846 (Source: Divisional Secretariat 2015). The Dehiwala Mt. Lavinia MC area consists of 29 Wards as shown in below Table 3-2.

Table 3-2 Household population (GN level) within Dehiwala Mt. Lavinia MC area

Ward	Population	Ward	Population
Wilawala	6,192	Kawdana west	6,467
Dhutugamunu	4,615	Mount-Lavinia	4,196
Kohuwala	5,596	Watarappala	6,256
Hathbodhiya	5,918	Kawdana	4,003
Saranankara	6,258	Katukurunduwatta	12,166
Galawala	5,631	Vidyalaya	4,196
Dehiwala west	5,154	Piriwena	4,984
Kalubowila	5,573	Wathumulla	4,531
Nedimala	8,884	Wedikanda	7,524
Dehiwala east	6,712	Aththidiya North	8,837
Udyana	5,815	Aththidiya south	7,616
Malwatta	3,506	Rathmalana west	5,692
Karagampitiya	5,527	Rathmalana east	655
Kawdana east	4,003	Viharaya	6,473
Jayathilaka	4,348	Kandawala	9,518

As shown in following, Dehiwala Mt. Lavinia MC own and control a larger number of public properties and institutes.

Table 3-3 Type and number of municipal establishment own by Dehiwala Mt. Lavinia MC

Public institute/premises	No. units
People's Gardens	1
Cinema halls	5
Public market owned by council	8
Weekly fairs	4
Meat stalls	5

Public institute/premises	No. units
Public play ground	11
Libraries	5
reading rooms	9
Community center	25
Auditorium	1
Cemeteries	4
Crematorium	4
Fire Brigade Center	1
Pavilions	8
Fitness center	16
Council pre schools	14
Council Ayurveda Dispensaries	4
Maternity	12
Lavatories	7
Children parks	20
Bathing rooms	17

Dehiwala Mt. Lavinia city host most of the government and privet sector institutes in the Southern Colombo region. Following table shows the number of government and privet/non-government establishments within Dehiwala Mt. Lavinia.

Table 3-4 Number of government and privet institutions within Dehiwala Mt. Lavinia MC

Public institutes	No. of units
Public Schools	32
Government Hospital	6
Privet Hospitals/ Decal center	22
Police Station	4
Privet schools	7
Railway stations	3
Post office	5

A major portion of MSW is generated from commercial sector in the city. Following Table 3-5 shows the number of different commercial (business) establishments in DMMC area.

Table 3-5 Type and number of business premises in DMMC area

Type	Wards																												Other	Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29		
Non-occupied	1			1	1								1		1						1	1		2					1		**10**
Guest House	3	1			1		1	7	11			1			2	3	4	29				1	3		2	2			1	4	**76**
Restaurant	1	4	2		1	1		7	1			2	2	2		1	2	16	2		4	1	1	1		2			1	5	**59**
Bar	1						1																								**2**
Meat Shops		2				1	1					1	1	1		1	1	1							1	1					**12**
Beauty Care	1			2		1		1	1		4	1	1		2			2			1	1		1						**19**
Salon	1	2	5	2	5	5	2	5	4	1	9	4	3	1	1	1	1	4	1			5	2	2	3	3			1	6	**79**
Gas Seller	1	1	1	1				1	1		1	1			1	1		1				1	1		3	1		2		3	**22**
Animal Foods																										1					**1**
Medical Center		1					3		1					1		2	1	1		1			1							2	**14**
Automobile work Shops	2	3	6	4	6	1			2	1	4			1							3	1		1		5			2	10	**52**
Printers and Press	2	1	3	1	2						6	1		1	2	1		1	4			2	1			1		2	4	5	**40**
Assembling									1																				1		**2**
Recycling shops						2					2				1		1														**6**
Industries	6		3	1				1	2	1	2			1	2	2		2	1	9	1	1		1	15	2		4	17	4	**78**
Service center	1	2	2				1	2			2	2			3	1	1		1		2			1	2				1	4	**28**
Vehicle spare parts	1	1	2		1				1	1		3			2						1			1						1	**15**
Jewellery															1		1			1										3	**6**
Galleries			1	1				1							2											1		2			**8**
Grinding mills							2				1		1			1						1				1			2	1	**10**
Accommodation			1					3										4													**8**
Stores	2	2	2			1	2	1	3	3	2	5	1	1		1	1		2	3	3	1	1	4	3				10	2	**56**
Bakery and pastry shop	1	2			1	1	1	2	1	1	3	3	2		4		1	1			5	1		1	2	1		1	4		**39**
Electric equipment sell			2												1																**3**
Electric rapier	1	1		3							1			1	2			1			1										**11**
Construction Material				1								2			1					1	1							1	2		**9**
Farm				1		3			2	1	3	2		2		3			2	1	2	1		1	3				1	9	**37**
Film hall			1		1				1							1															**4**
Fish shop						1					1				2		2											1	2		**9**
Filling shed		2						2	1						1		1	1												1	**9**
Fiberglas workshop											1																				**1**

Type	Wards																												Other	Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29		
Fitness center	1											1																			**2**
Funeral service	1				2		1						1									1									**6**
Welding shop	1					1	1		1		4				2						2				1						**13**
Garage	2		2		3	4					1	2			3				1	1	2	1		2		1			2	1	**28**
Tailor shop			1												1				1		3	1			1					1	**9**
Iron work/lath work			1			1	2				1	1		1	1			1	2	1	1		1		1	2				2	**19**
Garment factory		1							1		1	1		1		1			1	1	1	1			1				1	1	**13**
Laundry				1		1						1			1						1	3								1	**9**
Hardware	1			1							2		1													1				1	**7**
Food center		3	6	3	1	1	5	2	2	1	2	6		2	1	2		10	2	1	1	1			1	1	1		2	10	**67**
Hotel	2	6	3				2	1	5		2	2	5	2	1	2	1	10	1	1	3			2					3	3	**57**
Studios																														1	**1**
Office			1																												**1**
Fruit and vegetable																			1												**1**
Education center														1																	**1**
Pest control chemical																														3	**3**
Plastic manufacturing			3			2	2								1	1	1		1	2					1			1	6		**21**
Furniture show room											1				1					1					1						**4**
Timber stores	1							1																		1				1	**4**
Furniture work shop	1		1				1	1			1								1		1										**7**
Super market		3	1				2		2		2	1			3			2	1		1				2				1	3	**24**
Total	35	38	50	23	25	27	30	38	44	10	59	43	19	19	46	25	19	87	25	24	41	26	11	20	43	27	1	14	65	88	**1022**

Following Table 3-6 shows the number of premises (buildings) within the DMMC area which are classified as business and non-business (residential etc.).

