IMPACT OF FAMILY INCOME AND SIZE ON PER CAPITA SOLID WASTE GENERATION: A CASE STUDY IN MANMUNAI NORTH DIVISIONAL SECRETARIAT DIVISION OF BATTICALOA

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ABSTRACT

The generation of solid waste has become an increasing environmental and public health problem everywhere in the world, especially in developing countries. The rate of generation of solid waste in the society is increasing with an increase of population, technological development, and the changes in the life styles of the people. As family size and income are the most significant factors affecting the quantity of solid waste from household consumption, a study on the relationship among these is vital in the decision making on waste management strategies. Therefore, a study was conducted at Manmunai North Divisional Secretariat areas of Batticaloa district to find out the correlation among residential solid waste generation, family size and income. The household sector is one of the primary sources of solid wastes in the study area. This study covered 100 houses with different socioeconomic levels such as income level and family size. There were six components of solid waste; food waste, paper, polyethylene, plastic, glass and metal which were evaluated in this study.

Present study revealed that residential solid waste generation showed non-significant positive correlation (r = 0.184, p>0.05) with monthly income whereas significant positive correlation (r = 0.476, p<0.01) was found with the family size. Based on monthly income, generation of food, paper, plastic and glass waste showed non-significant positive correlation while non-significant negative correlation was found with polyethylene waste. Further, residential waste generation such as food, paper, plastic and metal showed significant positive correlation with family size

whereas generation of glass and polyethylene waste showed non-significant positive correlation with family size.

Keywords: Family size, Food waste, Income level, Plastics, Solod waste

INTRODUCTION

Solid wastes are the materials which arise from various human and animal activities and discarded as useless or unwanted (Rana, 2007). Solid waste generation is an inevitable consequence of production and consumption activities in any economy (Eugenia *et al*., 2002). UNEP (2005) also reported that fast expansion of urban, agricultural and industrial activities spurred by rapid population growth has produced a huge amount of solid waste that pollutes the environment and destroy resources. Globally the per capita amounts of municipal solid waste generated on a daily basis vary significantly (WRI, 1996). Globalization can promote economic growth, a desirable outcome. However, this economic growth in addition to population increase and urbanization will seriously strain municipal resources to deal with booming amounts of wastes (Medina, 2002).

Solid waste generation depends on the economy of the people and level of income of the family or individual. Previous studies have shown that for every Indian, an increase in income by Rs. 1000 results in an increase of solid waste generation by one kilogram per month. It is a common observation that with an increase of economic growth the waste generation grows in an equal manner. Economic growth and waste generation have not been decoupled in both developing and industrialized world (Visvanathan & Trankler, 2006). Medina (2002) also reported that a positive correlation tends to exist between a community's income and the amount of solid waste generated. Wealthier individuals consume more than lower-income ones, which result in a higher waste generation rate for the former. Income and household size are the most significant factors affecting the quantity of solid wastes from household consumption (Richardson & Havlicek, 1974). Visvanathan & Trankler (2003) reported that in a family with rich socioeconomic condition, daily waste generation rates were generally higher than the lower socioeconomic families.

Solid waste disposal is one of the major issues in Manmunai North (MN) area of Batticaloa. NECCDEP (2008) reported that about 60 to 80 tons solid waste are generated per day in MN area and from this only 40 to 45 tonnes are collected for

disposal. Enormous amounts of solid wastes are generated from various sources such as household, markets, commercial establishments and institutions including schools, hospitals and government offices in the MN area of Batticaloa. However, this study only deals with household sector in order to find out correlation between solid waste generation and socioeconomic factors such as income level and family size. The principal hypothesis of this study is that residential waste generation increases with increasing family size and income.

The objectives of this investigation were to determine the followings;

1. To identify the types of solid waste generated at household level in the Manmunai North (MN) area of Batticaloa;

2. To assess the quantity and composition of residential solid waste generated in the MN area; and

3. To find out the correlation among household solid waste generation, income level and family size.

MATERIALS AND METHODS

The study was conducted in the Manmunai North DS division of Batticaloa (Fig. 1) from 1 August to 30 September, 2008. At the initial stage of this study, a questionnaire survey was carried out among 150 randomly selected households within the MN area of Batticaloa to get primary data about their income and other information required for this study such as number of household members, methods of waste disposal and types of solid waste being generated from their houses. Based on this information, 100 households were selected by using stratified random sampling method to get the uniform number of samples in the study locations within Manmunai North DS divisions. Variation in income level, number of household members and types of solid waste being generated were also considered for the selection of households for this study.

