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CHARACTERISATION OF HOUSEHOLD SOLID WASTE IN THE TOWN OF THANJAVUR

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ABSTRACT

Increasing population level, urbanization and changing life style result in increased generation of solid waste both in rate and quantity. Improper municipal solid waste management (MSWM) may cause adverse effects on human health and environment. Lack of environmentally friendly, sustainable and affordable waste management has led to the wide spread of open dumping and burning of solid waste. Identification of waste characteristics is an important component towards efficient waste management. A study was undertaken in order to determine the composition, both physical and physico-chemical characteristics of waste and to study the relationship between standard of living and average per capita waste generation. For this study, the municipal town of Thanjavur was chosen. Ninety households were randomly selected for the collection of solid waste for the purpose of analysis. The total solid waste produced by each household was collected for a period of three weeks – on all seven days a week. The households were divided into three sampling categories, namely, low, medium and high income groups. The characteristics of the waste were determined and it was found to be in moderate range mostly comprising of food waste, while other waste like paper and textiles were the least abundant. Results show that the amount of waste increased with the standard of living 0.114, 0.102, 0.120 kg/day from high, medium and low income groups respectively .and the average waste generated is 0.112 kg. per day per person. Incidentally, this study also revealed that the biodegradable waste material had high moisture content and low calorific value and hence the generated waste would be good materials for use as compost.

KEYWORDS: Municipal Solid Waste, Household Waste, Income Categorization

Municipal solid waste includes wastes generated from residential, commercial, industrial, institutional, construction, demolition, process, and municipal services. Residential Single and multifamily dwellings generate food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g., bulky items, consumer electronics, white goods, batteries, oil, tires), and household hazardous wastes. Commercial Stores, hotels, restaurants, markets generate paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, etc (Tchobanoglous et al., 1993).

With rising economic growth and changing lifestyle and food habits, the amount of municipal solid waste also rapidly increase and alter its composition. Over the last decade, production markets increased the sophistication of packaging by using cans, aluminum foils, plastics and other non-biodegradable items causing more harm to the environment and public safety. Problem of waste materials and how it should be dealt with is an issue that affects most developing countries as it targets public health and sanitation. It is also interlinked with air pollution, water pollution and transportation problems [Gottinger, 1991].

With the advent of increase in the world population and demand for food and other necessities, waste generated also starts to increase drastically. The amount of waste generated daily by each household starts to rise that the municipal waste collection centers cannot handle the volume of wastes collected anymore. This inefficiencies and mismanagement causes serious impacts on health and problems to the surrounding environment [Prakriti, 2007]

In Tamilnadu, half of the population burns their solid wastes. Other methods households use are municipal solid waste collection system, open dumping, burying, recycling and composting. Even though burning is popular, collection services offered by the local governments is becoming a strong option to households. However, the major hindrance faced by the local governments in supporting municipal solid waste collection services is the lack of financial resources, thus collection services are mostly available to fewer households [Ballados, 2010]. The knowledge of the sources and types of waste in an area is required in order to design and operate appropriate solid waste management systems [Tchobanoglous et.al. 1993]

In most developing countries, solid waste management is undertaken by the local authorities. These services include waste collection (either from households or district collection points) to final disposal. However, the low financial base and human resource capacity of these local authorities mean that in most cases they are only able to provide a limited service [Barton et.al., 2008].

Solid waste management has become a considerable issue, in addition other environmental problems, especially for densely populated cities in developing countries. Therefore, augmentation of the

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solid waste management facilities and their operation & maintenance in a sustainable manner by urban local bodies would require huge capital investment, introduction of latest technologies which are cost effective. Public-Private Partnership in waste management and introduction of appropriate waste management practices are needed in order to prevent urban waste causing environmental pollution and health hazards [Das and Bhattacharyya, 2013]

In order to select and plant the most suitable system for storage, transportation and disposal of waste the composition and characterization study is play a significant role in waste management system. Characterization is also important to determine its possible environmental impacts on nature as well as on society [Alamgir et.al., 2005]. The physical and chemical characteristics aid in deciding the desired frequency of collection, safety measures to be taken during transportation, and methods of processing and disposal [Das and Bhattacharyya, 2013]. In order to determine the generation and composition of MSW, different methodologies can be used for sampling. Sampling can be through door-to-door waste collection or directly from waste collection trucks [Tchobanoglous et.al. 1993 and MoEF, 2000].

For the presence study, Town of Thanjavur, Tamilnadu was chosen. The town Thanjavur is located at 10°48′N 79°09′E 10.8°N 79.15°E The tributaries of river Cauvery, namely, the Grand Anaicut canal (Pudhaaru), Vadavaaru and Vennaaru rivers flow through the city. It is situated in the Cauvery delta, at a distance of 314 km (195 mi) south-west of Chennai and 56 km (35 mi) east of Tiruchirappalli. The city has an elevation of 57 m (187 ft) above mean sea level. The total area of the town is 36.33 km^2 (14.03 sq mi) and with 14 divisions covering 51 wards shown in figure 1. The town has an elevation of 57 meters above mean sea level. The population of the area is 2,22,943 (Census India 2011). The objective of the study was to assess the quantity and composition of residential solid waste generated and to assess the existing systems of solid waste management.

