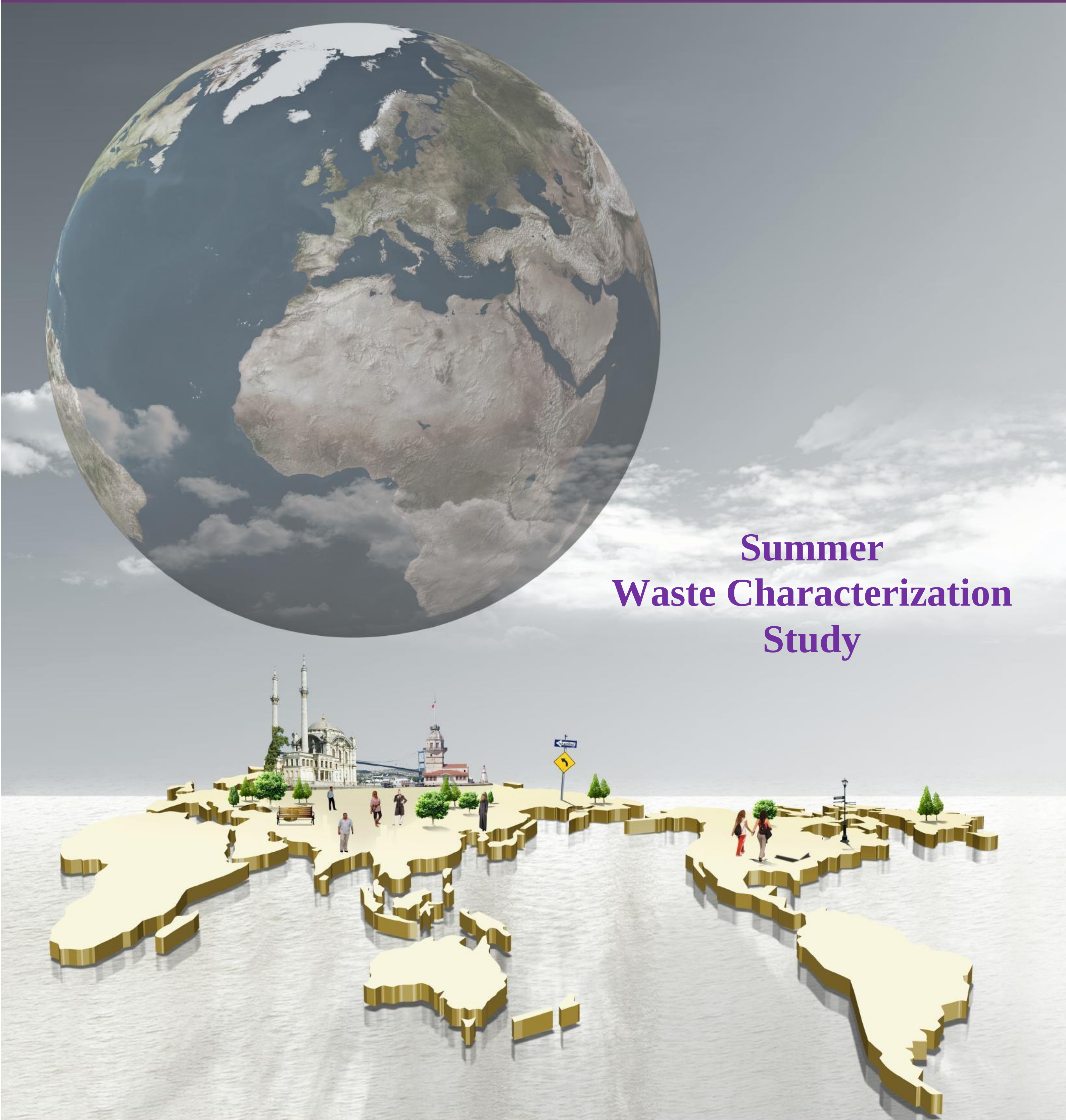
CONSULTING SERVICES PROJECT FOR INTEGRATED SOLID WASTE MANAGEMENT OF LAHORE CITY OF THE STATE OF PUNJAB IN PAKISTAN



Summer Waste Characterization Study

ISTAC

NOVEMBER/2011

CONSULTING SERVICES PROJECT FOR INTEGRATED SOLID WASTE MANAGEMENT OF LAHORE CITY OF THE STATE OF PUNJAB IN PAKISTAN

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ABBREVIATES

ISTAÇ A.Ş. : İstanbul Environmental Management Industry and Trading Company

LWMC   : Lahore Waste Management Company

ASTM   : Standards Test Methods for Determination of The Composition of Unprocessed Municipal Solid Waste

SWA-Tool : Methodology for the Analysis of Solid Waste, European Commission.

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EXECUTIVE SUMMARY

Introduction

The first step to be taken in the waste management studies requires the determination of the features of the waste. Waste amount, density, material group analysis, humidity content, loss on ignition and calorific value are the basic features reflecting the waste characteristic. In this study, the waste features mentioned above for determining the waste characteristic are researched. The results obtained will be the reference values in forming an optimum waste management. The results obtained, reflects just one study. Together with the increasing number of studies, the waste characteristic will be more evident.

Determinations

The biodegradable waste content of Lahore is the most prominent factor in the waste characterization study. So biodegradable waste content of the Lahore in summer, is quite high in general (over %60). High levels of biodegradable content throughout Lahore will provide considering the Technologies with high priority in elimination methods to be preferred.

Another important issue is that wastes of the similar regions having the same social welfare level have the similar features characteristically. On the other hand is that a certain social welfare level can be distinguishable from the regions with other social welfare levels significantly. This case can be evaluated positive in terms of directing the wastes with similar characteristics simply.

Suggestions

The waste characteristics display a significant variability when examined in long periods (10-20 years). Moreover it can also display serious variability in short periods (3-5 years) due to some factors. In this sense tracing the waste characteristic will be appropriate. These analyses are performed in routine and the variability attained should be based on the cause-effect relation. For the region or regions determined for any planning or investment, a more detailed study is needed besides a routine study.

Outcomes

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In this study, winter session solid waste characterisation for the city of Lahore is determined. In the 60 samples taken for this study, substance group analysis, waste density, humidity content, loss in ignition and high calorific value analyzes are performed.

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1.0 INTRODUCTION

Solid waste characterization constitutes the basis of integrated solid waste management. For a reliable integrated waste management, it is of great importance that solid waste characterization is determined by considering representativeness.

Solid waste analysis and test work requires sufficient and representative amount of samples. Solid wastes to be analyzed are available in different environments and physical conditions. Moreover, each sample to be taken must be in conformity with these physical conditions and waste to be characterized. Solid wastes to be analyzed are generally available in non-homogenous mixtures and different forms. In this case, taking representative sample requires a careful and well planned work (ASTM, 2003).

