WASTE AMOUNT AND COMPOSITION SURVEY REPORT

Integrated Solid Waste Management Master Plan for Gujranwala

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1. Introduction

According to a study (EPMC, 1996), daily waste generation of Pakistan was around 55,000 tons/day in 1996, with generation rate ranging between 0.283 kg/capita/day for Sibi to 0.613 kg/capita/day for Karachi. It was observed that per capita rate of waste generation was higher in urban areas particularly where the affluent class lived. While looking at these figures it must be kept in mind that these are generation rates, collection of the waste is another issue. Solid waste management system exists only in the large cities and a few intermediate ones. The existing Solid Waste Management System (SWM) manages as little as 50 per cent of the garbage generated by the major cities and transferred the collected waste to informal dumping sites since formal sites have not been adequately developed. On top of that whatever is collected does not reach a designated dumpsite, if any.

With this background, JICA took the initiative to develop 'Integrated Solid Waste Management Master Plan for the city of Gujranwala', a large city in the densely populated province, the Punjab. CTI Engineering International Ltd. was chosen as the Project Team to execute the project on behalf of JICA. The project team worked in close coordination with Gujranwala Waste Management Company (GWMC), the entity responsible for providing waste management services in the city of Gujranwala, and the Urban Unit, the organisation working on behalf of the local government department, government of the Punjab.

Solid Waste Management of the urban areas is a complex process. Among the first steps in the development of Integrated Solid Waste Management Plan of any city includes the determination of waste features. Waste amount generated, density of waste, types and amounts of different waste types, moisture content, Carbon & Nitrogen analysis, and 3-component analysis are some of the basic features reflecting the waste characteristics. Services of Lean & Green (Pvt) Limited were hired by JICA project team to conduct waste analysis and composition survey (WACS). The survey constitutes determination of waste features mentioned above. This report presents the findings of this survey conducted in the city of Gujranwala. Results obtained would act as reference values in forming optimum waste management decisions.

It is important to note that for data reliability sake, waste amount and composition survey was conducted three times, one for each of monsoon, winter and summer season, between September 2014 and June 2015. This report presents the third, in the series of three waste analysis and composition surveys. Field investigations for the third season were conducted from 18th May 2015 till 25th May 2015. Moreover, the last chapter of this report also contains the comparison of results from the 3 seasons.

2. Objectives

The purpose of the waste analysis and composition survey was to obtain data of waste amount and composition of municipal solid waste generated in Gujranwala city currently. For the city of Gujranwala, the survey helped estimate;

- Amount of waste generated
- Physical composition of waste
- Chemical analysis of waste

The results of the survey were constructive in understanding the waste stream of the project area and would help to formulate an appropriate integrated municipal solid waste management plan for Gujranwala City.

3. Scope of Work

The waste amount and composition survey area includes all city areas as well as peri-urban areas of Gujranwala. Waste sources surveyed include households, markets, shops & stores, hotels & restaurants, schools and institutes, offices and other commercial establishments. Analysis of data and reporting has been done to cater for the objectives of the survey. As mentioned earlier, the survey was conducted in three different seasons;

- The first season was between September-October of 2014,
- The second one was marked in February-March of 2015, &
- The last season was in May-June of 2015

4. Project Description

The waste amount and composition survey was carried out to collect data (weight of waste, apparent specific gravity (density), physical components, moisture content, carbon & nitrogen analysis, 3 component analysis). The survey was conducted in the following sequence:

- Collection and weighing of waste from the waste generation sources and recording it (including provision of plastic bags, preparing weighing equipment);
- Transporting the waste to a site where the waste composition analysis was done;
- Measuring apparent specific gravity (density) of a sample from each source by loading a plastic bucket of 30 litre capacity, lifting it to a height of 30 cm and then dropping to the ground;
- Dividing the sample into physical components (food, papers, textile, grass and wood, plastics, rubber and leather, metals, bottles and glass, ceramics and stone, and others (dust, dirt, etc.) and weighing them in a wet base;
- Preparing samples for chemical analysis and transporting them to laboratory for chemical analysis;
- Conducting tests for 3-Component Analysis, Carbon & Nitrogen Analysis, and Moisture Content Analysis according to the procedure stated below in section 5.2.2; and
- Analysing the data recorded.

5. Study Methodology

In the earlier discussions, JICA project team and Lean & Green (Pvt) Limited agreed on the sample size and distribution of samples to be collected from different sources. Before the start of field activities, all source locations including households and all commercial establishments were also chosen after mutual agreement of the two and the representatives of GWMC.

5.1 Waste Amount Survey

For the purpose of sample collection for waste amount survey, numerous samples were collected from following types of settlements and locations.

a. Residential Areas
b. Commercial Area
c. Institutions
d. Markets and Parks
e. Street Sweepings

The detail of samples is provided below.

5.1.1 Residential Areas (High, Middle, Low Income and Rural Area)

Before proceeding to the actual survey for measurement of wastes, the surveyors visited each chosen household and explained the owner the purpose, method and period of the survey. Upon obtaining consent of the household owners for cooperation with the survey teams, the data concerning the number of inhabitants, floor area and UC number of the household and GPS coordinates was reconfirmed. Other than this information following tasks were also performed as pre-survey activities:

i. Distribution of marked waste sampling bags (40 litre capacity) with specific sample codes to each household on the day preceding the first collection day.

ii. The plastic bags filled with solid waste from each household were collected at a fixed time in the morning throughout the 8-day survey period. These samples were brought to the GWMC workshop for waste composition survey. Each sample was weighed, segregated into 16 predetermined waste types and each type was weighed and recorded.

Photographs of the sample collection are presented below.

Figure 1: Distribution of Bags for Collection of Waste in High Income Area

Figure 2: Distribution of Bags for Collection of Waste in Middle Income Area

Figure 3: Distribution of Bags for Collection of Waste in Low Income Area

Figure 4: Distribution of Bags for Collection of Waste in Rural Area

Figure 5: Collection of Waste Bags from High Income Area

Figure 6: Collection of Waste bags from High Income Area

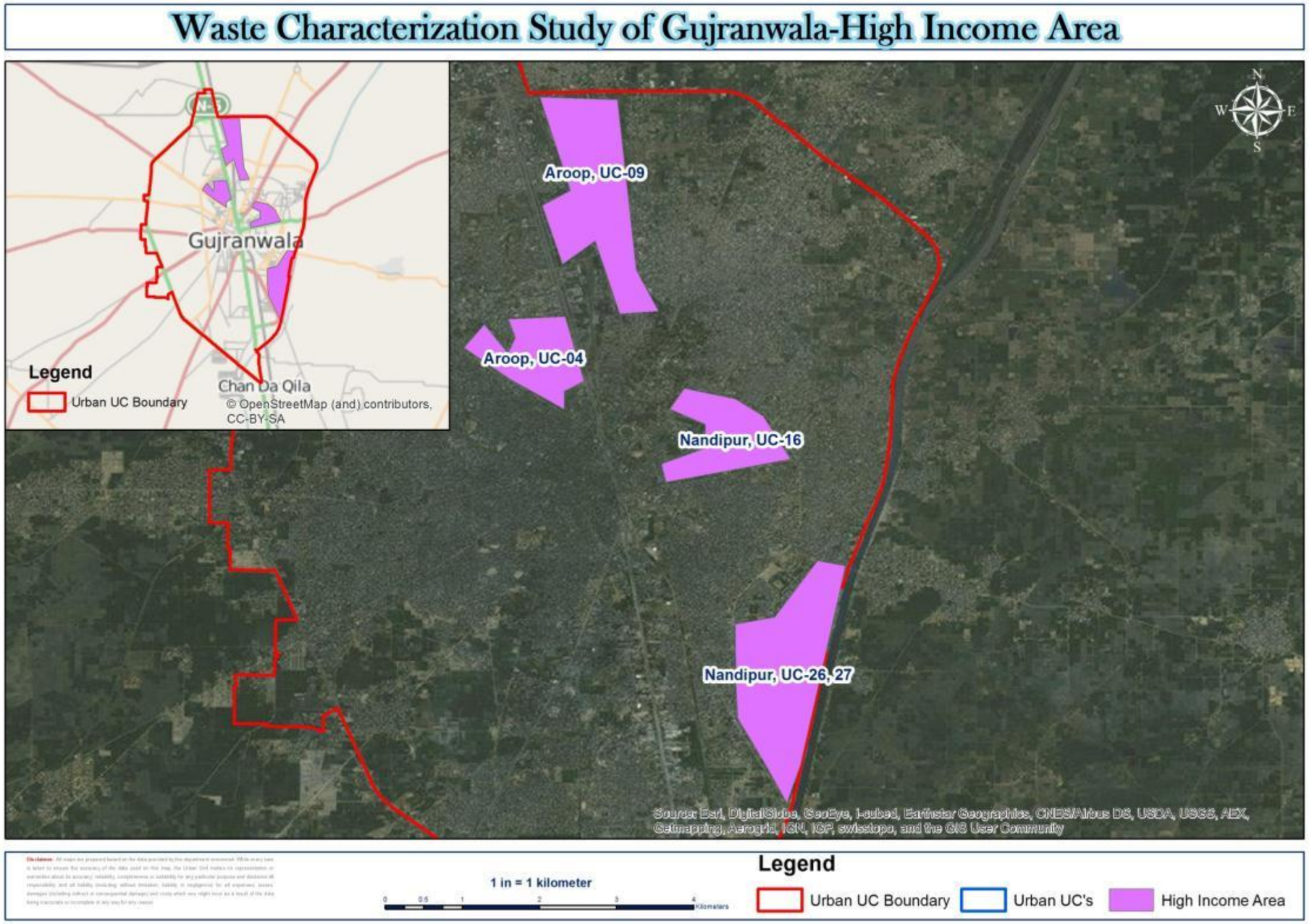
Figure 7: Collection of Waste Bags from Middle Income Area

Figure 8: Collection of Waste Bags from Middle Income Area

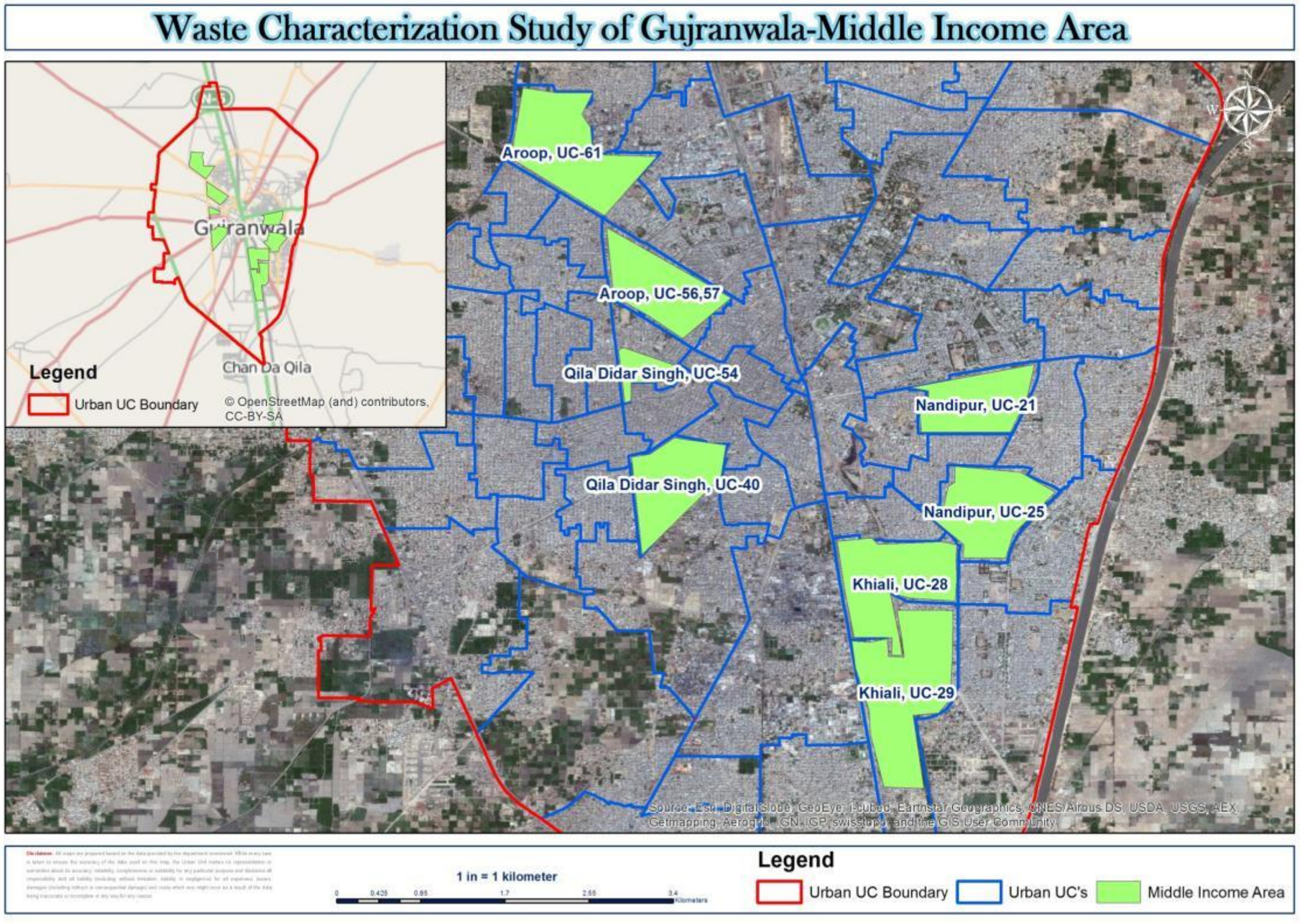
Figure 9: Collection of Waste Bags from Low Income Area

Figure 10: Collection of Waste Bags from Rural Area

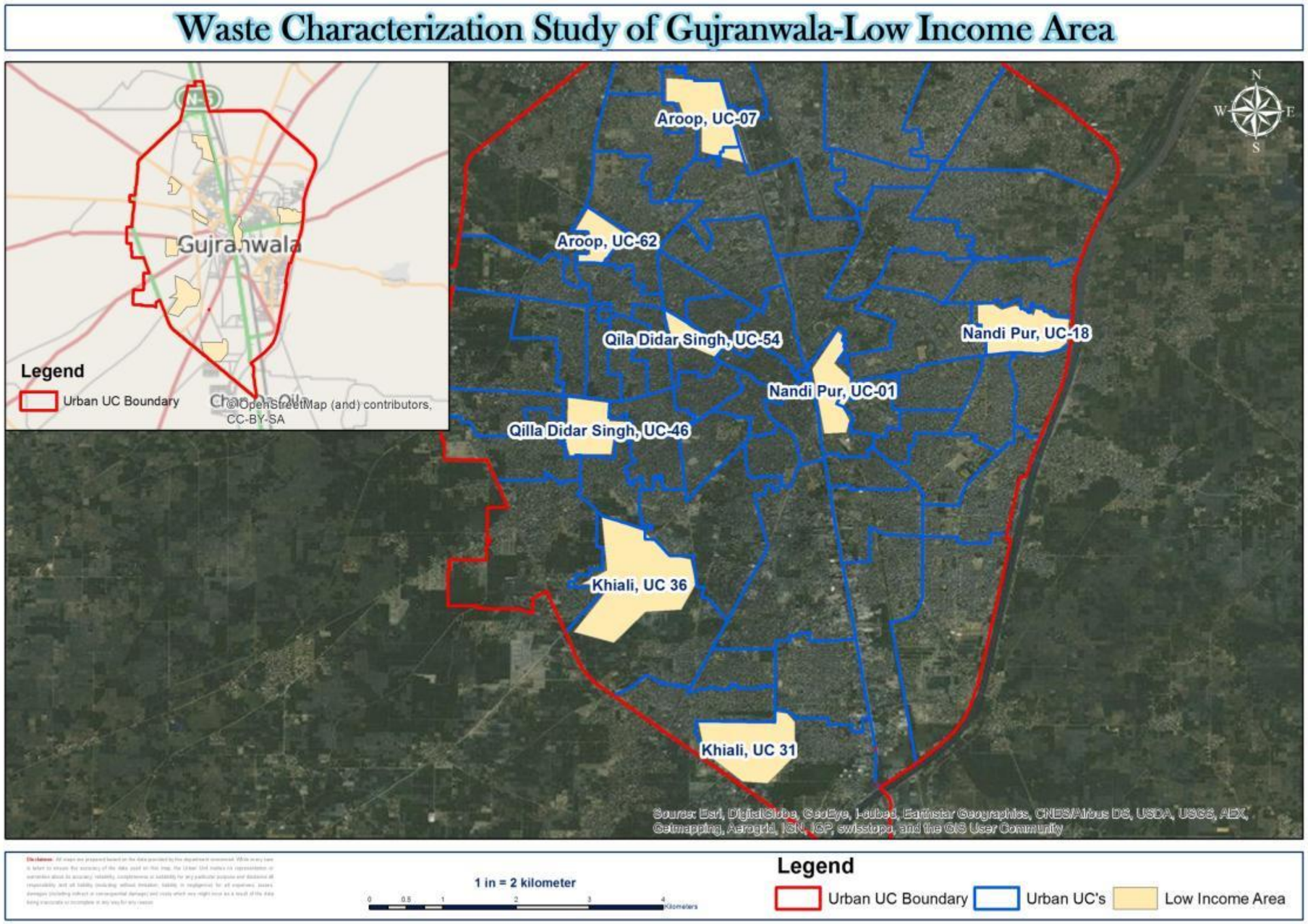
Location of sampling areas for all these residential groups is shown in following graphs.



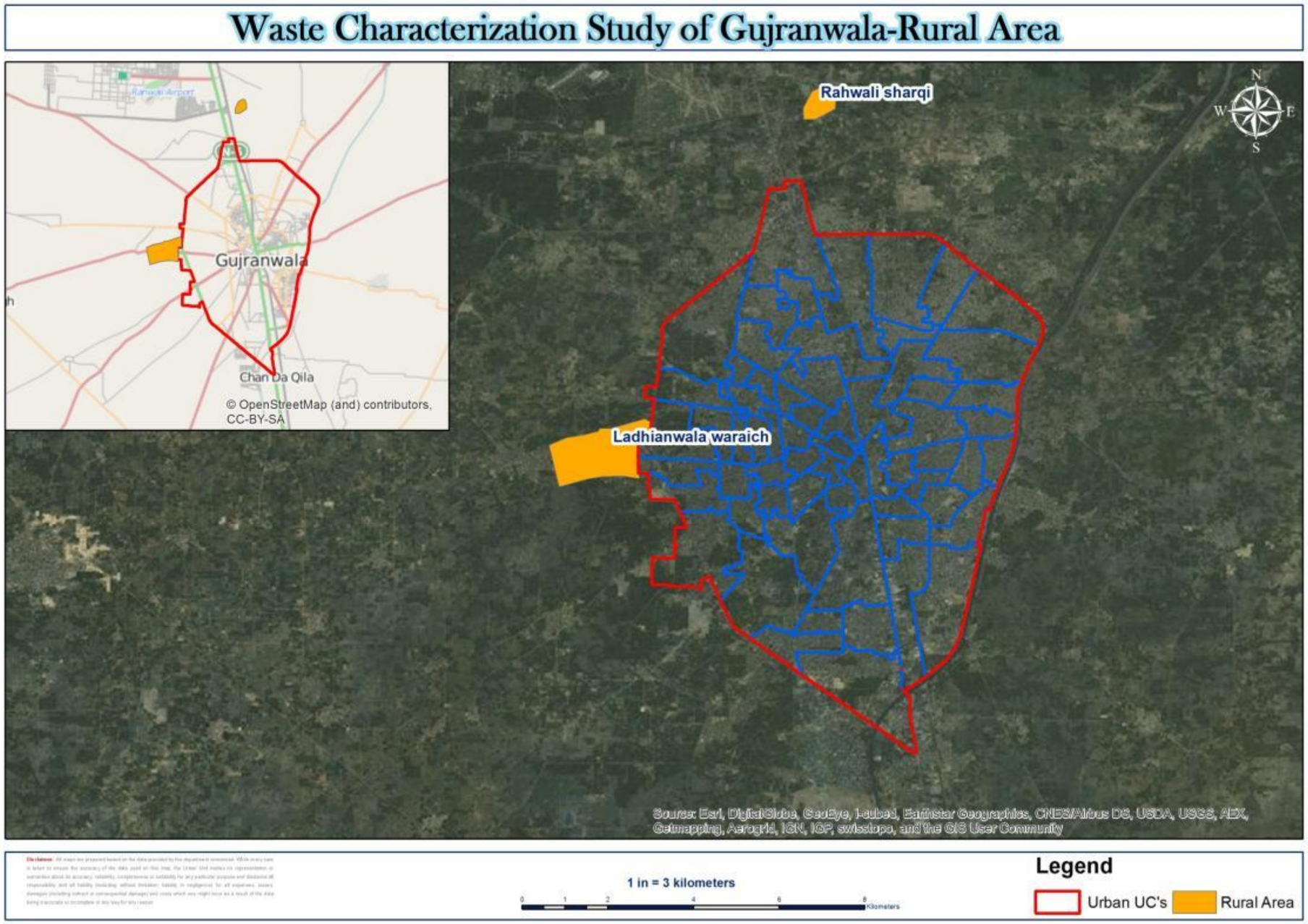
Map 1: Location of High Income Residential Areas for WAC Survey



Map 2: Location of Middle Income Residential Areas for WAC Survey



Map 3: Location of Low Income Residential Areas for WAC Survey



Map 4: Location of Rural Areas for WAC Survey

5.1.2 Commercial Establishments (Shops and Restaurants)

To sensitize the commercial establishments chosen, our surveyors visited the sampling sites and explained the chosen sample owners and the person in charge of discharging wastes for the purpose, period and the method of the survey. Upon obtaining consent of the selected participating owner to cooperate with the survey teams, the data concerning the number of staff, floor area, number of tables and seats, union council (UC) number of the sample and GPS coordinates were reconfirmed.

Table 1: Selected Commercial Establishment for WACS

Sr. No.	Commercial	No of Employees	Total Area
1.	Sufi Restaurant	10-19	12 Marla
2.	Sabri Restaurant	Less than 10	5 Marla
3.	Mian gee	10-19	5 Marla
4.	Usmania	Less than 10	4 Marla
5.	Shahbaz Tikka	20-49	120 Marla
6.	Gourmet	20-49	7 Marla
7.	Alnoor Shopping	20-49	1 Kanal
8.	Shopping centre Satellite town	10-19	3 Marla
9.	Metro Shoes	Less than 10	3 Marla
10.	Gul Ahmed	Less than 10	

Photographs of sample collection are presented below.

Figure 11: Collection of Waste from Fruit Market

Figure 12: Collection of Waste from Fruit Market

Figure 13: Collection of Waste from Fruit Market

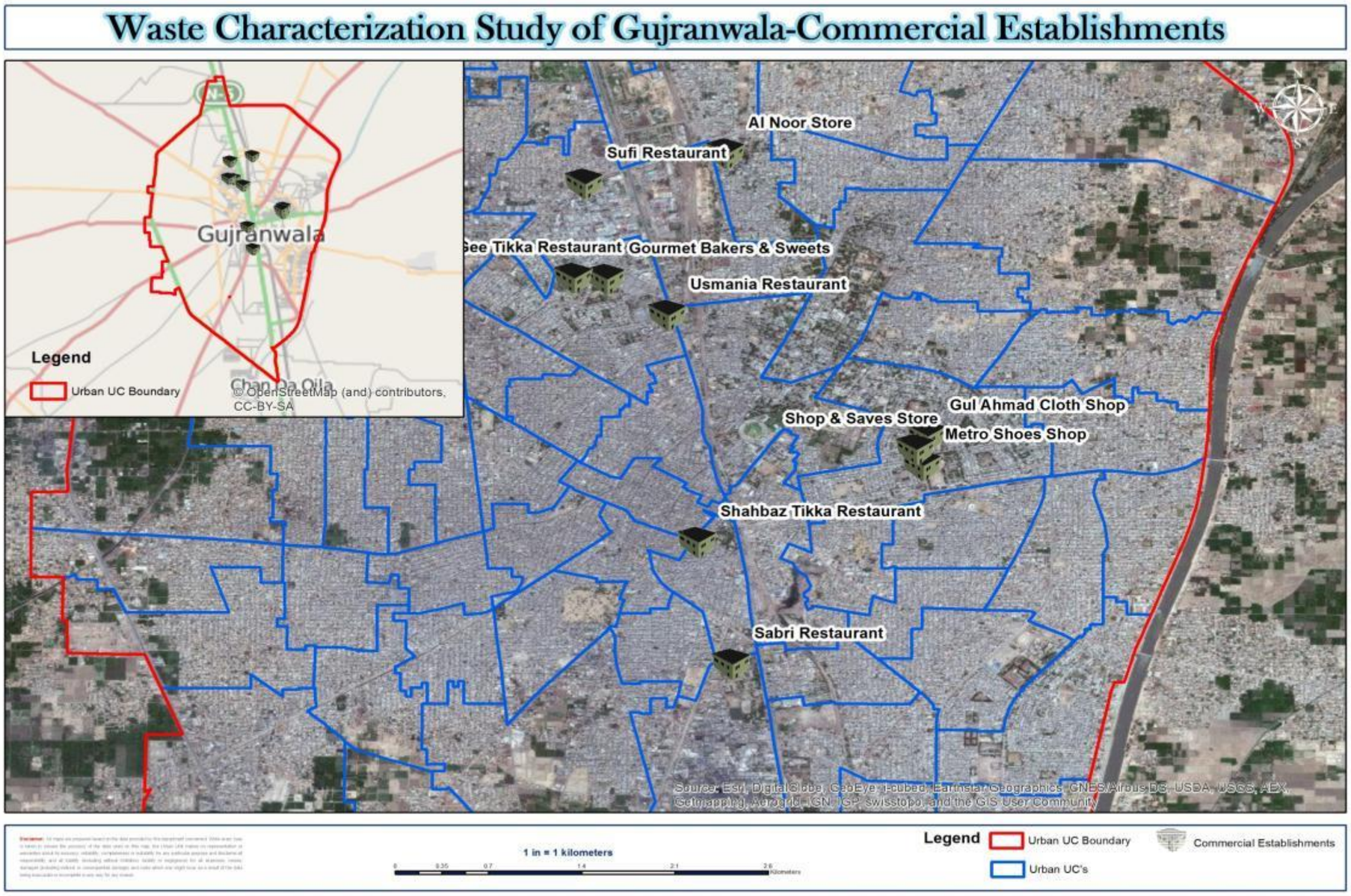
Figure 14: Collection of Waste from Restaurants

Figure 15: Collection of Waste from Institutions

Figure 16: Collection of Waste from Shops

Figure 17: Collection of Waste from Parks

Figure 18: Collection of Waste from Street Sweeping



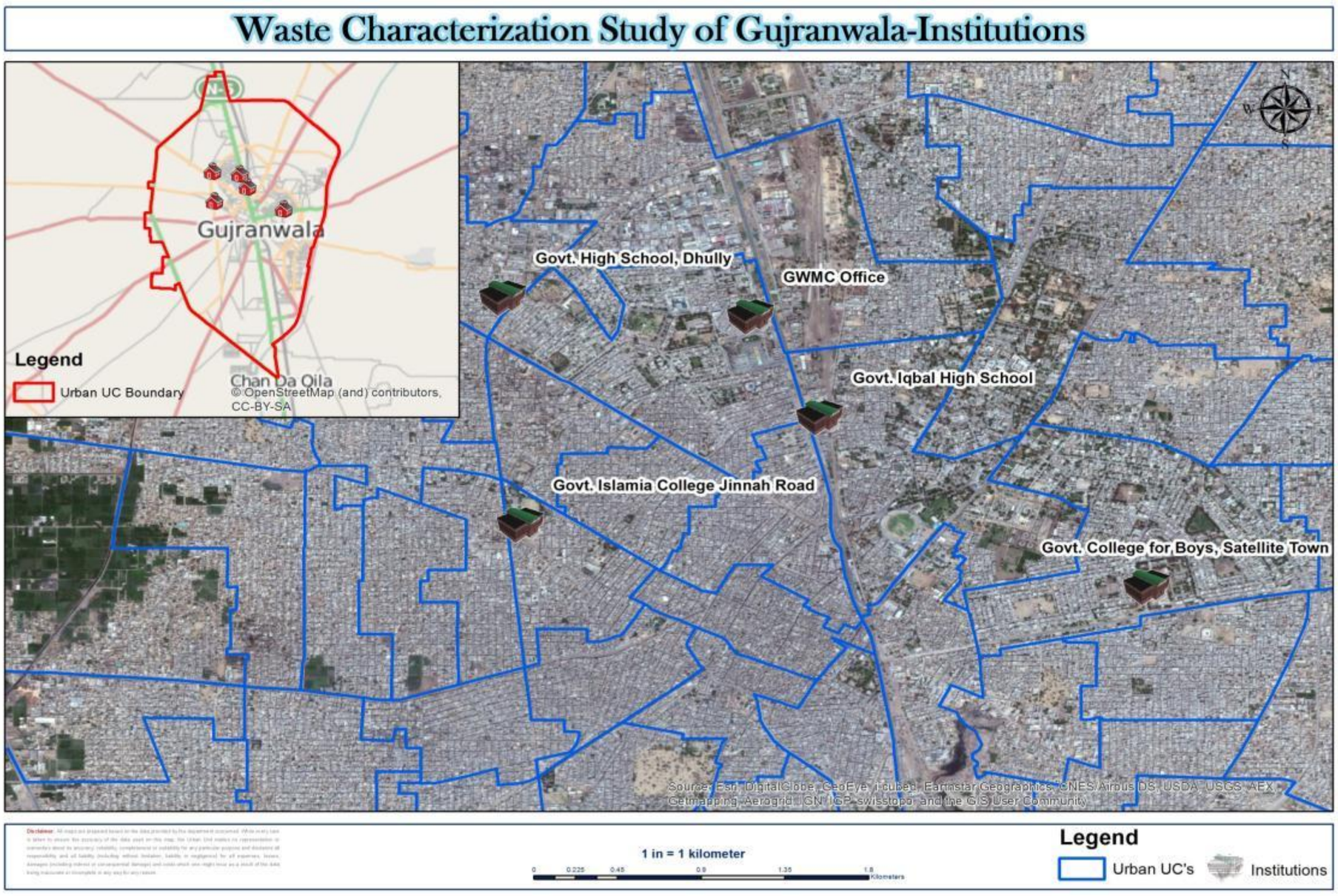
Map 5: Location of Commercial Establishments for WAC Survey

5.1.3 Institutions (Public Offices, Schools)

The surveyors visited the school personnel, public office managers and the staff in charge of waste discharge to explain the purpose, period and the method of the survey. Once the consent for cooperation was obtained, the data concerning the number of staff (and pupils of the school), floor area, UC number of the sample and GPS coordinates were reconfirmed.

