INFLUENCE OF UNDERGRADUATES ACTIVITIES ON THE WASTE COMPOSITION AND GENERATION RATES IN A RESIDENTIAL UNIVERSITY – CASE STUDY

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Abstract

The information with respect to waste composition, generation rate and its variation with time are required for the planning of proper waste management system. In this study, it was attempted to evaluate the composition and the variation of waste generation rate in the hostels of the undergraduates. The study was conducted in the premises and surroundings of the hostels of the undergraduates for a period of one year. The waste was collected from each and every hostel once in two months. The wastes were separated, weighted and percentages of different components were determined. The types of waste found in hostels of girls were less in numbers than that of boys. Over ~95 % of waste found in girls' hostels were food remains and boys generate food waste about ~71%. Per capita food waste generation by girls was ~ 207 g/day while it was ~23 g/day by boys. It appears that the amount of waste generation varied in different months basically due to examinations and other activities of the students. Based on this study, it can be concluded that major component of waste found in undergraduate hostels was food wastes and the generation rate slightly varies with the activities of undergraduates.

Key Words: Waste, Undergraduates, Waste Composition, Generation Rate, Temporal Variation

1. INTRODUCTION

Generation of different types of waste in various places such as industries, institutions, residences, is increasing at an alarming rate in the world. In considering Sri Lanka, waste collection, treatment and disposal is a serious problem in recent years due to various reasons. With the development, people are more likely to live in towns confined to a limited area aggravating the waste disposal problem. Therefore, more and more efforts have to be taken to tackle the waste disposal problem. The wastes found in residencies are composed of various materials such as degradable organics, non-degradable organics, various metals, glasses, rubber materials, textiles, papers, etc. According to the Visvanathan (2006) about 75 % of solid wastes in Sri Lanka are biodegradable. At same time these different wastes comes from various places such as markets, offices, schools, hospitals, factories, residences, etc.

Even though there are different methods that can be available for waste management, the universal waste management/disposal method that can be used in all locations in countries has not yet been developed. Therefore, it has to be developed well equipped sustainable waste management strategy for various locations in a particular country. In year 2001, it has been estimated that 6400 tons/day of solid waste were generated in Sri Lanka and day by day generation rates of wastes as well as the composition are being changed.

Wastes can generally be managed through reduction, reuse, recycling and final disposal by an environmentally friendly manner (McDougall et al, 2001). These methods can be used in micro level (in homes, institutions such as schools, offices, etc) or macro level (Urban councils or

municipal councils). The sustainable integrated waste management system is considered as the most effective and suitable procedure to be adopted for the management of waste in most parts of the world. In order to develop such a sustainable integrated waste management system, it is essential to have information about the types, amount, location and temporal variations of waste generation (Yost and Halstead, 1996). In this study, it was attempted to estimate the different types and amount of waste generation in the hostels of a higher education institution along with temporal variation through student activities.

2. MATERIALS AND METHODS

2.1. LOCATION
The estimation of waste composition is a vital part for the implementation of sustainable waste management system for anywhere. The amount of different types of waste was determined for a one year period (once in two months) in hostels of students at Faculty of Agriculture, University of Ruhuna. The faculty of agriculture was situated in Matara district, ~17 km away from Matara town along Matara-Kamburupitiya road. The faculty comprises different sections such as student hostels, staff quarters, canteen, departments, administrations complex, and research farm with an area of 65 ha. The students' hostels were located inside of the faculty.

There are 15 hostels within the faculty comprising 340 students with equal numbers of boys and girls. There are two types of hostels called as Work Units (WU) and Blocks (BL) and the different names basically are given for administrative purposes. Six WU are allocated 3 for boys and 3 for girls, each carries 30 students. Out of 8 Blocks, 4 were allocated for boys and rest for girls, each carries 20 students. The layouts of the hostels are structurally similar among WU and BL giving a common ground for each hotel when they are compared.

2.2. WASTE CATEGORIZATION
Waste estimation was performed for one year, once in two months. Total waste generated through one week in different hostels was collected, separated, categorized and estimated. Before the start of waste estimation, two color bin system was introduced to the hostels for the separation of waste into two basic categories namely degradable and non-degradable. All collected wastes in bins were categorized manually into different components such as paper, food waste, plastic, polythene, leather, wood, textile, rubber, animal waste, other organics, glass, metal, demolitions batteries, fluorescent, etc.