Table 3-6 Number of business and non-business premises in each ward of DMMC area

Ward number	Ward Name	Business premises	Non Business premises
1	Wilawala	286	1900
2	Dhutugamunu	691	2043
3	Kohuwala	500	2712
4	Kalubowila	231	2077
5	Hathbodhiya	301	2410
6	Saranankara	195	2321
7	Galawala	233	2029
8	Dehiwala west	266	2515
9	Dehiwala east	232	2449
10	Udyana	135	2028
11	Nedimala	341	3227
12	Malwatta	222	1582
13	Jayathilaka	717	1917
14	Karagampitiya	240	2093
15	Kadawana east	350	3451
16	Kadawana west	246	2879
17	Mount lavinia	204	2001
18	Vidyalaya	565	1866
19	Watarappola	273	2304
20	Katukurunduwatta	277	4310
21	Attidiya north	358	3266
22	Watumulla	320	2264
23	Wedikanda	220	2960
24	Pirivena	326	2097
25	Attidiya south	398	2779
26	Vihara	336	2670
27	Rathmalana west	78	1872
28	Rathmalana east	451	2143
29	Kandawala	636	3250
Total		**9628**	**71415**

4 Public Opinion Survey (POS)

This Public Opinion Survey (POS) was commissioned to identify a range of household waste management matters in relation to the household sector. Information on household waste management practices and information on householders' experiences with waste collection delivery services was collected for the purpose of improving our understanding of householder's experiences and attitudes and also to better understand prevailing situation in householder's point of view. The purpose of this survey research included;

a. To collect information on public attitudes to the waste management and environment in broader,
b. To value aspects of environmental health and protection,
c. To provide information on experiences with Local Authority's waste management service and,
d. To provide information on household waste management practices.

4.1 Public opinion survey methodology

The number of samples from Dehiwala Mt. Lavinia identified as 200 samples which are described in detail Table 4-1. The selection of households and areas within Dehiwala Mt. Lavinia MC was done after a consultative discussion with Municipal Authority, MSW section officers at DMMC and JICA expert team members. Dehiwala Mt. Lavinia MC has 29 wards as SWM areas. Samples were selected from representative zones approximately in equal numbers.

The survey was executed by a team of university students who were trained about the questionnaire, survey methodology and the data entering before dispatched to their respective fields. A senior expertise took the leadership and continuously supervised the field survey. The selected households were first educated about the survey, its main objectives and asked their cooperation before starting the field survey. In addition business and institutes, large waste generators, hospitals recycling shops and large public markets were also surveyed using appropriate questionnaires prepared in consultation with JICA experts.

Table 4-1 Category and number of samples for Public Opinion Survey

Category	Sampling area	Number of samples
High-income households	De Seram Rd, Barnes Avenue, 1st Lane Galle Rd, Mihidu Mawata, St Joseph Rd, Wasala Rd, Galle Rd	50
Middle-income Households	Rev.Wimalasiri Mw, Kalubovila, Hena Para, Melder Rd, Watarappala Rd, Piriwena Rd, Raja Mawata	50
Low-income Households	Apple Watta, Bodhiyawatta, Dheewara Niwasa, Bhathiya Mw, Walauwatta	50
Businesses /Service organization	Galle Rd, Dehiwala Rd Kalubovila, High-level Rd	43
Large waste generators		8
Markets		1
Hospitals		1
Recycling shops		1
NGO		1

Category	Sampling area	Number of samples
Total		**205**

The questionnaires were available in all languages (English/Sinhala/Tamil); however the questionnaire form was filled by the interviewer based on interviewees' response. The collected information was recorded in digital form using Microsoft Excel and reviewed for accuracy. The data was analyzed in detail for different objectives that generate an overview of the survey.

4.2 Results of Public Opinion Survey

- ✓ 87% of the surveyed households are Sinhalese, with 7 % of Muslims, 6 % Tamils. Data on the average number of people per household and monthly income is set out in below Table 4-2.

Table 4-2 Average and standard deviation values of income and family size

Category	Family size	Income (Rs/month)
High	4.1 ± 1.2	129, 740 ± 57, 887
Middle	4.7 ± 2.9	62, 360 ± 25, 793
Low	5.4 ± 1.9	28, 560 ± 32, 644
	No of workers	**Income (Rs/month)**
Business	5.0 ± 7.0	21, 644, 884 ± 83,955, 819

- ✓ In Dehiwala Mt. Lavinia MC, 100 % of surveyed households are provided with a garbage collection service, of which 97% stated they use this service. Only 24 % of surveyed households are "very satisfied" with present SWM service provision, while 51 % are "somewhat satisfied".