Table 2: Selected Institutes for WACS

Sr. No.	Institutions	No of People	Total Area
1.	Govt. Iqbal High School	500 to 999	11 Kanal
2.	Govt. College for Women, Satellite	500 to 999	140 Kanal
3.	Govt. Primary School, Dhulley	500 to 999	Nres
4.	Govt. Islamia College Jinnah Road	500 to 999	95 Kanal
5.	TMA Office Aroop & Qila Dedar Singh, Model Town	Less than 500	Nres



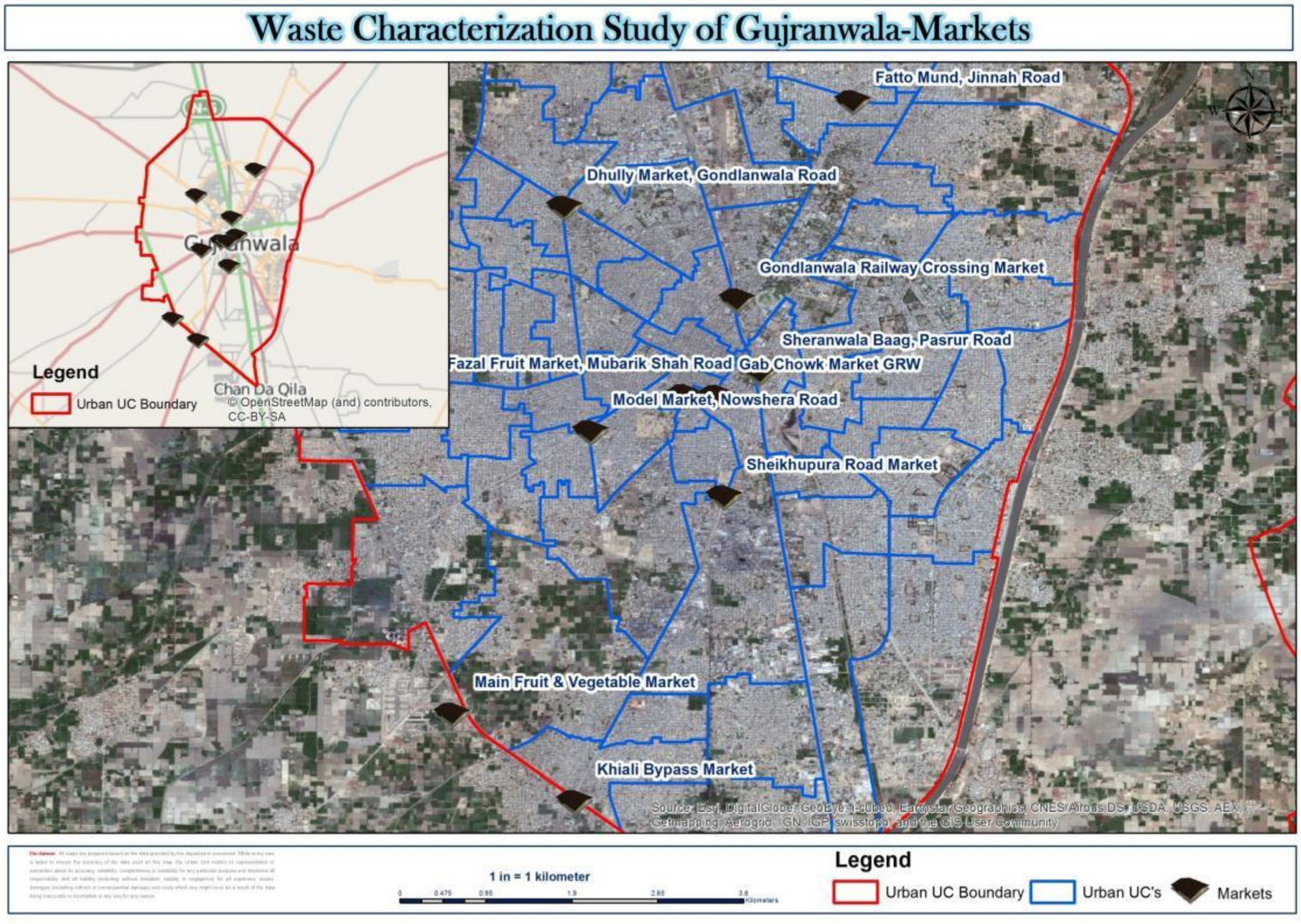
Map 6: Location of Institutions for WAC Survey

5.1.4 Markets

In the chosen markets, our surveyors met the market manager and stall owners to explain the purpose, period and the method of the survey. When the owner(s) for and market managers gave their consent for cooperation, the data and information concerning the number of stalls, floor area of the stalls, dimensions of a market, UC number of the sample and GPS coordinates were reconfirmed.

Table 3: Selected Market for WACS

Sr. No.	Markets	No of Employees	No of Shops	Total Area
1.	Main fruit Market	>100	200	5 Acre
2.	Fazal fruit Market	>100	45	8 Kanal
3.	Model market	10-19	1	120ft (length)
4.	Model Market Fatto Mund	>100	170-200	3-4 Marla
5.	Sheikhupra Road	50-99	300	60 Marla
6.	Sheranwala Bagh	>100	150	8 Kanal
7.	Outside of Dhulle Market	>100	65-70	60m (length)
8.	Gondalanwala Railway	20-49	25	260ft (length)
9.	Khyali Bypass	>100	70-80	436ft (length)
10.	GAB Chowk	<10	20	40m (length)



Map 7: Location of Markets for WAC Survey

5.1.5 Street Sweeping

For street sweeping data for waste characteristics, our surveyors after mutual agreement with the supervisors of GWMC street sweeping staff decided to collect and store temporarily the waste from street sweeping in the plastic bags distributed for this purpose. Selected street sweeping staff made a heap and packed the waste in the plastic bags that were then transported for physical composition analysis. The data concerning the street sweeping lengths are presented below;

Table 4: Selected Road along with lengths for street sweeping

Sr. No.	Roads	Lengths (meters)
1.	GT Road	4,070
2.	Pasrur Road	3,008
3.	Sheikhupura Road	4,246
4.	Sialkot Road	4,678
5.	Nowshera Road	3,226

5.1.6 Parks

GWMC and garden and parks cleaning staff supervisors were taken on board to collect data from the chosen parks. It was agreed that generated waste would be stored in the plastic bags distributed for this purpose and then transported for physical composition analysis. The data concerning parks, and UC numbers of the samples was recorded.

Map of the location for park is attached below.

Map 8: Location of Park surveyed for WAC Survey

5.1.7 Waste Measurement and Recording

This component of the survey started after receiving waste samples from the source. The collected samples were then processed as follows;

a. Samples were brought to the base camp and weighed.

b. The samples were classified into their categories using the fixed label on the plastic bag to show the code number for each household (High, Middle, Low and Rural area), commercial establishment, public facilities, markets and street waste.

c. Measurements of weight for each sample by a bench platform scale was carried out and recorded on the respective recording sheet.

d. Measurement of the volume for samples of each source by opening the plastic bags and emptying the waste in a calibrated plastic barrel of capacity 30 litre was ensured. To achieve an accurate measurement of the volume, the barrel was lifted to a height of about 30 cm and dropped. This procedure was repeated for three times. This helped in recording the volume on the respective record sheet.

e. After recording the weight and volume, calculations for the bulk density (kg/l) and the unit generation for a household (kg/cap./day & l/cap./day)), for market (kg/100 m^2/day & l/100 m^2/day), etc. were performed.

Waste Amount Survey

The table below highlights the number of samples collected from each source type.

Table 5: Type of Waste Generation Sources and Number of Samples for Waste Amount Survey

Types		Waste Amount Survey				
		Area	Samples per Area	Number of Samples	Survey Days	Total Samples
Household	High	2	5	10	8	80
	Middle	6	5	30	8	240
	Low	4	5	20	8	160
	Rural	2	5	10	8	80
Commercial	Restaurants	1	5	5	8	40
	Others	1	5	5	8	40
Markets		5	2	10	8	80
Institutions		5	1	5	8	40
Street Sweeping		1	1	1	8	8
Parks		1	1	1	8	8
Total				97		776

A total of 97 sampling points were selected for the survey. These points are listed in Annexure I of the report. Survey was carried out for eight consecutive days. The rate of waste generation per capita in households and other analyses were performed on the data hence received.

5.2 Waste Composition Survey

The samples were characterized physically and chemically according to pre-determined parameters. These parameters are presented in the following sections.

5.2.1 Physical Composition

Table below shows samples selection for physical composition survey.

Table 6: Number of Samples for Physical Composition Survey

Type of Waste Generation Source		Waste Composition Survey		
		Samples	Survey Days	Number of Physical Compositions
Household	High	1	8	8
	Middle	1	8	8
	Low	1	8	8
	Rural	1	8	8
Commercial	Restaurants	1	8	8
	Others	1	8	8
Markets		1	8	8
Institutions		1	8	8
Street Sweeping		1	8	8
Parks		1	8	8
Total		10		80

The sample waste shall be sorted into 16 kinds of waste composition as shown in the table below. The sorted waste was labelled properly the name of each waste composition.

Table 7: Waste Components for Physical Composition Analysis

Sr. No.	Waste Components
1	Kitchen waste
2	Papers (recyclable /clean paper)
3	Papers (non-recyclable /clean paper)
4	Textile
5	Grass and Wood
6	Plastic (recyclable plastic)
7	Plastic (non-recyclable plastic)
8	Leather and Rubber
9	Metal (recyclable metal)
10	Metal (non-recyclable metal)

11	Bottle and Glass (recyclable bottles and glasses)
12	Bottle and Glass (non-recyclable bottles and glasses)
13	Ceramic, stone and Soil, etc.
14	Domestic hazardous waste
15	Sieve Remaining
16	Miscellaneous

The composition ratio of each waste in wet base, xi (%), can be calculated as follows.

$$Xi = \frac{\text{Weight of each weight composition (kg)}}{\text{Total amount of each waste composition (kg)}} x100$$

5.2.1.1 Bulk Density

For bulk density, each composite sample was weighted on weigh balance and recorded it on the respective recording sheet. Similarly volume of each composite sample was measured by a calibrated plastic barrel of 30 litres capacity. The barrel was lifted to a height of about 30 cm and dropped it repeatedly for three times and then measure the volume of waste. The bulk density (kg/l or ton/m^3) was calculated by dividing the weight with the volume of waste.

5.2.2 Chemical Composition

As for physical survey, sample selection for chemical survey as determined prior to survey commencement is presented below in table.

Table 8: Number of Samples for Chemical Composition Survey

Type of Waste Generation Source		Waste Composition Survey				
		Discharge Source	**Sampling Days**	**3 Component Analysis**	**Carbon and Nitrogen Analysis**	**Moisture Content**
		F	No	Samples	Samples	Samples
Household	High	1	3	3	3	3
	Middle	1	3	3	3	3
	Low	1	3	3	3	3
Markets		1	3	3	3	3
Total		4		36	36	36

5.2.2.1 Moisture Content.

The waste of each composition was put into a container for measuring the moisture content of each composition at laboratory. At least, 1 (one) kg of each waste sample was secured. The sample was sealed for avoiding the moisture change.

The sample was put in oven or incubator to control the temperature in the range of 90 to 100 degree Celsius for 4 to 5 days. The moisture content of each waste composition, wi, can be calculated as follows.

wi (%) = ((Weight of sample of each waste composition before drying (kg) – Weight of sample of each waste composition after drying (kg)) / (Weight of sample of each waste composition before drying (kg))) x 100

5.2.2.2 Carbon Nitrogen Analysis

The nitrogen was analysed in laboratory using Total Kjeldahl Nitrongen Method (official method of AOAC international, 16th Edition, Method No. 955.04 using mercuric oxide or metallic mercury HgO or Hg) as a catalyst.

5.2.2.3 Three Component Analysis

The following 3 (three) component shall be analyzed.

- Combustible component

- Ash component, and
- Moisture

As for the combustible and ash component, the analyses were made based on the following recommended procedure.

1. 5 to 6 g of the waste sample were measured by a 100 ml skull crucible furnace whose weight was already measured
2. Heat above sample at the temperature of 800 degree Celsius at an electric furnace for 3 (three) hours
3. The sample was then cooled and dried at the temperature of 105 ∓ 5 degree Celsius.
4. The dried sample was cooled at the desiccators for 20 to 30 minutes, and the weight was measured.

The combustible and ash component were calculated as follows.

Combustible component in dry base, v (%) = (Sample weight (g) – The weight of the remaining sample after heating at the temperature of 800 degree Celsius (g)) / (Sample weight (g)) x 100

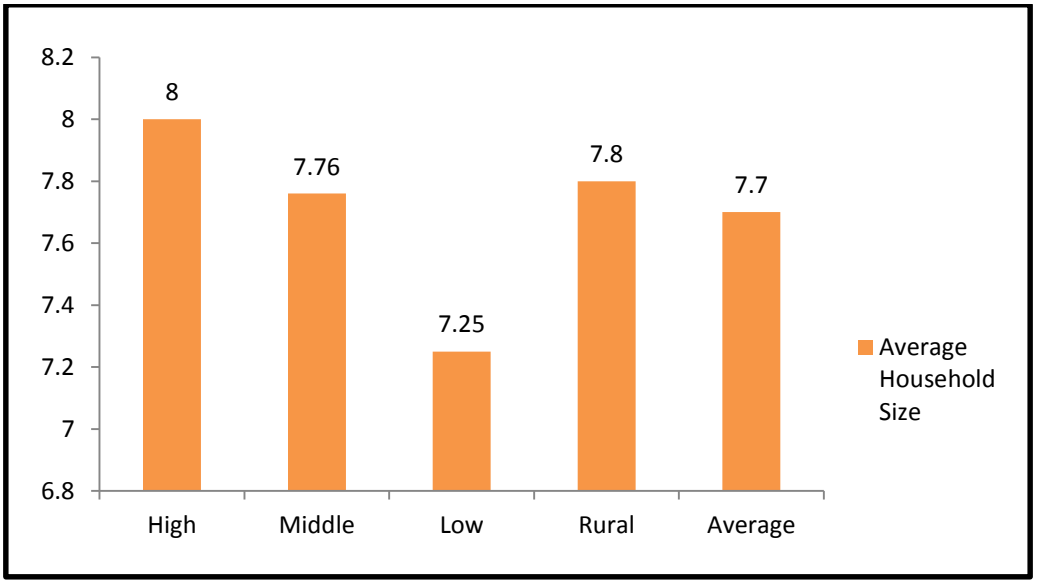
Ash component in dry base, a (%) = the weight of the remaining sample after heating at the temperature of 800 degree Celsius (g) / (Sample weight (g)) x 100

6. Sample Area Selection

Waste sampling sites were identified through detailed discussion and site visits along with the waste managers of JICA project team. It included selection of union council as per income level, selection of household for sample collection, selection of restaurants, shops, institutions, street sweeping points and park. Details of location of these sampling points have been place at Annexure I.

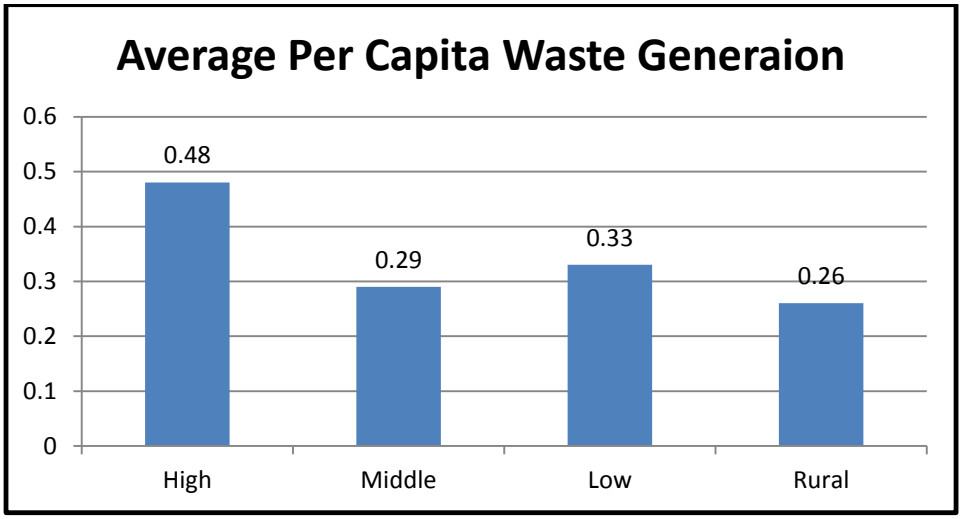
7. Results & Discussion

A total of 776 samples from 97 sources were analysed in the waste amount survey. Approximately 3173 kg waste in total was taken to the workshop area and homogenous mixing was carried out. The waste segregation was conducted on total amount of waste collected for characterization survey. The field investigations were conducted consecutively for 8 days however results for the first day were not included in the analysis to avoid the previous day's accumulated waste at the source. The data obtained from the waste amount survey and the household size of each sample source has been given in Annexure II. The average household size of high, middle low and rural areas is 7.76 people. The graph shows the household size in graphical format.



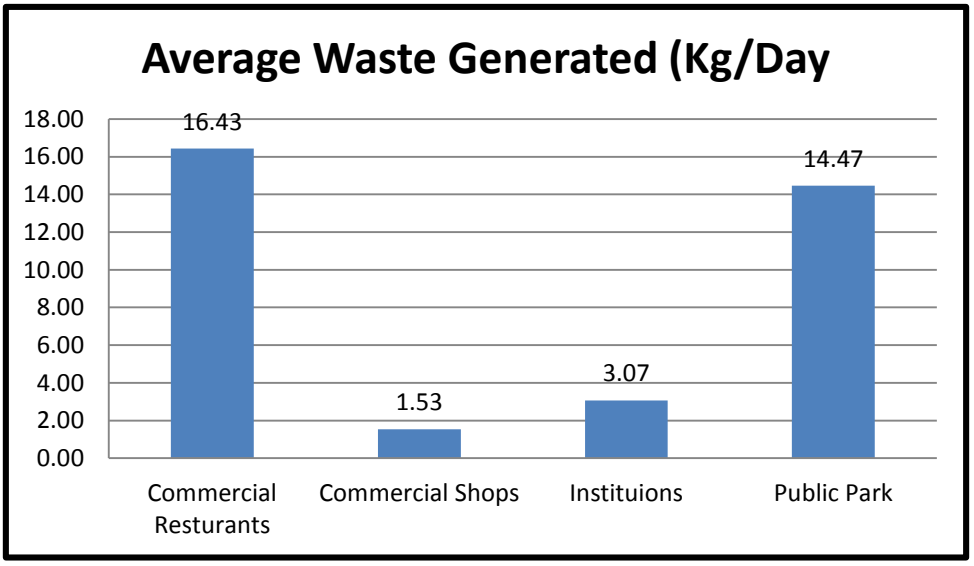
Graph 1: Average Household Size for High, Middle, Low Income and Rural Areas

The average waste generation in each house hold level is shown in the graph below.



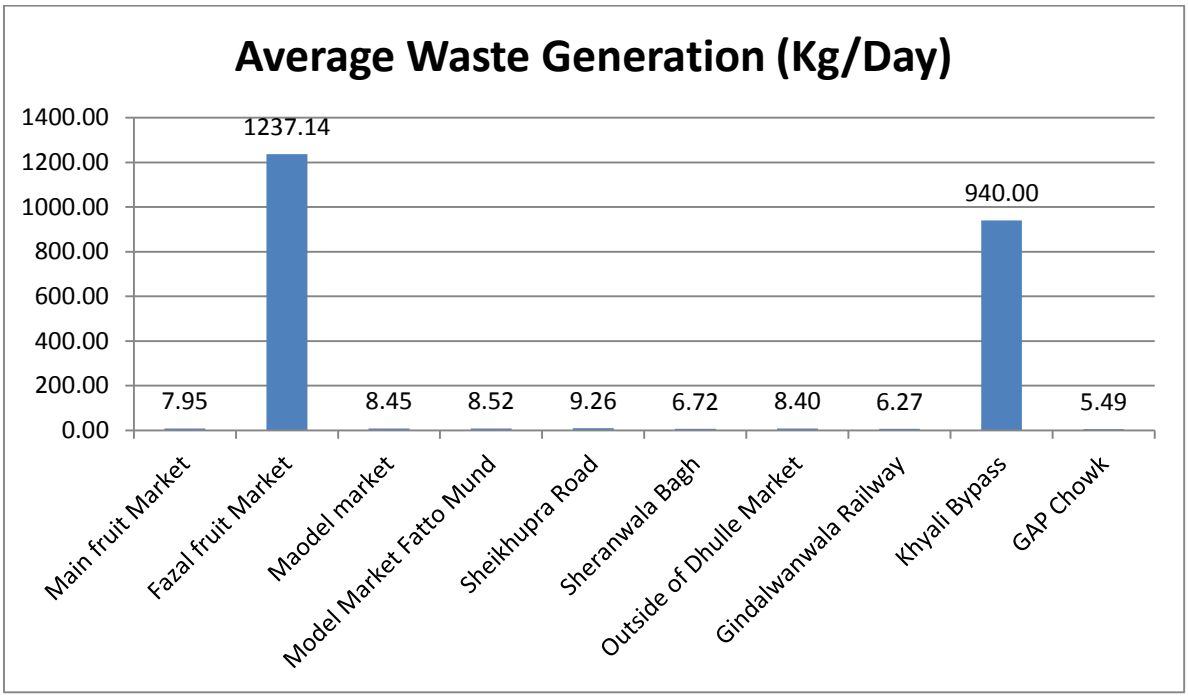
Graph 2: Average per Capita Waste Generation at Household Level

The waste amount survey was also conducted for commercial areas which included restaurants and shops, fruit and vegetable markets, institutions, street sweeping and public parks. Detailed data for the waste amount from these sources is given in annexure II. As there is no information available for number of personnel generating the specific amount of waste, average weight for the 7 days has been used in the graph.



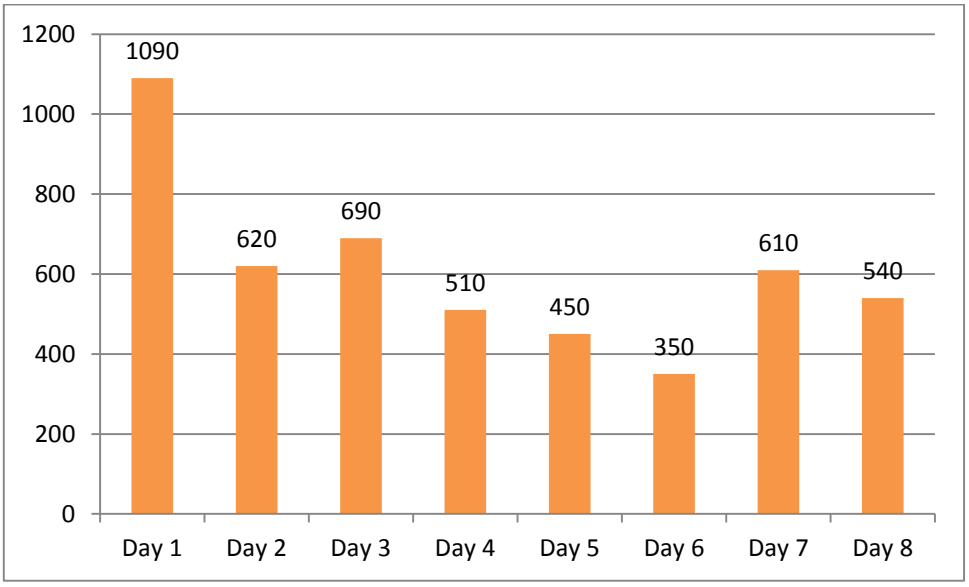
Graph 3: Average Waste Generated (Kg/Day) from Commercial and Other Sources

Similarly waste amount survey has been conducted in fruit and vegetable markets of Gujranwala. There are 2 wholesale fruit & vegetables markets where GWMC has placed a container of 5 m^3. Other markets, which are basically unofficial sale points of fruits and vegetable, are scattered all over the city. 8 major points were selected for sample collection in the unofficial sale points. Detail data for these have been presented in tabular form at annexure II. A summary is given in form of graph given below.



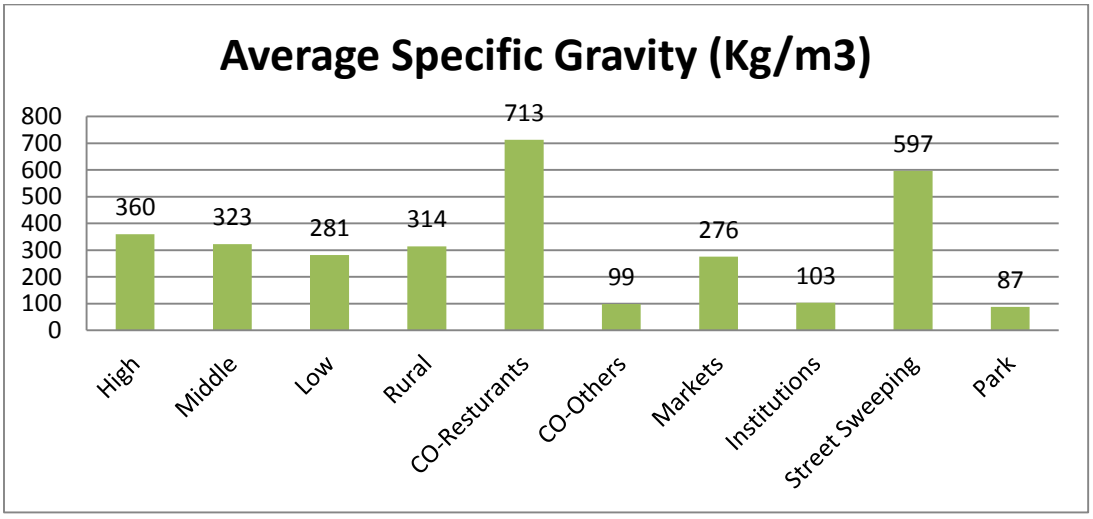
Graph 4: Average Waste Generation (Kg/Day) for the Fruit and Vegetable Markets

Similarly waste amount survey was conducted on specific roads for gathering information of waste generation. Four roads were selected and waste was collected from 1 kilometre distance. Graph 5 shows amount of waste generated per day.



Graph 5: Waste Generation per day for Roads

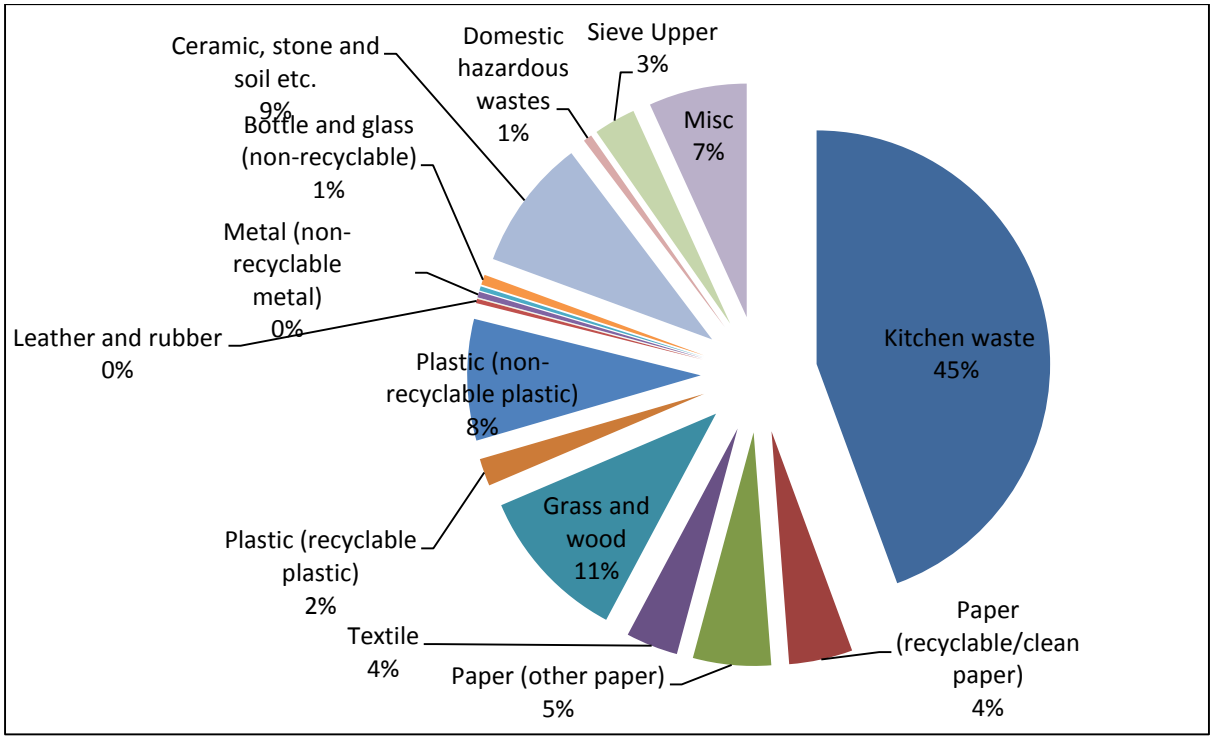
Specific gravity for each category was calculated by standard procedures. Daily data for eight days was recorded and data for the 7 days (i.e. day 2 till day 8) were analysed for results. Accumulated average for all types of waste is calculated as 234 kg/m^3. Tabular data have been given in annexure II. Average for 7 days is shown in the graph given below;



Graph 6: Average Specific Gravity (Kg/m^3) for the Sampled Data

7.1 Physical Composition

Average value by weight for total 80 waste characterizations conducted, were given in Figure 7. Results are in conformity with the characteristics of typical developing countries. Over 70% values, Biodegradable and Paper, Diaper, Textile, Combustibles, Non-Combustibles are the important components following these. Detailed data for the waste composition survey for each source is given in annexure III.

