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CHARACTERIZATION OF DOMESTIC SOLID WASTE IN RURAL AREAS

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Abstract — *The objective of the study is to determine characterize the physical composition of the generated domestic solid waste in rural areas. The study was carried out in Union Council (UC) Maryam Zai Badaber, Peshawar. As Badaber, Peshawar has no proper solid waste collection system in order to determine number of generated solid waste samples to be collected the population of the entire UC Maryam Zai Badaber obtained from Pakistan bureau of statics (6th population and housing census 2017). Accurate number of representative samples in different mohallahs or hamlets of the UC has been determined through using published tables reported by Israel in 1992. While the representaive sample with in different hamlets of UC was carried out using the technique of simple random sampling. Besides, this preference will be given to the willingness of respondent or representative of the household. Plastic bags were provided for consecutive 14 days to the100 representative housholds for the collection of domestic solid waste samples the samples were collected sharp after 24 hours the collected solid waste samples were transferred to a temporary established centralized facility for characterization as per ASTM D 5231-92 (Reapproved 2003). It was concluded that the domestic solid waste generated with in rural areas comprising 35% of green waste (bio-degradable waste), recyclable waste 35% and 30% of non-bio- degradable solid waste. It was concluded that domestic solid waste was not properly managed due to the lack proper solid waste management system.*

Keywords- *Manual sorting, Sorting sample, Waste fraction, Composition*

I. INTRODUCTION

Solid waste management and proper disposal are presently considered as a global challenge, especially in economically developing countries because of their growing populations, change in life style, alterations in community living standards, and increasing waste generation rates which results an increase in land requirements for waste disposing and proper dumping. Unsuitable collection, processing, transport and disposal of solid waste can result many problems that will threaten human health (un-hygienic conditions, outbreak of diseases, breeding of rats and flies that spread pathogens, surface and ground water pollution), affect economy, environmental degradation (air and soil pollution), and living organisms, and consequently obstruct sustainable development (Taghipour et al., 2016).

MSW can used for the generation of electricity it's a well-known fact. Most of the researchers reported since 1970's regarding the use of the biodegradable component of MSW to generate biogas (landfill gas), which can also be used for the generation of electricity and has no environmental impacts and improve sustainability through the reduction of greenhouse gas emissions (landfills gas) and the replacement of energy sources i-e oil, coal and natural gas (Aguilar-Virgen et al., 2010).

Waste management especially in urban areas of low income countries are expensive and may serve as the single highest budget item in local administrations. Where on average twenty percent of municipal budgets are allocated for waste management. In certain cases the devoted budget resources for the management of waste can be much higher. In high income countries, proper management of solid wastes account more than ten percent of municipal budgets, while in middle income it accounts about four percent. A total of 2.01 billion tons of municipal solid waste is annually generated in world. Conservatively, at least thirty percent of which is not properly managed in an environmentally safe manner. Average solid waste generated per person per day worldwide is 0.74 kilogram but widely ranges, from 0.11 to 4.54 kilograms with wide income variations. High-income countries comprises sixteen percent of the world's population generates thirty four percent or 683 million tons of the world's total waste. It is expected that global waste may reach to 3.40 billion tons by the year of 2050 (World Bank, 2018).

Besides this global population over the next 50–75 years is expected to increase by three billion or more which results a huge increase in the number of peoples living in urban areas (more than double) (Jury & Vaux, 2005).

The extant of problems related with solid waste management is very wide and involves the consideration of all the aspects that either directly or indirectly associated with solid waste generation and its management. These aspects may include rate of increase in urbanization, urban areas pattern and density, proper planning and control of development, temperature and precipitation of the area, physical composition of generated solid waste and density, recyclable solid wastes separation by scavengers, and the respective municipality capacity, adequacy and limitation to manage the solid waste generated. The numbers of households along with growth of population are prime factor that affects solid waste generation and its management at various stages i-e collection, handling, processing, transportation and disposal (Mahar et al., 2007).