2.3. WEIGHT DETERMINATION AND INTERPRETATION
The weight of categorized waste was determined in wet weight basis using mechanical balances. Two mechanical weighing balances were used because same sensitivity is not enough for the determination of weight of waste which are found in very little amounts such as polythene. Different waste components were interpreted in percentages as well as in weight basis. The waste estimation was performed for a one year period.

3. RESULTS AND DISCUSSION

Hostels are the main area of the faculty where a large number of undergraduates reside and generate more wastes. According to this study, it was found that amount of wastes generated and

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their compositions are varied in girls and boys hostels. The information with respect to waste generation and composition with temporal variation in a residential university is rather new and provides an opportunity to formulate sustainable integrated waste management systems for other universities in Sri Lanka having quite similar environments.

3.1. WASTE COMPOSITION IN BOYS' HOSTELS

The collected wastes in both girls and boys hostels were separated into different categories based on their physico-chemical properties. The waste components were discarded paper, food waste, plastics, polythene, glass, textiles and metals and other types such as pet droppings, sanitary waste, electronic wastes, etc were found in very small quantities. The most prominent waste components found in the study were discarded paper, food, polythene and plastics in both girls and boys hostels. The food waste was found to be a major component in wastes while metal represents the smallest component.
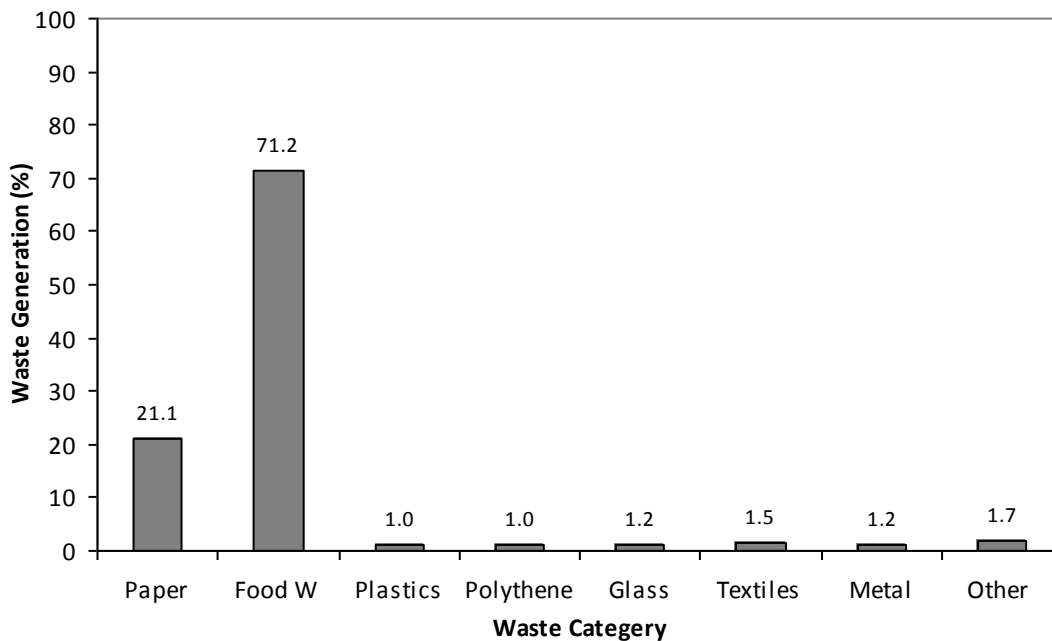

Figure 1: Waste Generation in Boys' Hostels

The types of waste found in boys' hostels were high even though the amount of waste generation was low. Discarded paper (~21%) and food waste (~71%) represent the higher proportion of waste in boys' hostels. Other types of waste were very in small quantities amounting to less than ~2% in each type, compared with paper and food waste.

3.2. WASTE COMPOSITION IN GIRLS' HOSTELS

It was found that around 95% of waste generated by girls was food waste (Figure 2). This phenomenon is basically due to the preparation of meals by themselves in their hostels. Most of the boys get their meals from outside and few of them only prepare their own food in the hostels. In the observation it was found that the wastage of prepared food by girls was also quite higher than boys.