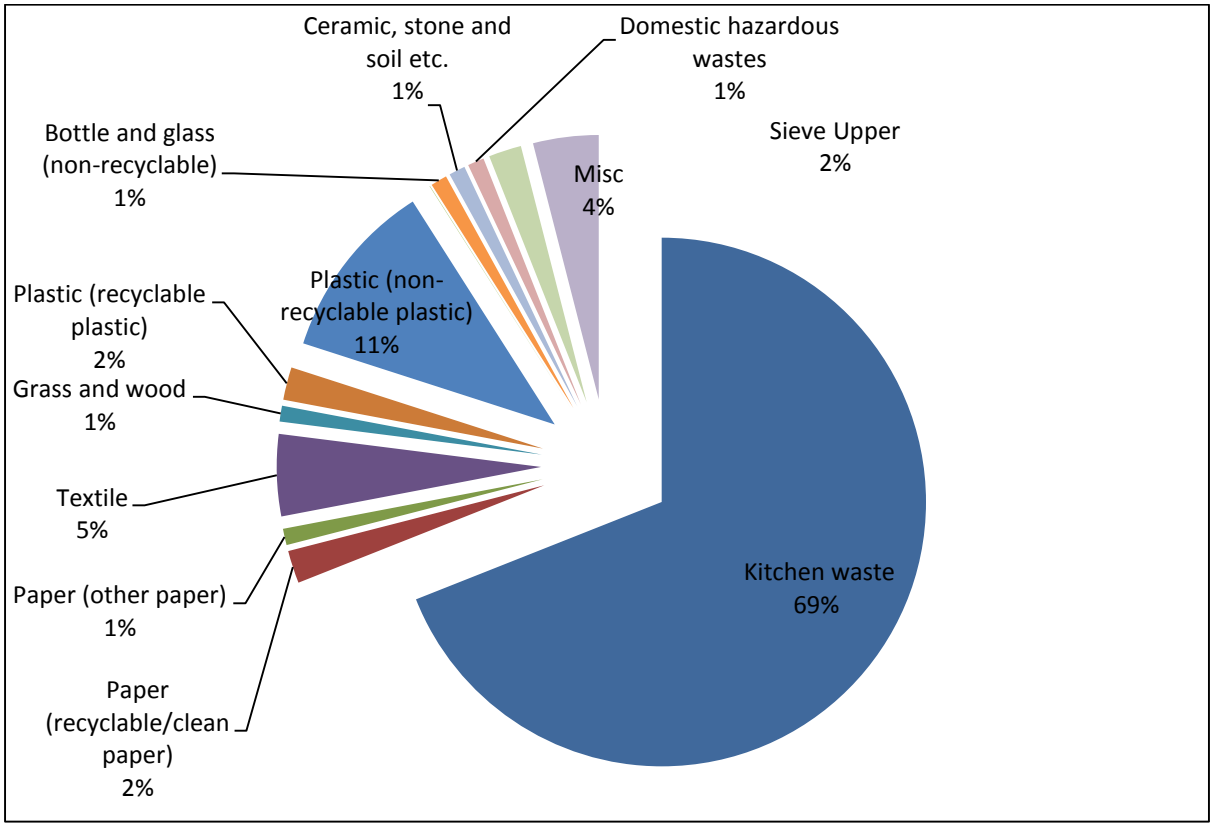


Graph 7: Average Composition of Household Waste

Results obtained from each income level, commercial, markets, institutions, street sweeping and park were considered graphically.

7.1.1 *Low Income Areas*

In Graph 8, results of the samples taken from low income regions are contained. The most interesting waste type in the results is biodegradable wastes with 69% proportion.



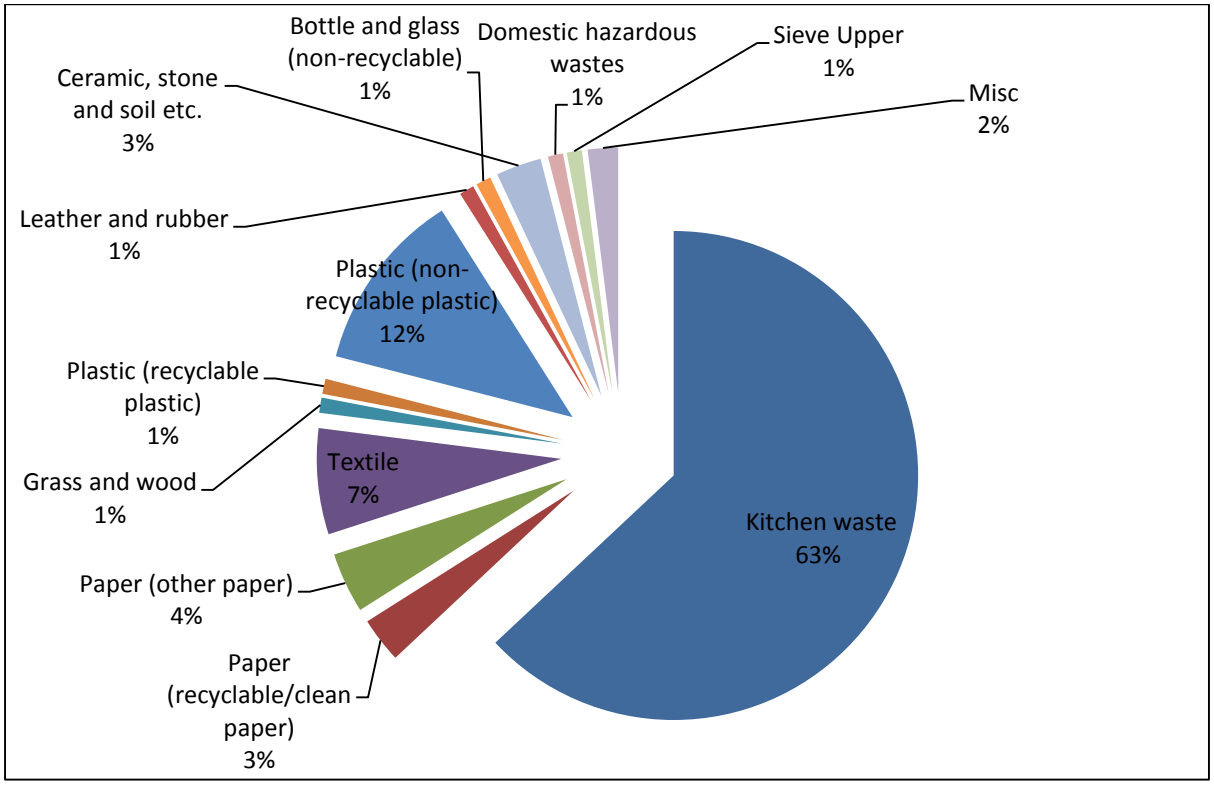
Graph 8: Waste Composition for Low - Income Households

Other prominent components are plastic; textile, miscellaneous, and paper and their percentages by weight are 13%, 5%, 5% and 3% respectively.

Though use of diapers is found in all income level groups. In low income areas this could be linked availability of low-cost baby diapers the area. Similarly there is low percentage of recyclable plastics and metal both, which is directly linked with socio-economic condition of the area.

7.1.2 *Middle Income Areas*

Waste content of middle-income level is presented in Graph below.



Graph 9: Waste Composition from Middle Income Group

As in other groups biodegradable waste has the highest percentage reaching up to 63%. This value was expected to be lower as compared to biodegradable in low-income areas. Other prominent waste components are respectively Plastic 13%, Paper 7%, Textile 7%,Ceramic, stone and soils 3%, Sieve and Miscellaneous 3%.

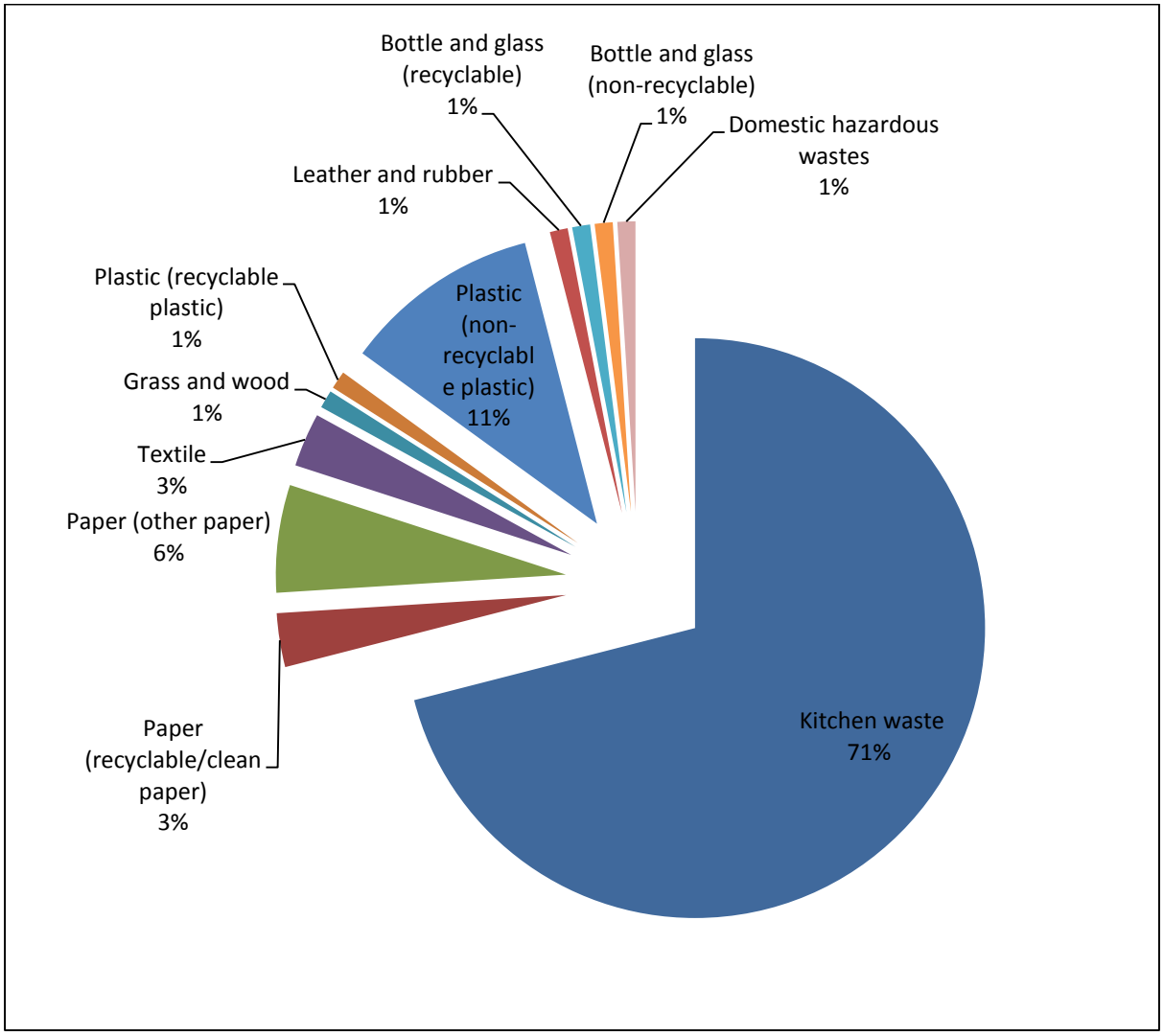
The comparison is a typical increase in some of the non-recyclable components such as plastics and paper. It may be noted that this income level group prevails in the city and most of people who are earning their living from white collar jobs, small business like shops, restaurants, and cottage industries belong to this income level group.

7.1.3 High Income Areas

Graph 10 presents the average composition of waste collected from high – income areas.

The most interesting waste type in the results is biodegradable wastes with 71% proportion. Biodegradable wastes' being high in low-income urban areas compared to the other income levels.

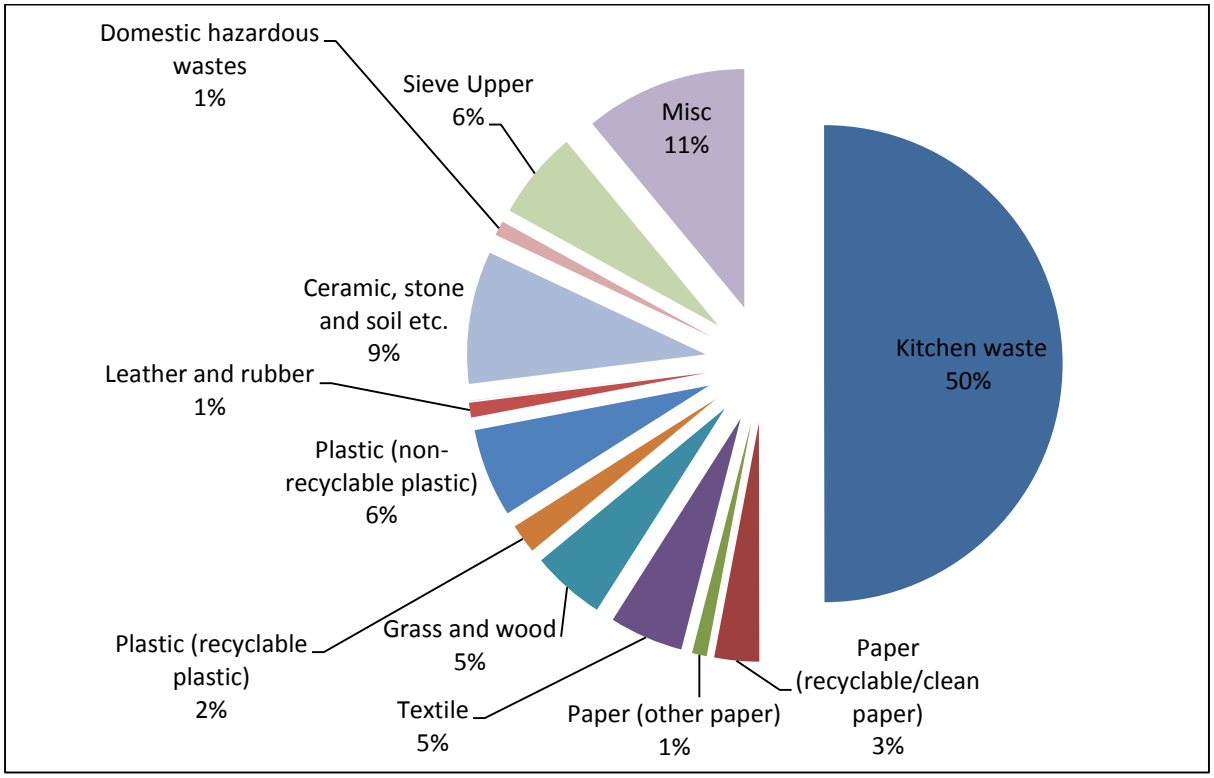
Other prominent waste components in high – income level group are respectively Plastic 12 %, Paper 9% and Textile 3%.



Graph 10: Waste Composition from High Income Group

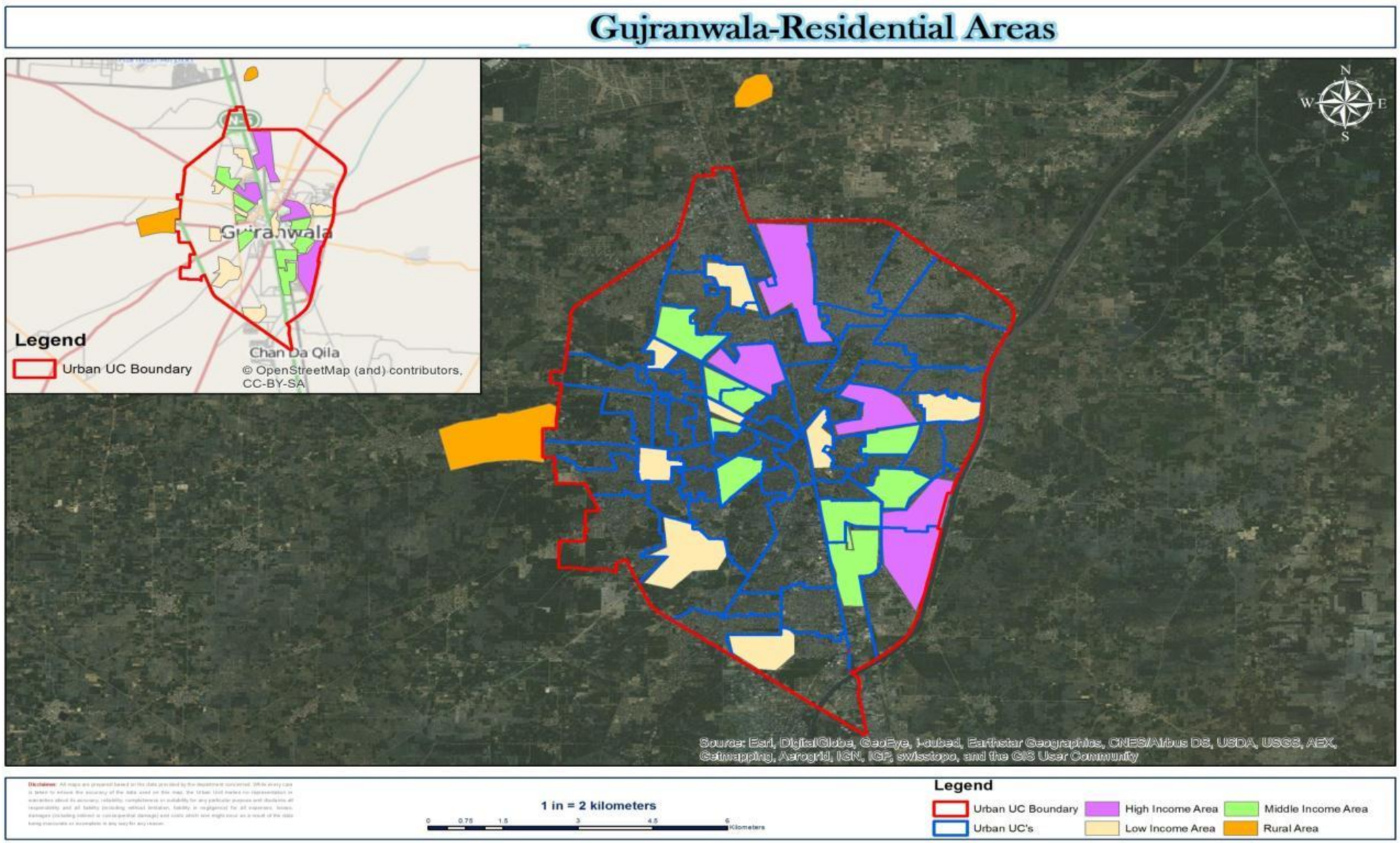
7.1.4 Rural Areas

Results for the rural areas waste composition are given in graph 11. These rural areas are located in close proximity of city outside the boundary of urban union councils of Gujranwala. As GWMC had to spread its services to these rural union councils in the future so this study may help them in developing the waste management plans for these areas very soon.



Graph 11: Waste Composition for Rural Group

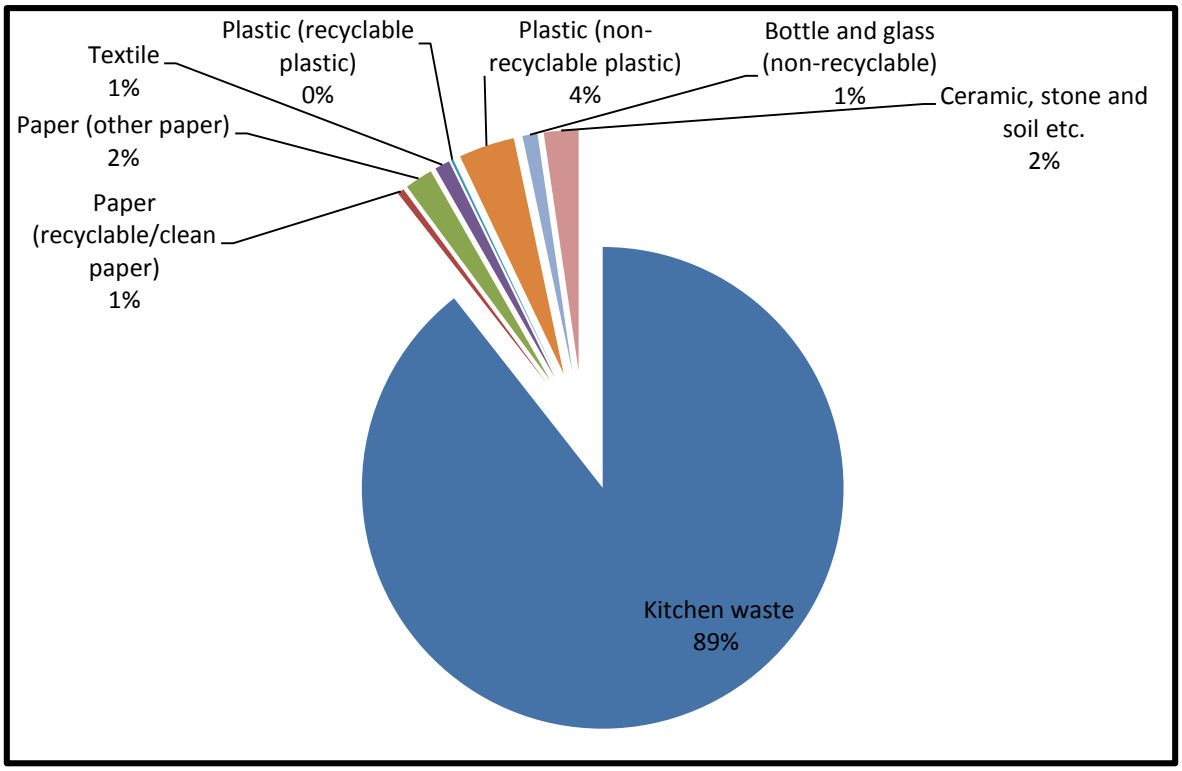
The results show two that percentage of biodegradables waste is maximum 50%. Other significant components are miscellaneous 11%, ceramic, stone and soil 9%, plastic 8%, sieve upper 6%, paper 4%, grass and wood 5%, Textile 5%, grass and wood 5% and textile is 5%.



Map 9: Residential Areas Map of Gujranwala

7.1.5 *Commercial Areas – Restaurants*

The waste characterization pie chart for the commercial category that covered restaurants is close to what can easily be predicted for the culinary industry. Being a food service sector the waste stream was seen to be dominated by kitchen waste.

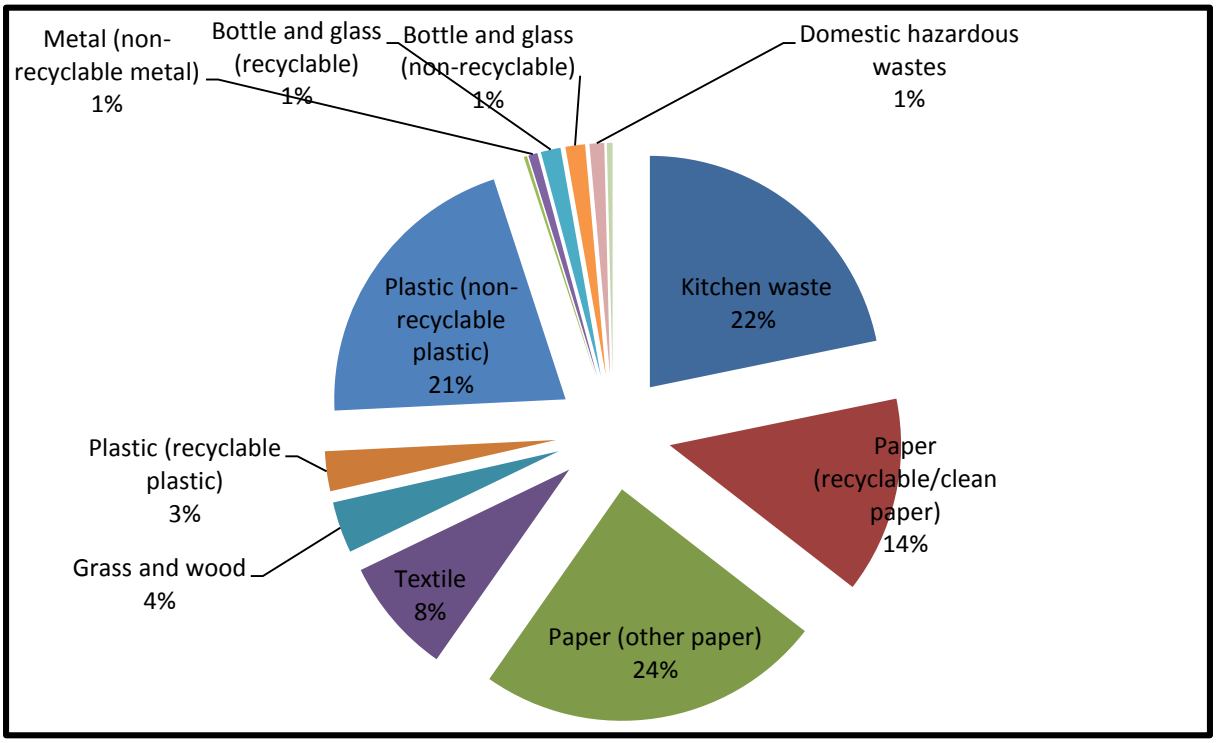


Graph 12: Waste Composition of Commercial Restaurants

This category, comprising of fresh vegetable and fruit scraps and peelings contributed 89% to the waste stream that came from this sector. Non-recyclable plastic and non-recyclable papers were seen to be the second and the third most prominent components in the waste. These contributed to about 4% and 2% respectively. These stand as prominent components owing to the sector's utilization and discarding of paper from everyday use, receipts, and shopping bags. The results are displayed in the graphical form in graph 12.

7.1.6 *Commercial Establishments*

This category covers the commercial zones with shopping centres and markets at its heart. Shoe stores, clothing brands, retail shops were sampled for their waste characteristics.



Graph 13: Waste Composition from Commercial Waste Generation Sources

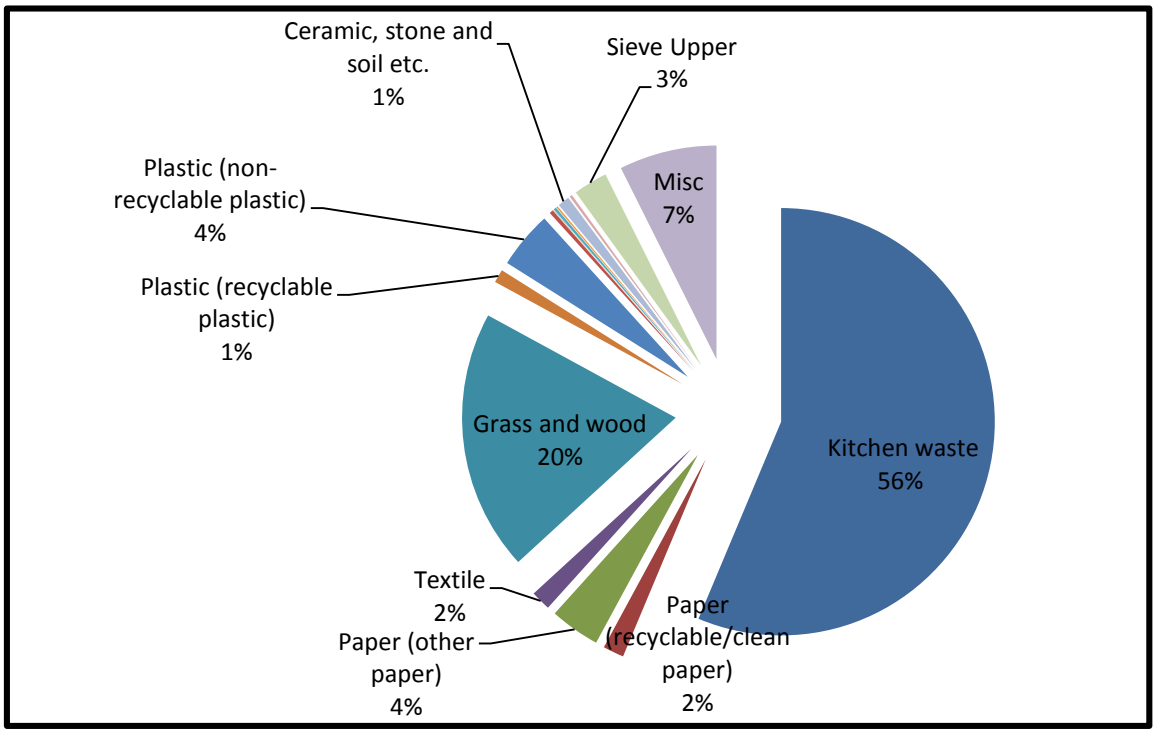
The waste stream arising from the sector vividly reflects the activities that are primarily occurring at the sampled sites. Non-recyclable paper makes up 24% of the waste that comes from this category. The second most prominent component of the waste is kitchen waste that is seen to contribute 22% and the third category is plastic non-recyclable waste that account for 21% that can be visualised in graph 13.

7.1.7 *Market Areas*

Waste composition in markets is presented in graph 14 below. While looking at this representation of various components on percent proportion the component that catches the eye is presence of grass and wood and paper.

