Assessment of solid waste management in Wattala-Mabola urban council, Sri Lanka

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ABSTRACT

As a developing country, Sri Lanka faces severe issues with solid waste management. The formation of waste caused by urbanization and economic development has negatively affected the environment and socio-economic development. This study investigated the domestic waste disposal practice of the public and its impacts on the environment in the Wattala-Mabola urban council area. A standard questionnaire has been created to obtain the data through the public survey. The study used a random sampling method to get quantitative data using a questionnaire. The adequate sample size is essential to avoid sampling errors in the random sampling method. The $(n = p(100\text{-}p) Z^2/E^2)$ equation was used to decide the population size of the study. As per the equation, the sample size of the study area is calculated as 384. Thus the 384 questionnaires were issued to six Grama Niladhari Divisions. As a result, the study has found that the 50.26% generated waste of the area is food debris. Food debris and plastic are the leading waste generated by the people. As per the primary data collection, some people categorize their domestic waste before the dumping stage. However, the Local authority fails to collect the waste regularly in a categorized manner because of the local authority's insufficient working force and machinery. As another significant problem, throwing garbage into the drainage system will hinder the flow of water. These problems can be overcome by raising public awareness of waste reduction methods and proper waste sorting practices in daily life. The governments need to design, enforce, and control the best ways to deal with domestic waste.

Keywords: Solid waste, waste management, urbanization, disposal

1. INTRODUCTION

Worldwide population growth and their modern lifestyle cause dramatic waste generation (Cohen, 2006). Countries in the world face severe health hazards and environmental problems due to the irregular disposal of solid waste (Douti *et al.*, 2017). It is a significant threat to the environments of developing countries since most of the solid waste generated ends up directly in open dumps (Bandara and Hettiaratchi, 2010).

The wastes do not have affordable worth, and it is considered garbage or discarded useless material (Abdulrahman *et al.*, 2014). An arranged administration is essential for solid waste to maintain the environment hygienically. The waste management process includes collection, transportation, processing, recycling, and waste materials disposal (Singh, Gupta and Chaudhary, 2014). The majority of the nations don't manage wastes properly. Number of studies have shown that the majority of urban solid waste in developing countries is generated by households (55% 80%), market areas (10% 30%) (Nabegu, 2017).

Solid waste management techniques change between developing countries and developed countries. It determines by the population expansion, technical knowledge, and financial states of the country (Marshall and Farahbakhsh, 2013). The process of waste management needs a considerable amount of investment, but social practice and knowledge are essential for successful urban development with a waste-free city (Gunarathne, de Alwis and Alahakoon, 2020; Sharma, Joshi and Kumar, 2020; Adam, 2019, 2020; Rita, 2021; Moses, 2021; Christian, 2021; Afera, 2020; Wijewardena, 2021).

Waste collection in a legitimate manner is the primary testing step of solid waste management (Odonkor, Frimpong and Kurantin, 2020). Solid waste is collected in mixed states in developing countries and dumped in environmentally sensitive places like roadsides, marshy lands, low-lying areas, public places, forest and wildlife areas, and water bodies. It causes heavy pollution in the air, water, and land surface, and it causes diseases (Timmerman and White, 1997) The amount of solid waste is increasing with population growth, technological development, and people's lifestyle (Sivakumar and Sugirtharan, 2010). Rapid urbanization and economic development in most areas in the country have adverse effects on the environment and socio-economic development due to waste generation (Flörke *et al.*, 2013).

As a developing country, Sri Lanka faces serious issues for solid waste management, and it is a rising challenge in urban areas of Sri Lanka. The country is with a 65,610 km^2 land area (Brown et al., 2003; Swamy, 2020). It has twenty-five districts within nine provinces. The total population of the country is 20,913,410. As long as people have been living in settlements and residential areas cause to solid waste issue.