The higher proportion of paper wastes in boys' hostels are basically due to the meal packets taken from outside. Further, boys read news papers frequently rather than girls and it will also increase

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the paper components of the wastes in boys' hostels. No glass and metals were found in girls' hostels (Figure 2). During the study period, it was observed that boys have discarded their waste into introduced bins, separately according to the category while the cooperation of girls for this activity was quite ineffective. Their attention for waste separation was poor and waste was put around waste bins.
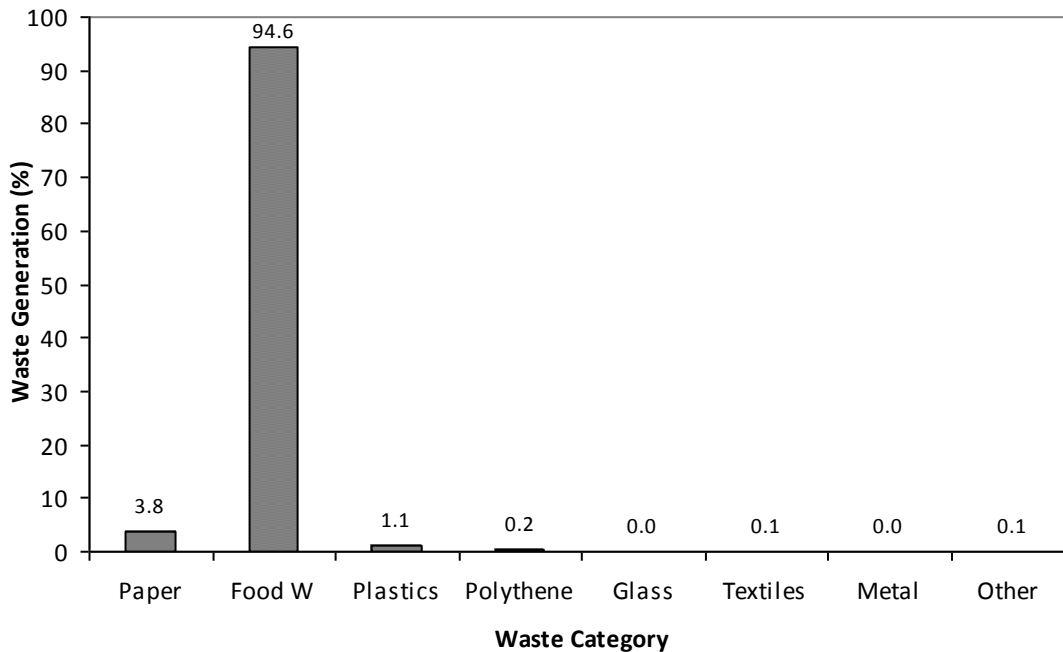

Figure 2: Waste Generation Potential in Girls' Hostels

The values for generation of different types of waste in Sri Lanka are different from the determined values (Visvanathan et al, 2004). The national values were calculated based on the total waste generation and the population in Sri Lanka. In our study, waste generation rates were calculated for certain categories of people. Therefore, if per capita waste generation were calculated for the different groups of people based on their economic conditions, education, ethnic groups, climatic conditions, geographical area, etc; actual values for the particular groups of the people can be estimated and those values are certainly, different than actual values.

3.3. WASTE GENERATION RATE BY BOYS AND GIRLS

The per capita waste generation was calculated in each waste category based on the monthly waste generation rate in boys' and girls' hostels. The generation rates of different types of waste are shown in figure 3. The food waste generation by girls (~207 g/day/person) is comparatively higher than boys (~23 g/day/person). Normally girls prepare their food in hostels and therefore food waste is comparatively higher than boys who normally bring the meal packets from outside. In contrary, the generation of other waste types such as leather, wood, textiles, rubber, glasses and metal by boys' were very high compared with the girls.

Most of them presume that the abundant waste type in almost all the places is polyethylene and plastics. However, in this study, it was found that the generation rate of plastics and polythene in both boys' and girls' hostels were very low compared to discarded paper and food wastes. The generation rate of plastics and polythene waste by boys' were 0.34 and 0.32 g/day/person and it was less than the generation rate of girls'. Girls do shopping more frequently and they may bring