It is worth mentioning here that it is a common practice to pack fruits and vegetables in wooden crates with dried straw, old newspapers and other discarded paper serving as cushioning to this merchandise. This is quite prevalent in whole sale markets dealing in farm fresh fruits and vegetables. The wooden crates along with the cushioning material are discarded daily in abundance after the products are extracted and sold. In addition, rotten fruits and vegetables are also sent to the waste bins that are often accompanied by soil and dirt. This is the reason behind the present composition with kitchen waste (here may be termed as vegetable or green waste) approximately 56% of the total waste.

It shows that kitchen waste is the most abundant of all the components into which the samples were segregated. Grass and wood contributes 20%; miscellaneous 7%, non-recyclable paper and plastic 4%, sieve upper 3% each and textile and paper recyclable 2% of the total composition.

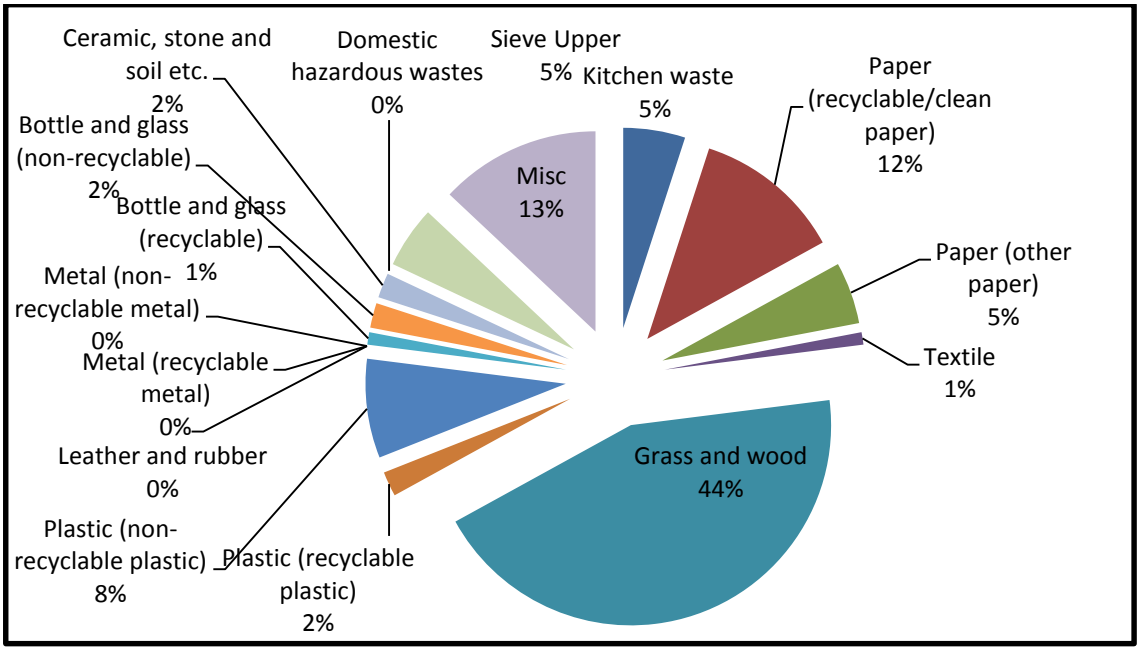


Graph 14: Waste Composition from Market Sources

7.1.8 Institutions

In this category, waste samples from educational institutes and offices were collected and analyzed for composition.

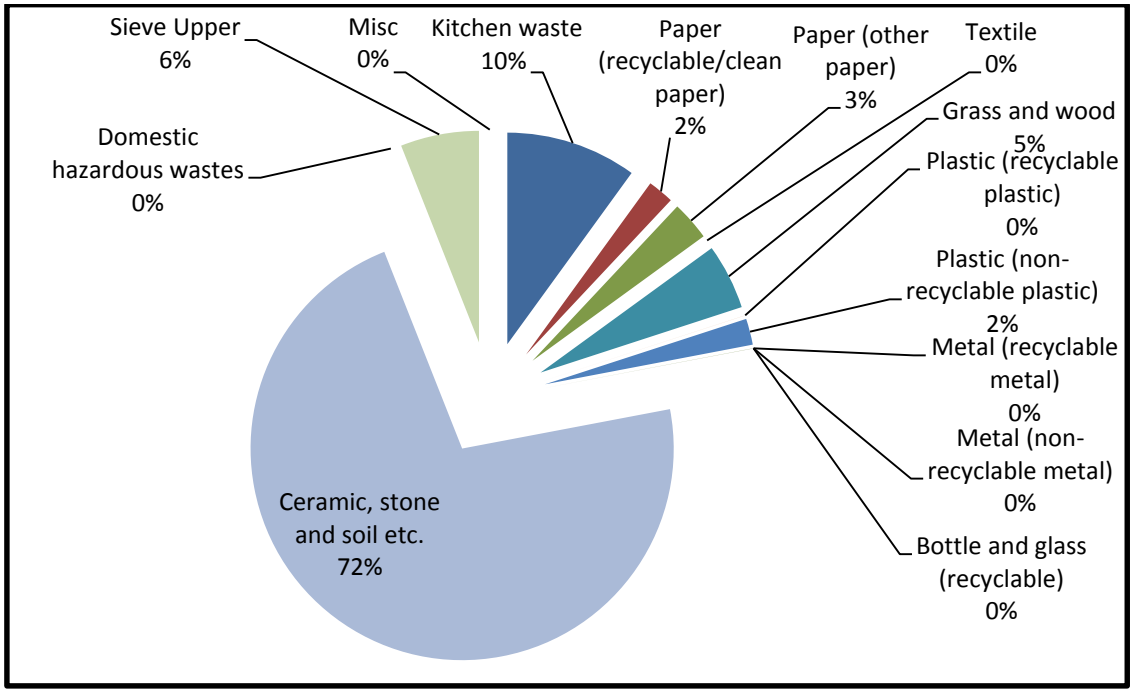
According to the composition analysis presented in graph 15, grass & wood stands as the major component, contributing 44% to the total percentage composition. Miscellaneous 13% and paper contributes 12%, plastic contributes 8%, sieve upper, kitchen and non-recyclable paper contribute 5% to the total. This sort of composition that is dominated by leafy, woody and earthy components arises due to the fact that all the sampled sites have large play areas and plantation covered grounds that add large volumes of grass clipping and green pruning. Paper is a predominant waste from schools, colleges and offices and so, there is no astonishment associated to its percentage that the statistics reveal.



Graph 15: Waste Composition from Institutions

7.1.9 Street sweeping

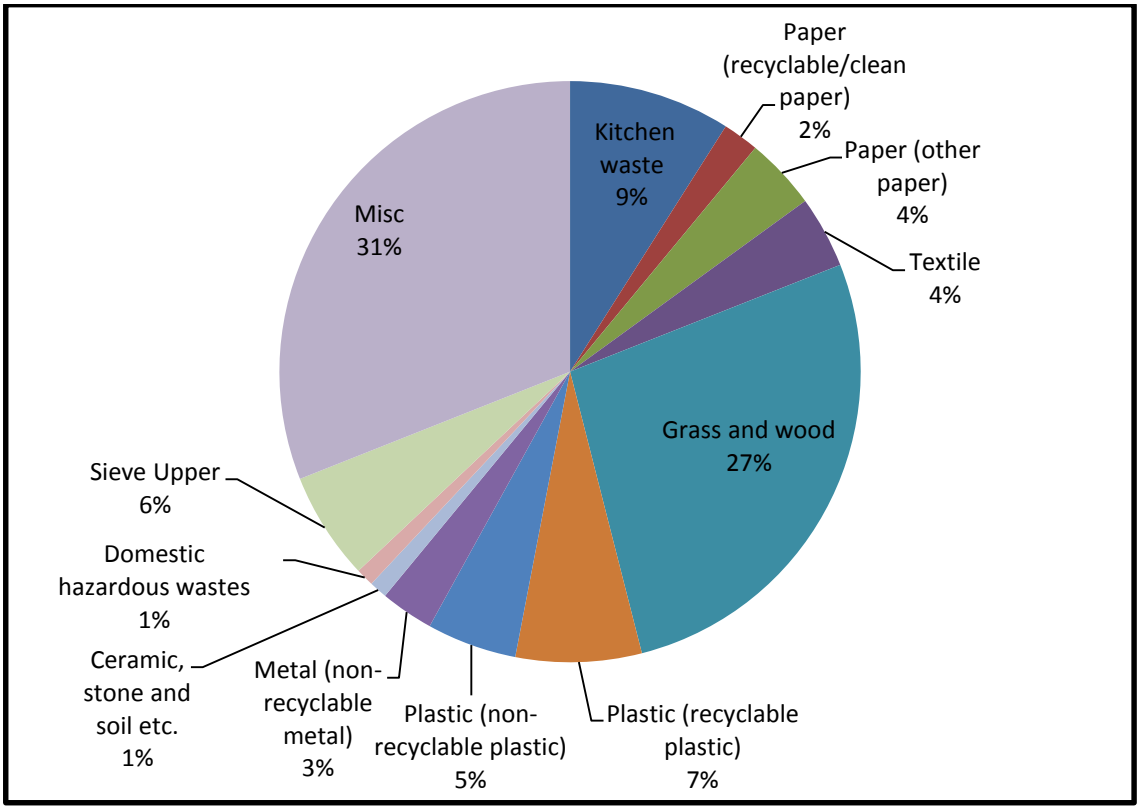
Waste from street sweeping contained the highest proportion of miscellaneous and sieve remaining. Composition analysis indicates about 72% and 10% of the waste comprised of ceramic stone and soils and kitchen waste respectively. Sieve upper contributed 6%, grass and wood 5%, paper non-recyclable 3% and paper recyclable and plastic non-recyclable contributes 2% to the total percentage composition. This is depicted in graph 16.



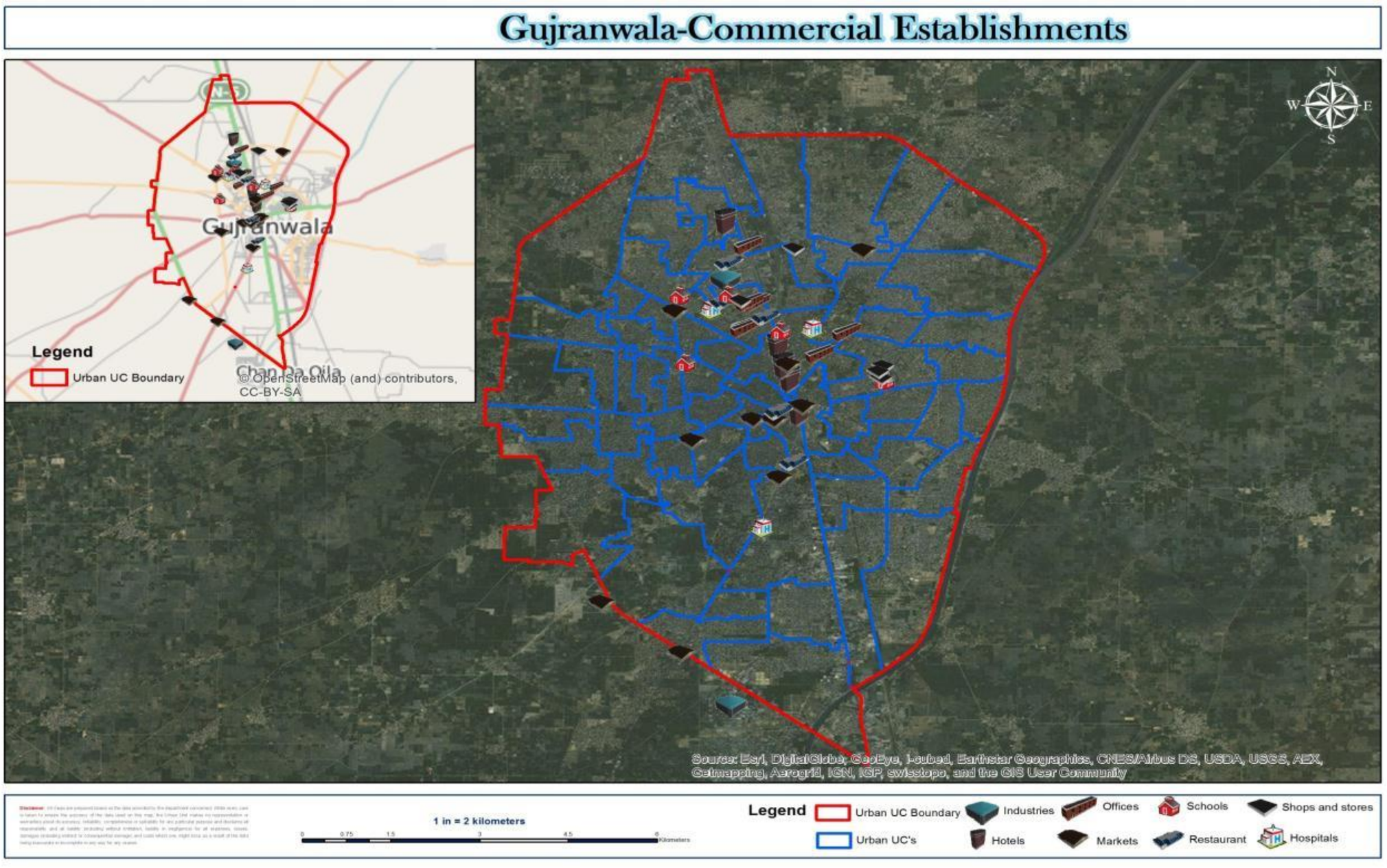
Graph 16: Waste Composition Statistics from Street Sweeping

7.1.10 Park Area

Graph 17, shows that misc 31% followed by grass and wood proportion comes into view as the largest category that makes up the waste load, contributing 27% to the total percentage composition. This includes grass and plant pruning and loose tree leaves. Kitchen 9%, Paper 12% and sieve upper 6%, paper 6% account for the total waste.



Graph 17: Waste Composition Statistics from Park Areas



Map 10: Commercial Establishments Map of Gujranwala

7.2 Chemical Composition

The chemical analysis has been performed for the representative samples of waste. For the chemical analysis same waste components as described in physical composition were used. They are tabulated below for ready reference.

Table 9: Serial Numbers of Waste Components for Chemical Composition Analysis

Sr. No.	Waste Components
1	Kitchen waste
2	Papers (recyclable /clean paper)
3	Papers (non-recyclable /clean paper)
4	Textile
5	Grass and Wood
6	Plastic (recyclable plastic)
7	Plastic (non-recyclable plastic)
8	Leather and Rubber
9	Metal (recyclable metal)
10	Metal (non-recyclable metal)
11	Bottle and Glass (recyclable bottles and glasses)
12	Bottle and Glass (non-recyclable bottles and glasses)
13	Ceramic, stone and Soil, etc.
14	Domestic hazardous waste
15	Sieve Remaining
16	Miscellaneous

Following analyses were carried out for the collected samples of waste;

a) Analysis of three components for waste types 1 to 16
b) Analysis of carbon and nitrogen concentration in waste types 1, 2, 3 and 5
c) Measurement of moisture content of combustible waste (types 1, 2, 3, 4, 5 and 8)

The laboratory analysis was conducted by the nationally accredited Pakistan Council for Scientific and Industrial Research (PCSIR), Lahore. The sample analysis method used for conducting the analysis was ASTM (2007) and AOAC (2012).

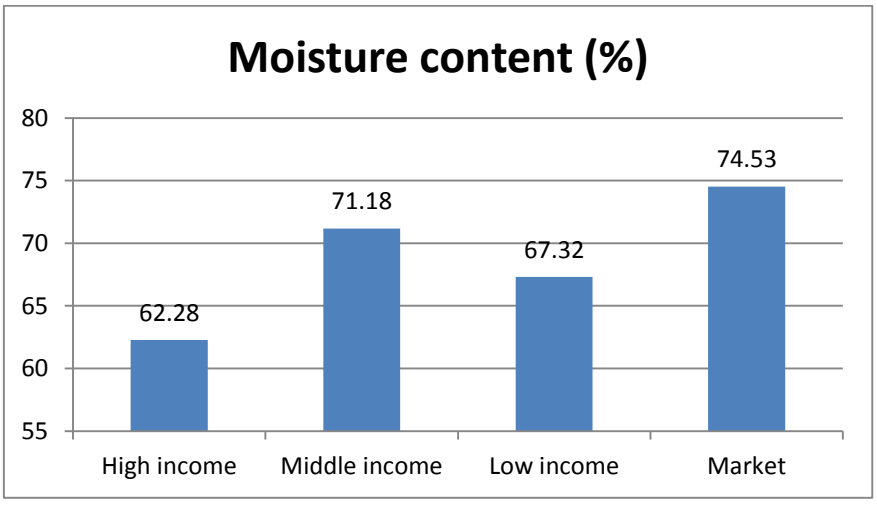
7.2.1 Moisture Content (MC) Analysis

The average of moisture content analysis performed for 36 samples turned out to be 68.83% with high income areas accounting for 62.28%, middle income regions for 71.18%, low income 67.32% and market areas with 74.53%. The moisture content of waste with high organic waste content is observed in the market areas and middle income regions which was unexpected in case of middle income region. The current scenario observed in the middle income region was unexpected as the general trend reveals the organic products to be at a decelerating consumption rate in middle income regions and is considered to carry higher percentages in the low income regions comparatively.

Table 10: Moisture Content Test Results

Sr. No.	Discharge Source	Sample Code	Results	Average
1	High Income Group	H-1-MC-01	80.23	62.28
2		H-1-MC-02	61.11	
3		H-1-MC-03	11.33	
4		H-2-MC-01	74.5	
5		H-2-MC-02	73.5	
6		H-2-MC-03	69.18	
7		H-3-MC-01	64.27	
8		H-3-MC-02	71.63	
9		H-3-MC-03	54.77	
10	Middle Income Group	M-1-MC-01	66.11	71.18
11		M-1-MC-02	76.03	
12		M-1-MC-03	76.52	
13		M-2-MC-01	61.62	
14		M-2-MC-02	78.55	
15		M-2-MC-03	82.68	
16		M-3-MC-01	64.88	
17		M-3-MC-02	67.96	
18		M-3-MC-03	66.23	
19	Low Income Group	L-1-MC-01	76.72	67.32

20		L-1-MC-02	67.71	
21		L-1-MC-03	67.37	
22		L-2-MC-01	77.09	
23		L-2-MC-02	67.55	
24		L-2-MC-03	65.03	
25		L-3-MC-01	60.95	
26		L-3-MC-02	60.72	
27		L-3-MC-03	62.78	
28	Market (Fruit & Vegetables)	FV-1-MC-01	69.18	74.53
29		FV-1-MC-02	71.32	
30		FV-1-MC-03	74.62	
31		FV-2-MC-01	77.73	
32		FV-2-MC-02	70.27	
33		FV-2-MC-03	79.03	
34		FV-3-MC-01	71.27	
35		FV-3-MC-02	78.8	
36		FV-3-MC-03	78.57	



Graph 18: Average Moisture Content (%) of Waste Samples

7.2.2 Carbon and Nitrogen (C&N) Analysis

The average value calculated for carbon to nitrogen ratio for all the analysed samples was 141.12 with high income regions having 105.2, middle income 185.27, low income region 126.61 and 147.39 for market waste. The chemical analysis also observed the carbon to nitrogen ratio of the sampled waste being highest in the middle income areas followed by market and low income regions, whereas high income showed the lowest carbon to nitrogen ratios in the respective waste samples.

Carbon content (%) = (100-ash %)/1.83[1]

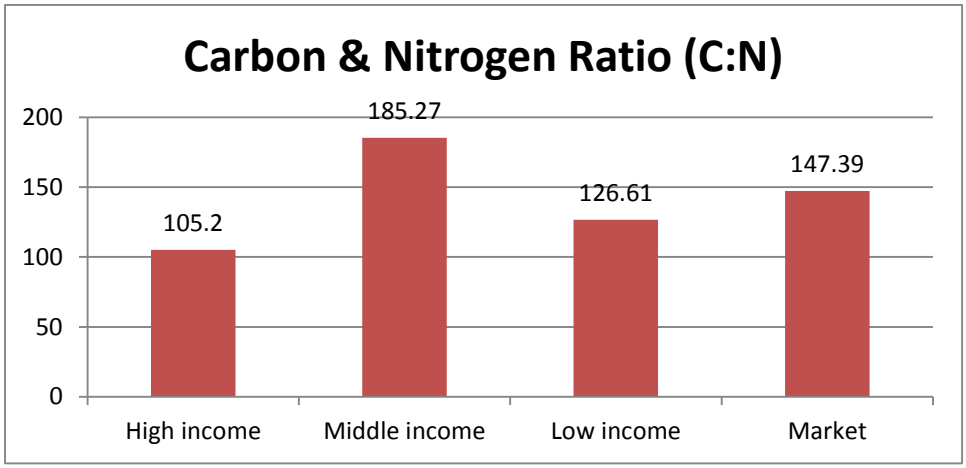
Table 11: Carbon and Nitrogen Ratio Test Results

						Average		
Sr. No.	**Discharge Source**	**Sample Code**	**C (%)**	**N (%)**	**C/N**	**C**	**N**	**C/N**
1	High Income Group	H-1-CN-01	51.94	0.84	61.84	51.32	0.58	105.20
2		H-1-CN-02	53.45	0.58	92.16			
3		H-1-CN-03	52.88	0.76	69.58			
4		H-2-CN-01	51.81	0.75	69.08			
5		H-2-CN-02	51.68	0.24	215.32			
6		H-2-CN-03	52.08	0.80	65.1			
7		H-3-CN-01	48.87	0.40	122.17			
8		H-3-CN-02	51.85	0.50	103.7			
9		H-3-CN-03	47.32	0.32	147.87			
10	Middle Income Group	M-1-CN-01	51.56	0.51	101.11	52.29	0.42	185.27

[1] Barrington, S., D. Choiniere, M. Trigui and W. Knight, 2002. Effect of carbon source on compost nitrogen and carbon losses. Bioresour. Technol., 83: 189-194. DOI: 10.1016/S0960-8524(01)00229-2

11		M-1-CN-02	52.39	0.28	187.09			
12		M-1-CN-03	51.66	0.50	103.32			
13		M-2-CN-01	52.29	0.65	80.45			
14		M-2-CN-02	52.27	0.23	227.27			
15		M-2-CN-03	52.86	0.53	99.74			
16		M-3-CN-01	48.99	0.78	288.19			
17		M-3-CN-02	50.74	0.13	181.2			
18		M-3-CN-03	57.88	0.19	399.06			
19	Low Income Group	L-1-CN-01	52.27	0.84	62.22	45.33	0.52	126.61
20		L-1-CN-02	51.35	0.46	111.63			
21		L-1-CN-03	52.37	0.93	56.32			
22		L-2-CN-01	34.31	0.55	62.38			
23		L-2-CN-02	50.74	0.64	79.28			
24		L-2-CN-03	40.38	0.65	75.97			
25		L-3-CN-01	43.13	0.19	227.02			
26		L-3-CN-02	30.96	0.20	254.79			
27		L-3-CN-03	52.46	0.25	209.85			
28	Market (Fruit & Vegetables)	FV-1-CN-01	51.42	0.99	51.94	50.07	0.46	147.39
29		FV-1-CN-02	51.76	0.48	107.84			
30		FV-1-CN-03	51.31	0.81	63.34			
31		FV-2-CN-01	51.54	0.41	125.7			
32		FV-2-CN-02	51.39	0.55	93.44			

33		FV-2-CN-03	51.33	0.30	171.1			
34		FV-3-CN-01	47.67	0.20	238.33			
35		FV-3-CN-02	46	0.18	255.57			
36		FV-3-CN-03	48.24	0.22	219.29			



Graph 19: Average Carbon & Nitrogen Ratio (C: N)

7.2.3 *Three Component (3C) Analysis*

For the three component analysis the following components were analysed

i. Moisture content
ii. Ash Content
iii. Combustible content

The average of moisture content analysis performed in the three component analysis for 36 samples turned out to be 55.94% with high income areas accounting for 71.35%, middle income regions for 71.19%, low income 64.64% and market areas with 69.21%.

The moisture content of waste with high organic waste content is observed in the high income and middle income regions which was unexpected in case of high and middle income regions. The current scenario observed in the high income region was

unexpected as the general trend reveals the organic products to be at a decelerating consumption rate in high income regions and is considered to carry higher percentages in the middle income regions comparatively.

The average of combustible content analysis performed in the three component analysis for 36 samples turned out to be 20.08% with high income areas accounting for 21.87%, middle income regions for 19.5%, low income 21.21% and market areas with 17.74%.

Similarly the average ash content for these samples were 10.81% with high income areas accounting for 6.78%, middle income regions for 9.3%, low income 14.14% and market areas with 13.05%. The combustible content with high organic content was high in low income area and that of least in the high income area.

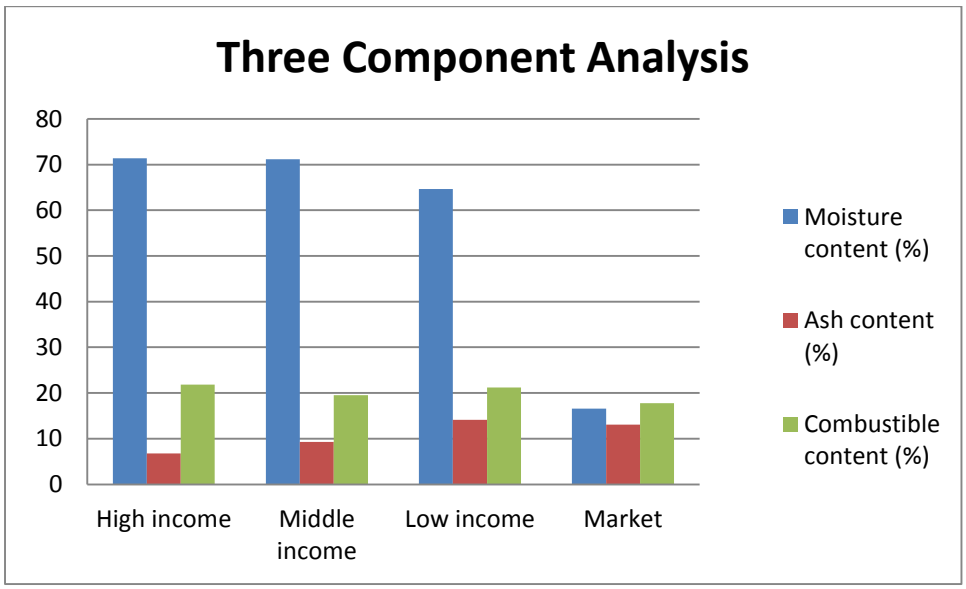


Figure 19: Average Three Component Analysis

Table 12: Three Component Analysis Test Results

Sr. No.	Discharge Source	Sample Code	Results			Average		
			Moisture content (%)	Ash content (%)	Combustible (%)	Moisture content (%)	Ash content (%)	Combustible (%)
1	High Income Group	H-1-CA-01	69.09	9.43	21.48	71.35	6.78	21.87
2		H-1-CA-02	71.67	5.13	23.2			
3		H-1-CA-03	73.47	9.2	17.34			
4		H-2-CA-01	68.18	4.52	27.3			
5		H-2-CA-02	66.67	5.96	27.38			
6		H-2-CA-03	74.44	2.46	23.1			
7		H-3-CA-01	76.59	5.14	18.26			
8		H-3-CA-02	69.34	9.75	20.91			
9		H-3-CA-03	72.73	9.45	17.82			
10	Middle Income Group	M-1-CA-01	73.32	8.14	18.54	71.20	9.30	19.50
11		M-1-CA-02	70.19	8.43	21.33			
12		M-1-CA-03	75.04	4.6	20.36			
13		M-2-CA-01	77.64	7	15.37			
14		M-2-CA-02	61.49	16.57	21.95			
15		M-2-CA-03	59.31	17.77	22.92			
16		M-3-CA-01	71.32	7.68	21			
17		M-3-CA-02	79.61	5.03	15.36			

18		M-3-CA-03	72.8	8.49	18.71			
19	Low Income Group	L-1-CA-01	74.5	12.89	12.61	64.65	14.14	21.21
20		L-1-CA-02	59.59	18.82	21.59			
21		L-1-CA-03	67.53	12.96	19.51			
22		L-2-CA-01	47.48	29.51	23.01			
23		L-2-CA-02	67.39	8.9	23.71			
24		L-2-CA-03	59.99	14.7	25.31			
25		L-3-CA-01	71.9	9.31	18.79			
26		L-3-CA-02	66.73	9.42	23.85			
27		L-3-CA-03	66.69	10.78	22.54			
28	Market (Fruit and Vegetables)	FV-1-CA-01	61.69	16.56	21.75	69.21	13.05	17.75
29		FV-1-CA-02	64.75	18.62	16.63			
30		FV-1-CA-03	72.61	9.6	17.78			
31		FV-2-CA-01	75.97	6.04	17.99			
32		FV-2-CA-02	64.47	14.93	20.6			
33		FV-2-CA-03	77.62	10.04	12.34			
34		FV-3-CA-01	65.36	14.12	20.52			
35		FV-3-CA-02	73.76	10.02	16.22			
36		FV-3-CA-03	66.65	17.55	15.8			

8. Summary of Results

The third survey in the series of three waste amount and composition survey revealed some interesting figures. The information that we take from this survey are delineated below;

1. The average size of the household for high income groups comes out as 8. For the size of middle, low and rural groups is 7.76, 7.25 and 7.8 respectively. The overall average of these groups is 7.7.
2. Waste generation rate in kg per capita per day for high income groups turns out to be 0.48. The generation rate for middle and low income is 0.29 and 0.33 respectively. Generation rate for rural households is 0.26
3. Similarly waste generation rate for commercial set ups is 16.43 kg/day, it is 1.53 for shops, 3.07 for institutions, 6.07 from street sweeping and as high has 14.47 for parks.
4. Analysis shows that specific gravity for waste from high income is 360 kg/m3, 323 and 281 for middle and low income, whereas 314 for waste from rural areas.
5. Analysis of moisture content revealed more or less comparative results, it ranges from 62.28% for high income to 71.18% for middle income and 67.32% for low income areas. Moisture content in waste of fruits and vegetable markets was determined as 74.53%. It may be stated that value for high income is the odd one here.
6. The average value calculated for carbon to nitrogen ratio for all the analysed samples was 141.12. Separately it was 105.2 for high income regions, 185.27 for middle income, 126.61 for low income group and 147.391 for market waste.
7. For the three component analysis combustible content analysis showed that high income areas has 21.87%, middle income regions account for 19.5%, low income 21.21% and market areas has 17.74% value for combustible content.
8. Lastly the average ash content for all the samples were 10.82% with high income areas accounting for 6.78%, middle income regions for 9.3%, low income 14.14% and market areas with 13.05%.