Therefore, in order to achieve goal of sustainable development, integrated solid waste management systems are required to be implemented as a tool. For integrated solid waste management, solid waste separation serve as one of the

key elements that contributes to a successful recycling program. The main objective of their study was to evaluate solid waste generation rate, characterization and recycling potential for academic building of patinas university. Two periods were identified for sampling and characterization i-e semester break and term period in th former only post graduate students are available at university while in later all the academic activities with in university are at its peak. The collected solid waste were characterize after two days, three times a week for entire month in each period. It was found that the solid waste generation rate is 5.58 and 4.66 kg per person per day for term period and semester break respectively. The results shows that almost 80 percent of generated solid waste was found to be recyclable having paper as predominant compound followed by plastic (Malakahmad et al., 2010).

At the same time changes in population results huge alterations in waste generation rates its composition and composition patterns. It is a fact that developing a proper waste management system or improving the existing one needs extensive field studies (surveys, interviews etc.) along with multi-disciplinary approach (social, economic and technical approaches) (Bushra, 2000).

In many of the developing countries, the most common practice of solid waste disposal is through open dumping and indiscriminate or uncontrolled burning. Such disposal of solid waste causes environmental degradation i-e surface and ground water sources through leachate, soil through direct contact with waste as dumpes upon it. The research study involved the following steps of selecting a representative sample through statified random sampling method, sample collection from the selected reprentative samples, analysis of the collected samples and obtaining information regarding house hold characteristics i-e size of households, income level, educational level etc. A representative sample consist a total of 50 households having 244 persons. Visits were made for the collection of generated solid wastes at regular interval for seven days. The results of the shows that a total of 275.63kg of solid waste was generated by fifty households of 244 persons per week which indicates that 0.16 kg of solid waste was generated per person per day. Analysis of the generated solid waste sample reveales that generated solid wastes consists 51.34% of garbage, 33.62% of combustable and 15.04% of non-combustible waste (Anagement, 2014).

II. MATERIALS AND METHODS

The research area Badaber is located in south of Peshawar city about 10 kilometres on Kohat road with latitude 330 57’28’’ N, longitude 71034’25’’ E and elevation of 359m as shown in Figure 1. Badaber consists of both residential area and commercial area. The commercial area mainly situated along Kohat road Peshawar having shops of vegetable, cloths, mechanics, tailors, butcher shops and general stores while residential area is purely occupied by household. Badaber Peshawar lies in town four where we have no proper solid waste management system. According to Pakistan bureau of statistics (6th population and housing census 2017 Unit & Hh, 2017) the population of Badaber is 62865 and further divided in to Huri zai, Huri zai mera and Maryam zai having population 21263, 14690 and 26912 respectively.

Accurate number of representative sample for conducting research study is obtained by using tables reported in (Israel, 1992) that will accurately specify the number of samples in accordance to population, level of precision, confidence level and degree of variability. Badaber Maryam zai is selected for the collection of samples on the basis of its maximum population. As per the mentioned research regarding sample determination 100 representative sample is required for the population of 20,000 individuals or greater.