As the population of the settlement unit increases, so does variety and unit quantity of the solid waste. Solid wastes' quantities and qualities change depending on the country, and even within the same country according to the region, and within the same city according to the district. Although this change depends on the society's socio-economic structure, it is more dependent on income level and consumption and usage habits. If solid wastes are not collected regularly and disposed appropriately, they pose a threat for the environment and public health. Particularly in the developing countries, due to insufficient solid waste management, solid wastes cause air, water, soil and visual pollution. To monitor solid waste structure that change depending on several components, samples must be taken periodically.

In this study, urban waste characterization to constitute the basis of the waste management to be established in Lahore was determined. By carrying out laboratory analyses in addition to material group categories, characterization of waste was determined. Obtained values were evaluated in terms of waste characterization and waste management.

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2.0 METHODOLOGIES

In scope of Pakistan, Lahore city solid waste characterization work, one field study was planned for both summer and winter months. To determine solid waste characterization of summer season, characterization work was conducted between 1-7 July 2011 after making field analyses.

In the characterization work, the standard titled American ASTM D5231 "Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste" and methodology titled "European Commission-Methodology for the Analysis of Solid Waste(SWA-Tool)" were taken as the basis.

In the characterization work, socio-economic structure of the regions was considered. In this context, 3 different social welfare levels as low income, middle income and high income were taken as the basis in the regions, where samples were taken from. Besides, by considering Commercial Regions and Institutes, samples were taken from there too (Table 2.1).

Table 2.1 Region Classification for Samples to Be Taken for Lahore Waste Characterization Work

No	Regions
1	Low-Income Regions
2	Middle-Income Regions
3	High-Income Regions
4	Commercial Regions
5	Institutes

Lahore Waste Management Company initiated waste management from the selected pilot regions. With the site investigation, it was determined that these pilot regions represent general Lahore. In the characterization study, pilot regions selected were focused on. Moreover, to compare pilot regions with the others, random samples were taken from other regions.

Before commencement of the work, regions, from which the samples are to come from, were determined, and samples were directed to the field according to the determined work schedule. In such regions, routine collection works were performed without selecting wastes. Before waste loaded vehicles are directed to the work region, weighing was realized (Photograph 2.1). Waste vehicles' capacity ranges between 5-10 m^3. Information concerning the region and waste quantity were received from each incoming vehicle and recorded (Photograph 2.2). All wastes on the vehicles were unloaded to take samples (Photograph 2.3).

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Photograph 2.1 Weighting Solid Waste Collection Vehicles in Weighbridge

Photograph 2.2 Receiving Information of the Region where Waste Comes from

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Photograph 2.3 Discharging Solid Wastes Coming from Determined Regions

Then, by mixing the tractor with scoop, a homogenous mixture was obtained (Photograph 2.4). Due to the size of the samples, it was not deemed adequate to use quartering method. Sample taking in a representative manner was realized by making use of shovel from each side of the waste made homogenous.

Photograph 2.4 Mixing the Waste Discharged from the Vehicle by Clipper to Take Samples

In taking characterization sample, 0.5 m^3-scale container with open top, made of iron and with carrying holders was used. In sample taking, scale container was filled completely without compressing (Photograph 2.5, Photograph 2.6). 0.5 m^3-sample volume was chosen, as it meets with the criterion of working with 91-136-kg samples stated in ASTM standard.

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Photograph 2.5 Filling Wastes in 0.5 m3 Volume Container for Classification Work

Photograph 2.6 Discharging Representative Samples Taken in the Place of Classification

To prevent confusion among the samples taken to conduct characterization, tables reading sample code were used. Therefore, no confusion occurred (Photograph 2.7).

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Photograph 2.7 View of the Tables Placed next to Solid Waste Aggregates

In waste characterization, 3 groups worked. To have the pre-work segregation operation more reliable, workers to carry out segregation work were provided training on the issue (Photograph 2.8). Separate buckets were procured for each substance group, and segregated substance groups were put in those buckets. Before the work, bucket tare was taken.

Photograph 2.8 Providing Training to the Staff to Carry out Segregation Work

Before the work, workers to carry out segregation work were provided training on the issue. It was explained in detail, which substance group will be segregated to which category. For segregation work, urban wastes were classified under 14 categories (Table 2.2). With the

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follow-up of the segregation work by the technical staff, it was ensured that the segregation work is realized adequately (Photograph 2.9, Photograph 2.10). For segregation work to be more effective, materials other than bio-degradable ones were separated from the aggregate first, and then, by assigning a worker for each material, segregation time was optimized. This is 30 minutes in average.

Table 2.2 Solid Waste Characterization Material Substance Groups

COMPONENTS		**EXPLANATION**
1	Combustibles	Combustible waste which are undefined in other categories
2	Diaper	Baby diapers and hygienic peds
3	Elec.-Electronic W.	Every type of elec. And electronic wastes.
4	Glass	Every type of glasses
5	Hazardous W	Accumulator, battery, madical waste etc.
6	Biodegradable W	Food waste, fruits, vegatables etc.
7	Metals	All kind of metals
8	Non-Combustibles	Stone, demolation waste, bond, curbside
9	Paper-Cardboard	Newspaper, magazines, office papers etc.
10	Pet	Water bottles
11	Nylon	Shopping bags
12	Plastics	All kind of plastics except pet
13	Tetrapak	Milk and juice cardboard
14	Textile	All kind of textile wastes

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Photograph 2.9 View from Solid Waste Classification Work

Photograph 2.10 View from Solid Waste Classification Work

Weighing of those samples, of which segregation work was completed, was made in 10 g sensitive digital scale. For weighing the samples, formulation table was prepared in Microsoft Excel. By entering weight of each substance group in the table, characterization percentage values were obtained automatically (Photograph 11, Photograph 12, Photograph 13).