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most of the items in polythene bags. On the other hand, girls prefer to have food in hostels and therefore they bring food items such as short eats and sweets to hostels from outside shops. The food shop vendors frequently and prefer to use polythene bags for the wrapping of food items. Therefore, polythene waste in hostels of girls may be higher than in hostels of boys. In addition, girls care more about their beauty and they frequently use more toilet items such as cream, oils and ointments. The containers of such items are, most of the time, plastics and it will increase the plastic waste generation in hostels of girls. At the same time, containers used for most of the canned foods (ice cream, milk, etc) are plastics. Therefore, hostels of the girls process more plastic waste than boys' hostels.
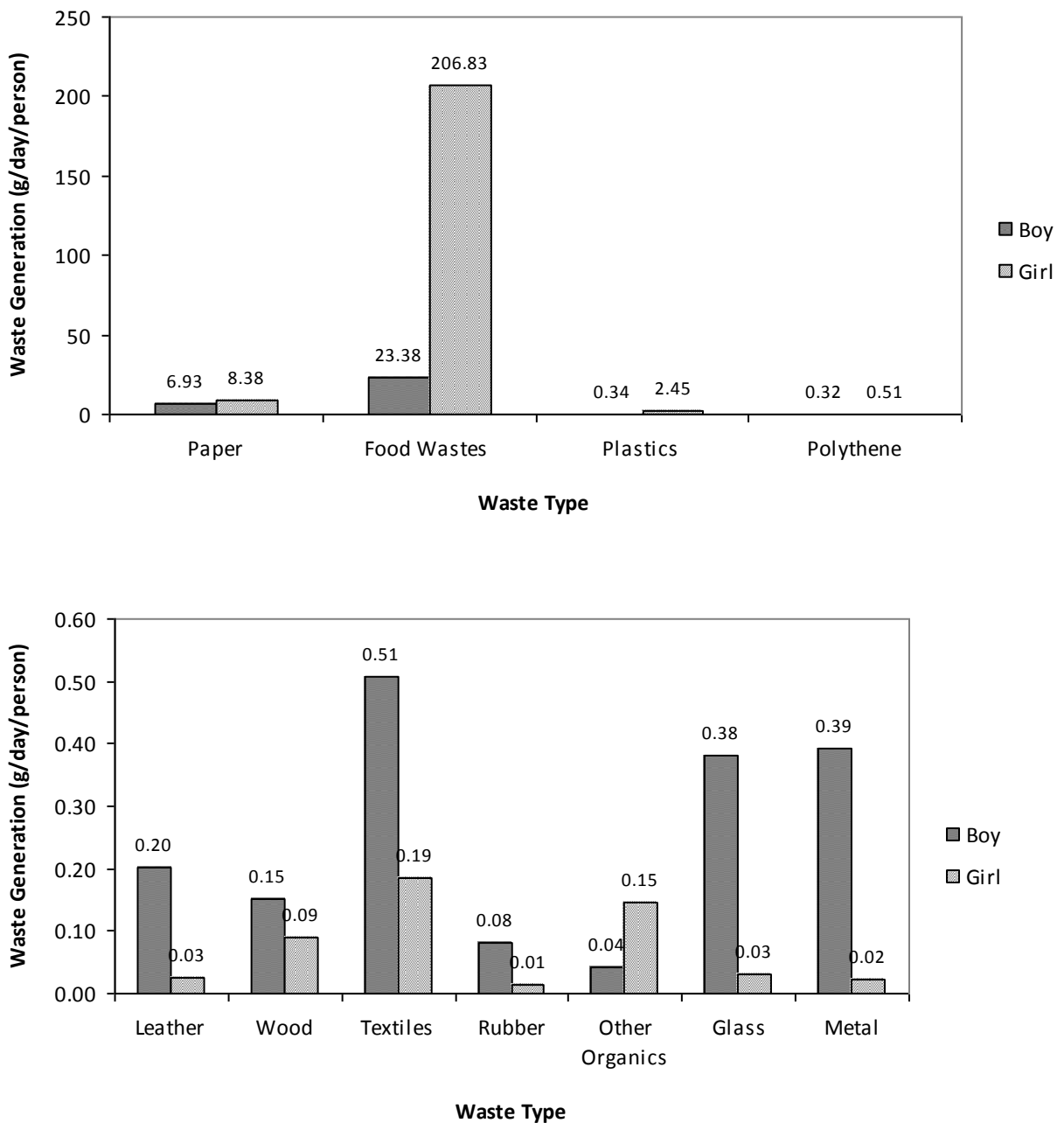

Figure 3: Different Types of Waste Generation Rates by the Students

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According to a study conducted in the University of British Columbia, Canada by Felder et al. (2001), the major components of wastes were food remains (34%) and discarded papers (23%). However, in our study, food and paper wastes contribution to the total waste is much higher. In the same study (Felder et al., 2001), the per capita total waste generation was in between ~370-420 g/day. The results obtained by our study, per capita waste generation was very low (~219 g/day for girls' and ~33 g/day for boys) compared with reported values. The quantity and composition of waste generation in an area is influenced by socio-economic conditions of residents, cultural behaviors, climatic factors and demographic attributes (Beukering et al. 1999). The per capita waste generation in Sri Lanka is in between ~0.40 -0.85 kg/day (Visvanathan and Tränkler, 2003) and the values obtained in this study is much less than those values. Since most of the undergraduates living the hostel do not prepare the meals and the garden waste is also not included, the values reported in this study are reasonable.