9. Seasonal combined average

This chapter provides the result of averages of all the three seasons combined for the analysis. The structure of the chapter is the same as that of the results and discussion to make it consistent in terms of analysing and comparing of results.

9.1 Physical Composition

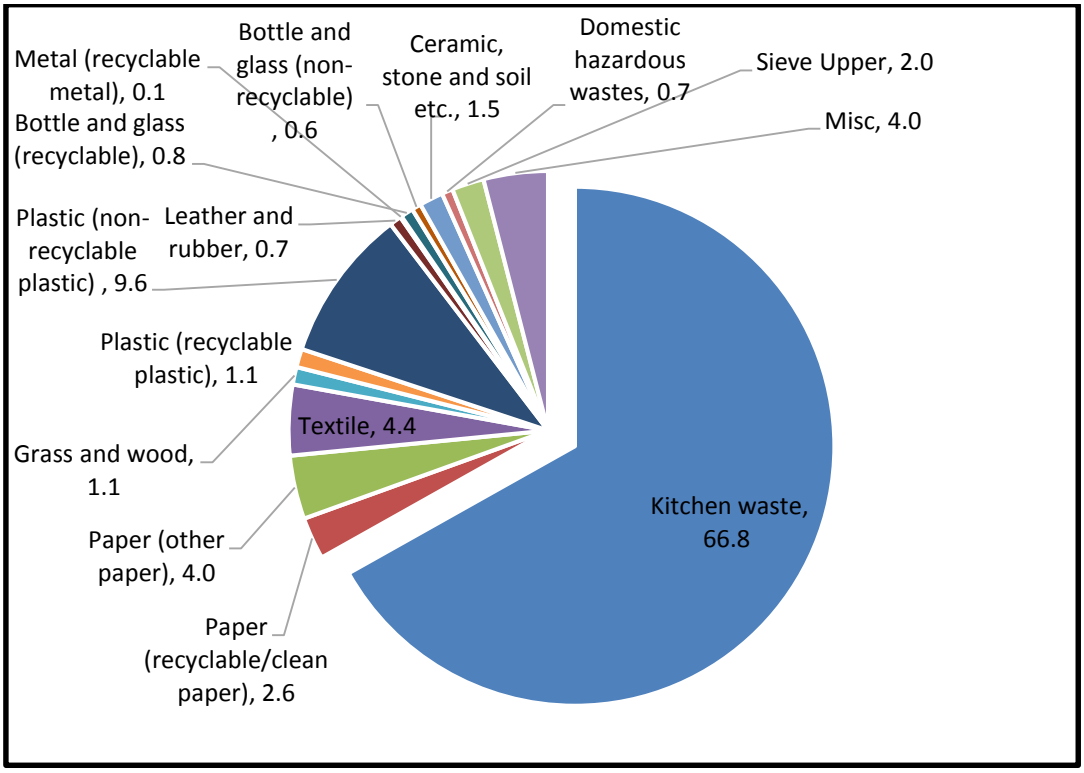
The average combined values of all the three seasons are presented below;

9.1.1 Low Income Areas

In Graph 20, results of the samples taken from low income regions are contained. The averages for the three seasons have been calculated and has been demonstrated in the graph. The most interesting waste type in the results is biodegradable wastes with 66.8% proportion.

Other prominent components are plastic; textile, miscellaneous, and paper and their percentages by weight are 9.5%, 4.4%, 4% and 4% respectively.

Though use of diapers is found in all income level groups. In low income areas this could be linked availability of low-cost baby diapers the area. Similarly there is low percentage of recyclable plastics and metal both, which is directly linked with socio-economic condition of the area.

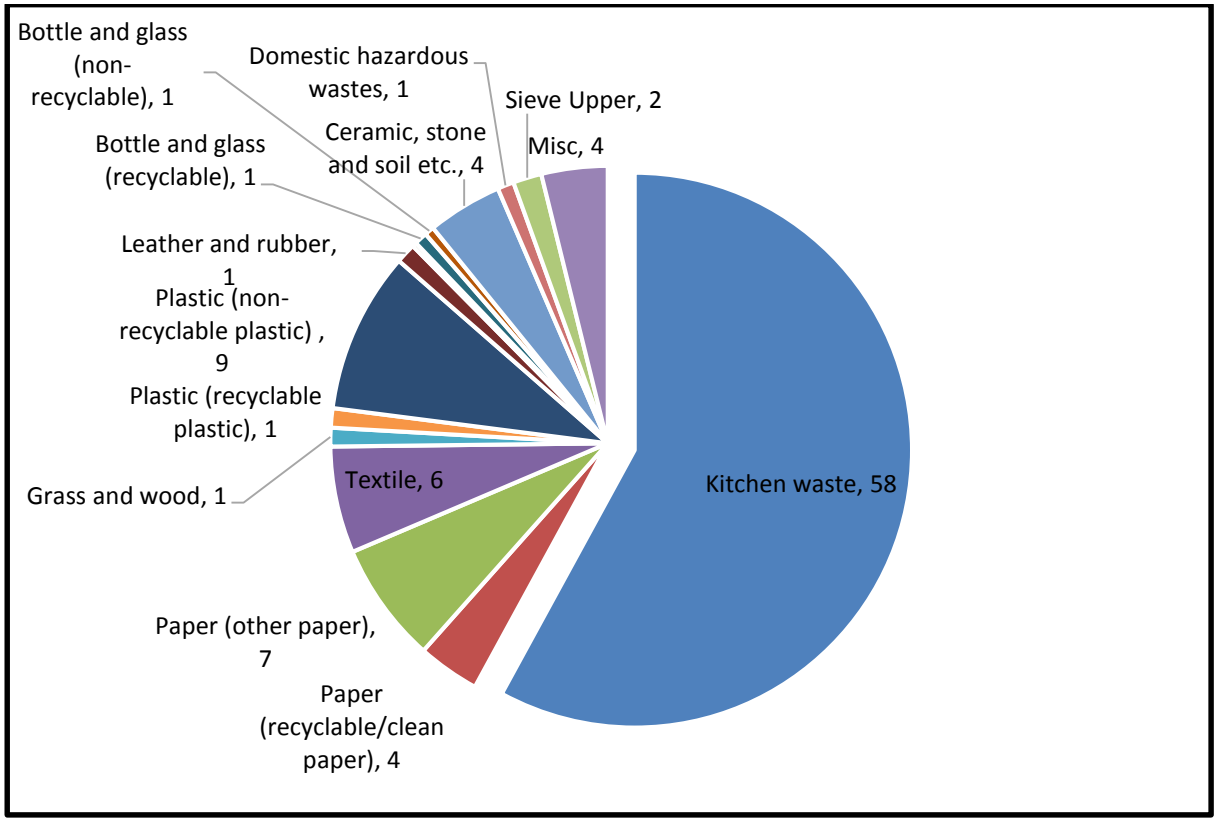


Graph 20: Combined Average Waste Composition for Low - Income Households

9.1.2 Middle Income Areas

As in other groups biodegradable waste has the highest percentage reaching up to 58%. This value was expected to be lower as compared to biodegradable in low-income areas. Other prominent waste components are respectively Plastic 9%, Paper 7%, Textile 6%,Ceramic, stone and soils 4%, Sieve and Miscellaneous 6%.

The comparison is a typical increase in some of the non-recyclable components such as plastics and paper. It may be noted that this income level group prevails in the city and most of people who are earning their living from white collar jobs, small business like shops, restaurants, and cottage industries belong to this income level group. Waste content of middle-income level is presented in Graph below.



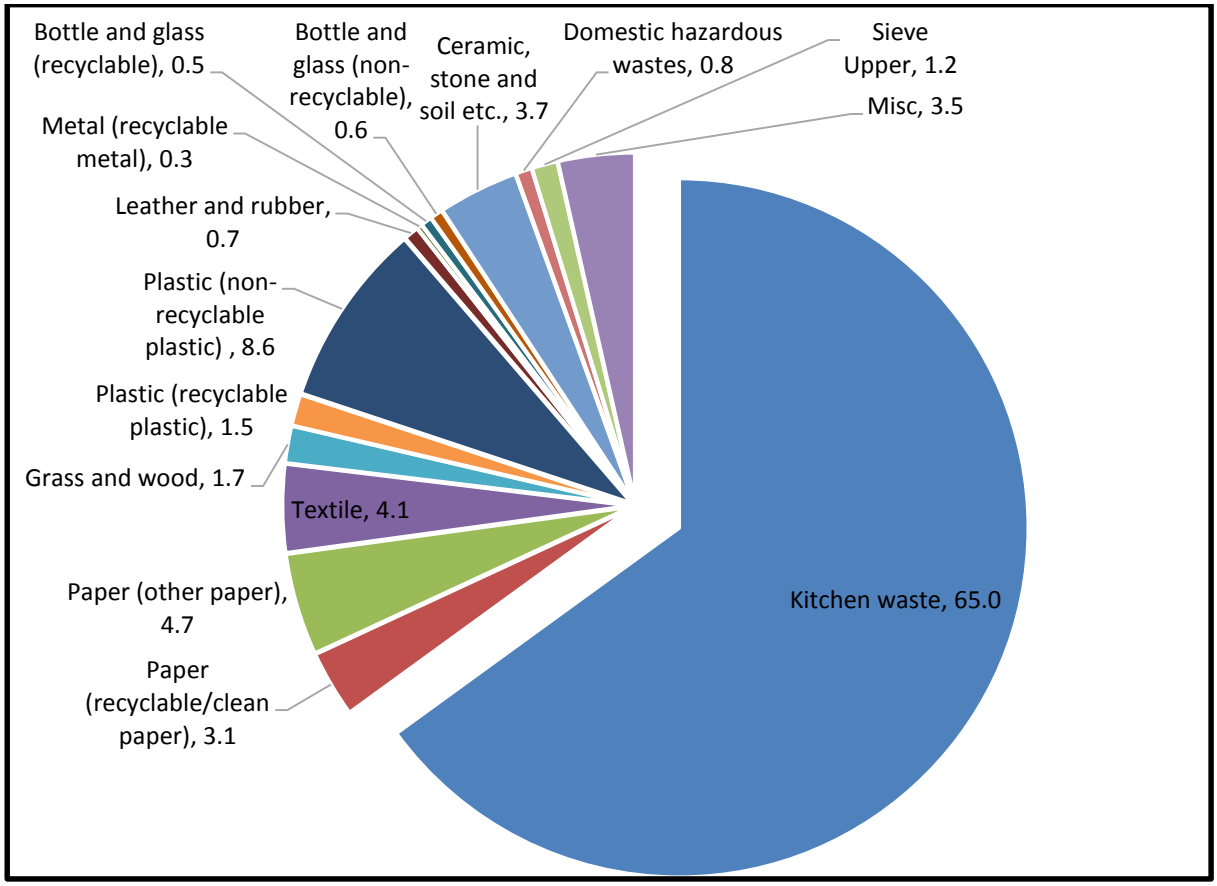
Graph 21: Combined Average Waste Composition from Middle Income Group

9.1.3 High Income Areas

Graph 22 presents the average composition of waste collected from high – income areas.

The most interesting waste type in the results is biodegradable wastes with 65% proportion. Biodegradable wastes' being high in low-income urban areas compared to the other income levels.

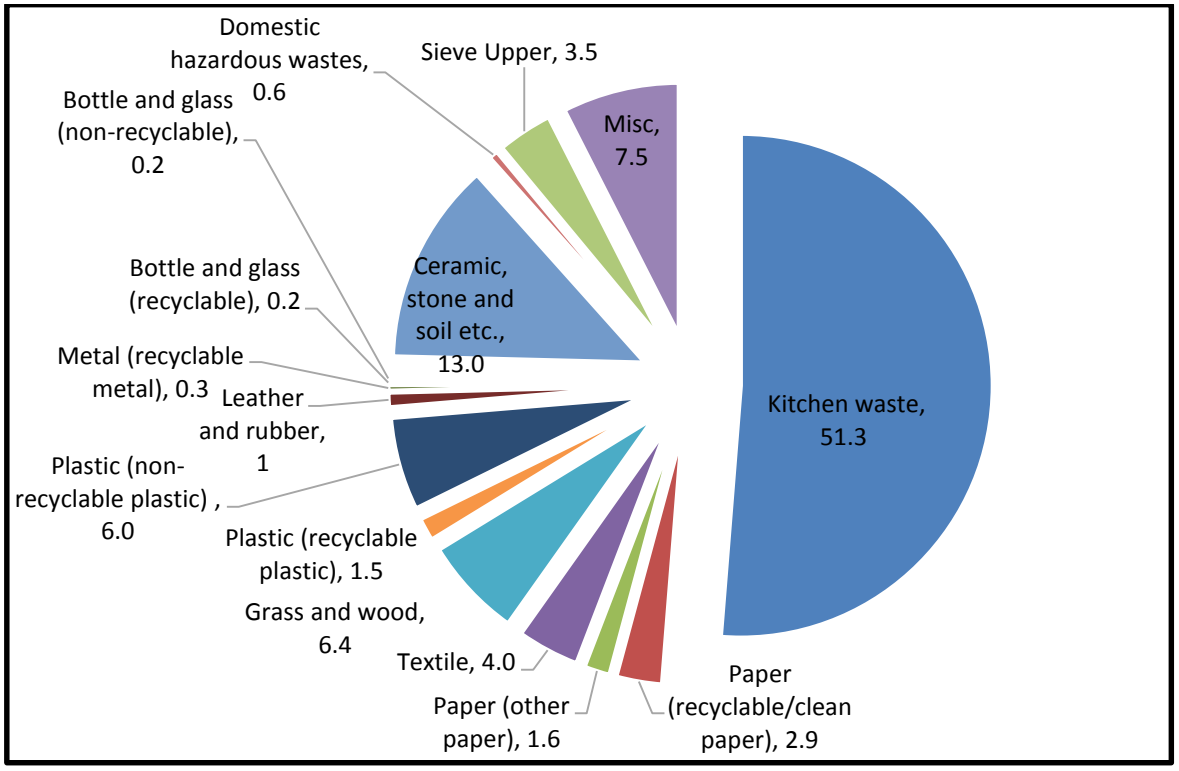
Other prominent waste components in high – income level group are respectively Plastic 8.6 %, Paper 4.7% and Textile 4.1%.



Graph 22: Combined Average Waste Composition from High Income Group

9.1.4 Rural Areas

Results for the rural areas waste composition are given in graph 23. These rural areas are located in close proximity of city outside the boundary of urban union councils of Gujranwala. As GWMC had to spread its services to these rural union councils in the future so this study may help them in developing the waste management plans for these areas very soon.

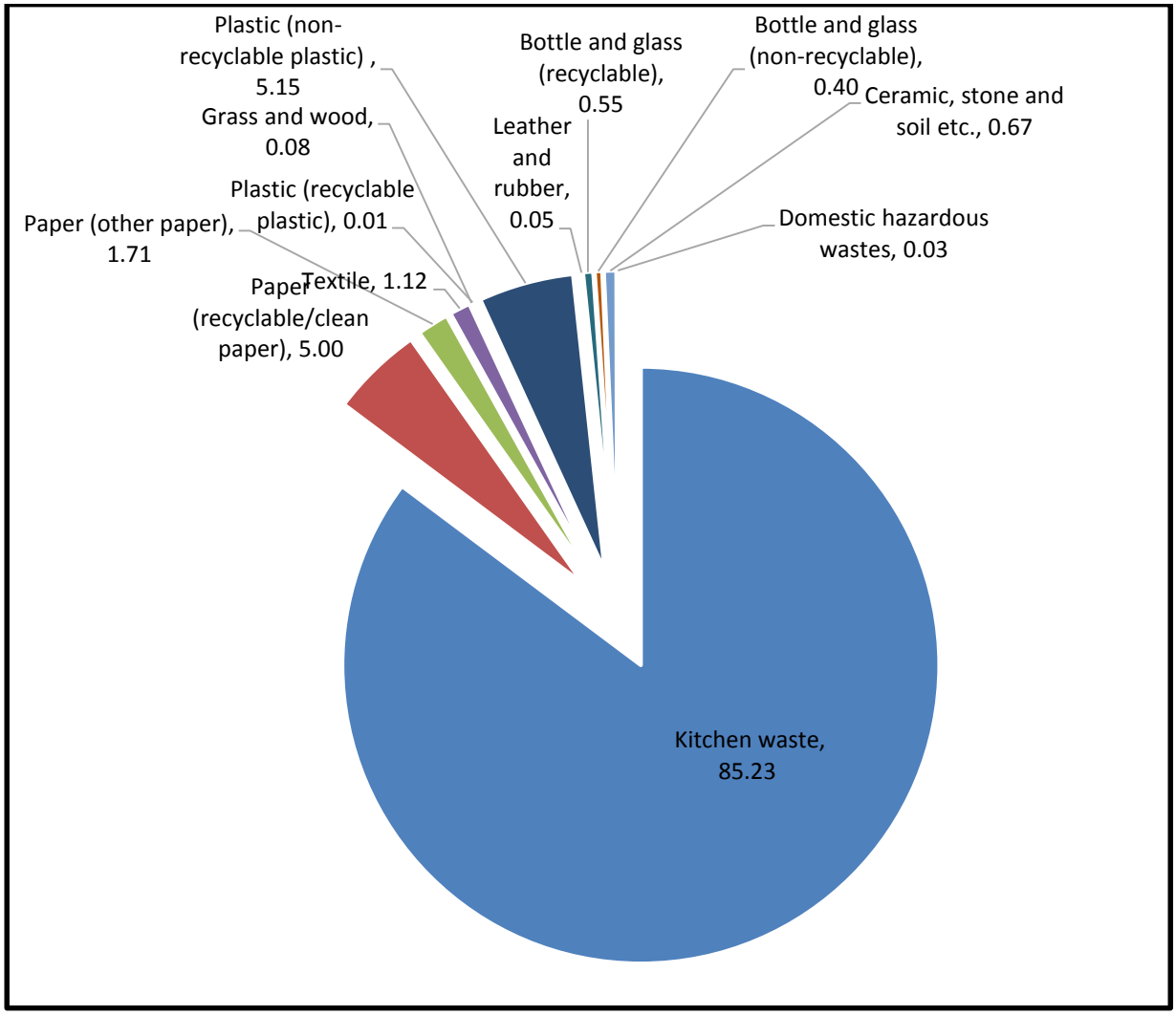


Graph 23: Combined Average Waste Composition for Rural Group

The results show two that percentage of biodegradables waste is maximum 50%. Other significant components are miscellaneous 7.5%, ceramic, stone and soil 6%, plastic 6%, sieve upper 3.5%, paper 1.6%, grass and wood 6.4%.

9.1.5 Commercial Areas – Restaurants

The waste characterization pie chart for the commercial category that covered restaurants is close to what can easily be predicted for the culinary industry. Being a food service sector the waste stream was seen to be dominated by kitchen waste.

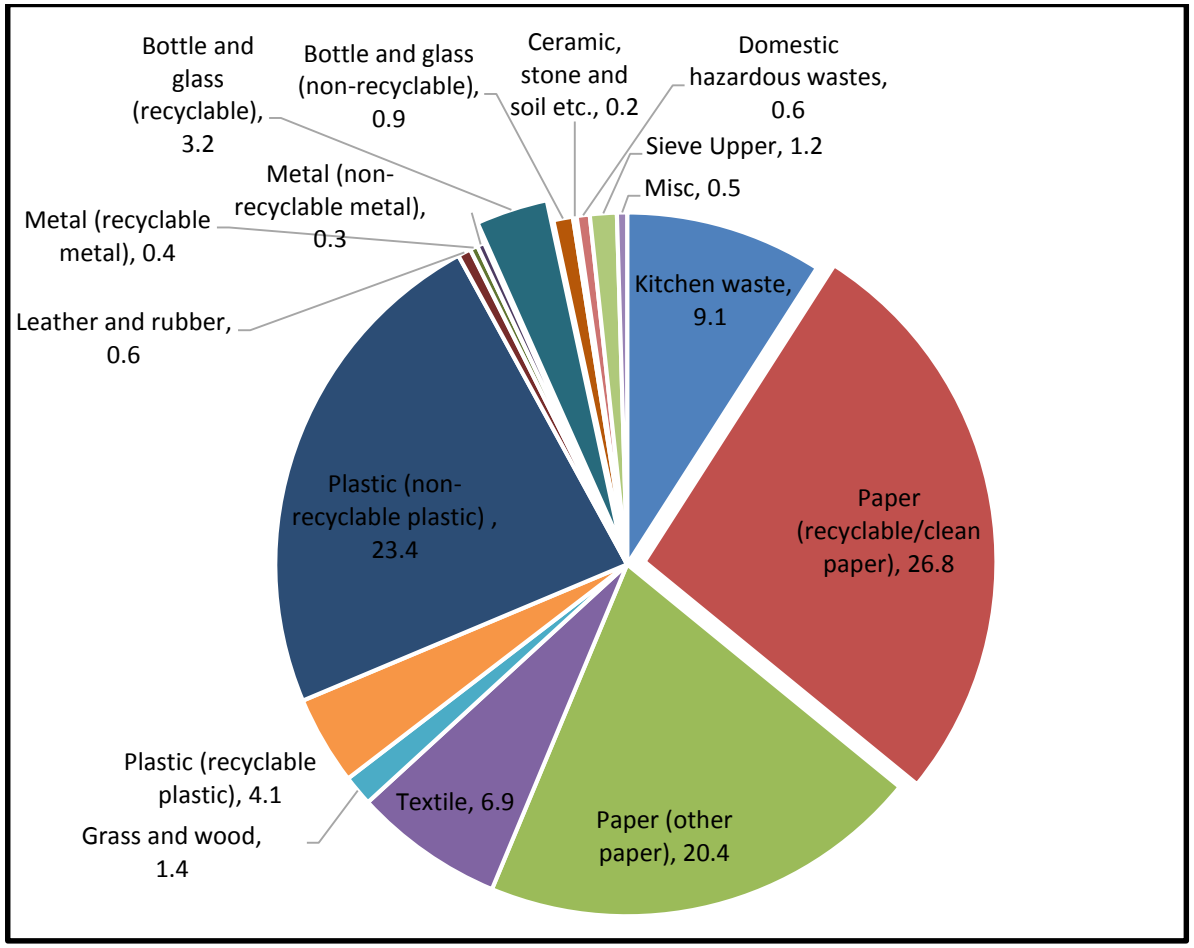


Graph 24: Combined Average Waste Composition of Commercial Restaurants

This category, comprising of fresh vegetable and fruit scraps and peelings contributed 85.23% to the waste stream that came from this sector. Non-recyclable plastic and recyclable papers were seen to be the second and the third most prominent components in the waste. These contributed to about 5.15% and 5% respectively. These stand as prominent components owing to the sector's utilization and discarding of paper from everyday use, receipts, and shopping bags. The results are displayed in the graphical form in graph 24.

9.1.6 Commercial Establishments

This category covers the commercial zones with shopping centres and markets at its heart. Shoe stores, clothing brands, retail shops were sampled for their waste characteristics.



Graph 25: Combined Average Waste Composition from Commercial Waste Generation Sources

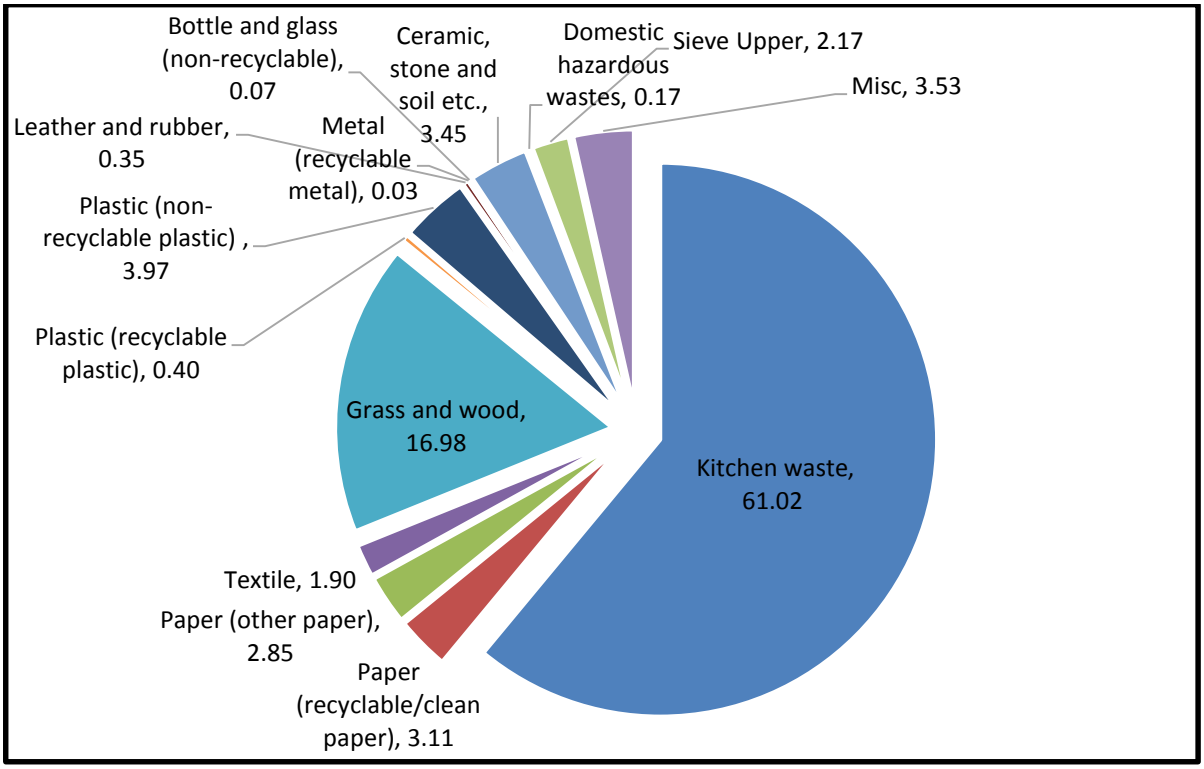
The waste stream arising from the sector vividly reflects the activities that are primarily occurring at the sampled sites. Recyclable paper makes up 26.8% of the waste that comes from this category. The second most prominent component of the waste is Plastics of non-recyclable category of waste that is seen to contribute 23.4% and the third category is non-recyclable paper waste that account for 20.4% that can be visualised in graph 25.

9.1.7 Market Areas

Waste composition in markets is presented in graph 26 below. While looking at this representation of various components on percent proportion the component that catches the eye is presence of grass and wood and paper.

It is worth mentioning here that it is a common practice to pack fruits and vegetables in wooden crates with dried straw, old newspapers and other discarded paper serving as cushioning to this merchandise. This is quite prevalent in whole sale markets dealing in farm fresh fruits and vegetables. The wooden crates along with the cushioning material are discarded daily in abundance after the products are extracted and sold. In addition, rotten fruits and vegetables are also sent to the waste bins that are often accompanied by soil and dirt. This is the reason behind the present composition with kitchen waste (here may be termed as vegetable or green waste) approximately 61% of the total waste.

It shows that kitchen waste is the most abundant of all the components into which the samples were segregated. Grass and wood contributes 16.98%; miscellaneous 3.53%, non-recyclable paper and plastic 3.97%, sieve upper 2.17% each and textile and paper recyclable 3.11% of the total composition.

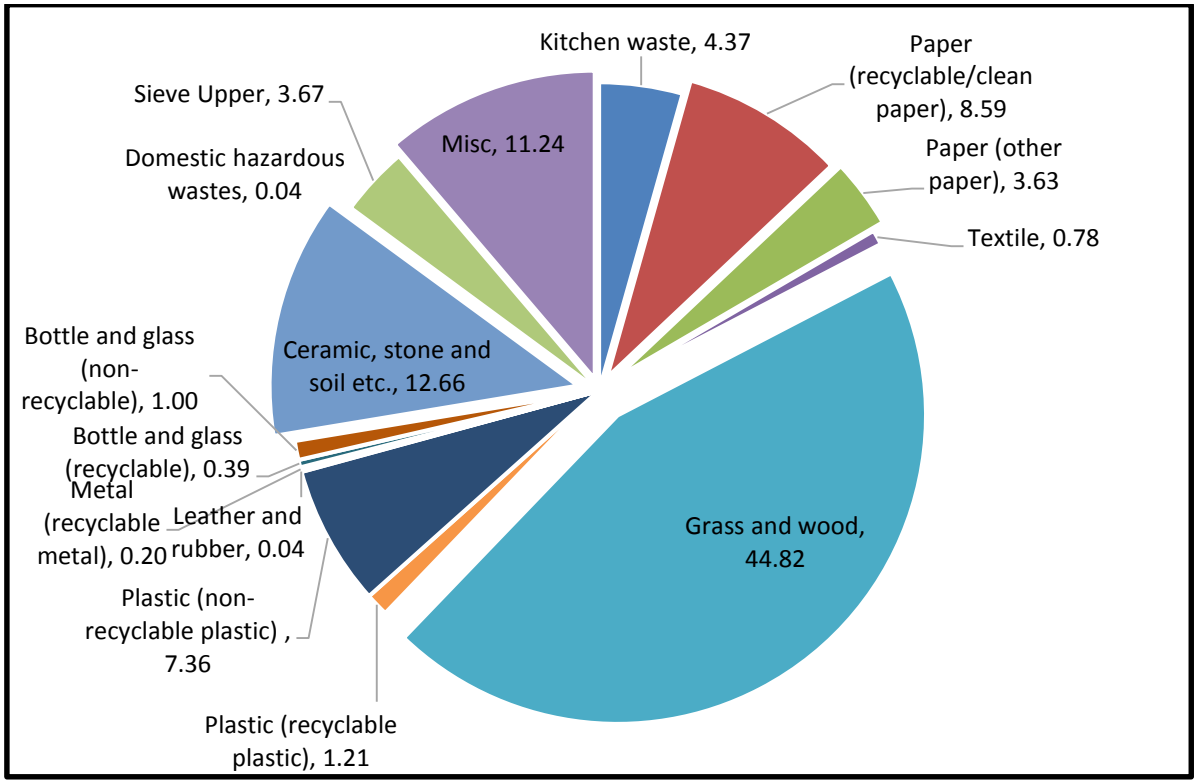


Graph 26: Combined Average Waste Composition from Market Sources

9.1.8 Institutions

In this category, waste samples from educational institutes and offices were collected and analyzed for composition.