Bags were issued to each family (6 bags/family) for the collection of different types of solid waste such as food waste, paper, polyethylene, plastic, glass and metal. All families were instructed to collect these different types of solid waste in separate bags. Collected solid wastes were weighed at regular intervals. Food waste was weighed daily and other types of waste were weighed once a week for a period of two months (August to September, 2008). Collected data were tabulated and average amounts of different types of waste generated in a month were determined. Collected

data were statistically analyzed using SPSS for Windows software package to find out the correlation among solid waste generation, income level and family size.
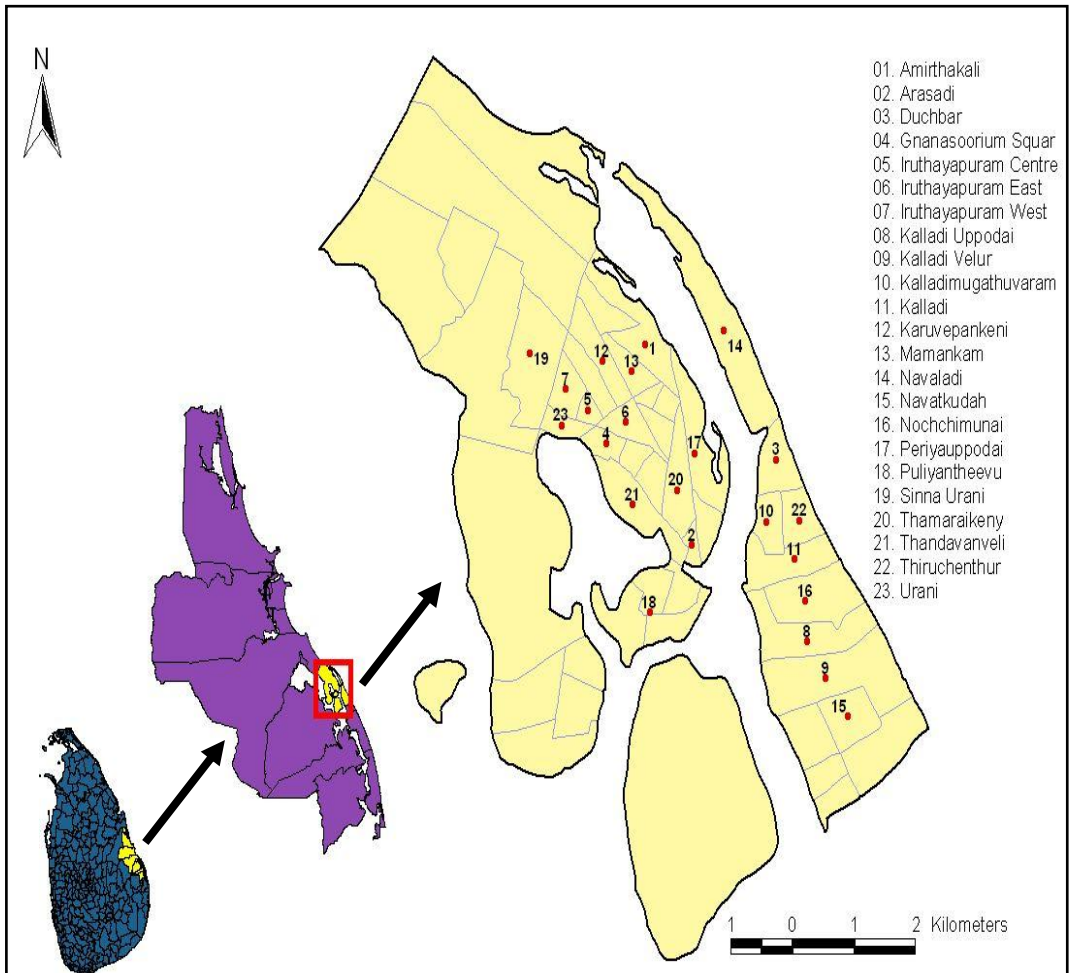

| 01. Amirthakali |
| 02. Arasadi |
| 03. Duchbar |
| 04. Gnanasoorium Squar |
| 05. Iruthayapuram Centre |
| 06. Iruthayapuram East |
| 07. Iruthayapuram West |
| 08. Kalladi Uppodai |
| 09. Kalladi Velur |
| 10. Kalladimugathuvaram |
| 11. Kalladi |
| 12. Karuvepankeni |
| 13. Mamankam |
| 14. Navaladi |
| 15. Navatkudah |
| 16. Nochchimunai |
| 17. Periyauppodai |
| 18. Puliyantheevu |
| 19. Sinna Urani |
| 20. Thamaraikeny |
| 21. Thandavanveli |
| 22. Thiruchenthur |
| 23. Urani |