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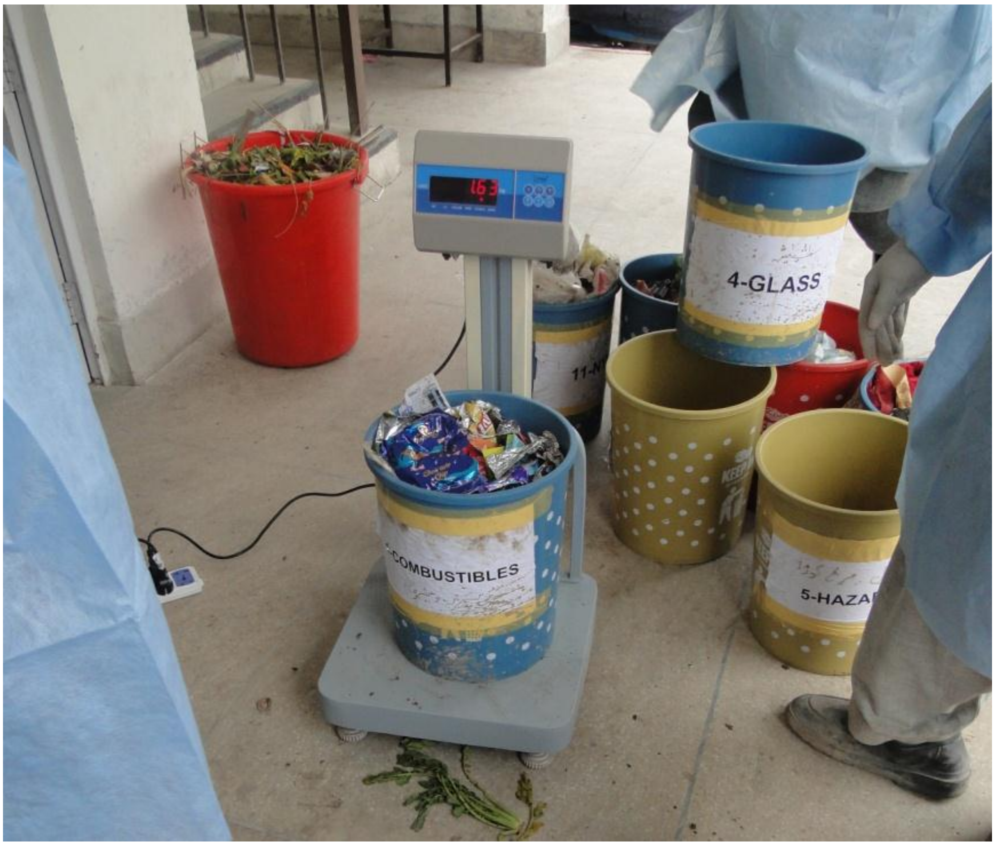
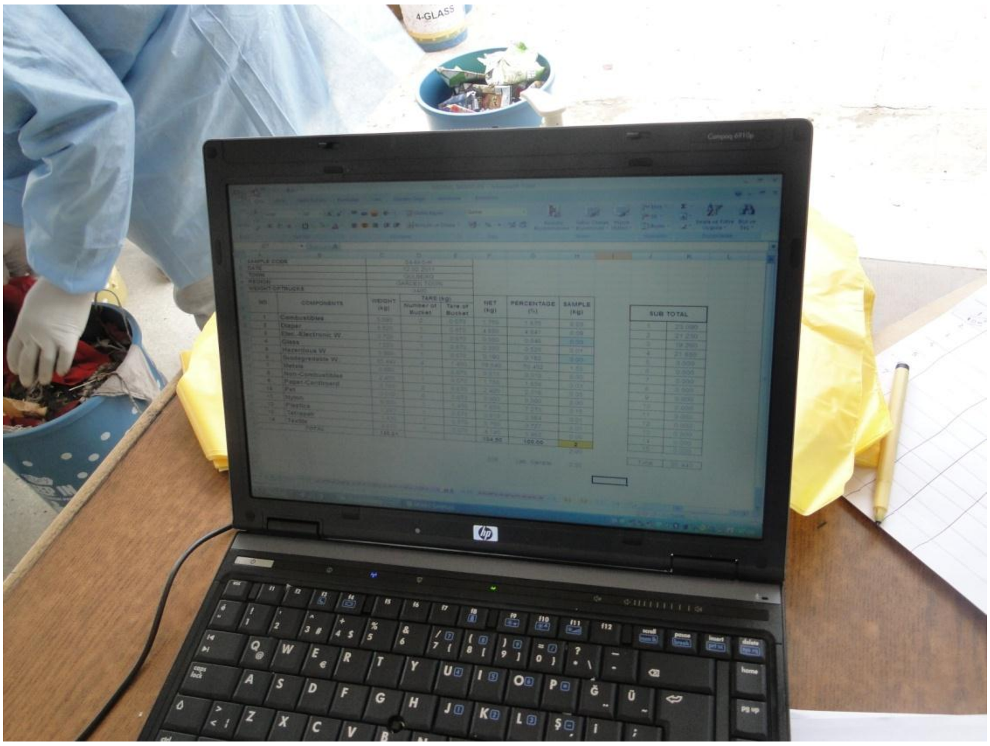


Photograph 2.11 Work of Segregation by Categories – Weighing Wastes



Photograph 2.12 Recording Weighing Results in the Computer

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Photograph 2.13 View of Classified Components

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From samples, on which substance analysis was conducted, 2-kg samples were taken for laboratory analysis (Photograph 15). Since representative quality is important, determined percentage values were used in taking laboratory samples. 2-kg laboratory samples were put into sample bags, descriptive waste code was written and they were labeled (Photograph 15). They were delivered to the laboratory staff holding international certificate, to have their laboratory analyses conducted.

Photograph 2.14 View of Sample Taking for Laboratory Analyses

Photograph 2.15 Giving Waste Codes to Laboratory Samples

3.0 RESULTS

3.1 Characterisation Results

In summer characterization work, urban waste was evaluated in 5 categories, and work was conducted on total 60 samples. Waste categories were titled as Low Income, Middle Income, High Income, Commercial and Institutions, and number of samples taken for each subgroup are respectively 12, 12, 12, 12 and 12. 44 of the samples are from model regions, while number of samples from random regions is 16. For characterization work, approximately 177.780 kg waste in total was taken to the work region, and by homogenous mixing, waste segregation work was conducted on approximately 7500 kg waste. Considering that waste density is 241 kg/m^3 in average, segregation work was conducted on approximately 30-35 m^3 waste. Average value by weight for total 66 waste characterizations conducted, were given in Figure 3.1. Results are in conformity with the characteristics of typical developing countries. Over 60% values, Biodegradable and Nylon, Textile, Diaper, Paper-Cardboard, Combustibles, Non-Combustibles are the important components following these.