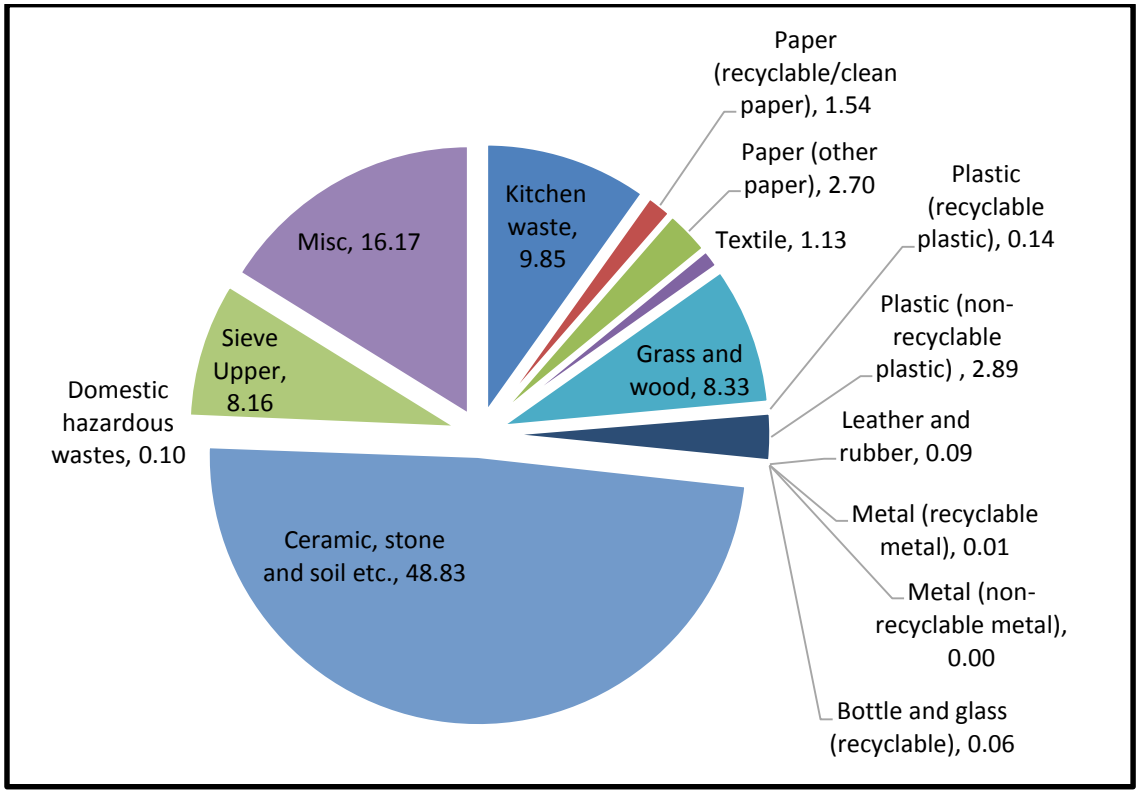
According to the composition analysis presented in graph 27, grass & wood stands as the major component, contributing 45% to the total percentage composition. Miscellaneous and paper contributes 14.87%, plastic contributes 8%, and sieve upper, kitchen and non-recyclable paper contribute 16.63% to the total. This sort of composition that is dominated by leafy, woody and earthy components arises due to the fact that all the sampled sites have large play areas and plantation covered grounds that add large volumes of grass clipping and green pruning. Paper is a predominant waste from schools, colleges and offices and so, there is no astonishment associated to its percentage that the statistics reveal.



Graph 27: Combined Average Waste Composition from Institutions

9.1.9 Street sweeping

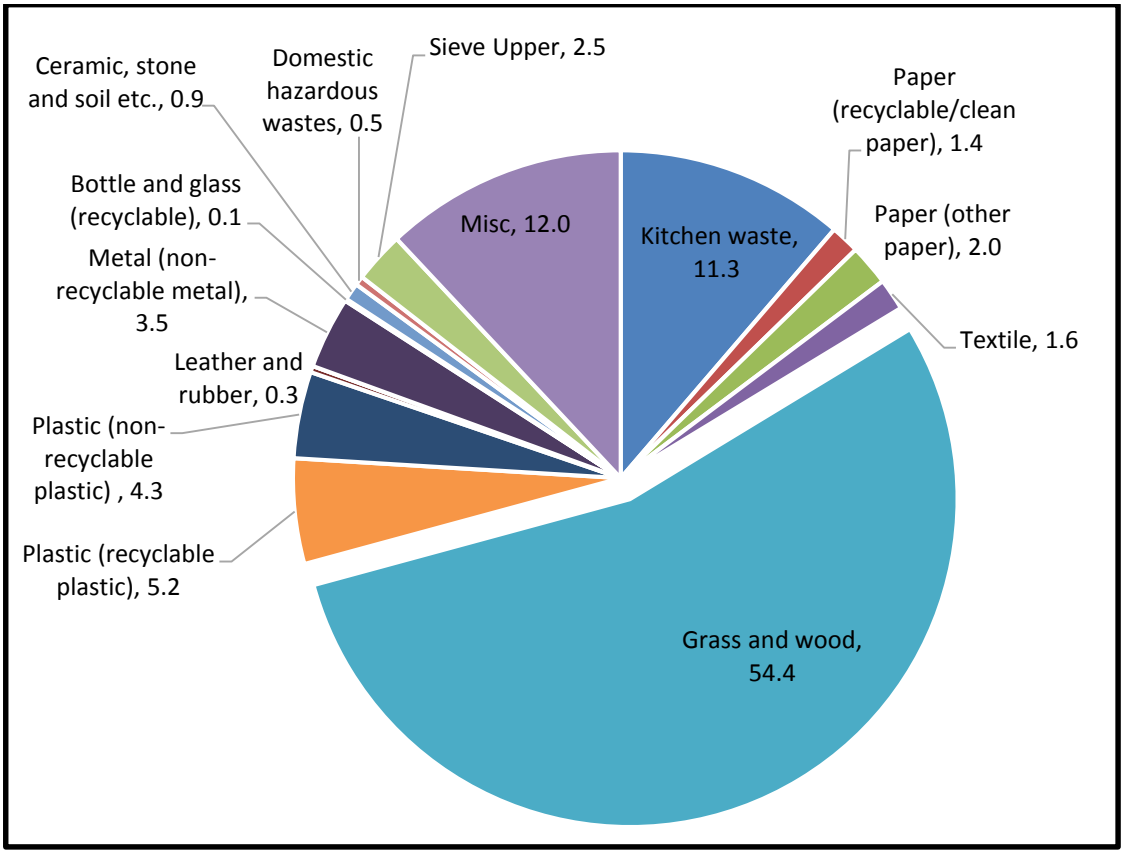
Waste from street sweeping contained the highest proportion of miscellaneous and sieve remaining. Composition analysis indicates about 48.83% and 9.85% of the waste comprised of ceramic stone and soils and kitchen waste respectively. Sieve upper contributed 8%, grass and wood 8%, paper non-recyclable 2.7% and paper recyclable and plastic non-recyclable contributes 4% to the total percentage composition. This is depicted in graph 28.



Graph 28: Combined Average Waste Composition Statistics from Street Sweeping

9.1.10 Park Area

Graph 29, shows that misc. 12% followed by grass and wood proportion comes into view as the largest category that makes up the waste load, contributing 54% to the total percentage composition. This includes grass and plant pruning and loose tree leaves. Kitchen 11%, Paper recyclable 1.4% and sieve upper 2.5%, paper other 2% account for the total waste.



Graph 29: Combined Average Waste Composition Statistics from Park Areas

9.2 Chemical Composition

The average combined three seasonal chemical composition analysis will be presented in this section;

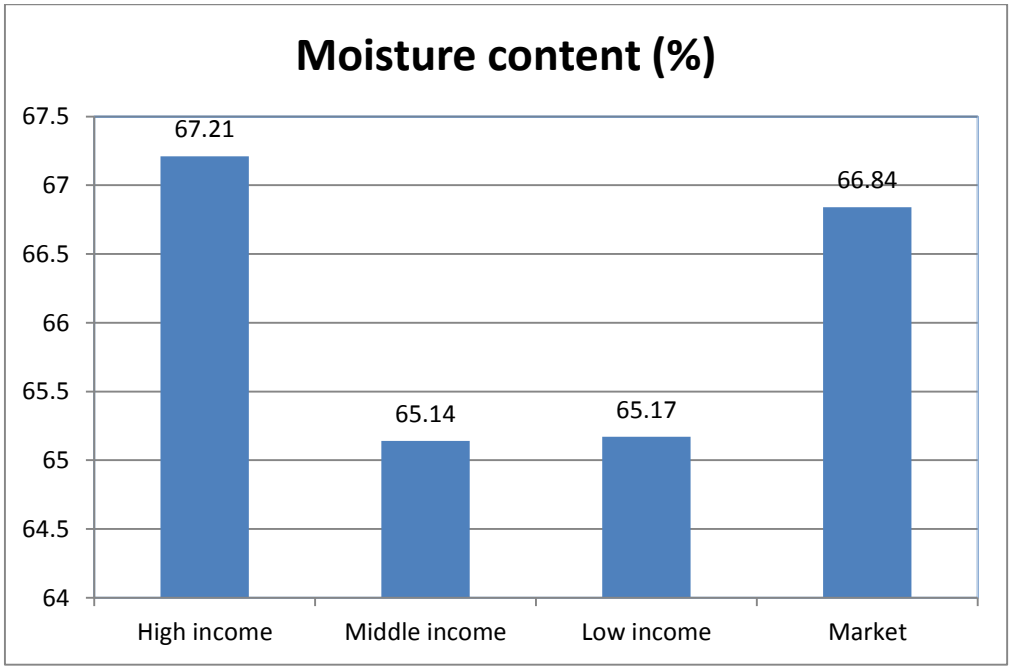
9.2.1 Moisture Content (MC) Analysis

The average of moisture content analysis performed for 36 samples during the 3 seasons turned out to be 66.09% with high income areas accounting for 67.21%, middle income regions for 65.14%, low income 65.17% and market areas with 66.84%. The moisture content of waste with high organic waste content is observed in the high income regions and market areas which was unexpected in case of high income region. The current scenario observed in the high income region was

unexpected as the general trend reveals the organic products to be at a decelerating consumption rate in high income regions and is considered to carry higher percentages in the middle income regions comparatively.

Table 13: Three Seasonal Moisture Content Test Results

Sr. No	Discharge Source	Moisture Content (%) Season 1	Moisture Content (%) Season 2	Moisture Content (%) Season 3	Moisture Content (%) 3 Seasons Average
1.	High Income Group	59.36	79.98	62.28	67.21
2.	Middle Income Group	46.5	77.73	71.16	65.14
3.	Low Income Group	54.35	73.84	67.32	65.17
4.	Market (Fruits & Vegetables)	58.82	67.18	74.53	66.84



Graph 30: Average Combined Moisture Content (%) of Waste Samples

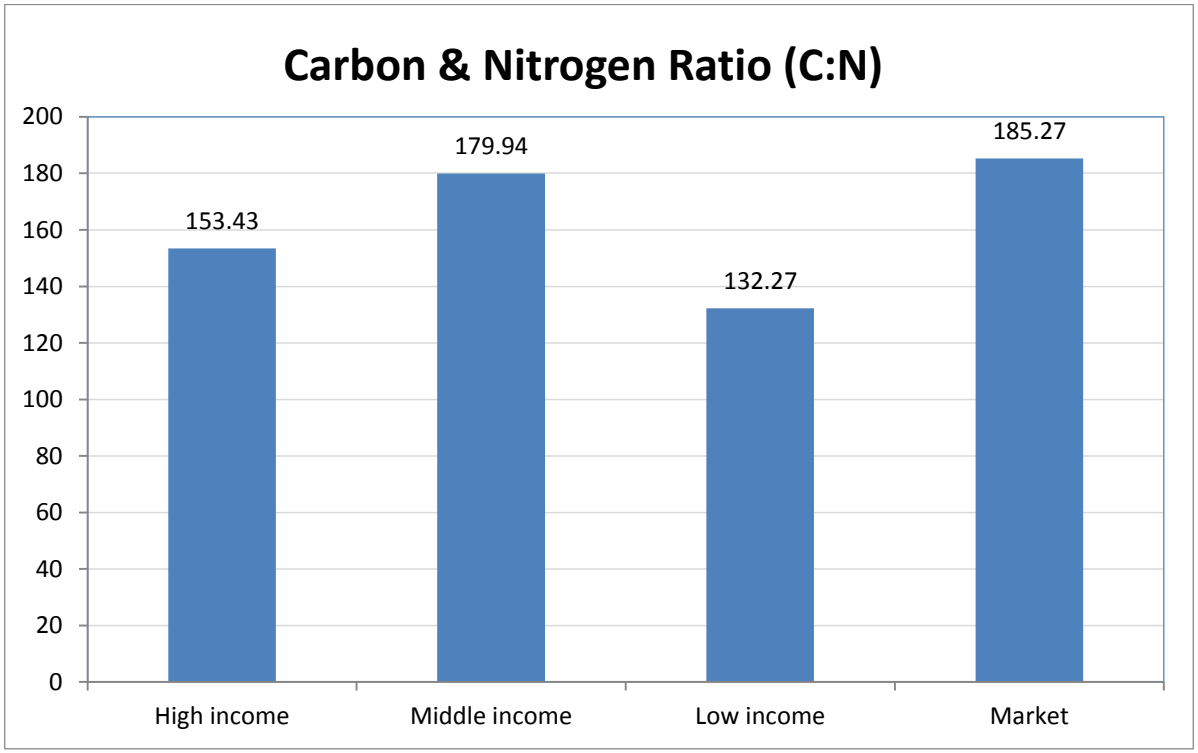
9.2.2 Carbon and Nitrogen (C&N) Analysis

The average value calculated for carbon to nitrogen ratio for all the analysed samples over the periodic sampling during three seasons was 162.8 with high income regions having 153.43, middle income 179.94, low income region 132.27 and 185.55 for market waste. The chemical analysis also observed the carbon to nitrogen ratio of the sampled waste being highest in markets followed by the middle income and high income areas and low income regions showed the lowest carbon to nitrogen ratios in the respective waste samples. Carbon content (%) = (100-ash %) /1.83[2]

Table 14: Three Seasonal Carbon and Nitrogen Ratio Test Results

Type of Waste Generation Source		Carbon (%)		Nitrogen (%)		C/N	
		1st	Average	1st	Average	1st	Average
		2nd		2nd		2nd	
		3rd		3rd		3rd	
Household	High Income	51.00	51.45	0.61	0.49	113.31	153.43
		52.04		0.29		241.77	
		51.32		0.58		105.20	
	Middle Income	47.78	50.01	0.68	0.44	131.13	179.94
		49.96		0.22		273.91	
		52.29		0.42		185.27	
	Low Income	48.83	47.62	0.51	0.46	113.13	132.27
		48.70		0.36		157.08	
		45.33		0.52		126.61	
Markets (Food, Vegetable, etc.)		46.14	48.15	0.36	0.36	80.65	185.55
		48.24		0.27		265.61	
		50.07		0.46		147.39	

[2] Barrington, S., D. Choiniere, M. Trigui and W. Knight, 2002. Effect of carbon source on compost nitrogen and carbon losses. Bioresour. Technol., 83: 189-194. DOI: 10.1016/S0960-8524(01)00229-2



Graph 31: Average Combined Carbon & Nitrogen Ratio (C: N)

9.2.3 *Three Component (3C) Analysis*

For the three component analysis the following components were analysed

iv. Moisture content
v. Ash Content
vi. Combustible content

The average calculations for the moisture content analysis performed during the three sampling seasons in the three component analysis for 36 samples turned out to be 70.27% with high income areas accounting for 73.22%, middle income regions for 70.23%, low income 69.33% and market areas with 68.3%.

The moisture content of waste with high organic waste content is observed in the high income and middle income regions which was unexpected in case of high income region. The current scenario observed in the high income region was unexpected as the general trend reveals the organic products to be at a decelerating consumption

rate in high income regions and is considered to carry higher percentages in the middle income regions comparatively.

The average of combustible content analysis performed in the three component analysis for 36 samples over three sampling seasons turned out to be 39.79% with high income areas accounting for 43.25%, middle income regions for 39.25%, low income 40.33% and market areas with 36.35%.

Similarly the average ash content for these samples were 12.13% with high income areas accounting for 6.95%, middle income regions for 11.60%, low income 12.16% and market areas with 17.80%. The combustible content with high organic content was high in high income area and that of least in the low income area.

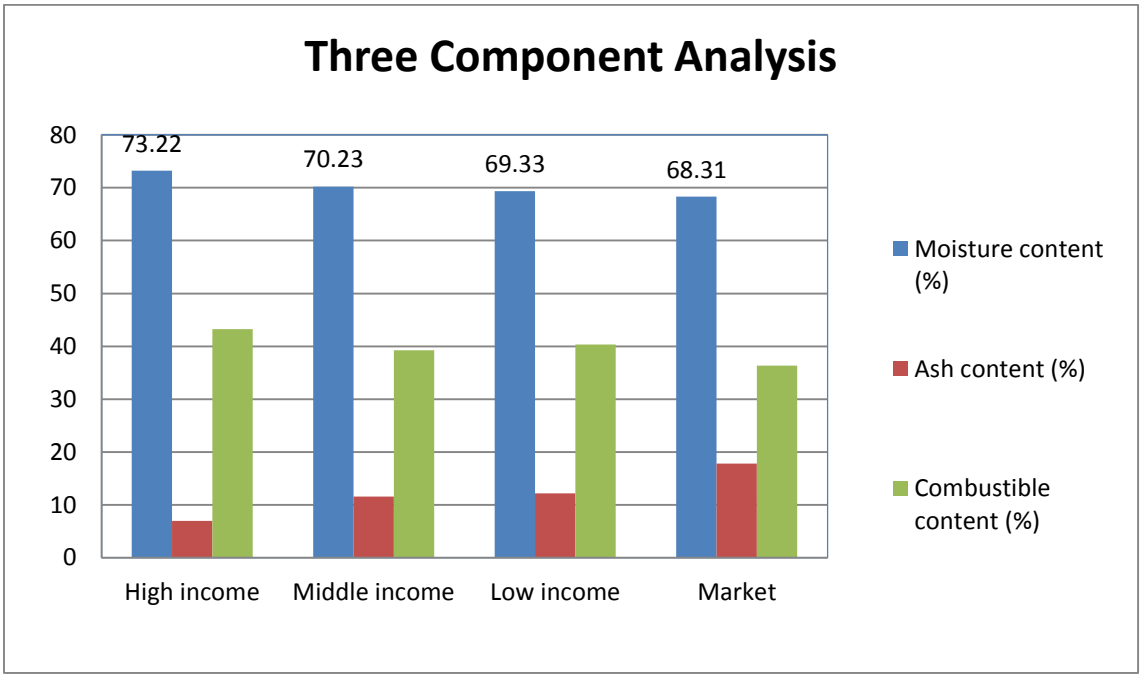


Figure 20: Average Combined Three Component Analysis

Table 15: Three Seasonal Three Component Analysis Test Results

Sr. No	Discharge Source	Average – Season 1			Average – Season 2			Average – Season 3			3 Seasons Average		
		Moisture content (%)	Ash content (%)	Combustible (%)	Moisture content (%)	Ash content (%)	Combustible (%)	Moisture content (%)	Ash content (%)	Combustible (%)	Moisture content (%)	Ash content (%)	Combustible (%)
1.	High Income Group	70.28	0.82	28.90	78.0	6.5	15.5	71.3	6.8	21.9	73.2	4.7	22.1
2.	Middle Income Group	63.3	1.0	35.7	76.3	12.1	11.6	71.2	9.3	19.5	70.2	7.5	22.3
3.	Low Income Group	65.46	0.95	33.59	77.9	9.9	12.2	64.6	14.2	21.2	69.3	8.4	22.3
4.	Market (Fruits & Vegetables)	67.4	0.90	31.70	69.3	17.4	13.3	69.2	13.1	17.7	68.6	10.5	20.9

ANNEXURES

ANNEXURE 1 – SAMPLING AREA DETAIL

Type		Area Code	No.	Tag #	Area Name	GPS Coordinates
Household by income group	High	1	1	H-1-1	Model Town	N 32° 10' 18.8" E 74° 10' 38.1"
			2	H-1-2		N 32° 10' 18.7" E 74° 10' 36.2"
			3	H-1-3		N 32° 10' 18.8" E 74° 10' 36.4"
			4	H-1-4		N 32° 10' 18.0" E 74° 10' 35.4"
			5	H-1-5		N 32° 10' 17.3" E 74° 10' 34.4"
		2	1	H-2-1	Satellite Town	N 32° 10' 18.8" E 74° 10' 38.1"
			2	H-2-2		N 32° 10' 18.7" E 74° 10' 36.2"
			3	H-2-3		N 32° 10' 18.8" E 74° 10' 36.4"
			4	H-2-4		N 32° 10' 18.0" E 74° 10' 35.4"
			5	H-2-5		N 32° 10' 17.3" E 74° 10' 34.4"
	Middle	1	1	M-1-1	Data gunj Baksh	N 32° 09' 01.7" E 74° 10' 34.6"
			2	M-1-2		N 32° 09' 02.6" E 74° 10' 34.7"
			3	M-1-3		N 32° 09' 02.6" E 74° 10' 34.7'
			4	M-1-4		N 32° 09' 02.8" E 74° 10' 34.9"
			5	M-1-5		N 32° 09' 03.0" E 74° 10' 34.6"
		2	1	M-2-1	Asghar Colony	N 32° 08' 20.6" E 74° 11' 47.4"

Type		Area Code	No.	Tag #	Area Name	GPS Coordinates
			2	M-2-2		N 32° 08' 20.6" E 74° 11' 47.4"
			3	M-2-3		N 32° 08' 20.4" E 74° 11' 48.2"
			4	M-2-4		N 32° 08' 20.4" E 74° 11' 48.2"
			5	M-2-5		N 32° 08' 20.2" E 74° 11' 49.1"
		3	1	M-3-1	Rana Colony	N 32° 08' 05.3" E 74° 11' 45.3"
			2	M-3-2		N 32° 08' 04.9" E 74° 11' 48.5"
			3	M-3-3		N 32° 08' 04.3" E 74° 11' 45.7"
			4	M-3-4		N 32° 08' 04.3" E 74° 11' 45.7"
			5	M-3-5		N 32° 08' 04.9" E 74° 11' 45.5"
		4	1	M-4-1	Gobin Garh	N 32° 09' 58.6" E 74° 10' 19.8"
			2	M-4-2		N 32° 09' 59.1" E 74° 10' 19.6"
			3	M-4-3		N 32° 09' 59.1" E 74° 10' 19.5"
			4	M-4-4		N 32° 09' 01.0" E 74° 10' 21.5"
			5	M-4-5		N 32° 09' 01.0" E 74° 10' 21.4"
		5	1	M-5-1	Wahdat Colony	N 32° 09' 17.9" E 74° 12' 27.1"
			2	M-5-2		N 32° 09' 18.1" E 74° 12' 27.1"
			3	M-5-3		N 32° 09' 18.1" E 74° 12' 27.1"

Type		Area Code	No.	Tag #	Area Name	GPS Coordinates
			4	M-5-4		N 32° 09' 17.3" E 74° 12' 27.2"
			5	M-5-5		N 32° 09' 16.9" E 074° 12' 27.2"
		6	1	M-6-1	Nasir Colony	N 32° 08' 57.7" E 74° 12' 26.9"
			2	M-6-2		N 32° 08' 58.0" E 74° 12' 26.9"
			3	M-6-3		N 32° 08' 58.5" E 74° 12' 27.0"
			4	M-6-4		N 32° 08' 59.8" E 74° 12' 28.9"
			5	M-6-5		N 32° 08' 59.9" E 74° 12' 26.9"
	Low	1	1	L-1-1	Mubarik Colony	N 32° 09' 13.9" E 74° 09' 44.3"
			2	L-1-2		N 32° 09' 13.9" E 074° 09' 44.3"
			3	L-1-3		N 32° 09' 14.0" E 74° 09' 44.3"
			4	L-1-4		N 32° 09' 14.0" E 74° 09' 44.3"
			5	L-1-5		N 32° 09' 13.9" E 74° 09' 44.3"
		2	1	L-2-1	Thehri Sansi	N 32° 06' 28.3" E 74° 11' 41.8"
			2	L-2-2		N 32° 06' 28.1" E 74° 11' 41.6"
			3	L-2-3		N 32° 06' 28.4" E 74° 11' 41.6"
			4	L-2-4		N 32° 06' 27.6" E 74° 11' 44.7"
			5	L-2-5		N 32° 06' 27.6" E 74° 11' 44.7"

Type		Area Code	No.	Tag #	Area Name	GPS Coordinates
		3	1	L-3-1	Baghwala	N 32° 10' 25.8" E 74° 09' 43.6"
			2	L-3-2		N 32° 10' 25.0" E 74° 09' 43.3"
			3	L-3-3		N 32° 10' 25.1" E 74° 09' 42.9"
			4	L-3-4		N 32° 10' 25.3" E 74° 09' 43.4"
			5	L-3-5		N 32° 10' 25.6" E 74° 09' 43.4"
		4	1	L-4-1	Ram Basti	N 32° 09' 32.1" E 74° 11' 39.1"
			2	L-4-2		N 32° 09' 32.1" E 74° 11' 39.1"
			3	L-4-3		N 32° 09' 32.1" E 74° 11' 39.1"
			4	L-4-4		N 32° 09' 32.1" E 74° 11' 39.1"
			5	L-4-5		N 32° 09' 32.0" E 74° 11' 38.0"
Rural	Rural	1	1	R-1-1	Ladhewala Waraich	N 32° 09' 20.7" E 74° 06' 27.9"
			2	R-1-2		N 32° 09' 22.0" E 74° 06' 23.8"
			3	R-1-3		N 32° 09' 19.7" E 74° 06' 31.0"
			4	R-1-4		N 32° 09' 19.7" E 74° 06' 30.9"
			5	R-1-5		N 32° 09' 18.2" E 74° 06' 30.5"
		2	1	R-2-1	Rahwali Sharqi	N 32° 09' 20.1" E 74° 06' 27.8"
			2	R-2-2		N 32° 05' 06.6" E 74° 10' 02.8"

Type		Area Code	No.	Tag #	Area Name	GPS Coordinates
			3	R-2-3		N 32° 05' 07.1" E 74° 10' 02.7"
			4	R-2-4		N 32° 05' 07.2" E 74° 10' 02.8"
			5	R-2-5		N 32° 05' 06.7" E 74° 10' 02.7"
Commercial	Restaurant	1	1	CR-1-1	Sufi Restaurant	N 32° 10' 53.65" E 74° 10' 46.90"
			2	CR-1-2	Sabri Restaurant	N 32° 08' 49.4" E 74° 11' 22.9"
			3	CR-1-3	Mian gee	N 32° 10.488' E 74° 10.737'
			4	CR-1-4	Usmania	N 32° 10' 19.98" E 74° 11' 06.84"
			5	CR-1-5	Shahbaz Tikka	N 32° 09' 20.61" E 74° 11' 14.28"
	Others	2	1	CO-2-1	Gourmet	N 32° 10.480' E 74° 10.868'
			2	CO-2-2	Alnoor Shopping	N 32° 07. 995' E 74° 11.756'
			3	CO-2-3	Shopping centre Satellite town	N 32° 09' 44.7" E 74° 12' 07.3"
			4	CO-2-4	Metro Shoes	N 32° 09' 40.6" E 74° 12' 08.9"
			5	CO-2-5	Gul Ahmed	N 32° 09' 48.17" E 74° 12' 09.91"
Market Containers	Market	1	1	Ma-1-1	Main fruit Market	N 32° 07' 23.9" E 74° 09' 37.7"
		2	2	Ma-2-1	Fazal fruit Market	N 32° 09' 16.50" E 74° 10' 59.47"
		3	1	Ma-3-1	Model market	N 32° 09' 02.86" E 74° 10' 26.04"