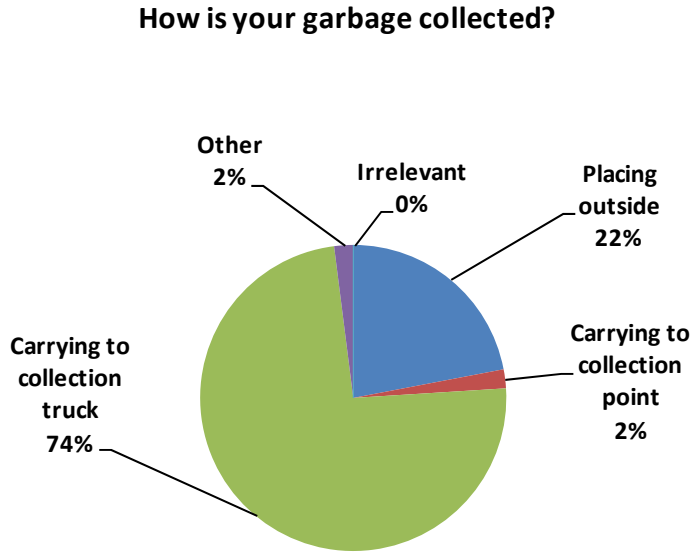


Figure 4-1 Method of garbage discharge by residence in MMC area

- ✓ Households' main methods of waste discharge are shown in Figure 4-1. The most common methods are carrying garbage to collection truck (74%) and discharging it outside their premises for house to house collection (22 %).
- ✓ Only 09 % of surveyed households receive a daily garbage collection service while 47 % stated that they received the service 2-3 times/week. Similarly, 23% discharge their garbage 2-3 times per week, but 39 % as soon as it is generated and 34 % discharge their garbage daily.
- ✓ In general, adult females handle waste in about 63 % of surveyed households and the duty is covered by servants in 19% of households. In high income households servant's contribution is as high as 32%.
- ✓ As shown in Figure 4-2, on average 21 % of households separate their garbage into organic and inorganic waste at the source of generation but only 4 % of high-income households are doing so. About 19 % of surveyed households are not/less willing to cooperate with source separation for recycling. Further, 33 % are very much willing and 10% are somewhat willing to cooperate in source separated garbage collection system.
- ✓ Also, 79 % of surveyed households stated that there are recyclable collectors or someone who comes to collect their reusable or recyclable materials. Hence, informal recycling system is well established in Dehiwala Mt. Lavinia MC area.

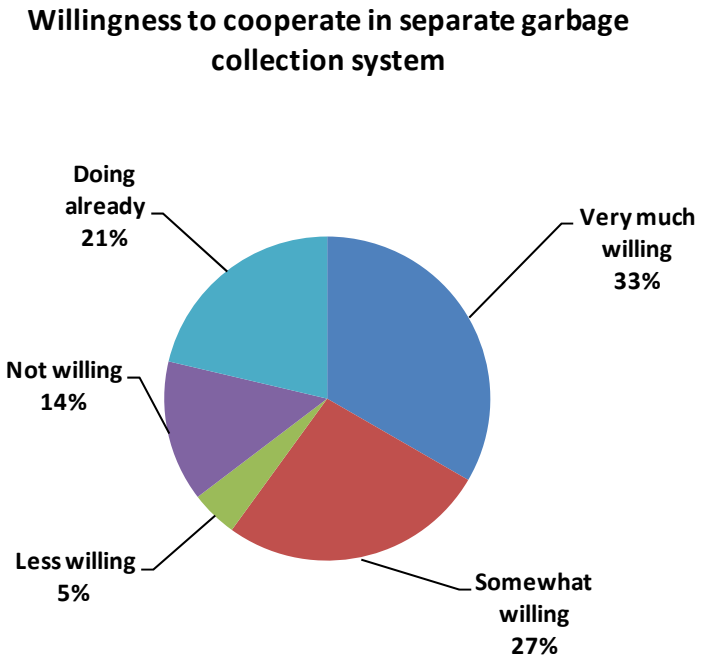


Figure 4-2 Willingness of residence for a source separated garbage collection system in Dehiwala Mt. Lavinia MC

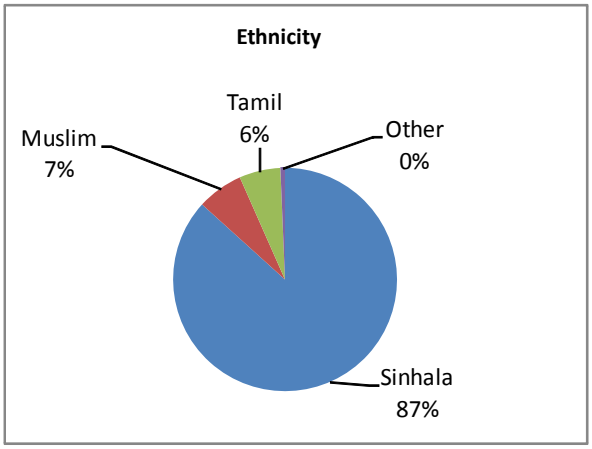
- ✓ Only 3 % of surveyed households use kitchen/garden waste for composting and used the finished compost for their own garden.
- ✓ Not many surveyed households (87 %) have ever discussed proper garbage discharge methods at the community level.

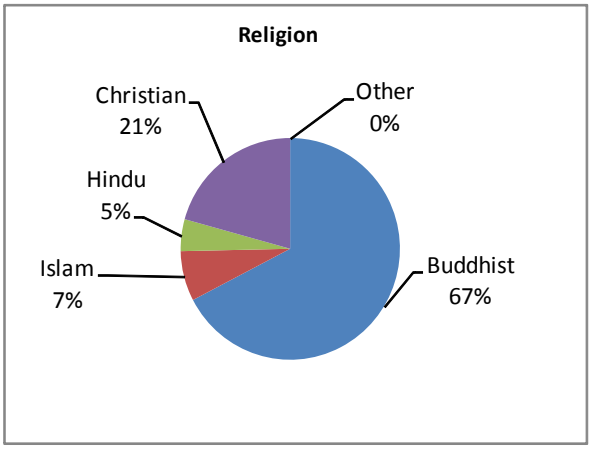
- ✓ 73 % households stated that SWM awareness programmes are very necessary while 25 % stated “somewhat necessary”. Only 2 % of surveyed households stated that awareness campaigns are not necessary or not needed at all.
- ✓ 60 % of household do not like to pay for SWM service mainly because of the revenue tax they paid for DMMC. The average WTP (willingness to pay) for improved SWM services is 75 ± 132 Rs/month per household.
- ✓ Out of all surveyed households, 35 % stated that they sale/give-off Glass & Bottle for recycling and 35 % of residence sale/give-off Plastics for recycling. Also, 14 % of household’s sale/ give-off can & metal for recycling. Cardboard and paper recycling were 6 % and 21 % respectively.