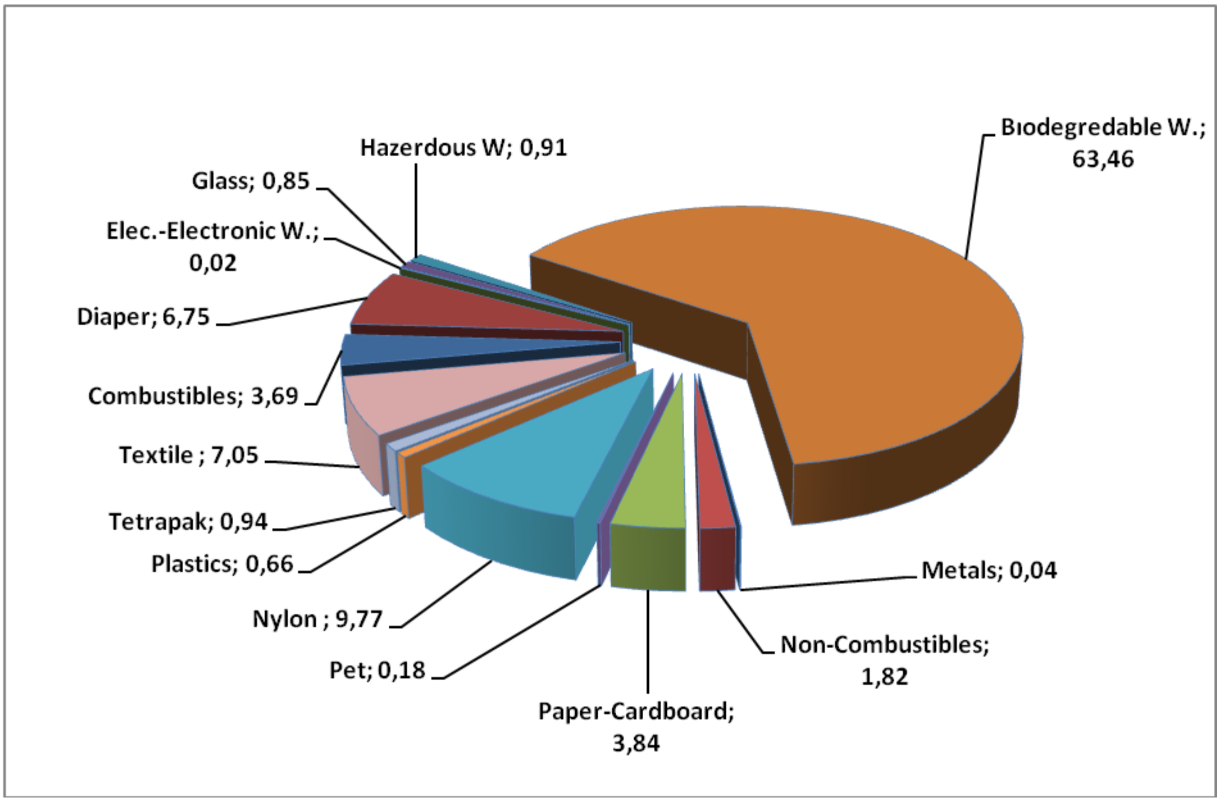

Figure 3.1 Lahore City Waste Characterization Average Value by Weight

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When model regions and random ones are compared, it is seen that there are no significant differences among low, middle, high Income and commercial classes (Figure 3.2). When all waste components are evaluated, average deviation between Model and Random Regions was found to be 0,57% which is good level for characterization study. This indicated that model regions are representative of other regions of the city. But results of Institute samples display differences. Standart deviation of institude samples is 1,68% which is also good results. There is something different for diaper in comparison Random and Model Areas. Because of a couple of hospital samples sorted in this study diaper percentages vary in high numbers which is 9,96. But this special stiation for hospital wastes.

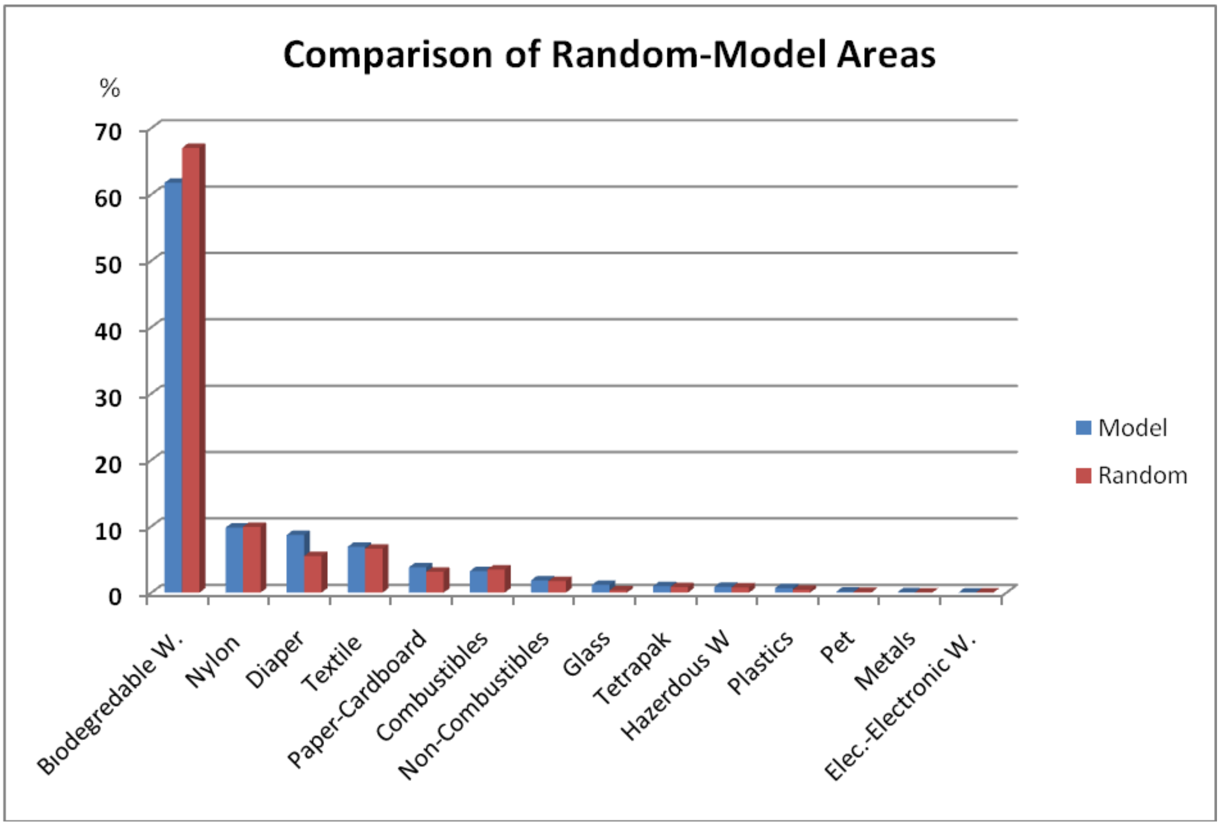

Figure 3.2 Comparison of the Average of the Samples Taken from Model and Random Regions

Table 3.1 contains model, random region results of all classes and their percentage averages by weight. In this way, wastes from different income levels, commerce and institutions can be easily compared. While comparing the values, with a general approach 2-3% of the biodegradable part can be considered as non-combustible. But in summer study it is determined that street sweepings and demolition waste get lower in compare to winter. This results from the difficulties in separating non-combustible waste components such as street waste, demolition waste from biodegradable part. Moreover, due to the difficulty of separating biodegradable waste in 100% level, almost 1% thereof can be considered as combustible and paper-carton, nylon, textile etc. wastes.