3.4. VARIATION OF WASTE GENERATION IN HOSTELS OF BOYS AND GIRLS

The different types of waste generation in six months period in boys' and girls' hostels are shown in figure 4 and 5, respectively. In January and July, the generation of waste (food waste) was higher in boys' hostels compared to other months and on the contrary, the waste generation is lower in girls' hostels in the same months (January and July). January and July were the study leave and examination period of the academic year 2008/2009.
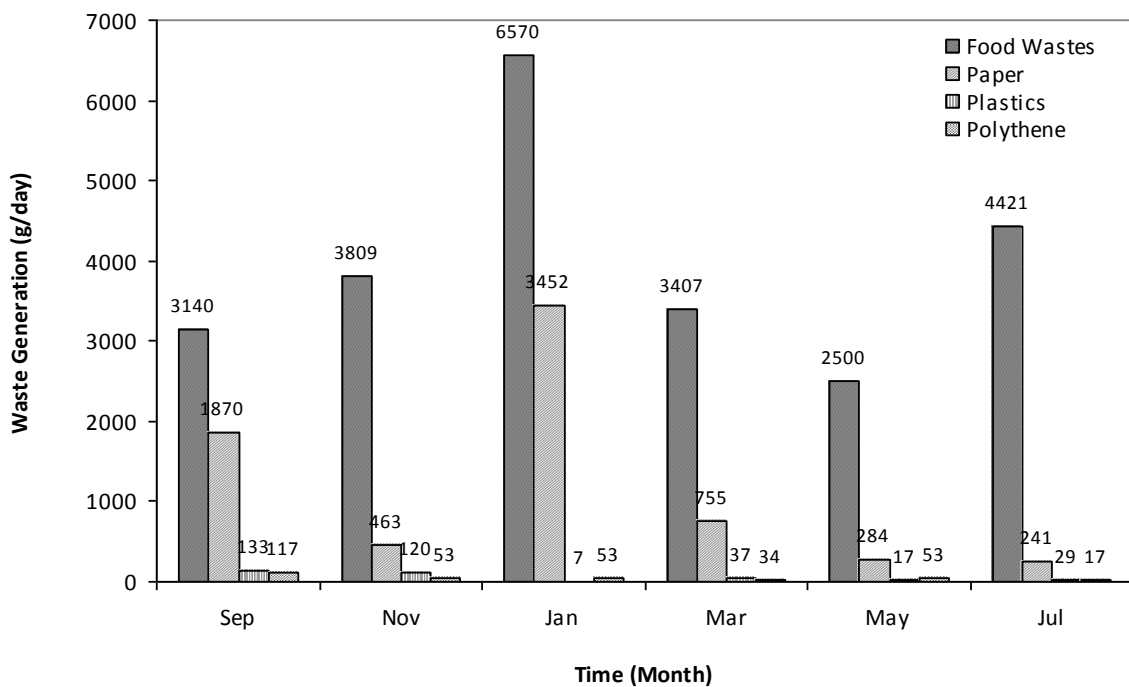

Figure 4: Waste Generation in Boys' Hostels in Different Months

Normally the boys do not prepare their meals at hostels; instead they take meals from food vendors. Probably most of them take lunch and breakfast in cafeteria and some of them bring lunch packets from outside to the hostels. Most of the boy students like to have their dinner at hostels taking from outside restaurants and vendors outside the University. The less number of students prefer to have dinner at cafeteria during academic terms. Therefore, the food waste generation in boys' hostels is normally less. However, during study leave and examination period, the most of boys like to have their breakfast, lunch and dinner at hostels taking from outside. As a