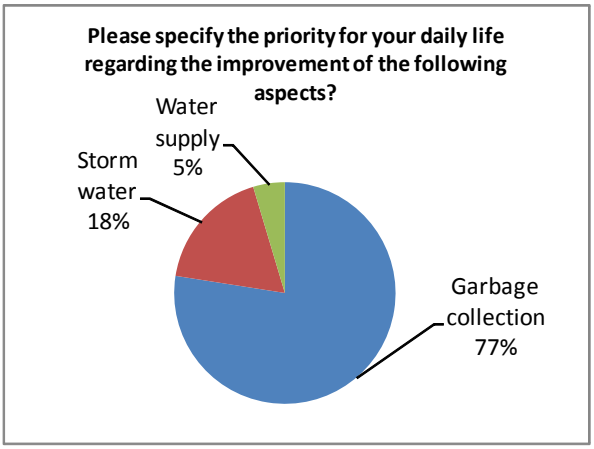
Annex

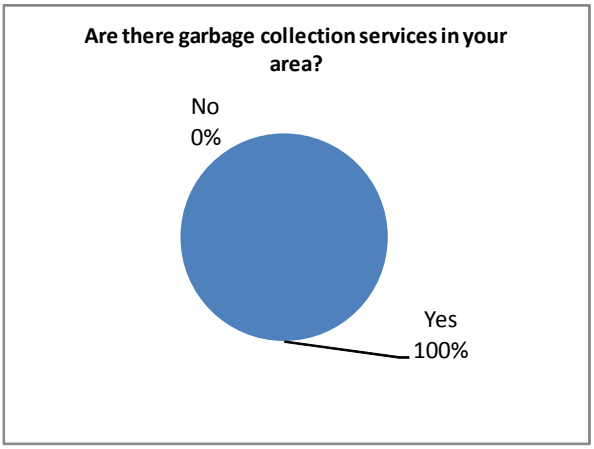
DEHIWALA Mt. LAVINIA MUNICIPAL COUNCIL

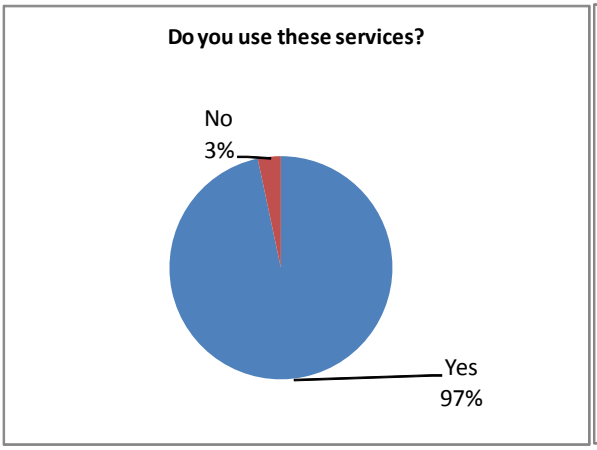
Response to Public Opinion Survey for Household

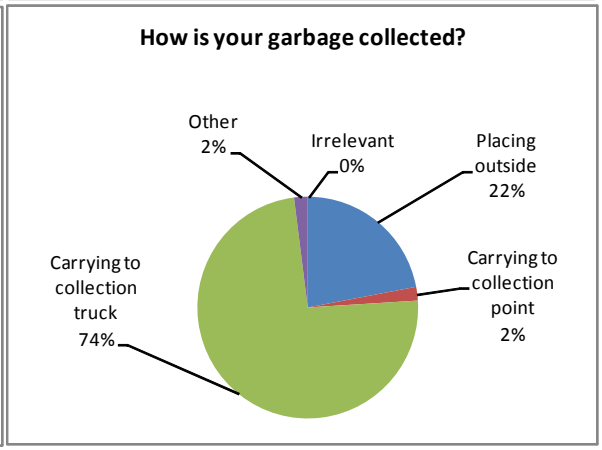












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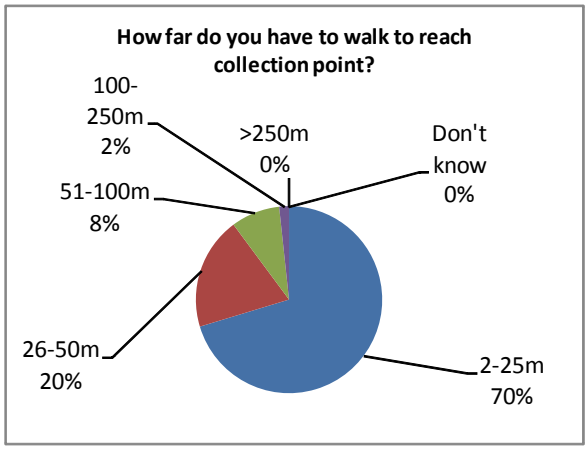