Table 3.13 Change of Waste Content according to Income Level, Commercial, Institutional, Model and Random Regions

TYPE of REGION		LOW INCOME			MIDDLE INCOME			HIGH INCOME			COMMERCIAL			INSTITUTIONS			OVER ALL
COMPONENTS		MOD.	RAN.	ALL	MOD.	RAN.	ALL	MOD.	RAN.	ALL	MOD.	RAN.	ALL	MOD.	RAN.	ALL	
1	Combustibles	3,82	1,62	3,45	2,52	2,93	2,59	2,78	2,77	2,77	2,46	1,55	2,31	4,66	8,67	7,33	3,69
2	Diaper	5,00	1,14	4,36	9,68	7,70	9,35	5,56	6,20	5,67	2,05	5,45	2,62	21,17	7,09	11,78	6,75
3	Elec.-Electronic W.	0,12	0,00	0,10	0,02	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02
4	Glass	1,08	0,48	0,98	1,55	0,52	1,38	0,22	0,24	0,22	0,71	0,00	0,59	2,26	0,46	1,06	0,85
5	Hazerdous W	0,71	0,00	0,59	0,89	0,65	0,85	0,13	0,00	0,11	0,01	0,17	0,04	2,61	3,15	2,97	0,91
6	Bıodegredable W.	60,62	77,32	63,40	63,54	63,68	63,56	68,42	69,34	68,57	72,32	72,39	72,34	43,86	52,22	49,44	63,46
7	Metals	0,02	0,02	0,02	0,18	0,00	0,15	0,01	0,00	0,00	0,02	0,00	0,02	0,02	0,03	0,03	0,04
8	Non-Combustibles	2,01	1,29	1,89	0,88	1,89	1,05	4,57	2,74	4,26	1,05	2,08	1,22	0,70	0,69	0,69	1,82
9	Paper-Cardboard	3,22	1,84	2,99	4,74	2,34	4,34	2,49	2,78	2,54	2,60	1,33	2,38	6,05	7,41	6,96	3,84
10	Pet	0,09	0,00	0,08	0,37	0,00	0,30	0,08	0,00	0,07	0,01	0,05	0,02	0,15	0,57	0,43	0,18
11	Nylon	10,82	7,52	10,27	9,48	10,91	9,71	7,96	8,45	8,04	8,95	11,37	9,35	11,78	11,32	11,48	9,77
12	Plastics	0,82	0,12	0,70	1,19	0,55	1,08	0,56	0,24	0,51	0,20	0,57	0,27	0,69	0,76	0,74	0,66
13	Tetrapak	0,62	0,47	0,60	0,63	0,49	0,61	0,48	0,47	0,48	0,55	0,42	0,53	2,68	2,42	2,50	0,94
14	Textile	11,05	8,17	10,57	4,34	8,35	5,00	6,75	6,78	6,75	9,06	4,62	8,32	3,37	5,22	4,61	7,05

3.2 Evaluation by Classes

Results obtained for each income level, commerce and institutions were considered graphically.

3.2.1 Low Income Areas

In Figure 3.3, characteristic values for the wastes from the regions with low income levels are provided. Contrary to the expectations, biodegradable waste content is 63,40% or lower when compared with the other income levels. The most important factor ensuring these low levels of biodegradable waste is regarded as the high levels of the textile and nylon wastes with the percentage of 10,5 and 10,2, respectively. Diapers, combustibles and cardboard-paper wastes, being the other types of wastes standing out in the low-income group have the percentages of 4,36, 3,45 and 2,99, respectively.

The considerable amount of increase is not observed in the textile and nylon wastes. The percentage of the diaper showed a little decrease, however its level is close to the winter characterization. Diaper differs in all income groups at 5-10%.

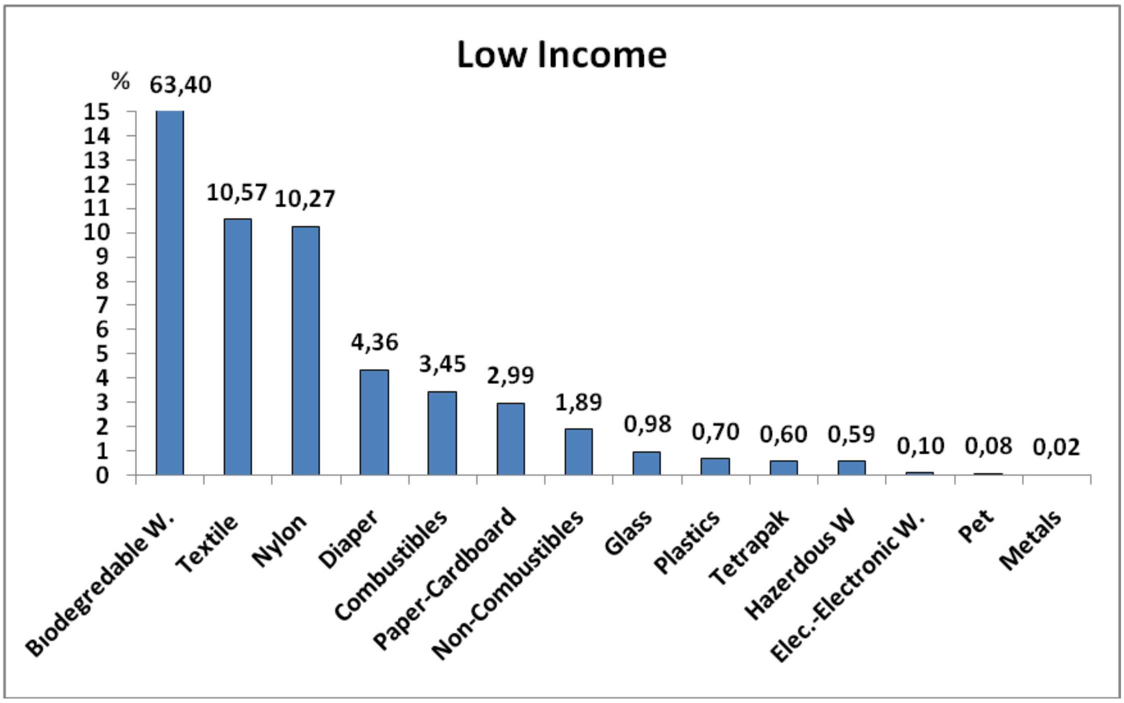

Figure 3.3 Weight Average of Low Income Regions

3.2.2 Middle Income Areas

Waste content of middle-income level was given in Figure 3.4. As in other groups, biodegradable waste has the highest percentage with 63.61%. This value is expected to be lower than low-income regions' biodegradable percentage. Other prominent waste components are respectively Nylon 9.67%, Diaper 9.58%, Textile 5.42%, Paper-Cardboard

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4.24%, Combustibles 2.61%.

The increase in the waste compositions has decreased the percentage of the biodegradable waste. Evaporation arising in the droughty seasons is the most determinant factor in this respect. Another situation to be noted is the considerable increase in the cardboard-paper wastes and decrease in non-combustibles. Besides it is observed increase in the percentage of the combustibles.