Figure 1:   Locations of study at Manmunai North Divisional Secretariat Division of Batticaloa

RESULTS AND DISCUSSION

Socioeconomic factors considered in the study

(a) Income level

Income level was one of the major socioeconomic factors considered in the selection of households. The income level of the society was divided into six major categories. Table 1 shows the number of families falling into each category.

Table 1:   Frequency distribution of various income levels at study area

Income Level (SL Rupees)	Frequency Distribution (Number of families)
5000-10,000	0
10,000-15,000	10
15,000-20,000	18
20,000-25,000	22
25,000-30,000	24
Above 30,000	26

According to Table 1, majority of the families are getting high income level (> SL Rs. 30,000) whereas none of the families have reported a lowest income level (i.e., < SL Rs. 10,000).

(b) Family size

Based on questionnaire survey, 100 households were selected with vast variation in family size. Table 2 shows the frequency distribution and percentage of household members per family for each category.

Table 2:   Frequency distribution of household members in the study area

Number of Household Members/Family	Frequency Distribution
Two	6
Three	20
Four	30
Five	28
Six	16

Residential solid waste generation in study area

Table 3 shows the mean total waste generation per month among 100 households studied, waste generation per household per month, composition of different types of wastes generated and per capita waste generation for each type.

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Table 3: Residential solid waste generation in the MN area of Batticaloa

Types of Waste	Mean waste generation/Month (kg) (100 families)	Mean waste generation/ Household/ day (kg)	Composition %(wt)	Mean waste generation/ person/ day (kg)
Food waste	3401.54	1.13	87.95	0.26
Paper	139.30	0.05	3.60	0.01
Glass	90.10	0.03	2.14	0.01
Polyethylene	82.90	0.03	1.86	0.01
Metal	81.90	0.03	2.33	0.01
Plastic	71.82	0.02	2.12	0.01
Total	3867.56	1.29	100.0	0.31

As shown in Table 3, mean total waste generation from hundred households was 3867.56 kg/month. Food waste generation (3401.54 kg) was greater than other types of waste whereas plastic waste generation was very much lower (71.82 kg) than all other types of waste studied in this area. Based on these results, every person generates 260g of food waste per day and food waste contributes nearly 88% of the total waste generated in the study area. Average waste generation per household and per capita waste generation were 1.29kg/day and 0.31 kg/day respectively.

Composition of residential solid waste in study area

Income level, economic growth and lifestyle have strong influence on Municipal Solid Waste (MSW) composition (Zhu *et al*., 2008). Benjamin & Mansoor (2004) have revealed that MSW quantity and composition analysis is fundamental for the planning of municipal waste management services. The composition dictates the technology needed for waste processing prior to disposal (NRI, 2003).

It was observed that the food waste is usually the predominant component in the waste stream due to the habit of fresh food consumption and composition of all other types of waste are low in all households studied (Table 3). Visvanathan (2006) also found that food wastes dominate over the major portion of the waste generated in most developing countries in Asia like China, India, Sri Lanka, and Thailand. Similarly, study conducted by NRI (2003) reported that average compositions of the

solid waste in Batticaloa district were 57.4% biodegradable, 17.12% wood, 16.45% paper, 8.26% plastic and polyethylene, 2.9% metal and 2.2% glass. The overall socio-economic condition of the MN area is also very much responsible for the very high percentage of organic component.

Further, this study revealed that the percentage of recyclables like paper, polyethylene, plastic, glass and metal were small in all locations. Metal and glass waste generation are more or less same when compared to the previous study results (NRI, 2003). In the study area, local scavengers pick up scrap metal and glass on a regular basis and return to recycling centres.