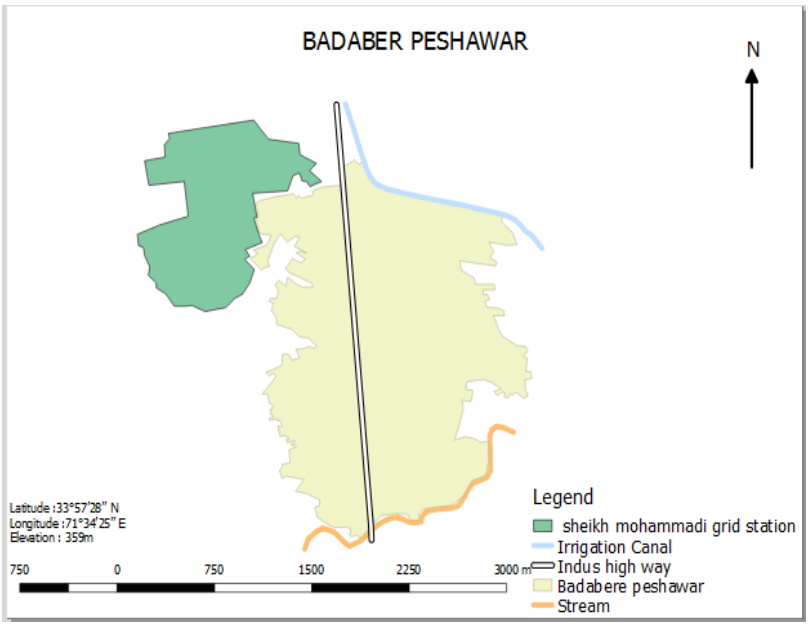

Figure 1: Map of Badaber Peshawar

Distribution of samples over the area is carried out through simple random sampling where each and every element of the household in a residential area has an equal chance of being selected in the sample. The number of samples will be then equally distributed in village councils and then in mohallahs. A representative sample in mohallah or hamlets will be selected on the basis of simple random sampling. Labeled plastic bags are provided to the household's representative as shown in Figure 2. The provided domestic solid waste samples were collected sharp after 24 hours for consecutive 14 days. The collected samples will be transported from the study area to a temporary established centralized processing facility at Javed abad Deh Bahadur near Ghari-qamar din Peshawar for segregation and weighing through Suzuki van as shown in Figure 3.

Weighing and segregation of the transferred collected samples will be carried out as per ASTM D 5231-92 (Re-approved 2003). Samples should be characterized for minimum period of one week. The sample should consist of unprocessed solid waste. Segregation of samples may be carried out at landfill site, waste processing, conversion facilities, and transfer stations. The weight of representative sample for segregation should be in rang of (91 to 136 kg).

Metal, Plastic, or Fiber Containers, sufficient for storing and weighing each waste component. Mechanical or Electronic Weigh Scale with least count of 45.35gram or 0.1lb will be used for weighing purposes. Manual sorting of the samples will be carried out. One sorting sample is selected from each collection vehicle which is practically possible in my can due to unavailability of proper waste management system in our research area as shown in Figure 4.

Figure 2: Labeling of plastic bags for domestic solid waste samples

Figure 3: Transport of collected domestic solid waste

Figure 4: Weighing collected domestic solid waste fractions

III. RESULTS AND DISCUSSION

The study was carried out for two consecutive weeks from 29/10/2018 to 11/11/2018 where weather was partially sunny and having scattered clouds and single time raining throughout. The solid waste samples were collected by both the team from the representative households in different hamlets of the UC, till 12:00 pm, where the collection of samples starts from 9 am approximately. Then these collected samples were transferred to centralize approximately in 31.85 minutes. An average of 578 kg were collected from the designated households. After emptying the labeled bags the solid waste were properly mixed and at average a sample of 100 kg were taken from the mixed domestic solid waste sample and sorted manually for which a person requires 50 to 68 minutes. At average 60 minutes are requires for segregating a sample of 101.5 kg into its components manually. And it was found that the weight of a used diaper varies 0.18 kg to 0.32 kg with an average of 0.22 kg. The waste composition found as per ASTM D 5231-92 testing procedure is shown in Table 1 and Figure 6.

Table 1: Average solid waste composition for week 1 and 2

S. No.	Waste Components	Weight (Kg)	Percent Composition	Standard Deviation
1	Papers and card board	4.7	4.60	1.00
2	Plastics	5.74	5.62	0.72
3	Fruits, vegetables wastes	26.14	25.60	1.34
4	Glass	6.32	6.19	1.95
5	Cloths	2.96	2.90	1.67
6	Metals	1.38	1.35	0.70
7	Woods, trees branches	2.44	2.39	0.47
8	Construction/demolition wastes	12.51	12.25	0.83
9	Dry grass and leaves	5.94	5.82	0.60
10	Ash and Dust	17.31	16.95	1.89
11	Polythene bags	3.42	3.35	0.48
12	Ceramics	2.42	2.37	0.53
13	Rubbers	3.14	3.07	0.46
14	Bones	1.24	1.21	0.37
15	Diapers	5.84	5.72	0.60
	Total weight of sample	102.12	99.39	