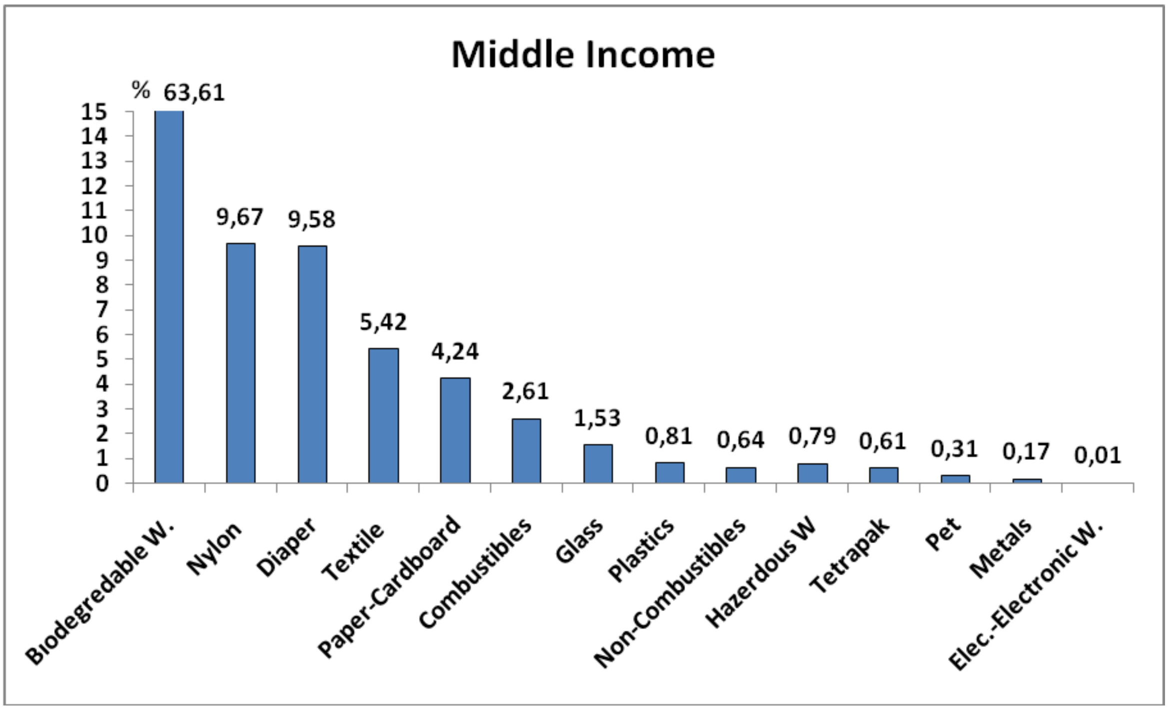

Figure 3.4 Weight Average of Middle Income Regions

3.2.3 High Income Areas

Biodegradable waste content is seen to be higher than in other income groups (Figure 3.5). As a natural result of the increasing packaged product consumption with the increase in social welfare level, package value within the waste is high. In parallel with this, biodegradable waste content percentage's decrease is expectable in high-income regions. High biodegradable waste obtained 68,57% in the results is due to significant amount of park and garden wastes in the waste content. Other prominent waste components in high-income level regions are respectively Nylon 8.04%, Textile 6.75%, Diaper 5.67%, Non-Combustibles 4.26%, Combustibles 2.77% and Paper-Cardboard 2.54%. When the results of the summer-winter work obtained in the high-income level are compared, the waste compositions differ in terms of percentage, but the percentage ranking remains unchanged.

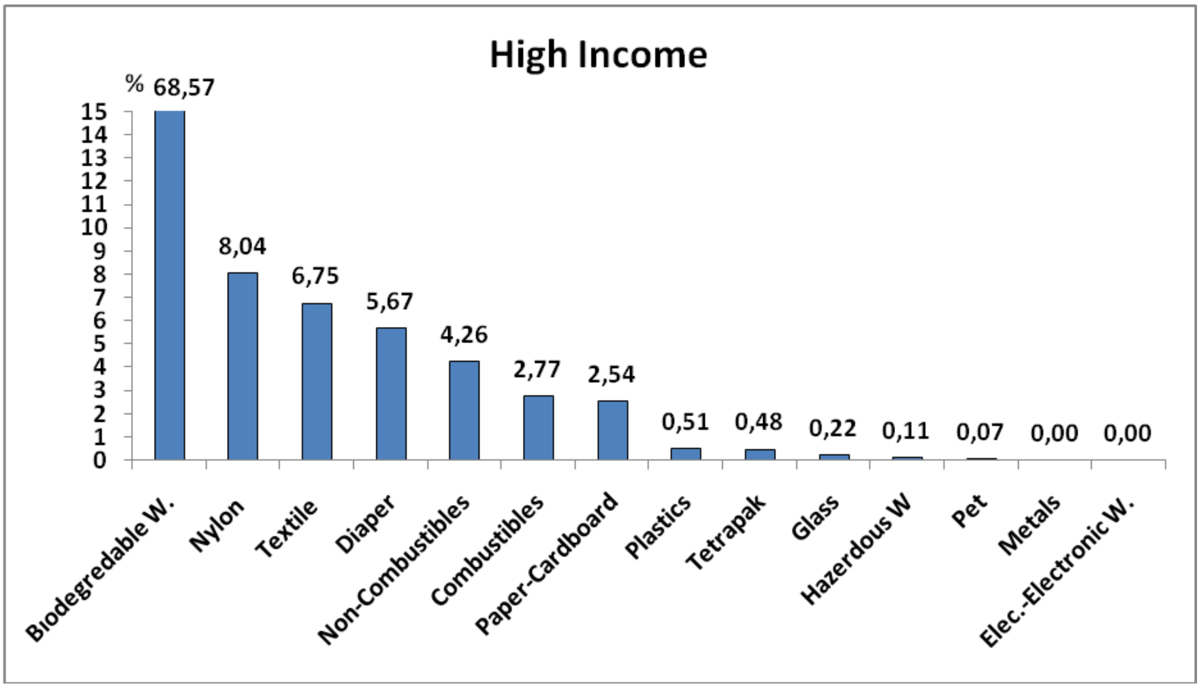

Figure 3.5 Weight Average of High Income Regions

3.2.4 Commercial and Intitutions

Samples taken from commercial regions show typical domestic waste characteristic (Figure 3.6). Biodegradable waste content reached to peak figures in commercial regions. It is not an expected situation in the waste characterization. To find the source of this situation the commercial regions can be monitored. As is the case in winter characterization, nylon and textile wastes stand out with 8.61% and 8.29%, respectively.