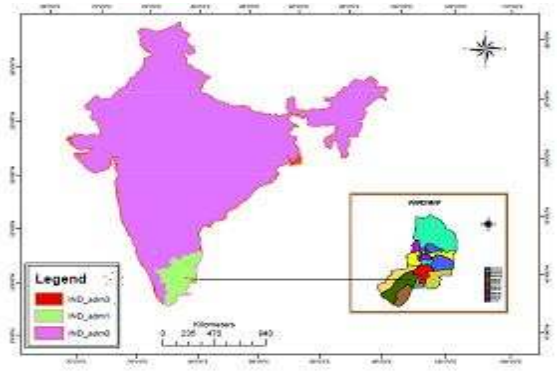

Figure 1: Study area Map showing Thanjavur

METHODOLOGY

Thanjavur comprises of 51 wards. Questionnaire method was adopted through household questionnaire survey which aimed to obtain the perspectives and feedback of residents about current systems of solid waste management. For each of the 30 households selected for waste composition study, questionnaires were administered to get primary data required for this study such as number of household members, annual income, types of solid waste being generated from their houses, etc. Questionnaire survey has been conducted for 51 wards and the select the sampling based on their income.

In this study, Thanjavur town was divided in to three sampling areas namely: low income, medium income and high income area. The low, medium and high income area was selected based on the income is less than 1.25 lakh, 2.5 lakh to 4 lakh and more than 4 lakhs respectively (Directorate of Economics & Statistics, Govt. of Tamilnadu). Thirty households were selected randomly from each sampling area for the composition study and that making a total of 90 households.

Two polythene bags of 5 Kg capacity were provided to the residents of selected households for the collection of daily generated waste. One bag for food and vegetable waste and another bag for other waste such as papers, plastics, glass, metals, textiles, fines, miscellaneous and garden waste. These bags were collected properly and the waste should be sorted in to different categories manually by handpicking and weighed individually. After weighing each sample again accurately in laboratory, composite samples of each category were prepared for physical and chemical analysis. Table 1 and Table 2 shows the sample fractions and parameters analyzed The collected samples were segregated manually [Sivapalan et.al., 2003 and Namdeo et.al., 2008] for biodegradable and non-biodegradable

matters and weighted separately which is presented in the Figure 2.

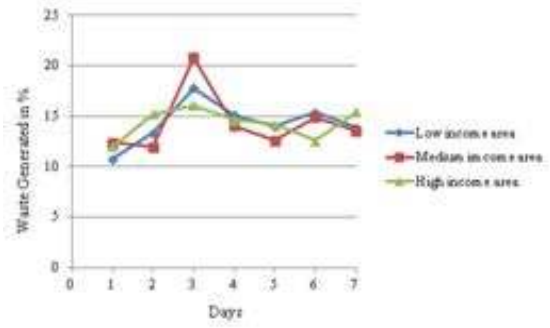

Figure 2: Waste generation per day in Thanjavur

The percent composition of wastes generated from the different locations examined is presented in the Table 1.0.

Table 1: Soild Waste Composition

Items	Composition (%)		
	Low income area	Medium income area	High income area
Food waste	89.035	65.845	73.935
Papers	3.194	3.316	4.593
Plastics	5.421	5.857	5.897
Glass	0.013	0.525	0.009
Metals	0.03	0.223	0.063
Textiles	0.456	0.079	0.056
Gardenwaste	1.027	23.236	4.655
Inert materials	0.825	0.256	0.853

The physical composition the amount of biodegradable and non biodegradable waste in three sampling areas were evaluated and presented in Figure 3. The degradable fraction is quite high in Indian MSW, essentially due to the habit of using fresh vegetables [Late and Mule, 2012].

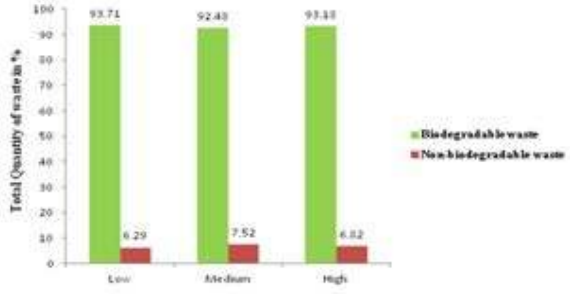

Figure 3: Quantity of Bio and non-biodegradable Waste

Per capita waste generation in three sampling areas were evaluated and presented in Fig.

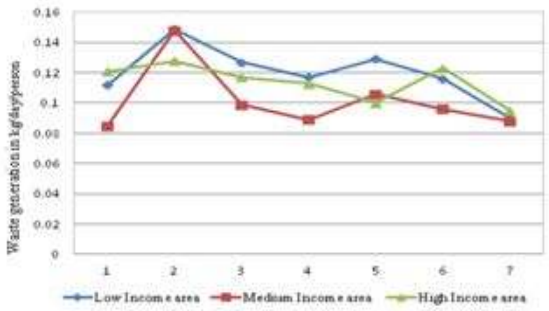

Figure 4: Per Capita Generation Rate

The Moisture content, bulk density and other characteristics of solid waste in three sampling areas were evaluated and presented in Table 2.