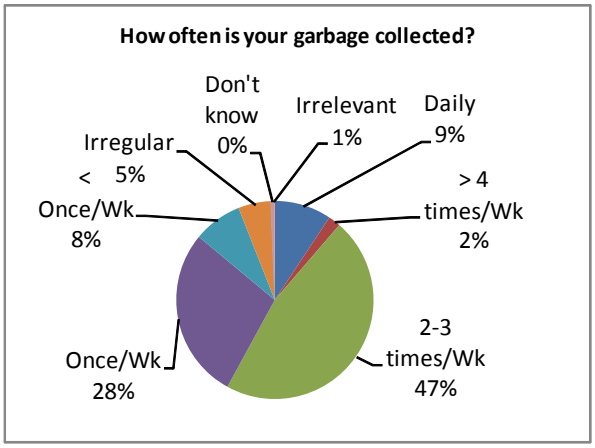

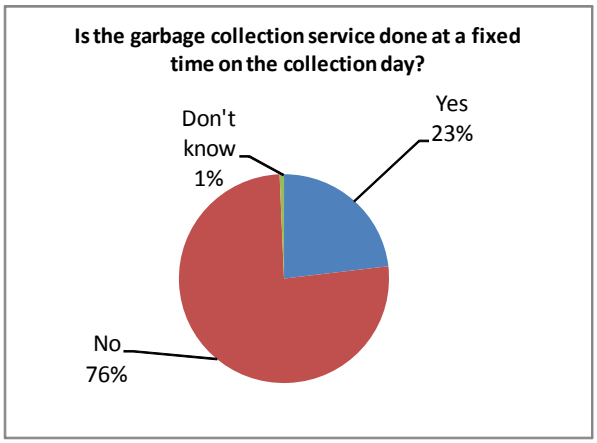

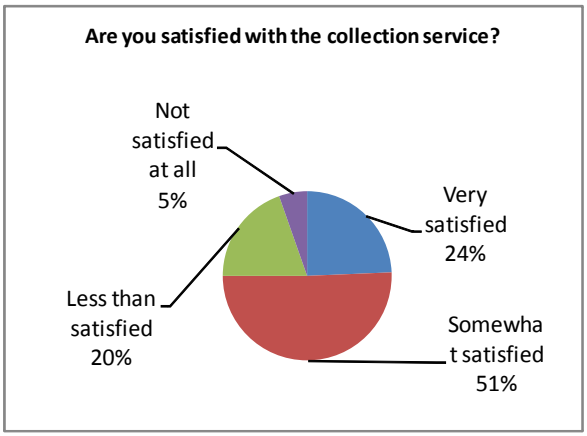

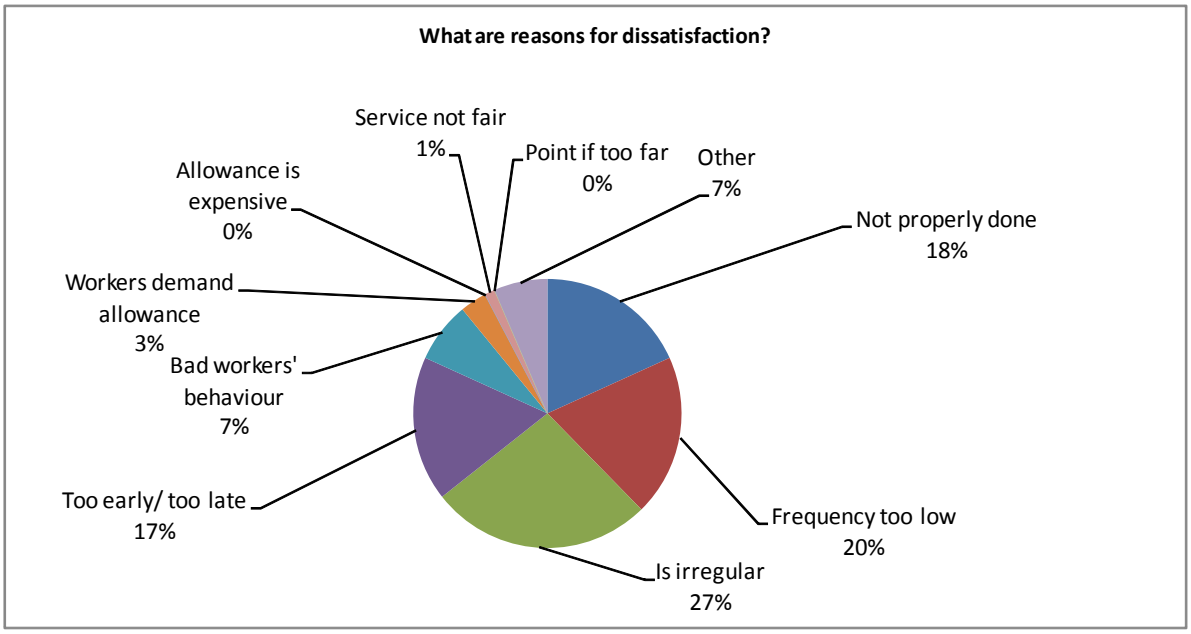

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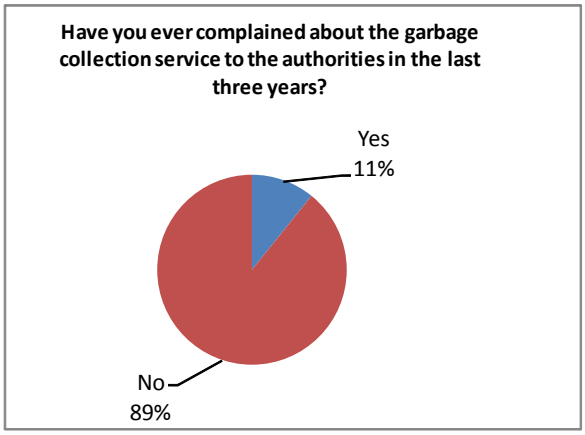