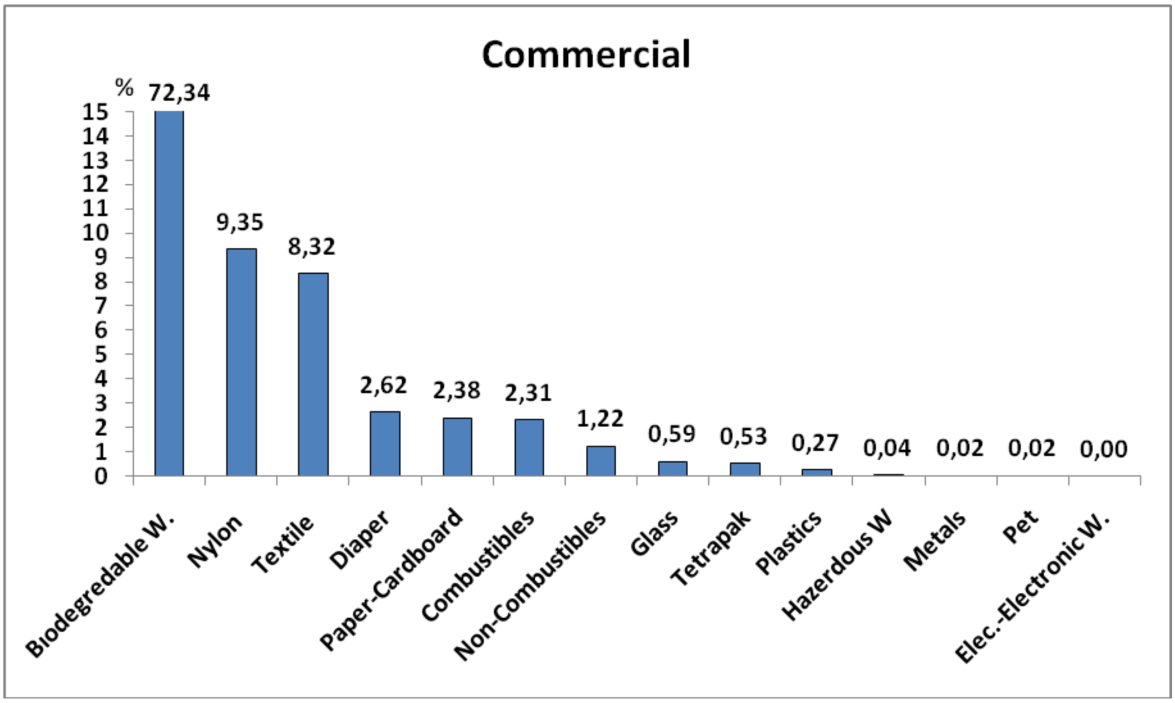

Figure 3.6 Weight Average of Commercial Regions

While evaluating the results obtained from the samples taken from institutions given at Figure 3.7. When institution samples are evaluated in general, recoverable waste is seen to be high. It will be adequate to initiate recovery works from institutions. The level of biodegradable waste in the samples taken from institutions is high with the rate of 49,44% . This situation results from the high level of park and garden wastes formed in the institutions. The other prominent waste composition is diaper which is under the level of 1% in the winter characterization, but recorded to be 11,78% in this work. This situation results from the high diaper content of the samples taken from the hospitals in the summer work. In the winter work, the waste was not taken from the hospitals.

The significant waste compositions are Nylon, Combustible, Paper-Cardboard, Textile and Tetrapak, respectively. The other prominent composition is hazardous wastes with the rate of 2,97%. This situation results from the failure in efficient collection of the medical wastes from the hospitals.

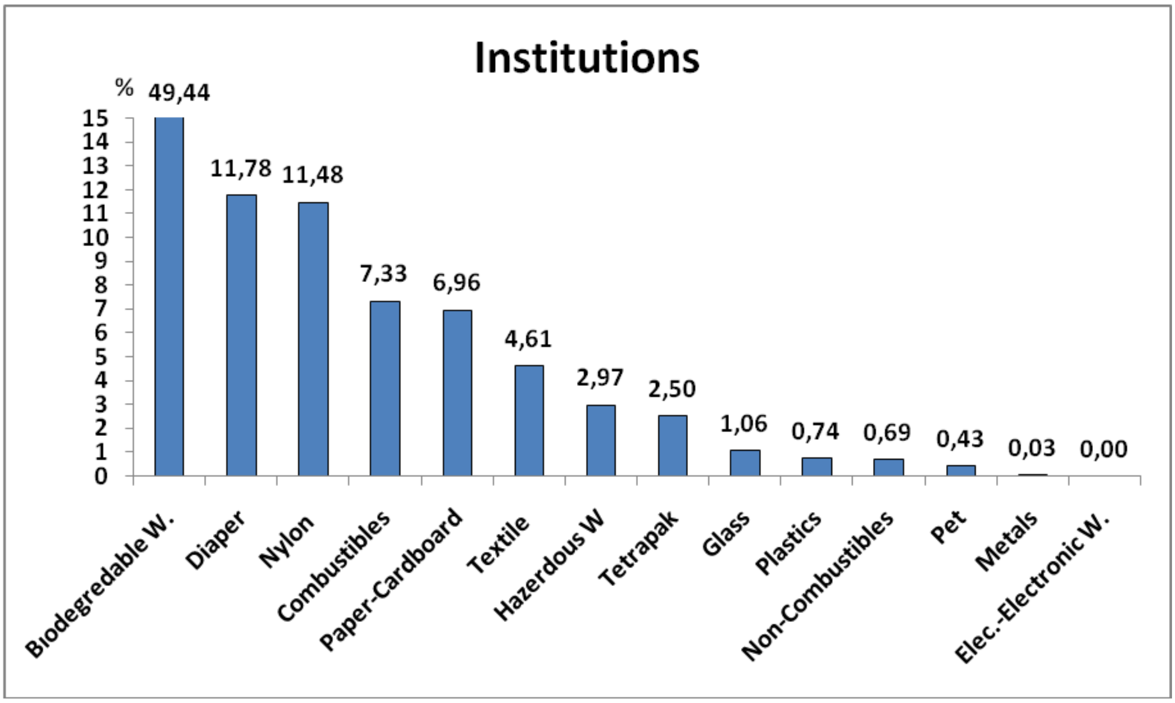

Figure 3.7 Weight Average of Model Region Institutes

3.3 Labaratory Analysis

In the laboratory samples, for summer season, taken as representatively from the samples taken to determine the waste content, the humidity content, ignition loss and high calorific value(Gross Calorific Value) determination analyzes are performed. The laboratory analyzes are realized in the internationally accredited SGS Group Laboratory. For these analyses, followed is the ASTM and ISO-DIN standard methods which have international validity. The results pertaining to the laboratory analyzes are given in Table 3.4.

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The average of humidity content analysis performed in 60 samples in total is found as % 63. It is expected that the humidity content of wastes is low in dry seasons. This situation differs in Lahore City due to monsoon rain. In the first 2 days of the 5-day waste characterization work conducted, it is observed rainfall. While in the rainy days humidity content of the wastes is 71,82 on average, it is found as 59,91% on average in dry days. Regarding humidity content of the wastes, besides rainfall, the amount of material having a feature of water retention included in the waste has also important impact.

The average of the volatile matter content for all the content is at level of %23,5. For the samples in which the inert matter is high, this value is observed to be even under %15 levels. The highest volatile matter levels are found in the samples taken from the institutes. Organic Matter (ARB) value of inert materials will exceed the level of 50% through separate collection of street rubbishes and wreckage wastes.

For the calorific value, only the high (gross) calorific value is considered. The waste calorific value shows increase with the increase in the social welfare level and accordingly the increase in the packaged and burnable products. The lower calorific value of Lahore can be considered in the subsequent studies, as H, O, C, S, N and Ash analyzes are needed for the determination of the lower calorific value, it is deemed to be unnecessary in this stage. The calorific values show parallelism with the volatile matter values. The highest values are found in the samples taken from the institutes. The average high calorific value is at the level of 1.481 kcal/kg. When high (gross) calorific value increased by the time over 3.000 kcal/kcal values thermal technologies can be taken to consideration.