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result, the generation of waste is normally expected to be higher during these periods. The results of the study confirmed the above argument (Figure 4).
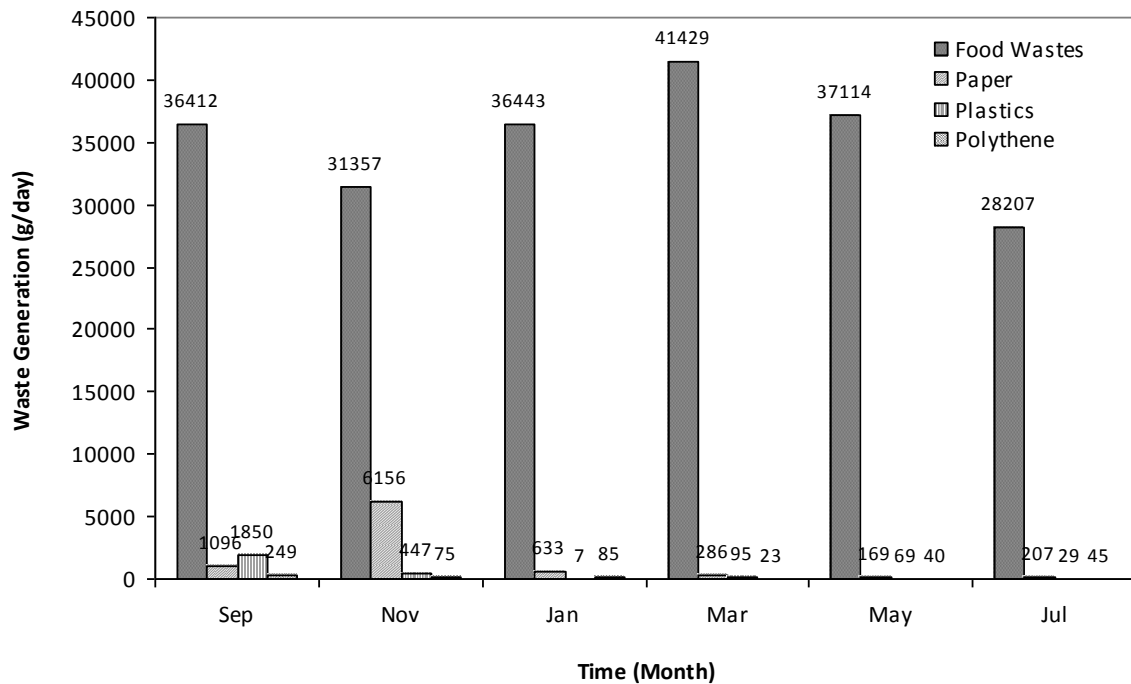

Figure 5: Waste Generation in Girls' Hostels in Different Months

Normally girls are preparing their meals at hostels and therefore, the waste generation is also high in girls' hostels. During study leave and examination periods, girls also like to have their meals from the outside. Therefore, overall waste generation in hostels could be less during these times. This phenomenon was clearly reflected in this study (Figure 5). It was observed that the generation of paper waste in all the boys' hostels has increased in January. During examination periods, as mentioned earlier, boys tends to gather in hostels and prefer to have their meals in the hostels. Therefore, the wrappings of the meal packets were discarded and as a result the paper wastes generation has increased.

During later stages of the study, research team introduced the awareness program for resource and energy conservation. Therefore, in later periods of the study, the reduction of paper waste generation was observed. However, during examination periods, the concern about waste management by students was rather poor. Further third and final year students tend to be concerned more about energy conservation and waste management than other students. Paper was the second highest waste found in any boys' hostel and the amount was higher than in girls' hostels. The extracurricular activities performed by boys are normally higher than girl students and therefore, it may increase the paper waste generation in boys' hostels.

In September 2007, a significantly higher polythene amount was observed. During this period, it was noted that some function of the students was held in the hostels and more polythene was used for decorations.

In boys' hostels, the plastic waste was very low. Normally, the boys rarely use plastic bottles or plastic bags. In girls hostels generally plastic waste generation is more than in boys' hostels. Therefore, much attention should be given for hostels where girls are resided when planning a program for plastic waste management.

4. CONCLUSIONS

The study concluded that the major components of wastes found in hostels of undergraduates were food remains and discarded papers. Plastics, polythene, textile, metals, glasses were found in very small quantities. The food waste generation is higher in hostels of girls over hostels of boys. However, higher number of different types of waste was noticed in hostels of boys. The per capita food waste generation by boys and girls who are living in hostels were ~207 g/day and ~23 g/day, respectively. More plastic and polythene wastes were determined in hostels of girls over that of boys. Temporal variation of waste generation, basically, food and paper wastes with student activities were noticed during the study period. Based on the study, it can be concluded that more attention should be paid to manage food and paper waste when sustainable integrated waste management systems are developed for residential universities where undergraduates are living.

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