Table 2: Proximate Analysis of Waste

Description	Low income area	Medium income area	High income area
Moisture Content (%)	30	32	28
Bulk Density (kg/m^3)	268.819	189.335	216.989
Volatile Matter (%)	46.5	48.1	47.2
Ash (%)	13.4	12.5	14.4
Fixed Carbon (%)	9.1	9.3	10.4

RESULTS AND DISCUSSSION

It is observed from Fig. 1 and Table 1, all three sampling areas the amount of waste generated may be varied all the seven days. Due to the festival time all residential households cleaned their houses and that leads to the generation of more quantity of municipal solid waste. Food waste was found to be the most abundant of wastes from the low density area, comprising about 89.035 wastes generated in that area. This was followed by 65.845% from the medium density area and 73.935% in the high density. From the study it was found out that the food waste is more in all three density population areas. Paper waste generated from low, medium and high density population areas were 3.194%, 3.316 % and 4.593% respectively. The paper content generally varies between 1.0 and 6.0% and increases with the increase in population [Bhoyar et.al., 1996].

Plastics represented 5.421% of waste generated in low and 5.857% in medium income areas and 5.897% of waste generated in the high income area. The low,

medium and high income area generated less of other wastes including metal, glass, textiles and fines. Garden waste made up of 1.027% waste produced in the low income area while the medium and high income area produced 23.236 % and 14.594% garden waste respectively. The results showed an increasing trend for the biodegradable fraction, and also show an increase in the day-to-day use of plastic and paper [Das and Bhattacharyya, 2013]. This may have resulted from the recent explosion in packaged water business and the boom in polythene bag packaging and the manufacture of other disposable products in the country [Cointreau, 1994].

The quantity of waste paper in India, is much less, as even the quantity thrown away is picked up by people for its use as a fuel and also for packaging of materials / food sold by road side hawkers. The metal content is also low, (less than 1%). These low values are essentially due to the large scale recycling of these constituents [Late and Mule, 2012]. Paper is recycled on a priority basis while plastics and glass are recycled to a lesser extent [Kurian, 2002]. It has been noticed that the percentage of recyclables (paper, glass, plastic and metals) is very low, because of rag pickers who segregate and collect the materials at generation sources, collection points and disposal sites [Sharholy et.al., 2008]. Refuse characteristics vary not only from city to city but even within the same city, as it depends on factors such as the nature of local activities, food habits, cultural traditions, socio-economic factors, climatic conditions, and seasons [Das and Bhattacharyya, 2013].

The per capita waste generation was observed between 0.085 Kg/person/day and 0.149 Kg/person/day with the mean of 0.114 Kg/person/day in high density area, 0.102 Kg/person/day in medium density area and 0.120 Kg/person/day in low density area. The quantity of MSW depends on a number of factors such as food habits, standard of living, degree of commercial activities and seasons. Data on quantity variation and generation are valuable in planning for collection and disposal systems [Katiyar et.al., 2013].

The moisture content for the sampling areas were found to be 28% and 33%. The moisture content varies from 25% to 65% [Late and Mule, 2012]. The solid waste generated in residential areas consists of considerable moisture, a favorable condition for composting. The average density of solid waste was found to be 216.989 Kg/m^3 in high income area, 189.335Kg/m^3 in medium income area and 268.819 Kg/m^3 in low income area. Bulk density is important for the selection of waste collection equipment. For example, compactor trucks are most effective if the waste has a low bulk density [Bichi and Amatobi, 2013]. Table 2 shows that the proximate analysis of solid waste from residential areas. The volatile matter varies from 46% to 48% and fixed carbon value varies from 9% to 10.5% and the ash content from 9.1 to 10.4%.

CONCLUSION

The results obtained during the study that;

1. More efforts are needed to encourage the source reduction and resource recovery.
2. The solid waste generates from residential areas of town comprises the maximum portion of degradable material as compare to non-degradable waste.
3. Reclamation of plastic, glass, paper, etc., from the waste is recommended as it would not only reduce the volume of waste, but could also be economic because recovered materials can provide jobs
4. The characterization study of waste collected from sampling area reveals that, parameters of waste like moisture content, density, organic matter, Ash and fixed carbon were found in the moderate range.
5. It reflects that wastes generated from Residential areas in Thanjavur town are suitable for the application of composting techniques and possible to generate revenue.
6. Several problems were identified by the households to be present with the current system of service. It is also recommended that the municipality must check if the existing processes and equipments used in the collection service comply with public health and safety standards.
7. Whatever measures are taken by the municipal authority, it is not possible to control solid waste generation. Unless and until there is a change in the attitude of the people, this problem can not be solved. The culture of polythene cover packing should be avoided completely.

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