Table 3.4 Results of Laboratory Analysis (SGS International Laboratory)

NO	SAMPLE MARKİNG	Moisture (ARB) %	Organic Matter (ARB) %	Gross Calorific Value (ARB) Kcal/Kg
		110 °C by 24 Hours (Till Constant)	550 °C by 02 Hours	Based on ISO-DIN 51900-2
1	1-M-l-C	79,70	11,48	729,00
2	2-M-l-L	68,72	17,87	1109,00
3	3-M-l-L	64,88	18,15	1013,00
4	4-M-l-I	68,24	23,89	1521,00
5	5-M-l-I	81,43	15,07	993,00
6	6-M-l-H	57,48	19,40	1141,00
7	7-M-l-M	70,62	20,47	1317,00
8	8-M-l-M	83,89	12,64	826,00
9	9-M-l-C	65,23	27,02	1518,00
10	10-M-l-H	52,56	14,45	717,00
11	11-M-2-H	73,05	13,32	753,00
12	12-M-2-C	81,98	11,32	**687,00**
13	13-M-2-H	75,00	16,90	1010,00
14	14-R-2-I	82,75	10,24	605,00
15	16-R-2-I	30,23	58,43	4120,00

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16	17-R-2-L	60,61	16,72	935,00
17	18-R-2-I	55,14	25,94	1704,00
18	19-R-2-H	59,86	24,66	1581,00
19	20-M-2-L	54,37	26,34	1596,00
20	21-M-2-L	63,48	25,98	1498,00
21	22-M-2-C	70,75	17,01	947,00
22	23-M-2-M	83,91	10,72	651,00
23	24-M-2-M	65,83	24,47	1485,00
24	25-R-2-C	62,81	22,47	1334,00
25	26-M-3-C	63,03	23,98	1505,00
26	27-M-3-H	65,67	23,77	1483,00
27	28-M-3-C	60,27	23,74	1440,00
28	29-M-3-H	65,55	22,60	1376,00
29	30-R-3-I	48,61	36,53	2252,00
30	31-R-3-C	56,35	23,31	1445,00
31	32-M-3-M	60,07	31,01	1700,00
32	33-M-3-M	65,86	26,37	1708,00
33	34-R-3-I	68,96	23,52	1477,00
34	35-M-3-L	59,12	26,94	1900,00
35	36-M-3-L	58,13	30,26	1904,00
36	37-M-4-I	42,87	28,54	2184,00
37	38-M-4-C	59,32	24,88	1571,00
38	39-M-4-H	72,11	22,18	1401,00
39	40-M-4-H	61,44	22,71	1263,00
40	41-R-4-I	52,08	26,52	1706,00
41	42-R-4-M	74,54	14,02	808,00
42	43-M-4-M	61,44	28,06	1800,00
43	44-R-4-H	44,75	24,76	1448,00
44	45-R-4-L	51,51	38,62	2742,00
45	46-M-4-L	53,15	26,51	1835,00
46	47-M-4-C	49,76	32,60	2056,00
47	48-M-4-L	49,09	24,93	1518,00
48	49-R-4-I	59,82	28,78	1890,00
49	50-M-4-M	53,55	28,60	1847,00
50	51-M-5-H	47,67	27,10	1722,00
51	52-M-5-H	51,79	24,20	1536,00
52	53-M-5-C	72,59	18,71	1157,00
53	54-R-5-I	64,16	25,96	1551,00
54	55-M-5-I	68,33	24,48	1645,00
55	56-M-5-C	72,61	19,64	1234,00
56	57-M-5-L	59,76	26,61	1853,00
57	58-M-5-L	49,58	31,24	1878,00
58	59-M-5-M	67,56	24,10	1593,00
59	60-R-5-M	65,87	21,33	1308,00
60	61-M-5-M	71,71	20,33	1348,00

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Averages	**62,69**	**23,54**	**1481,23**

3.4 Individual Parameters Water Content Analysis

The effect of monsoon rains on moisture content of solid waste was researched due to the monsoon rains on first two days of characterization study. The study was focused on 6-waste components expected to be high water holding capacity. The moisture content of components was investigated as separate samples taken. The water holding capacity and moisture content of Biodegradable, Diaper, Textile and Paper were determined 77, 18; 71, 83; 64, 58; and 63, 22 respectively.

During the rainy season, the moisture content of waste can be over 70% level due to the high water holding capacity of this type of components. This situation can bring about operation problems in disposal plants in terms of waste management.

Table 3.5 Individual Parameters Water Content Analysis (SGS International Laboratory)

	Sample **Marking**	Number of Samples	**Moisture (ARB)** %	
			110 °C by 24 Hours (Till Constant)	
1	Combustible	1	60,59	43,81
		2	27,02	
2	Naylon	1	65,81	55,42
		2	45,02	
3	Biodegradable	1	72,11	77,18
		2	82,25	
4	Diaper	1	72,25	71,83
		2	71,4	
5	Paper	1	55,38	63,22
		2	71,05	
6	Textile	1	73,85	64,58
		2	55,31	

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4.0 DISCUSSION AND CONCLUSION

In the study made, the biodegradable matter content in the domestic wastes forming in Lahore takes very important place (over % 63,46). Excluding the institutes, high values in percentages are not obtained in the packaging wastes. This case changes by the welfare level and varies as the decrease of biodegradable waste in percentage, increase in the packaging type materials both in amount and percentage. ,

The average waste density is determined as 241 kg/m3. Considering the case, the range value of 250-400 kg/m3 can be used in planning. For the regions with the high waste density such as biodegradable wastes, debris wastes, street junks etc. high values of 350 kg/m3 and for some specific regions 400 kg/m3 can be used in projections.

Average humidity content of all samples is determined % 63. Humidity content increased at 10% on average against the winter characterization with the effect of monsoon rain. As it is observed rainfall for 2 days in 5-day work, it is expected that the humidity content of wastes increases over 70% in the period with continuous rainfall.

Ignition loss and gross calorific value is measured in low levels in parallel to the waste characteristic. These values are at the levels of % 23,54 and 1.481 kcal/kg on average respectively.

The results obtained can be used as reference in planning and assessments to be performed. More realist information can be obtained on waste characteristic together with the repetition of the analysis in certain periods.

With this work, summer and winter characterization work is completed. Winter and summer characterization reports are generally independent of each other. Final characterization report in which results of both characterization reports are evaluated and alignments between them are performed shall be submitted to Lahore Waste Management Company later.

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5.0 REFERENCES

ASTM, 2003. Standards Test Methods for Determination of The Composition of Unprocessed Municipal Solid Waste, D 5231-92.

SWA-Tool (2004). Methodology for the Analysis of Solid Waste, European Commission.