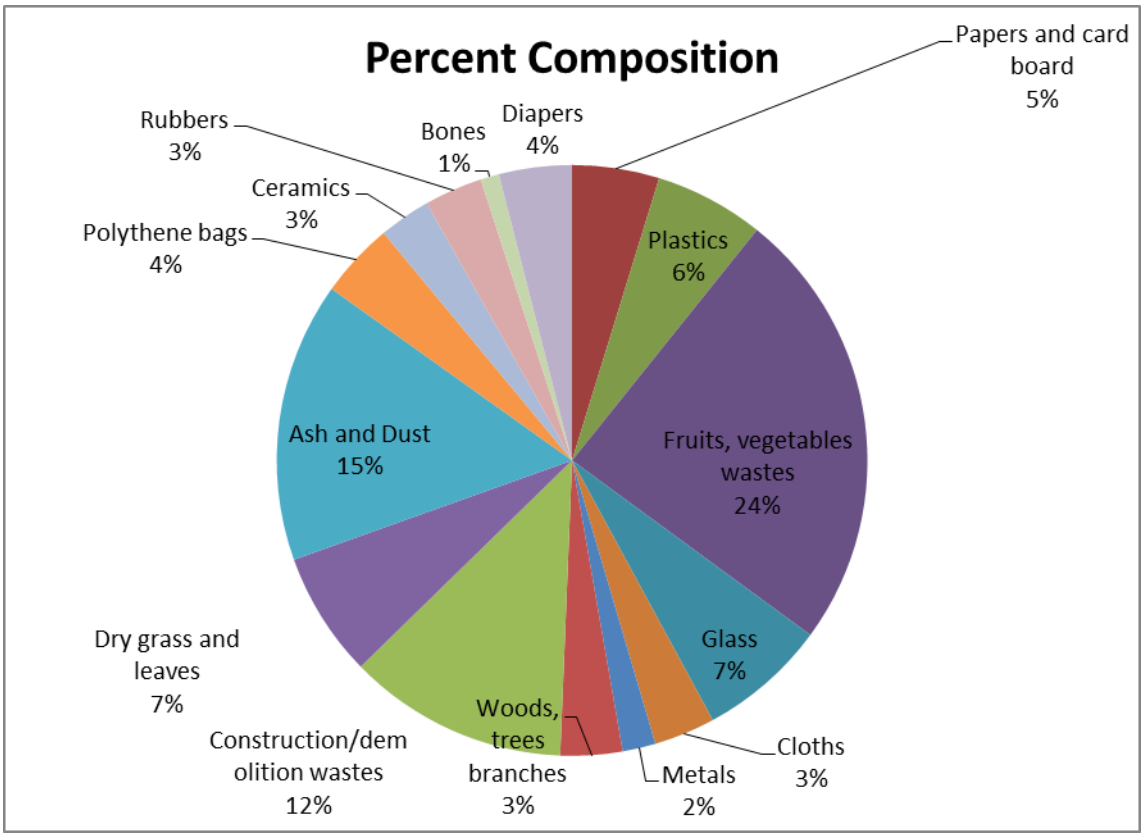

Figure 5: Average domestic solid waste composition in week 1 and week 2

IV. CONCLUSIONS

Conclusions made after the research study:

- The domestic solid waste comprises 33.60 percent of saleable solids, 33.43 percent of biodegradable solids and 32.97 percent of non-biodegradable solids.
- The biodegradable component of the solid waste can be used for making compost fertilizer or to feed livestock.
- On the basis of this study it is expected that the percent composition of biodegradable waste component in domestic waste increases due to rotting of vegetables and fruits in summer season.
- Manual sorting of 100 kg of domestic solid waste sample required 55 to 65 minutes with an average of 60 minutes per person.
- By segregating saleable and biodegradable waste from the domestic solid waste the serviceable life of landfill increases as these in combination comprises 67.03 percent of the domestic solid waste generated and after segregation they are no more a part of waste transferred to landfill.
- The remaining non-biodegradable material comprises construction and demolition waste, ash and dust, ceramics and diapers. Non-biodegradable component without diapers these can be used to fill ground depressions.
- It was concluded that domestic solid waste was not properly managed due to the lack proper solid waste management system and disposed off through open dumping along the road side, in natural streams, vacant land and in land depressions.

V. RECOMMENDATIONS

- Public education and awareness is very important and now necessary to change their attitude and behaviour while disposing domestic solid waste.
- It is necessary to established solid waste management system in rural areas to minimize the environmental and health impact of improper domestic solid waste disposal.
- After the establishment of the waste collection system labor should be hired for segregation of the collected domestic solid waste.
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