Table 4: Correlation Coefficients among income level, family size and different types of solid waste generated

Type of waste	Monthly income	Number of Household Members
Food waste	0.173	0.459**
Paper	0.032	0.311*
Polyethylene	-0.064	0.067
Plastic	0.201	0.395**
Glass	0.233	0.235
Metal	0.308*	0.371**
Average waste generation/ Household/Month	0.184	0.476**

* = Significant at 5% probability level
** = Significant at 1% probability level

Correlation between household waste generation and total monthly income

Correlation study has revealed that although not significant at 5% probability level, the household waste generation is positively correlated with monthly income (r = 0.184, p>0.05) i.e. household waste generation is increasing with increasing household income (Table 4). Beukering & Sehker (1999) also reported that a positive relationship existed between income levels and waste generation at the household level.

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There may be several reasons for non-significant positive correlation. It might have happened due to number of household members, getting food items from outside and reusing some types of waste. Many research findings pointed out that generally waste generation increases as income rises. The most important factor affecting this correlation is number of household members. For example, in some families income level was high but, waste generation was low. Less number of members in that family may be the reason for this condition. Most of the people (about 70%) living in study area are government servants/employees in private company or NGO/labours/students. These people used to have their breakfast/lunch in canteens/hotels/ neighbour's home. This activity reduces waste generation in their homes. In many households, peoples reuse some types of waste such as glass (e.g., bottles), plastic (e.g., cans, pipes), paper (e.g., news paper, cardboard boxes) and polyethylene bags. About 10% of people in study area sell bottles/ papers/ metal items to local scavengers or shops and earn income. These situations might be the reasons for non-significant correlation between income and waste generation.

Correlations between total monthly income and types of waste generated

Positive correlations between monthly income and types of waste generated were evident for food ($r = 0.173$, $p > 0.05$), paper ($r = 0.032$, $p > 0.05$), plastic ($r = 0.201$, $p > 0.05$) and glass ($r = 0.233$, $p > 0.05$) but, they were not significant at 5% level.

There was non-significant negative correlation ($r = -0.064$, $p > 0.05$) between polyethylene waste and total monthly income. It denotes that as household income increases polyethylene waste generation decreases. Duminda & Prasansa (2005) also revealed that family income is negatively related to usage of shopping (carry bag) bag. The main reason for the negative correlation is reusing of polyethylene waste. Nearly 40% of people living in study area reuse polyethylene wastes. This activity reduces the polyethylene waste generation in their houses. However, a significant positive correlation ($r = 0.308$, $p < 0.05$) was found with metal waste generation. Increase in income leads to increase in consumption of goods, which may have resulted in an increase in metal waste generation.

Correlation between household waste generation and family size

Family size is an important determinant in household waste production (Ghorbani *et al.*, 2007). In the present study too, a significant positive correlation (r = 0.476, p<0.01) was found between household waste generation and family size.

Correlation between family size and different types of waste generated

Family size had significant positive correlations with food (r = 0.459, p<0.01), paper (r = 0.311, p<0.05), plastic (r = 0.395, p<0.01) and metal (r = 0.371, p<0.01) waste generation. This is obviously due to the reason that increase in household members leads to increase in resource consumption resulting increase in waste generation at their houses.

However, glass (r = 0.235, p>0.05) and polyethylene (r = 0.067, p>0.05) waste generation showed non-significant positive correlation with family size. The main reason for this relationship may be due to the reuse of polyethylene and waste glasses.

Household attitudes and participation on waste segregation process

Participation in solid waste segregation was somewhat erratic in some families. They did not bother to spend time in segregating their residential waste in a proper manner. Some types of waste were mixed with other type of waste, for an example paper wastes were mixed with food waste. Majority of the residents (about 60%) expressed their inadequate knowledge regarding solid waste management. Some participants (15%) felt that waste segregation would be a time consuming task. Therefore, awareness must be created about waste segregation procedure at household level and its benefits to protect the environment.

CONCLUSIONS

This study indicated that the quantity and characteristics of waste are two major important factors in designing the cost effective and environmentally compatible waste management system. The food waste is identified as the predominant waste in entire study area. Hence, there is a possibility to adopt environmentally friendly waste management practices such as compost making at household level due to the higher generation of biodegradable wastes. Residential solid waste generation has shown positive relationship with family income and size.

Food, paper, plastic, metal and glass waste generation increases with an increasing income level whereas polyethylene waste generation decreases with increasing income level. Further, residential waste generation increases with increasing family size.

ACKNOWLEDGEMENTS

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