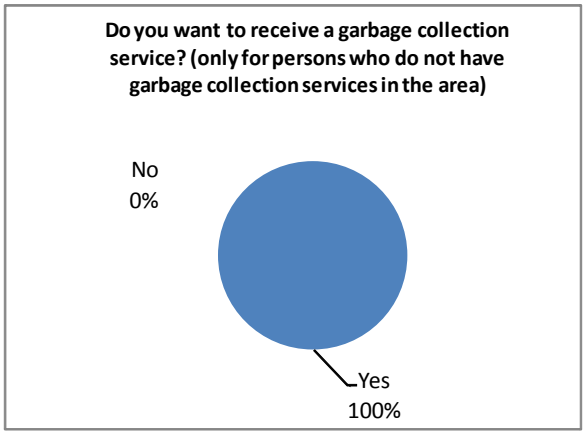

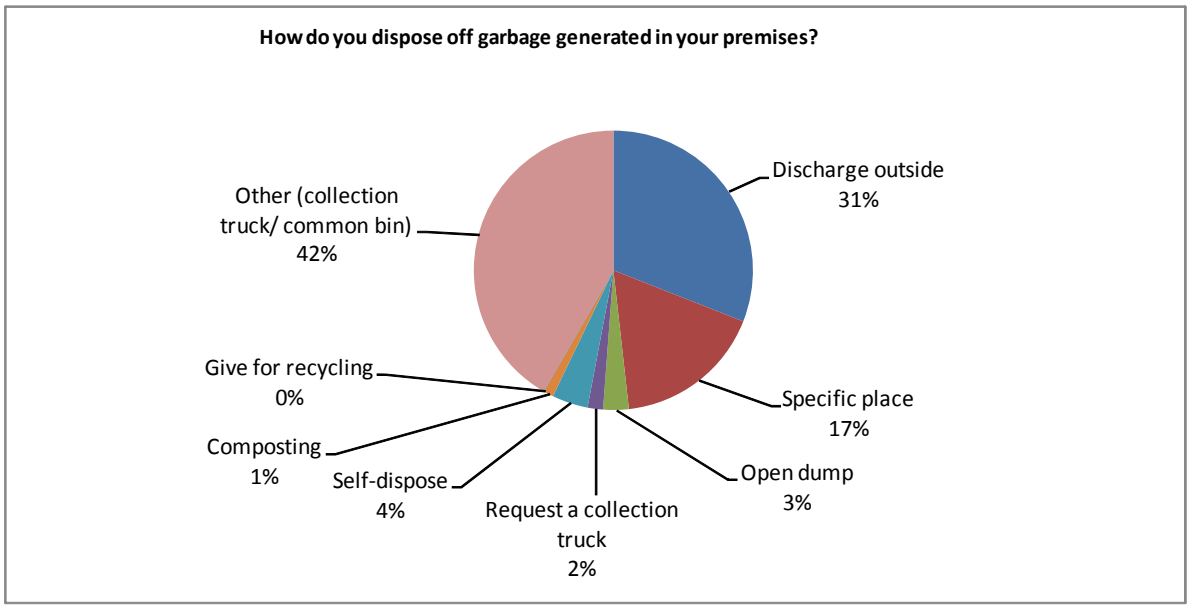

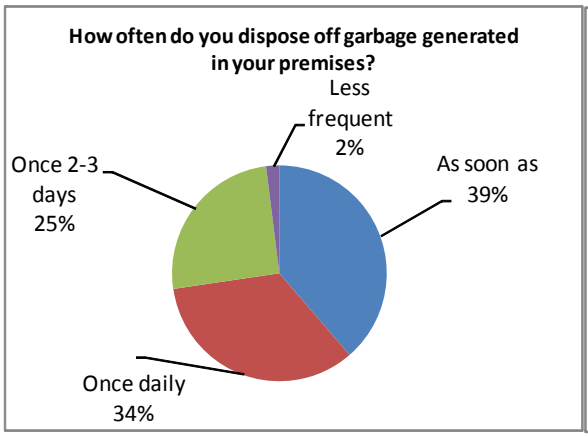

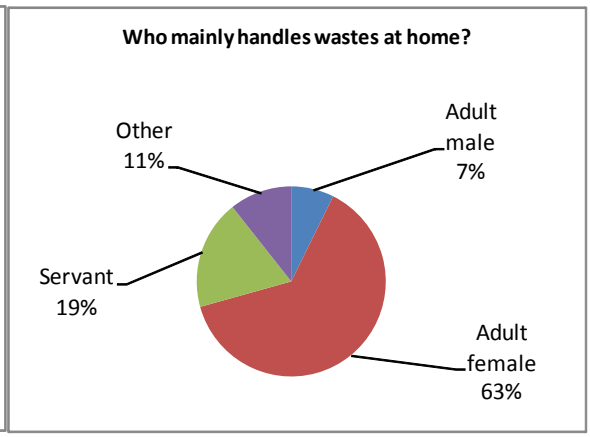

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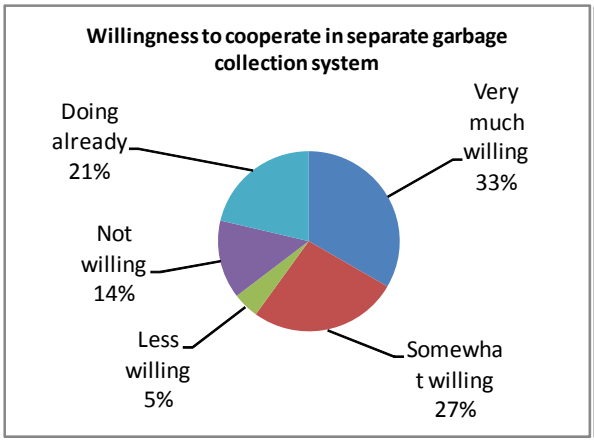