Type		Area Code	No.	Tag #	Area Name	GPS Coordinates
		4	2	Ma-4-2	Model Market Fatto Mund	N 32° 07' 99.5" E 74° 11' 75.6"
		5	1	Ma-5-1	Sheikhupra Road	N 32° 08' 39.22" E 74° 11' 13.75"
		6	2	Ma-6-2	Sheranwala Bagh	N 32° 09' 24.33" E 74° 11' 27.48"
		7	1	Ma-7-1	Outside of Dhulle Market	N 32° 10' 23.43" E 74° 10' 16.05"
		8	2	Ma-8-2	Gindalwanwala Railway	N 32° 09' 50.02" E 74° 11' 17.85"
		9	1	Ma-9-1	Khyali Bypass	N 32° 06.855' E 74° 10.333'
		10	2	Ma-10-2	GAP Chowk	N 32° 09. 068' E 74° 11.249'
Institutions	Institutions	1	1	I-1-1	Govt. Iqbal High School, GRW.	N 32° 10.80' E 74° 11.212'
		2	1	I-2-1	Govt. College for Women, Satellite GRW.	N 32° 09' 34.46" E 74° 12' 15.09"
		3	1	I-3-1	Govt. Primary School, Dhulley, GRW.	N 32° 10' 30.6" E 74° 10' 20.7"
		4	1	I-4-1	Govt. Islamia College Jinnah Road, GRW.	N 32° 09.916' E 74° 10. 357'
		5	1	I-5-1	TMA Office Aroop and Qila Dedar Singh, Model Town, GRW.	N 32° 11.022' E 74° 11.350'
Street Sweeping		1	1	S-1-1	4Roads	

Type	Area Code	No.	Tag #	Area Name	GPS Coordinates
Park	1	1	P-1-1	Gulsha Iqbal Park	N 32° 11' 23.63" E 74° 10' 41.44"

ANNEXURE II –DATASHEET OF WASTE AMOUNT SURVEY

Type		Area	Sr.No. in Area	Tag #	Name of Area/ Source	Day 1 weight(kg)	Day 2 weight(kg)	Day 3 weight(kg)	Day 4 weight(kg)	Day 5 weight(kg)	Day 6 weight(kg)	Day 7 weight(kg)	Day 8 weight(kg)	Average Wt for 7 Days	House Hold Size	Per Capita Weight	Average Per Capita Waste Generation
Household by income group	High	1	1	H-1-1	Model Town	8.17	0.88	2.43	0.93	4.38	4.71	0.8	3.11	2.46	5	0.49	0.48
			2	H-1-2		9.94	4.59	8.37	3.27	5.63	3.78	4.54	4.24	4.92	10	0.49	
			3	H-1-3		3.65	2.99	2.61	1.86		6.74	4.8	1.48	3.64	8	0.46	
			4	H-1-4		14.68	2.94	6.23	9.76	0.85	3.7	2.06	5.49	4.43	10	0.44	
			5	H-1-5		5.34	5.09	2.16	5.15	2.57	8.83	3.28	4.81	4.56	8	0.57	
		2	1	H-2-1	Satellite Town	0.5	0.53	1.15	0.43	1.36		1.8	1.07	0.91	3	0.30	
			2	H-2-2		14.36	11.04	8.08	5.84	8.19	5.71	9.58	8.67	8.16	15	0.54	
			3	H-2-3		7.48	3.66	2.1	2.21	3.23	2.28	1.86	5.49	2.98	6	0.50	
			4	H-2-4		13.01	5.57	6.82	4.69	6.4	6.36	6.18	7.05	6.15	10	0.62	
			5	H-2-5		2.24	0.97	3.97	2.6	1.27	1.58	2.24	2.29	2.13	5	0.43	
	Middle	1	1	M-1-1	Data gunj Baksh	9.26	4.53	3.91	7.95	5.94	8.73	3.9	3.66	5.52	8	0.69	0.29
			2	M-1-2		2.01	0.96	0.33	1.67	0.25	0.62	1.86	0.85	0.93	6	0.16	
			3	M-1-3		2.04	0.45	0.64	0.64	0.87	0.57	1.11	1.87	0.88	8	0.11	
			4	M-1-4		1.2		1.93	1.14	2.42	0.71	0.5	8.48	2.17	7	0.31	
			5	M-1-5		3.36	1.51	0.59	0.85	0.74	0.88	0.47	1.47	0.93	6	0.16	
		2	1	M-2-1	Asghar Colony	3.25	0.63	2.26	1.59	2.96	1.26	0.96	1.79	1.64	8	0.20	
			2	M-2-2		3.85	3.45	0.33	1.54	1.5	1.26	6.17	3.6	2.55	10	0.26	
			3	M-2-3		12.84	0.93		1.29	1.21	1.21	2.23	3.42	1.47	14	0.11	
			4	M-2-4		7.76	1.48	1.87	2.91	5.09	4.48	0.73	4.07	2.95	10	0.29	
			5	M-2-5		4.96	5.01	0.98	5.37	2.62	2.03	6.41	2.55	3.57	10	0.36	
		3	1	M-3-1	Rana Colony	10.75	4.11	5.61	5.13	6.78	2.78	3.54	6.92	4.98	10	0.50	
			2	M-3-2		5.94	0.43	0.77	1.75	3.06	2.68	2.77	0.82	1.75	6	0.29	
			3	M-3-3		7.62	1.65	0.3	2.85	0.45	0.1	2.9	0.76	1.29	8	0.16	
			4	M-3-4		5.65	9.02	0.7	1.16	1.59	1.55	0.85	1.72	2.37	12	0.20	

Type		Area	Sr.No. in Area	Tag #	Name of Area/ Source	Day 1 weight(kg)	Day 2 weight(kg)	Day 3 weight(kg)	Day 4 weight(kg)	Day 5 weight(kg)	Day 6 weight(kg)	Day 7 weight(kg)	Day 8 weight(kg)	Average Wt for 7 Days	House Hold Size	Per Capita Weight	Average Per Capita Waste Generation
			5	M-3-5		1.01	0.99	0.2	0.89	0.97	1.74	0.29	7.03	1.73	5	0.35	
		4	1	M-4-1	Gobin Garh	2.1	0.82	1.03	2.91	1.5	1.7	2.3	0.76	1.57	10	0.16	
			2	M-4-2		5.57	3.09	1.81	1.13	0.69	1.95	2.94	2.87	2.07	10	0.21	
			3	M-4-3		0.37	0.27	1.42	1.16	2.84	1.82	0.49	1.33	1.33	5	0.27	
			4	M-4-4		1.26	1.73	1.39	2.05	0.73	2.76	1.33	1.14	1.59	4	0.40	
			5	M-4-5		5.39	2.17	0.94	3.31		1.42	4.55	0	1.77	6	0.30	
		5	1	M-5-1	Wahdat Colony	1.88		0.85	0.47	1	0.7	1.35	3.14	1.07	6	0.18	
			2	M-5-2		4.87	0.19	3.72	4.06	4.15	2.73	3.83	0.74	2.77	4	0.69	
			3	M-5-3		0.87	0.13	0.52	0.23	0.45	1.87	0.23	1.12	0.65	5	0.13	
			4	M-5-4		3.7	2.7	2.34	5.09	3.86	2.18	1.31	2.68	2.88	9	0.32	
			5	M-5-5		4.44	3.02	1.87	2.4	3.78	2.67	1.28	1.83	2.41	7	0.34	
		6	1	M-6-1	Nasir Colony	1.93	3.23	0.09	1.83	4.01	1.88	1.03	1.65	1.96	13	0.15	
			2	M-6-2		1.01	1.47	0.46	0.75	0.31	0.44	2.07	0.91	0.92	6	0.15	
			3	M-6-3		2.21	1.51	3.5	2.21	6.08	3.11	3.32	4.39	3.45	10	0.34	
			4	M-6-4		1.01	0.57	0.74	1.51	1.23	0.95	1.22	1.95	1.17	6	0.19	
			5	M-6-5		5.99	2.84	1.98	2.06	1.35	2.35	4.31	5.27	2.88	4	0.72	
	Low	1	1	L-1-1	Mubarik Colony	2.39	0.31	1.3	0.98	0.58	1.99	2.91	0.62	1.24	4	0.31	0.33
			2	L-1-2		1.84	0.47	3.07	1.83	2.45	0.62	0.71	0.77	1.42	4	0.35	
			3	L-1-3		8.82	1.3	1.37	1.15	6.06	2.9	1.77	0.77	2.19	4	0.55	
			4	L-1-4		1.17	0.72	0.84	0.71		1.46	0.22	0.18	0.59	5	0.12	
			5	L-1-5		8.09	1.54	2.28	1.98	2.16	3.28	2.02	3.85	2.44	10	0.24	
		2	1	L-2-1	Thehri Sansi	2.48	2.41	1.43	6.77	4.65	1.13	1.77	1.3	2.78	5	0.56	
			2	L-2-2		0.49	0.21	1.05	0.98	0.94	1.72	1.2	0.96	1.01	4	0.25	
			3	L-2-3		7.48	2.49	1.6	2.16	3.82	4.13	4.48	15.8	4.93	4	1.23	
			4	L-2-4		0.65	0.33	1.08	0.48	0.2	0.91	0.29	0.82	0.59	12	0.05	

Type		Area	Sr.No. in Area	Tag #	Name of Area/ Source	Day 1 weight(kg)	Day 2 weight(kg)	Day 3 weight(kg)	Day 4 weight(kg)	Day 5 weight(kg)	Day 6 weight(kg)	Day 7 weight(kg)	Day 8 weight(kg)	Average Wt for 7 Days	House Hold Size	Per Capita Weight	Average Per Capita Waste Generation
			5	L-2-5		0.49	0.4	0.26	0.95	0.45	1.15	0.69	0.7	0.66	4	0.16	
		3	1	L-3-1	Baghwala	5	1.29	0.57	4.97	2.63	2.17	3.55	1.06	2.32	4	0.58	
			2	L-3-2		2.88	0.67	0.62	3.21	5.44	6.1	0.96	1.11	2.59	10	0.26	
			3	L-3-3		1.58	0.09	1	0.38	0.36	0.32	3.94	3.79	1.41	10	0.14	
			4	L-3-4			3.8	1.02	7.45	2.63	0.25	0.61	1.19	2.42	7	0.35	
			5	L-3-5		3.62	1.81	2.47	2.82	2.07	3.56	2.43	3.1	2.61	10	0.26	
		4	1	L-4-1	Ram Basti	3.33	1.24	3.51	0.18	2.46	3.72	0.15	1.58	1.83	6	0.31	
			2	L-4-2		3.55	0.33	0.51	0.39	0.06	0.78	0.2	0.98	0.46	10	0.05	
			3	L-4-3		8.5	7.71	4.57	3.52	2.45	4.48	3.41	6.78	4.70	18	0.26	
			4	L-4-4		2.46	0.86	2.05	0.83	3.58	0.38	0.7	0.49	1.27	10	0.13	
			5	L-4-5		5.82	2.4	1.74	4.2	0.38	0.64	1.63	1.88	1.84	4	0.46	
Rural	**Rural**	1	1	R-1-1	Ladhewala Waraich	2.52	0.81	1.14	3.27	1.17	1.05	3.33	6.02	2.40	11	0.22	0.26
			2	R-1-2		0.91	2.12	0.68	0.5	0.26	1.01	0.77	1.67	1.00	5	0.20	
			3	R-1-3		1.02	0.05	1.08	0.13	2.1	0.33	3.63	0.84	1.17	7	0.17	
			4	R-1-4		9.06	3.57	2.41	2.18	1.88	2.88	6.18	2.28	3.05	10	0.31	
			5	R-1-5		2.46			0.08	1.77	0.34	2.6	3.77	1.22	8	0.15	
		2	1	R-2-1	Rahwali Sharqi	1.08	0.79	0.26	0.24	0.4	0.82	1.89	0.6	0.71	10	0.07	
			2	R-2-2		0.48	6.41	6.52	3.22	3.61	0.85	1.18	5.87	3.95	7	0.56	
			3	R-2-3		6.71	1.41	1.11	3.19	2.78	2.62	3.13	2.95	2.46	5	0.49	
			4	R-2-4		6.4	2.3	0.73	2.25	0.96	9.31	5.21	0.52	3.04	9	0.34	
			5	R-2-5		5.28	0.21	1.3	0.46	1.11	0.8	0.58	0.47	0.70	6	0.12	
Commercial	**Restaurant**	1	1	CR-1-1	**Sufi Restaurant, Jinnah Road, GRW;** Replace of Shelton	27.76	11.41	10.08	12.35		8.29	11.75	12.27	9.45		16.43	

Type		Area	Sr.No. in Area	Tag #	Name of Area/ Source	Day 1 weight(kg)	Day 2 weight(kg)	Day 3 weight(kg)	Day 4 weight(kg)	Day 5 weight(kg)	Day 6 weight(kg)	Day 7 weight(kg)	Day 8 weight(kg)	Average Wt for 7 Days	House Hold Size	Per Capita Weight	Average Per Capita Waste Generation
			2	CR-1-2	**Sabri Restaurant, Sheikhupura Road, GRW**; Replace of Bundu Khan	8.8	13.95	17.71	20.98	24.2	24.56	5.47	33.49	20.05			
			3	CR-1-3	Mian gee	17.26	16.14	17.28	25.63	21.96	23.05	3.28	29.61	19.56			
			4	CR-1-4	Usmania		12.53	4.36	6.9	11.13	12.95	19.84	11.43	11.31			
			5	CR-1-5	Shahbaz Tikka	27.03	20.88	20.18	10.68	4.44	18.26	27.08	25.43	18.14			
	others	2	1	CO-1-1	Gourmet	3.37	3.66	2.64	3.31	4.43	4.25	4.63	2.53	3.64			1.53
			2	CO-1-2	Alnoor Shopping	2.05	0.94	0.72	4.08		0.67	0.85	1.57	1.26			
			3	CO-1-3	Shopping centre Sateelite town	1.01	0.13	0.1			0.31	2.11	2.73	0.77			
			4	CO-1-4	Metro Shoes	1.7	0.4	1.91	0.3		1.25	0.69	0.46	0.72			
			5	CO-1-5	Gul Ahmed	2.9	0.7	2.92	0.4		2.35	0.26	2.15	1.25			
Market Containers	**Market**	1	1	Ma-1-1	Main fruit Market	0.7	17.65	6.79	2.13	8.75	12.86	3.23	4.26	7.95			223.82
		2	2	Ma-2-1	Fazal fruit Market	0	2320	820	0	1400	0	0	4120	1237			
		3	1	Ma-3-1	Maodel market	10.9	12.7	10.51	5.94	9.55	6.28	6.48	7.66	8.45			
		4	2	Ma-4-2	Model Market Fatto Mund	6.65	5.56	8.31	11.07	10.44	12.09	3.47	8.7	8.52			
		5	1	Ma-5-1	Sheikhupra Road	4.79	9.93	5.35	11.21	13.08	14.87	2.72	7.66	9.26			
		6	2	Ma-6-2	Sheranwala Bagh	13.65	5.28	8.69	6.75	8.12	9.01	1.87	7.34	6.72			
		7	1	Ma-7-1	Outside of Dhulle Market	8.66	1.33	5.14	7.43	11.59	10	12.42	10.86	8.40			
		8	2	Ma-8-2	Gindalwanwala Railway	8.59	4.59	3.07	7.84	4.29	12.22	2.2	9.65	6.27			
		9	1	Ma-9-1	Khyali Bypass	2860	0	2160	1720	820	0	0	1880	940			

Type		Area	Sr.No. in Area	Tag #	Name of Area/ Source	Day 1 weight(kg)	Day 2 weight(kg)	Day 3 weight(kg)	Day 4 weight(kg)	Day 5 weight(kg)	Day 6 weight(kg)	Day 7 weight(kg)	Day 8 weight(kg)	Average Wt for 7 Days	House Hold Size	Per Capita Weight	Average Per Capita Waste Generation
		10	2	Ma-10-2	GAP Chowk	8.25	5.51	4.39	7.35	4.59	5.81	7.88	2.9	5.49			
Institutions	**Institutions**	1	1	I-1-1	1. Govt. Iqbal High School, GRW.	4.26			7.03	7.22	4.85		5.39	3.50		3.07	
		2	1	I-2-1	2. Govt. Degree College for Women, Satellite Town, GRW. / Govt. College Gujranwala for Boys, Satellite Town, GRW.	3.34	1.64	7.48	1.39	1.85	0.81		0.79	1.99			
		3	1	I-3-1	3. Govt. Primary School, Dhulley, GRW.	2.57	4.61	6.49	2.62	3.63	3.06		6.88	3.90			
		4	1	I-4-1	4. Govt. Islamia College Jinnah Road, GRW.	3.45	0.67	3.67	1.6	1.11	0.89		0.96	1.27			
		5	1	I-5-1	5. TMA Office Aroop and Qila Dedar Singh, Model Town, GRW.	2.01	5.12	4.36	5.87	9.05	3.87		4.43	4.67			
Street Sweeping		1	1	S-1-1	4 Roads	49.25	27.67	31.24	22.92	20.38	15.85	27.39	24.37	24.26		6.07	
Park		1	1	P-1-1	Gulsha Iqbal Park	10.1	17	16.8	20.2	9.04	18.05	11.45	8.96	14.47		14.47	

ANNEXURE III –DATASHEET OF WASTE COMPOSITION SURVEY

Sr. No	Item	HIGH INCOME								
		Day 1 (%)	Day 2 (%)	Day 3 (%)	Day 4 (%)	Day 5 (%)	Day 6 (%)	Day 7 (%)	Day 8 (%)	Average (%)
1.	**Kitchen waste**	66.82	67.50	80.52	72.25	71.16	69.03	62.70	76.45	71.4
2.	**Paper (recyclable)**	4.31	4.71	2.47	2.92	1.90	4.25	3.86	1.80	3.1
3.	**Paper (Tetra Pak & other paper)**	10.59	10.21	1.27	7.52	4.57	4.95	12.43	2.39	6.2
4.	**Textile**	2.07	0.96	0.50	4.58	0.65	5.11	4.30	2.16	2.6
5.	**Grass and wood**	0.00	0.00	1.15	0.40	0.96	0.33	0.00	0.76	0.5
6.	**Plastic (recyclable)**	1.94	1.18	0.65	0.86	1.21	0.60	1.85	0.92	1.0
7.	**Plastic (non-recyclable)**	8.13	9.49	11.35	6.81	14.33	11.59	10.08	14.14	11.1
8.	**Leather and rubber**	1.86	3.23	1.03	0.66	0.03	0.07	0.87	0.00	0.8
9.	**Metal (recyclable)**	0.35	0.63	0.00	0.40	0.00	1.16	0.94	0.00	0.4
10.	**Metal (non-recyclable)**	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11.	**Bottle and glass (recyclable)**	0.34	0.00	0.31	2.32	0.00	1.88	0.00	0.00	0.6
12.	**Bottle and glass (non-recyclable)**	0.69	0.00	0.00	0.00	5.19	0.00	0.91	0.12	0.9
13.	**Ceramic, stone and soil etc.**	1.55	1.29	0.00	0.00	0.00	0.00	1.78	0.28	0.5
14.	**Domestic hazardous wastes**	1.33	0.82	0.74	1.29	0.00	1.04	0.27	0.97	0.7
15.	**Sieve Remaining**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16.	**Miscellaneous**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17.	**Total**	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note: *Day 1 data were not included in the analysis as directed by the Client.*

Sr. No	Item	Middle Income								
		Day 1 (%)	Day 2 (%)	Day 3 (%)	Day 4 (%)	Day 5 (%)	Day 6 (%)	Day 7 (%)	Day 8 (%)	Average (%)
1.	**Kitchen waste**	64.43	53.90	64.50	65.43	67.60	65.63	58.63	62.51	62.6
2.	**Paper (recyclable)**	3.93	4.12	1.76	2.82	1.66	2.37	2.23	2.01	2.4
3.	**Paper (Tetra Pak & other paper)**	5.75	7.60	1.47	8.59	0.68	5.39	2.50	1.75	4.0
4.	**Textile**	4.52	14.40	5.71	3.76	6.08	4.19	4.01	7.05	6.5
5.	**Grass and wood**	0.00	0.11	0.12	0.72	2.24	0.72	0.61	0.94	0.8
6.	**Plastic (recyclable)**	0.81	0.67	1.89	0.86	1.10	1.26	1.63	0.59	1.1
7.	**Plastic (non-recyclable)**	12.72	8.52	15.07	9.27	10.86	11.70	12.90	15.69	12.0
8.	**Leather and rubber**	0.94	1.27	0.07	0.89	1.20	2.35	0.58	0.52	1.0
9.	**Metal (recyclable)**	0.98	0.11	0.91	0.66	0.17	0.25	0.18	0.23	0.4
10.	**Metal (non-recyclable)**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11.	**Bottle and glass (recyclable)**	0.25	0.07	0.69	0.00	0.00	0.00	0.00	0.00	0.1
12.	**Bottle and glass (non-recyclable)**	0.53	0.58	0.15	1.43	0.51	0.00	1.44	2.27	0.9
13.	**Ceramic, stone and soil etc.**	4.08	0.63	0.00	2.53	2.36	4.86	10.80	1.95	3.3
14.	**Domestic hazardous wastes**	1.06	1.36	2.82	0.03	1.22	1.28	2.53	0.21	1.3
15.	**Sieve Remaining**	0.00	0.00	3.90	0.00	2.68	0.00	0.93	0.00	1.1
16.	**Miscellaneous**	0.00	6.67	0.96	2.98	1.64	0.00	1.03	4.28	2.5
17.	**Total**	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note: *Day 1 data were not included in the analysis as directed by the Client.*

Sr. No	Item		Low Income							
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Average
		(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1	**Kitchen waste**	72.68	72.48	62.19	61.27	76.22	77.05	68.97	64.52	69.0
2	**Paper (recyclable)**	2.42	2.01	2.12	2.37	2.21	2.15	2.52	0.00	1.9
3	**Paper (Tetra Pak & other paper)**	3.45	1.07	1.47	0.50	0.72	1.00	2.19	0.46	1.1
4	**Textile**	3.52	5.64	5.18	11.19	4.53	2.03	2.25	7.20	5.4
5	**Grass and wood**	0.00	0.45	0.81	0.72	0.70	1.78	1.48	0.81	1.0
6	**Plastic (recyclable)**	0.06	3.18	1.30	0.89	1.75	0.90	1.02	1.87	1.6
7	**Plastic (non-recyclable)**	15.19	9.45	10.75	14.02	4.73	8.03	17.70	9.46	10.6
8	**Leather and rubber**	0.13	0.59	0.39	0.26	0.79	0.00	0.09	0.64	0.4
9	**Metal (recyclable)**	0.01	0.00	0.03	0.00	0.05	0.00	0.06	0.02	0.0
10	**Metal (non-recyclable)**	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	**Bottle and glass (recyclable)**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	**Bottle and glass (non-recyclable)**	0.46	1.63	1.11	1.80	1.34	1.48	0.00	1.08	1.2
13	**Ceramic, stone and soil etc.**	1.56	0.17	1.11	0.00	1.70	0.38	0.00	0.94	0.6
14	**Domestic hazardous wastes**	0.46	0.93	0.20	0.43	0.26	0.83	3.73	0.02	0.9
15	**Sieve Remaining**	0.00	0.00	2.70	1.92	1.61	0.73	0.00	5.16	1.7
16	**Miscellaneous**	0.00	2.39	10.65	4.63	3.38	3.68	0.00	7.82	4.6
16	**Total**	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.0

Note: *Day 1 data were not included in the analysis as directed by the Client.*

Sr. No	Item	Rural								
		Day 1 (%)	Day 2 (%)	Day 3 (%)	Day 4 (%)	Day 5 (%)	Day 6 (%)	Day 7 (%)	Day 8 (%)	Average (%)
1.	**Kitchen waste**	67.14	65.46	56.43	47.38	50.57	37.33	46.37	42.98	49.5
2.	**Paper (recyclable)**	2.47	2.84	6.31	1.98	0.38	2.28	4.32	3.15	3.0
3.	**Paper (Tetra Pak & other paper)**	0.90	0.35	1.03	0.77	1.58	0.80	0.00	0.54	0.7
4.	**Textile**	3.45	5.03	10.89	8.96	1.32	2.44	4.78	1.66	5.0
5.	**Grass and wood**	1.07	2.01	0.00	7.62	1.01	0.00	24.21	2.53	5.3
6.	**Plastic (recyclable)**	1.13	1.12	5.92	2.94	0.57	3.08	1.37	2.40	2.5
7.	**Plastic (non-recyclable)**	8.09	5.74	2.84	9.28	5.17	3.76	7.88	4.31	5.6
8.	**Leather and rubber**	0.15	0.89	0.00	3.84	0.00	0.00	0.47	0.00	0.7
9.	**Metal (recyclable)**	0.99	0.00	0.71	0.26	0.00	0.00	0.00	0.00	0.1
10.	**Metal (non-recyclable)**	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.0
11.	**Bottle and glass (recyclable)**	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.1
12.	**Bottle and glass (non-recyclable)**	0.00	0.24	0.00	0.00	0.69	1.80	0.00	0.00	0.4
13.	**Ceramic, stone and soil etc.**	0.00	0.00	2.21	0.00	0.76	47.72	9.42	1.70	8.8
14.	**Domestic hazardous wastes**	0.12	0.71	2.29	1.34	0.00	0.80	0.58	0.66	0.9
15.	**Sieve Remaining**	7.83	4.08	6.47	4.23	15.64	0.00	0.00	12.35	6.1
16.	**Miscellaneous**	6.67	11.53	4.89	11.40	22.26	0.00	0.00	27.72	11.1
17.	**Total**	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.0

Note: *Day 1 data were not included in the analysis as directed by the Client.*

Sr. No	Item	Commercial Restaurants								
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Average %
		(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	
1.	**Kitchen waste**	98.61	94.72	78.18	91.73	86.90	91.60	92.35	90.20	89.4
2.	**Paper (recyclable)**	0.00	0.29	0.22	0.60	1.46	0.00	0.45	0.16	0.5
3.	**Paper (Tetra Pak & other paper)**	0.00	1.08	0.54	1.25	5.80	1.64	1.27	1.54	1.9
4.	**Textile**	0.00	0.59	1.51	0.28	1.23	0.40	1.59	1.47	1.0
5.	**Grass and wood**	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.0
6.	**Plastic (recyclable)**	0.00	0.00	0.10	0.17	0.15	0.14	0.33	0.25	0.2
7.	**Plastic (non-recyclable)**	1.39	2.25	3.36	4.71	2.87	4.28	3.89	4.91	3.8
8.	**Leather and rubber**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9.	**Metal (recyclable)**	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.0
10.	**Metal (non-recyclable)**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11.	**Bottle and glass (recyclable)**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12.	**Bottle and glass (non-recyclable)**	0.00	1.08	1.73	0.38	1.59	1.95	0.11	0.19	1.0
13.	**Ceramic, stone and soil etc.**	0.00	0.00	14.34	0.63	0.00	0.00	0.00	1.28	2.3
14.	**Domestic hazardous wastes**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15.	**Sieve Remaining**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16.	**Miscellaneous**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17.	**Total**	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.0

Note: *Day 1 data were not included in the analysis as directed by the Client.*

Sr. No	Item	Commercial Others								
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Average %
		(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	
1.	**Kitchen waste**	0.18	0	0.30	52.88	0.00	0	58.97	18.47	21.8
2.	**Paper (recyclable)**	1.46	38.12	6.28	13.26	0.00	4.87	2.89	16.92	13.7
3.	**Paper (Tetra Pak & other paper)**	23.49	29.65	39.91	0.00	0.00	49.21	2.97	23.60	24.2
4.	**Textile**	21.30	2.21	10.91	4.79	0.00	23.03	1.57	6.32	8.1
5.	**Grass and wood**	0.00	0.74	0.45	0.00	0.00	0.00	20.33	0.00	3.6
6.	**Plastic (recyclable)**	0.27	0.74	1.35	1.28	0.00	3.82	5.70	3.81	2.8
7.	**Plastic (non-recyclable)**	41.41	21.92	29.60	23.96	0.00	16.32	7.54	25.15	20.7
8.	**Leather and rubber**	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9.	**Metal (recyclable)**	0.91	0	1.05	0.00	0.00	0.26	0.02	0.00	0.2
10.	**Metal (non-recyclable)**	0.00	0	0.00	3.83	0.00	0	0.00	0.00	0.6
11.	**Bottle and glass (recyclable)**	8.23	4.24	4.04	0	0.00	0	0.00	0.00	1.4
12.	**Bottle and glass (non-recyclable)**	0.00	0	0.00	0	0.00	2.5	0.00	5.72	1.4
13.	**Ceramic, stone and soil etc.**	0.00	0	0.00	0	0.00	0	0.00	0.00	0.0
14.	**Domestic hazardous wastes**	2.74	0	6.13	0	0.00	0	0.00	0.00	1.0
15.	**Sieve Remaining**	0.00	2.39	0.00	0	0.00	0	0.00	0.00	0.4
16.	**Miscellaneous**	0.00	0	0.00	0	0.00	0	0.00	0.00	0.0
17.	**Total**	100.00	100.00	100.00	100.00	0.00	100.00	100.00	100.00	100.00

Note: *Day 1 data were not included in the analysis as directed by the Client.*

Sr. No	Item	Market								
		Day 1 (%)	Day 2 (%)	Day 3 (%)	Day 4 (%)	Day 5 (%)	Day 6 (%)	Day 7 (%)	Day 8 (%)	Average (%)
1.	**Kitchen waste**	44.48	82.58	45.18	80.90	46.58	48.20	58.97	31.82	56.3
2.	**Paper (recyclable)**	1.09	3.97	0.79	0.72	0.33	0.68	2.89	1.69	1.6
3.	**Paper (Tetra Pak & other paper)**	0.00	0.00	6.90	4.50	5.33	4.43	2.97	2.36	3.8
4.	**Textile**	0.35	0.49	0.64	0.48	3.35	3.00	1.57	1.00	1.5
5.	**Grass and wood**	40.09	3.99	22.67	0.93	34.04	25.88	20.33	30.43	19.7
6.	**Plastic (recyclable)**	0.00	0.11	0.12	0.43	0.15	0.11	5.70	0.41	1.0
7.	**Plastic (non-recyclable)**	4.94	3.23	4.01	5.74	2.12	2.65	7.54	5.04	4.3
8.	**Leather and rubber**	0.00	0.00	0.00	0.22	0.95	0.48	0.00	0.44	0.3
9.	**Metal (recyclable)**	0.00	0.00	0.00	0.18	0.04	0.01	0.02	0.00	0.0
10.	**Metal (non-recyclable)**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11.	**Bottle and glass (recyclable)**	0.00	0.00	0.00	0.00	0.64	0.77	0.00	0.00	0.2
12.	**Bottle and glass (non-recyclable)**	0.00	0.00	0.09	0.43	0.00	0.33	0.00	0.00	0.1
13.	**Ceramic, stone and soil etc.**	0.00	0.00	1.74	0.21	0.84	0.97	0.00	2.46	0.9
14.	**Domestic hazardous wastes**	0.00	0.00	0.11	0.93	0.00	0.04	0.00	0.36	0.2
15.	**Sieve Remaining**	0.00	4.23	4.92	2.55	0.00	5.63	0.00	0.78	2.6
16.	**Miscellaneous**	9.05	1.40	12.85	1.79	5.63	6.82	0.00	23.20	7.4
17.	**Total**	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note: *Day 1 data were not included in the analysis as directed by the Client.*