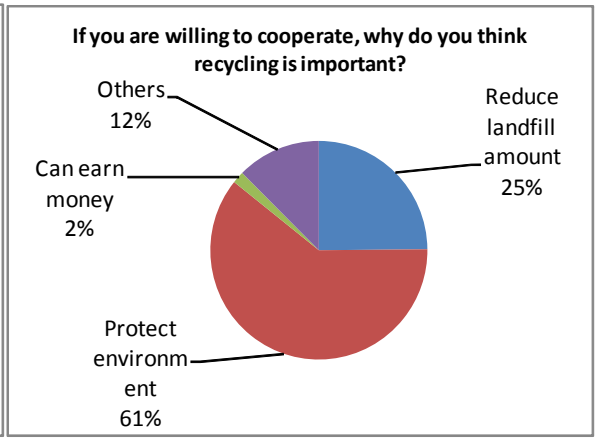

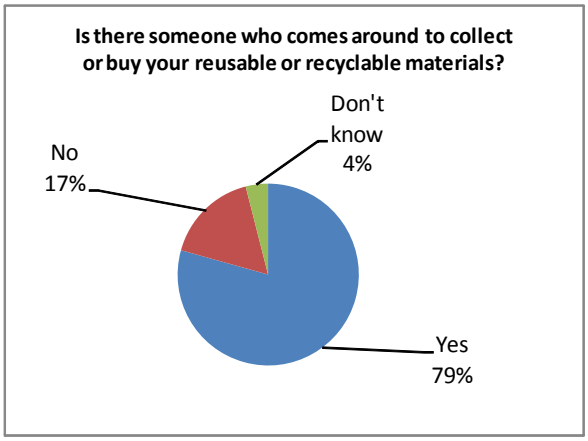

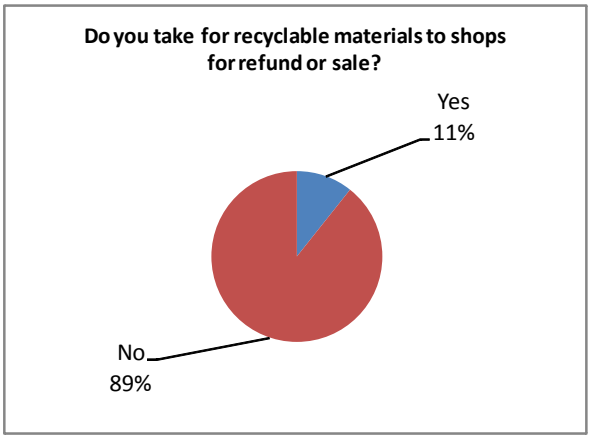

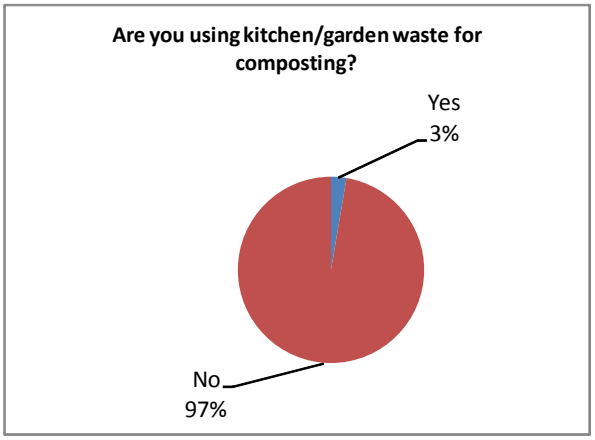

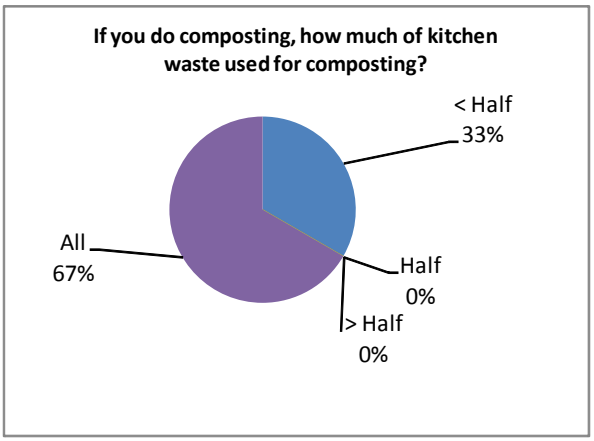

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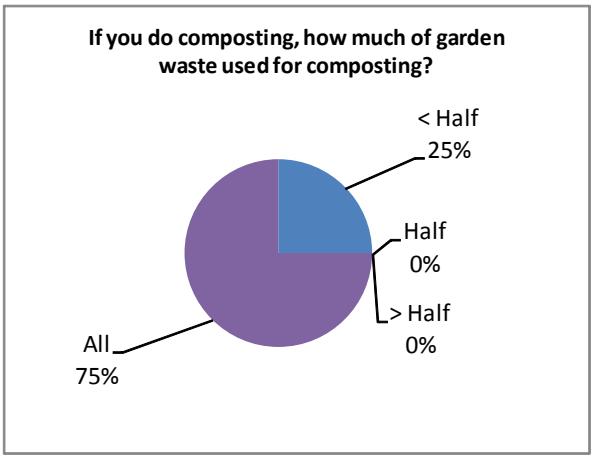

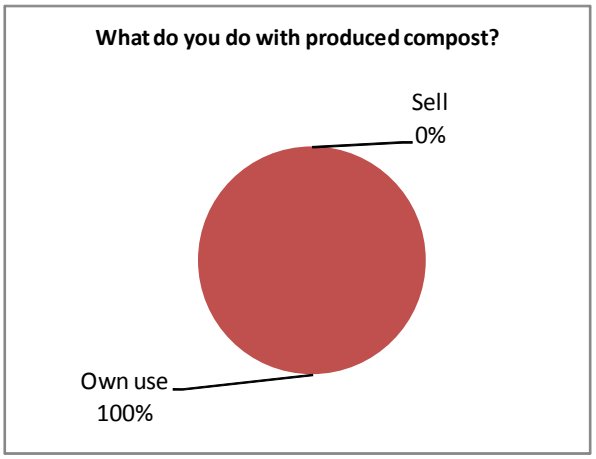

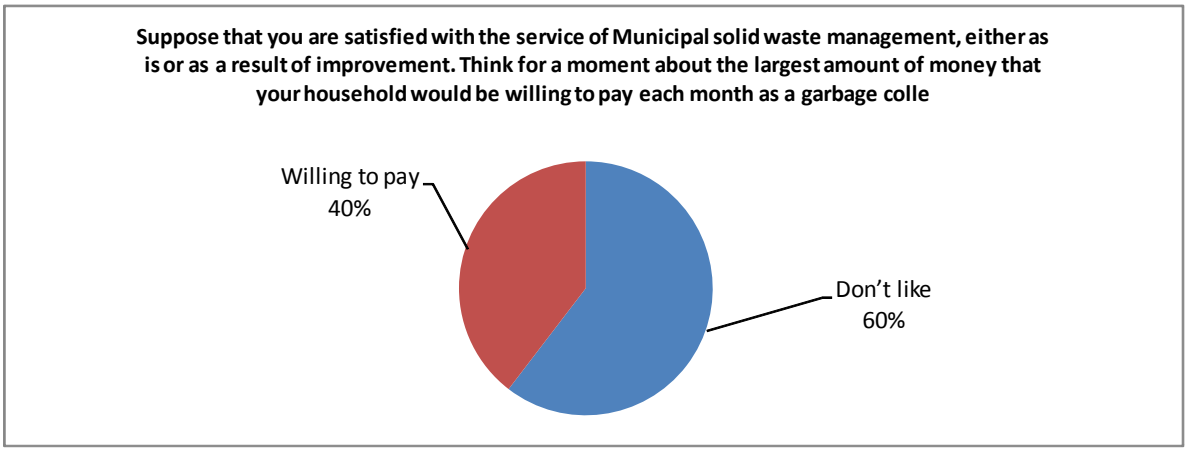

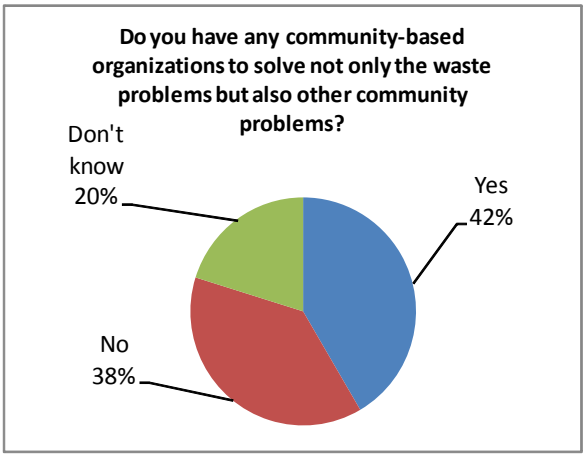

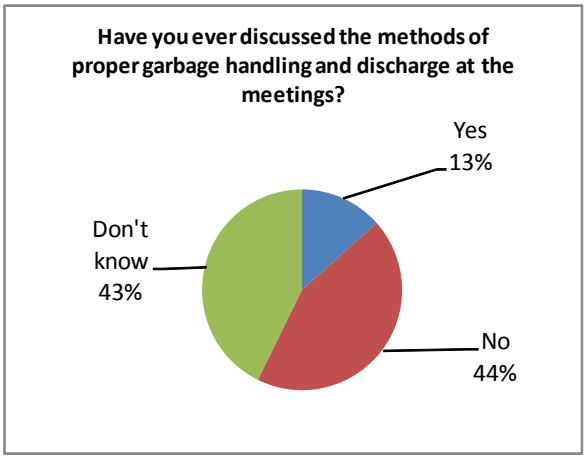
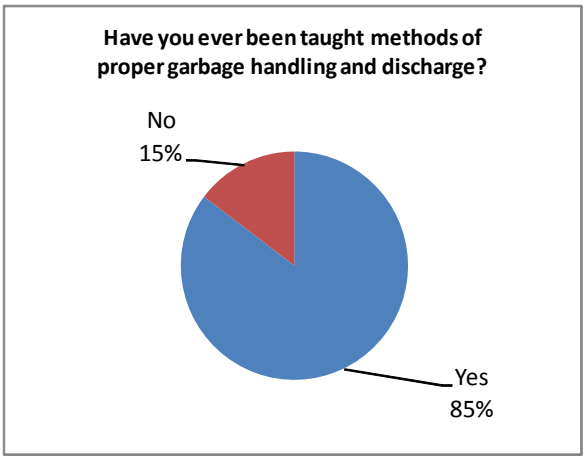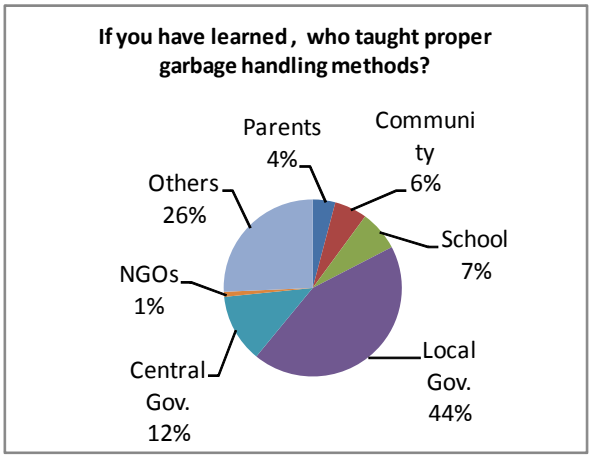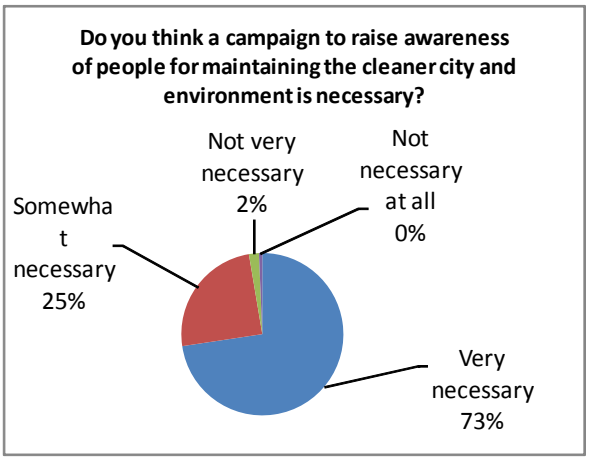
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