Waste Amount and Composition Survey Report (Season 3)

Environment Division, Lean & Green (Pvt) Limited

Sr. No	Item	Institutions								
		Day 1 (%)	Day 2 (%)	Day 3 (%)	Day 4 (%)	Day 5 (%)	Day 6 (%)	Day 7 (%)	Day 8 (%)	Average (%)
1.	**Kitchen waste**	0.0	0.0	0.0	2.56	22.0	0.0	**HOLIDAY (Institutions Close)**	5.1	4.9
2.	**Paper (recyclable)**	2.3	36.7	5.9	4.84	4.3	9.1		13.7	12.4
3.	**Paper (Tetra Pak & other paper)**	9.8	11.0	0.0	10.35	5.0	4.4		1.8	5.4
4.	**Textile**	2.3	0.0	0.0	0.45	3.2	0.6		1.9	1.0
5.	**Grass and wood**	40.1	29.0	57.3	30.44	56.2	46.7		46.2	44.3
6.	**Plastic (recyclable)**	3.8	3.4	0.6	1.39	1.4	1.4		1.1	1.5
7.	**Plastic (non-recyclable)**	5.1	8.4	3.6	7.51	5.9	9.8		12.3	7.9
8.	**Leather and rubber**	0.6	0.0	0.0	0.00	0.0	0.0		0.0	0.0
9.	**Metal (recyclable)**	0.0	0.0	0.0	0.00	0.0	0.0		0.3	0.0
10.	**Metal (non-recyclable)**	0.0	0.0	0.0	0.00	0.0	0.0		0.0	0.0
11.	**Bottle and glass (recyclable)**	0.0	8.1	0.0	0.00	0.0	0.0		0.2	1.4
12.	**Bottle and glass (non-recyclable)**	0.7	0.0	0.9	3.39	0.0	6.4		0.0	1.8
13.	**Ceramic, stone and soil etc.**	6.6	0.0	0.0	7.29	0.0	3.2		0.0	1.7
14.	**Domestic hazardous wastes**	0.7	0.0	1.5	0.00	0.0	1.0		0.0	0.4
15.	**Sieve Remaining**	7.2	0.0	8.8	13.19	0.0	5.3		0.0	4.6
16.	**Miscellaneous**	20.8	3.4	21.3	18.59	2.0	12.0		17.6	12.5
17.	**Total**	100.00	100.00	100.00	100.00	100.00	100.00		100.00	100.00

Note: *Day 1 data were not included in the analysis as directed by the Client.*

Sr. No	Item	Street Sweeping								
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Average
		(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1.	**Kitchen waste**	0.0	0.0	0.0	24.68	18.1	9.18	9.92	6.9	9.8
2.	**Paper (recyclable)**	0.6	4.2	0.0	1.44	0.7	3.10	1.33	3.2	2.0
3.	**Paper (Tetra Pak & other paper)**	0.0	0.6	0.9	4.75	3.9	2.78	2.11	3.5	2.7
4.	**Textile**	0.0	0.5	0.3	0.76	0.4	0.13	0.15	1.9	0.6
5.	**Grass and wood**	0.1	0.4	0.6	0.93	1.9	1.46	19.73	9.6	4.9
6.	**Plastic (recyclable)**	0.0	0.0	0.0	0.00	0.0	0.00	0.00	0.0	0.0
7.	**Plastic (non-recyclable)**	0.1	0.1	0.6	1.06	1.4	4.24	2.00	5.0	2.1
8.	**Leather and rubber**	0.2	0.0	0.0	0.00	0.0	0.13	0.11	0.2	0.1
9.	**Metal (recyclable)**	0.0	0.0	0.0	0.00	0.1	0.00	0.00	0.0	0.0
10.	**Metal (non-recyclable)**	0.0	0.0	0.0	0.00	0.0	0.00	0.04	0.0	0.0
11.	**Bottle and glass (recyclable)**	0.0	0.0	0.0	0.00	0.0	0.00	0.00	0.0	0.0
12.	**Bottle and glass (non-recyclable)**	0.0	0.0	0.0	0.00	0.0	0.00	0.00	0.0	0.0
13.	**Ceramic, stone and soil etc.**	0.2	92.8	95.0	57.04	66.1	71.14	59.31	62.7	72.0
14.	**Domestic hazardous wastes**	0.0	0.0	0.0	0.00	0.0	0.00	0.00	0.0	0.0
15.	**Sieve Remaining**	3.7	1.5	2.4	9.33	7.3	7.85	5.29	7.0	5.8
16.	**Miscellaneous**	95.1	0.0	0.0	0.00	0.0	0.00	0.00	0.0	0.0
17.	**Total**	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note: *Day 1 data were not included in the analysis as directed by the Client.*

Waste Amount and Composition Survey Report (Season 3)

Environment Division, Lean & Green (Pvt) Limited

Sr. No	Item	PARK								
		Day 1 (%)	Day 2 (%)	Day 3 (%)	Day 4 (%)	Day 5 (%)	Day 6 (%)	Day 7 (%)	Day 8 (%)	Average (%)
1.	**Kitchen waste**	6.79	6.21	6.52	8.56	9.52	9.29	9.18	13.41	9.0
2.	**Paper (recyclable)**	1.20	0.83	0.72	1.23	2.31	0.92	2.88	1.37	1.5
3.	**Paper (Tetra Pak & other paper)**	3.61	4.37	3.89	4.36	3.94	0.75	5.60	2.97	3.7
4.	**Textile**	0.00	21.01	0.00	2.46	1.01	1.59	0.00	0.63	3.8
5.	**Grass and wood**	28.86	39.48	51.72	18.35	24.21	13.05	21.62	19.23	26.8
6.	**Plastic (recyclable)**	24.65	0.61	0.60	2.46	3.49	27.53	0.55	11.20	6.6
7.	**Plastic (non-recyclable)**	5.41	1.42	1.98	2.61	13.57	3.41	8.03	7.08	5.4
8.	**Leather and rubber**	0.00	0.06	0.12	0.87	0.00	1.78	0.00	0.00	0.4
9.	**Metal (recyclable)**	0.00	0.00	0.00	1.64	0.00	1.78	0.00	0.00	0.5
10.	**Metal (non-recyclable)**	1.80	0.00	0.00	16.64	0.00	1.78	0.00	2.29	3.0
11.	**Bottle and glass (recyclable)**	2.41	0.00	0.00	1.64	0.00	1.56	0.00	0.00	0.5
12.	**Bottle and glass (non-recyclable)**	1.80	0.89	0.00	1.64	0.00	0.95	0.00	0.00	0.5
13.	**Ceramic, stone and soil etc.**	0.60	0.00	0.00	1.92	0.00	1.78	2.09	2.51	1.2
14.	**Domestic hazardous wastes**	0.60	0.00	0.00	1.64	1.35	1.78	0.00	0.00	0.7
15.	**Sieve Remaining**	3.01	22.82	4.79	1.64	3.60	1.78	0.00	4.34	5.6
16.	**Miscellaneous**	19.24	2.31	29.67	32.33	36.99	30.28	50.06	34.96	30.9
17.	**Total**	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note: *Day 1 data were not included in the analysis as directed by the Client.*

ANNEXURE IV –DATASHEET OF WASTE CHEMICAL ANALYSIS

Day-1

Sr No.	Discharge Source	Moisture Content (%)	C %	N %	Carbon Nitrogen Analysis	3 Component Analysis		
						Moisture Content (%)	Ash Content (%)	Combustibles (%)
1	High Income Group	80.23	51.94	0.84	61.84	69.09	9.43	21.48
2		61.11	53.45	0.58	92.16	71.67	5.13	23.2
3		11.33	52.88	0.76	69.58	73.47	9.2	17.34
4	Middle Income Group	66.11	51.56	0.51	101.11	73.32	8.14	18.54
5		76.03	52.39	0.28	187.09	70.19	8.43	21.33
6		76.52	51.66	0.50	103.32	75.04	4.6	20.36
7	Low Income Group	76.72	52.27	0.84	62.22	74.5	12.89	12.61
8		67.71	51.35	0.46	111.63	59.59	18.82	21.59
9		67.37	52.37	0.93	56.32	67.53	12.96	19.51
10	Market (Fruit & Vegetables)	69.18	51.42	0.99	51.94	61.69	16.56	21.75
11		71.32	51.76	0.48	107.84	64.75	18.62	16.63
12		74.62	51.31	0.81	63.34	72.61	9.6	17.78

Day-2

Sr No.	Discharge Source	Moisture Content (%)	C %	N %	Carbon Nitrogen Analysis	3 Component Analysis		
						Moisture Content (%)	Ash Content (%)	Combustibles (%)
1	High Income Group	74.5	51.81	0.75	69.08	68.18	4.52	27.3
2		73.5	51.68	0.24	215.32	66.67	5.96	27.38
3		69.18	52.08	0.80	65.1	74.44	2.46	23.1
4	Middle Income Group	61.62	52.29	0.65	80.45	77.64	7	15.37
5		78.55	52.27	0.23	227.27	61.49	16.57	21.95
6		82.68	52.86	0.53	99.74	59.31	17.77	22.92
7	Low Income Group	77.09	34.31	0.55	62.38	47.48	29.51	23.01
8		67.55	50.74	0.64	79.28	67.39	8.9	23.71
9		65.03	40.38	0.65	75.97	59.99	14.7	25.31
10	Market (Fruit & Vegetables)	77.73	51.54	0.41	125.7	75.97	6.04	17.99
11		70.27	51.39	0.55	93.44	64.47	14.93	20.6
12		79.03	51.33	0.30	171.1	77.62	10.04	12.34

Day-3

Sr No.	Discharge Source	Moisture Content (%)	C %	N %	Carbon Nitrogen Analysis	3 Component Analysis		
						Moisture Content (%)	Ash Content (%)	Combustibles (%)
1	High Income Group	64.27	48.87	0.40	122.17	76.59	5.14	18.26
2		71.63	51.85	0.50	103.7	69.34	9.75	20.91
3		54.77	47.32	0.32	147.87	72.73	9.45	17.82
4	Middle Income Group	64.88	48.99	0.78	288.19	71.32	7.68	21
5		67.96	50.74	0.13	181.2	79.61	5.03	15.36
6		66.23	57.88	0.19	399.06	72.8	8.49	18.71
7	Low Income Group	60.95	43.13	0.19	227.02	71.9	9.31	18.79
8		60.72	30.96	0.20	254.79	66.73	9.42	23.85
9		62.78	52.46	0.25	209.85	66.69	10.78	22.54
10	Market (Fruit & Vegetables)	71.27	47.67	0.20	238.33	65.36	14.12	20.52
11		78.8	46	0.18	255.57	73.76	10.02	16.22
12		78.57	48.24	0.22	219.29	66.65	17.55	15.8

ANNEXURE V –THREE SEASON AVERAGE PHYSICAL COMPOSITION

Categories	High Income				Middle Income				Low Income			
	SEASON 1	SEASON 2	SEASON 3	AVERAGE	SEASON 1	SEASON 2	SEASON 3	AVERAGE	SEASON 1	SEASON 2	SEASON 3	AVERAGE
Kitchen waste	58.0	68	69	65.0	55.2	55.6	63	58	67.6	64	69	66.8
Paper (recyclable/clean paper)	4.7	2.6	2	3.1	5.3	2.6	3	4	3.2	2.7	2	2.6
Paper (other paper)	0.8	12.4	1	4.7	1.9	15.2	4	7	0.5	10.4	1	4.0
Textile	5.0	2.3	5	4.1	5.7	5.9	7	6	4.9	3.3	5	4.4
Grass and wood	2.7	1.5	1	1.7	0.7	1.6	1	1	0.5	1.8	1	1.1
Plastic (recyclable plastic)	1.2	1.2	2	1.5	1.4	1	1	1	0.8	0.6	2	1.1
Plastic (non-recyclable plastic)	8.9	5.8	11	8.6	8.4	7.8	12	9	10.9	6.7	11	9.5
Leather and rubber	1.1	1	0	0.7	1.5	1	1	1	1.8	0.4	0	0.7
Metal (recyclable metal)	0.3	0.4	0	0.3	0.6	0.2	0	0	0.1	0.1	0	0.1
Metal (non-recyclable metal)	0.0	0	0	0.0	0.0	0	0	0	0.0	0	0	0.0
Bottle and glass (recyclable)	0.7	0.9	0	0.5	1.0	1.3	0	1	1.5	0.9	0	0.8
Bottle and glass (non-recyclable)	0.6	0.2	1	0.6	0.5	0.2	1	1	0.8	0	1	0.6
Ceramic, stone and soil etc.	9.6	0.6	1	3.7	8.3	1.8	3	4	2.5	1	1	1.5
Domestic hazardous wastes	0.7	0.6	1	0.8	1.0	0.9	1	1	0.8	0.3	1	0.7
Sieve Upper	0.0	1.6	2	1.2	0.0	4	1	2	0.0	4	2	2.0
Misc	5.7	0.9	4	3.5	8.7	0.9	2	4	4.2	3.8	4	4.0
Total	100.0	100	100	100.0	100.0	100	100	100	100.0	100	100	100.0

Categories	Commercial Resturant				Commercial Other				Market			
	SEASON 1	SEASON 2	SEASON 3	AVERAGE	SEASON 1	SEASON 2	SEASON 3	AVERAGE	SEASON 1	SEASON 2	SEASON 3	AVERAGE
Kitchen waste	76.90	89.8	89	85.23	1.2	4	22	9.1	48.96	78.1	56	61.02
Paper (recyclable/clean paper)	13.80	0.2	1	5.00	52.1	14.4	14	26.8	6.65	0.7	2	3.11
Paper (other paper)	0.54	2.6	2	1.71	3.8	33.3	24	20.4	0.45	4.1	4	2.85
Textile	0.06	2.3	1	1.12	5.5	7.2	8	6.9	2.42	1.3	2	1.90
Grass and wood	0.00	0.2	0	0.08	0.0	0.2	4	1.4	26.84	4.1	20	16.98
Plastic (recyclable plastic)	0.03	0	0	0.01	3.9	5.4	3	4.1	0.09	0.1	1	0.40
Plastic (non-recyclable plastic)	7.34	4.1	4	5.15	25.3	23.8	21	23.4	4.70	3.2	4	3.97
Leather and rubber	0.00	0.2	0	0.05	0.0	1.8	0	0.6	0.64	0.4	0	0.35
Metal (recyclable metal)	0.00	0	0	0.00	0.4	0.7	0	0.4	0.07	0	0	0.03
Metal (non-recyclable metal)	0.00	0	0	0.00	0.0	0	1	0.3	0.00	0	0	0.00
Bottle and glass (recyclable)	1.33	0.3	0	0.54	5.5	3.4	1	3.3	0.00	0	0	0.00
Bottle and glass (non-recyclable)	0.00	0.2	1	0.40	1.7	0	1	0.9	0.21	0	0	0.07
Ceramic, stone and soil etc.	0.00	0	2	0.67	0.1	0.4	0	0.2	8.45	0.9	1	3.45
Domestic hazardous wastes	0.00	0.1	0	0.03	0.5	0.3	1	0.6	0.52	0	0	0.17

Sieve Upper	0.00	0	0	0.00	0.0	3.7	0	1.2	0.00	3.5	3	2.17
Misc	0.00	0	0	0.00	0.0	1.4	0	0.5	0.00	3.6	7	3.53
Total	100.00	100	100	100.00	100.0	100	100	100.0	100.00	100	100	100.00

	Rural Area				Parks			
Categories	SEASON 1	SEASON 2	SEASON 3	AVERAGE	SEASON 1	SEASON 2	SEASON 3	AVERAGE
Kitchen waste	42.9	60.9	50	51.3	3.13	20.3	9	10.81
Paper (recyclable/clean paper)	2.9	2.8	3	2.9	1.00	1.1	2	1.37
Paper (other paper)	0.2	3.7	1	1.6	0.20	1.6	4	1.93
Textile	3.8	3.1	5	4.0	0.12	0.4	4	1.51
Grass and wood	9.3	5	5	6.4	63.31	66.1	27	52.14
Plastic (recyclable plastic)	0.8	1.6	2	1.5	7.41	0.5	7	4.97
Plastic (non-recyclable plastic)	6.6	5.3	6	6.0	2.07	5.2	5	4.09
Leather and rubber	0.5	1.3	1	0.9	0.20	0.7	0	0.30
Metal (recyclable metal)	0.4	0.6	0	0.3	0.00	0	0	0.00
Metal (non-recyclable metal)	0.0	0	0	0.0	7.23	0	3	3.40
Bottle and glass (recyclable)	0.0	0.6	0	0.2	0.00	0.3	0	0.10
Bottle and glass (non-recyclable)	0.0	0.7	0	0.2	0.00	0	0	0.00
Ceramic, stone and soil etc.	27.2	2.8	9	13.0	1.25	0.2	1	0.82
Domestic hazardous wastes	0.5	0.3	1	0.6	0.30	0	1	0.43
Sieve Upper	0.0	4.6	6	3.5	0.00	1.2	6	2.40
Misc	4.8	6.7	11	7.5	1.00	2.4	31	11.47
Total	100.0	100	100	100.0	87.22	100	100	95.73

	Institutions				Street Sweeping			
Categories	SEASON 1	SEASON 2	SEASON 3	AVERAGE	SEASON 1	SEASON 2	SEASON 3	AVERAGE
Kitchen waste	5.31	2.8	5	4.37	3.56	16	10	9.85
Paper (recyclable/clean paper)	10.78	3	12	8.59	1.73	0.9	2	1.54
Paper (other paper)	0.78	5.1	5	3.63	0.30	4.8	3	2.70
Textile	0.52	0.8	1	0.78	1.78	1.6	0	1.13
Grass and wood	42.63	47.8	44	44.81	16.69	3.3	5	8.33
Plastic (recyclable plastic)	0.83	0.8	2	1.21	0.11	0.3	0	0.14
Plastic (non-recyclable plastic)	7.39	6.7	8	7.36	3.47	3.2	2	2.89
Leather and rubber	0.02	0.1	0	0.04	0.17	0.1	0	0.09
Metal (recyclable metal)	0.44	0.2	0	0.20	0.01	0	0	0.01
Metal (non-recyclable metal)	0.00	0	0	0.00	0.00	0	0	0.00
Bottle and glass (recyclable)	0.18	0	1	0.39	0.08	0.1	0	0.06
Bottle and glass (non-recyclable)	0.30	0.7	2	1.00	0.00	0	0	0.00
Ceramic, stone and soil etc.	30.69	5.3	2	12.66	72.08	2.4	72	48.83
Domestic hazardous wastes	0.01	0.1	0	0.04	0.00	0.3	0	0.10

Sieve Upper	0.00	6	5	3.67	0.00	18.5	6	8.16
Misc	0.11	20.6	13	11.24	0.00	48.5	0	16.17
Total	100.00	100	100	100.00	100.00	100	100	100.00

ANNEXURE VI –THREE SEASON AVERAGE CHEMICAL COMPOSITION

Three Component Analyses

Sr No.	Discharge Source	Sample Code	Season 1			Season 2			Season 3		
			Moisture content (%)	Ash content (%)	Combustible (%)	Moisture content (%)	Ash content (%)	Combustible (%)	Moisture content (%)	Ash content (%)	Combustible (%)
1	High Income Group	H-1-CA-01	81.95	2.76	97.24	71.96	7.8	20.24	69.09	9.43	21.48
2		H-1-CA-02	60.98	4.93	95.07	82.11	3.86	14.04	71.67	5.13	23.2
3		H-1-CA-03	82.01	2.53	97.47	67.72	7.77	24.51	73.47	9.2	17.34
4		H-2-CA-01	74.61	6.2	93.8	77.06	9.79	13.16	68.18	4.52	27.3
5		H-2-CA-02	69.22	2.88	97.12	80.42	5.63	13.95	66.67	5.96	27.38
6		H-2-CA-03	76.81	2.42	97.58	73.76	6.97	19.28	74.44	2.46	23.1
7		H-3-CA-01	46.2	32.73	67.27	84.93	5.82	9.25	76.59	5.14	18.26
8		H-3-CA-02	66.46	1.84	98.16	86.72	4.08	9.2	69.34	9.75	20.91
9		H-3-CA-03	74.31	11.83	88.17	77.62	6.89	15.48	72.73	9.45	17.82
10	Middle Income Group	M-1-CA-01	65.24	13.32	86.68	73.03	9.27	17.7	73.32	8.14	18.54
11		M-1-CA-02	75.44	14.16	85.84	72.03	12.53	15.45	70.19	8.43	21.33
12		M-1-CA-03	69.84	8.45	91.55	72.54	12.41	15.05	75.04	4.6	20.36
13		M-2-CA-01	62.3	40.59	59.41	74.21	9.38	16.41	77.64	7	15.37
14		M-2-CA-02	8.27	2.65	97.35	79.63	6.04	14.34	61.49	16.57	21.95
15		M-2-CA-03	50.83	15.11	84.89	79.08	7.51	13.41	59.31	17.77	22.92
16		M-3-CA-01	71.06	10.38	89.62	77.57	10.39	12.04	71.32	7.68	21
17		M-3-CA-02	82.72	11.83	88.17	82.11	5.05	12.84	79.61	5.03	15.36
18		M-3-CA-03	83.57	4.02	95.98	76.06	36.48	-12.54	72.8	8.49	18.71
19	Low Income Group	L-1-CA-01	73.96	6.59	93.41	74.99	11.37	13.63	74.5	12.89	12.61
20		L-1-CA-02	76.98	6.46	93.54	74.35	11.95	13.7	59.59	18.82	21.59
21		L-1-CA-03	74.79	5.03	94.97	79.88	5.79	14.32	67.53	12.96	19.51
22		L-2-CA-01	62.32	11.76	88.24	63.49	15.49	21.02	47.48	29.51	23.01
23		L-2-CA-02	48.8	33.53	66.47	74.03	13.35	12.62	67.39	8.9	23.71
24		L-2-CA-03	33.57	19.2	80.8	77.92	6.25	15.83	59.99	14.7	25.31
25		L-3-CA-01	74.85	8.17	91.83	94.5	5.41	0.09	71.9	9.31	18.79
26		L-3-CA-02	74.85	8.17	91.83	67.31	15.84	16.85	66.73	9.42	23.85
27		L-3-CA-03	68.99	13.02	86.98	94.5	3.7	1.8	66.69	10.78	22.54
28	Market (Fruit and Vegetables)	FV-1-CA-01	59.5	10.09	89.91	64.34	19.28	16.38	61.69	16.56	21.75
29		FV-1-CA-02	63.4	36.7	63.3	65.05	17.62	17.33	64.75	18.62	16.63
30		FV-1-CA-03	65.5	18.54	81.46	55.03	25.57	19.41	72.61	9.6	17.78

Sr No.	Discharge Source	Sample Code	Season 1			Season 2			Season 3		
			Moisture content (%)	Ash content (%)	Combustible (%)	Moisture content (%)	Ash content (%)	Combustible (%)	Moisture content (%)	Ash content (%)	Combustible (%)
31		FV-2-CA-01	76.34	22.85	77.15	62.56	10.69	26.75	75.97	6.04	17.99
32		FV-2-CA-02	57	18.09	81.91	73.39	9.78	16.83	64.47	14.93	20.6
33		FV-2-CA-03	71.99	5.69	94.31	65.05	32.61	2.34	77.62	10.04	12.34
34		FV-3-CA-01				76.67	16.65	6.68	65.36	14.12	20.52
35		FV-3-CA-02				77.28	15.71	7.01	73.76	10.02	16.22
36		FV-3-CA-03				75.57	17.79	6.64	66.65	17.55	15.8

Moisture Content

Sr No.	Discharge Source	Sample Code	Results		
			Season 1	Season 2	Season 3
1	High Income Group	H-1-MC-01	44.55	70.89	80.23
2		H-1-MC-02	46.96	76.85	61.11
3		H-1-MC-03	49.78	86.03	11.33
4		H-2-MC-01	66.65	80.75	74.5
5		H-2-MC-02	68.5	86.53	73.5
6		H-2-MC-03	40.71	74.76	69.18
7		H-3-MC-01	80.12	87.77	64.27
8		H-3-MC-02	76.14	73.49	71.63
9		H-3-MC-03	60.79	82.75	54.77
10	Middle Income Group	M-1-MC-01	52.25	70.66	66.11
11		M-1-MC-02	11.43	77.06	76.03
12		M-1-MC-03	43.68	67.42	76.52
13		M-2-MC-01	45.68	76.47	61.62
14		M-2-MC-02	42.18	86.76	78.55
15		M-2-MC-03	49.28	81.56	82.68
16		M-3-MC-01	42.06	81.51	64.88
17		M-3-MC-02	52.43	80.66	67.96
18		M-3-MC-03	79.52	77.5	66.23
19	Low Income Group	L-1-MC-01	63.77	70.43	76.72
20		L-1-MC-02	49.63	69.92	67.71
21		L-1-MC-03	59.6	72.89	67.37
22		L-2-MC-01	54.81	73.23	77.09
23		L-2-MC-02	39.02	76.16	67.55
24		L-2-MC-03	36.85	74.64	65.03
25		L-3-MC-01	55.46	70.62	60.95
26		L-3-MC-02	71.1	88.58	60.72
27		L-3-MC-03	58.88	68.13	62.78
28	Market (Fruit & Vegetables)	FV-1-MC-01	46.61	53.39	69.18
29		FV-1-MC-02	36.32	50.81	71.32
30		FV-1-MC-03	56.92	41.26	74.62

Sr No.	Discharge Source	Sample Code	Results		
			Season 1	Season 2	Season 3
31		FV-2-MC-01	44.15	78.04	77.73
32		FV-2-MC-02	58.45	77.81	70.27
33		FV-2-MC-03	61.17	77.99	79.03
34		FV-3-MC-01	72.2	75.17	71.27
35		FV-3-MC-02	76.6	79.49	78.8
36		FV-3-MC-03	76.94	70.65	78.57

Carbon Nitrogen Ratio

Sr No.	Discharge Source	Sample Code	Season 1	Season 2	Season 3
1	High Income Group	H-1-CN-01	264.2	147.7	61.84
2		H-1-CN-02	136.2	138.93	92.16
3		H-1-CN-03	199.07	130.56	69.58
4		H-2-CN-01	46.35	146.45	69.08
5		H-2-CN-02	52.65	170.88	215.32
6		H-2-CN-03	83.4	116.93	65.1
7		H-3-CN-01	64.27	640.6	122.17
8		H-3-CN-02	84.16	375.47	103.7
9		H-3-CN-03	89.5	308.42	147.87
10	Middle Income Group	M-1-CN-01	81.79	126.47	101.11
11		M-1-CN-02	124.95	131.07	187.09
12		M-1-CN-03	65.97	259.62	103.32
13		M-2-CN-01	45.71	242.69	80.45
14		M-2-CN-02	47.55	208.09	227.27
15		M-2-CN-03	112	440.86	99.74
16		M-3-CN-01	74.98	426.36	288.19
17		M-3-CN-02	53	283.92	181.2
18		M-3-CN-03	119.88	346.14	399.06
19	Low Income Group	L-1-CN-01	49.61	124.39	62.22
20		L-1-CN-02	104.77	182.32	111.63
21		L-1-CN-03	255.26	95.46	56.32
22		L-2-CN-01	85.22	244.25	62.38
23		L-2-CN-02	119.5	237.89	79.28
24		L-2-CN-03	108.91	61.58	75.97
25		L-3-CN-01	131.76	163.65	227.02
26		L-3-CN-02	90.25	181.91	254.79
27		L-3-CN-03	72.93	122.29	209.85
28	Market (Fruit & Vegetables)	FV-1-CN-01	208.97	169.91	51.94
29		FV-1-CN-02	256.25	131.83	107.84
30		FV-1-CN-03	117.89	217.44	63.34
31		FV-2-CN-01	116.39	595.36	125.7

Sr No.	Discharge Source	Sample Code	Season 1	Season 2	Season 3
32		FV-2-CN-02	149.57	102.42	93.44
33		FV-2-CN-03	115.43	696.47	171.1
34		FV-3-CN-01	93.85	172.9	238.33
35		FV-3-CN-02	147.19	181.91	255.57
36		FV-3-CN-03	87.21	122.29	219.29

ANNEXURE VII –PHOTOGRAPHS OF WASTE CHARACTERIZATION ACTIVITY

Figure 21: Transportation of Waste in Mini Tippers

Figure 22: Tagging of Waste Bags for Identification

Figure 23: Tagged Waste Bags Collected From Residential Area

Figure 24: GPS Coordinates for Mapping of Collection Points

Figure 25: Waste bags transported at the base station

Figure 26: Source wise area marked at the base camp for storage of waste bags

Figure 27: Opening of source wise waste bag for characterization

Figure 28: Opening of source wise waste bag for characterization

Figure 29: Cutting of textile into small pieces before starting characterization

Figure 30: Reducing waste amount using coning method

Figure 31: Tapping of bucket for specific gravity

Figure 32: Segregation of waste for characterization

Figure 33: Segregation of waste for characterization

Figure 34: Screening of waste for soil extraction

Figure 35: Physical characterization Bins at the base camp

Figure 36: Weighing of waste at the weigh scale

ANNEXURE VIII: LABORATORY RESULTS