The Sri Lanka National Action Plan (1998-2001) has recognized solid waste disposals as one of the leading causes of environmental degradation. Local authorities in urban areas, do not have an appropriate disposal system. The recorded standard method of Municipal Solid Waste (MSW) disposal in the country is open dumping. (Thirumarpan and Dilsath, 2016). Only household garbage, light commercial garbage, and street garbage are collected as MSW. The MSW problem is most serious in the urban and suburban areas of Colombo. In Sri Lanka, the processing of MSW is mainly a function of the public sector. In most urbanized cities, the MSW management department is the largest employer of labor, and the cost is very high. In Sri Lanka, most of the costs of managing MSW are spent on waste collection and transportation, rather than for waste disposal and treatment (Troschinetz and Mihelcic, 2009). In the past, solid waste disposal was not regarded as a major issue for due to degraded land that could be used for free.

However, the land shortage is now the main problem facing the city government (Bandara and Hettiaratchi, 2010).

As per the Local Government Act, in Sri Lanka, local authorities are responsible for properly collecting and disposing of waste produced by the people in their region. Articles 129, 130, and 131 of the urban council ordinance stipulate the necessary provisions of article; sustainable management of landfills 20 articles 118, 119 and 120 of the urban council ordinance; and pradeshiya sabha articles 93 and 94 of law number. Generally speaking, the public health department of the local authority is responsible for solid waste management in addition to many other health aspects.(Bandara and Hettiaratchi, 2010; Wilson *et al.*, 2012)

The collection and disposal of MSW is overseen by a team of Public Health Inspectors (PHI). Supervisors are hired to assign responsibilities to collectors, including sweepers and personnel from vehicles. Workers did not receive training programs in aspects of solid waste management. The crew is supervised by a chief PHI and 6 PHI. The economic resources for solid waste management come from the health vote of the municipal government.

Current solid waste handling practices have caused many environmental and social problems. The main environmental impact of is the discharge of gas and leachate from landfills, due to the complex sequence of physical changes related to biological and chemical reactions in solid waste from landfills (Damgaard et al., 2011). Unless the necessary control mechanisms are in place, these releases to the medium can cause serious problems. The contribution of methane, released to the atmosphere through anaerobic degradation of waste in open landfills, to greenhouse gases is significant. It is said that on the scales of the world, about 8% of greenhouse gases emitted into the atmosphere come from landfills. In addition to the greenhouse gas, other gases released during waste degradation, such as H_2S and organic mercaptans, can also cause odor problems.

Air pollution is also caused by volatile organic compounds released into the atmosphere (Saral, Demir Yildiz, 2009). Inhalation of chemically polluted air and accidently intaken of contaminated food may cause epigenetical modifications in human body, which leads to develop various cancers in human body (Dushanan *et al.*, 2020).

The pollutants found in the leachate include organic pollutants, which are kinds of biodegradable municipal solid waste parts and various types of heavy metal decomposition products of soluble waste components (Reinhart, 1993). Current waste disposal practices have threatened ecologically valuable habitats, such as the Attidiya and Muthurajawela wetland reserves used as landfills. In addition to these environmental impacts, current practices will also cause many social impacts, such as loss of property value, traffic congestion, and health problems

During the time of recent years, waste generation is expanding in Sri Lanka. Colombo is the administrative and industrial city of the country. As per the economic activity of the district, it produces a massive amount of waste (Kumara and Pallegedara, 2020). As well as Wattala is a suburban area of the Colombo district. It is just located at the end of the Colombo border and starting of Gampaha district.

There are many modern production lines situated in Wattala on account of the area. It's the nearest city to pettah, which is known as the industrial capital of Sri Lanka. Wattala-Mabola urban council area is a rapidly developing city. The population density of the area is increasing day by day. Rapid population growth cause increase consumption, which leads to a high amount of waste generation. Thus the study was used to analyze the domestic waste disposal practice of the public and its impacts on the environment on the Wattala-Mabola urban council area.

2. STUDY AREA

Wattala-Mabola urban council is situated in the Gampaha district in the Western province of Sri Lanka. The study area is indicated in the Figure 1. It has the boundaries as follow;

- To the west by the Wattala pradeshiya sabha border.
- South by the Kelani River and Peliyadoda urban council border.
- To the east and the north by the Kelaniya, Mahara, and Wattala pradeshiya sabhas boundaries.
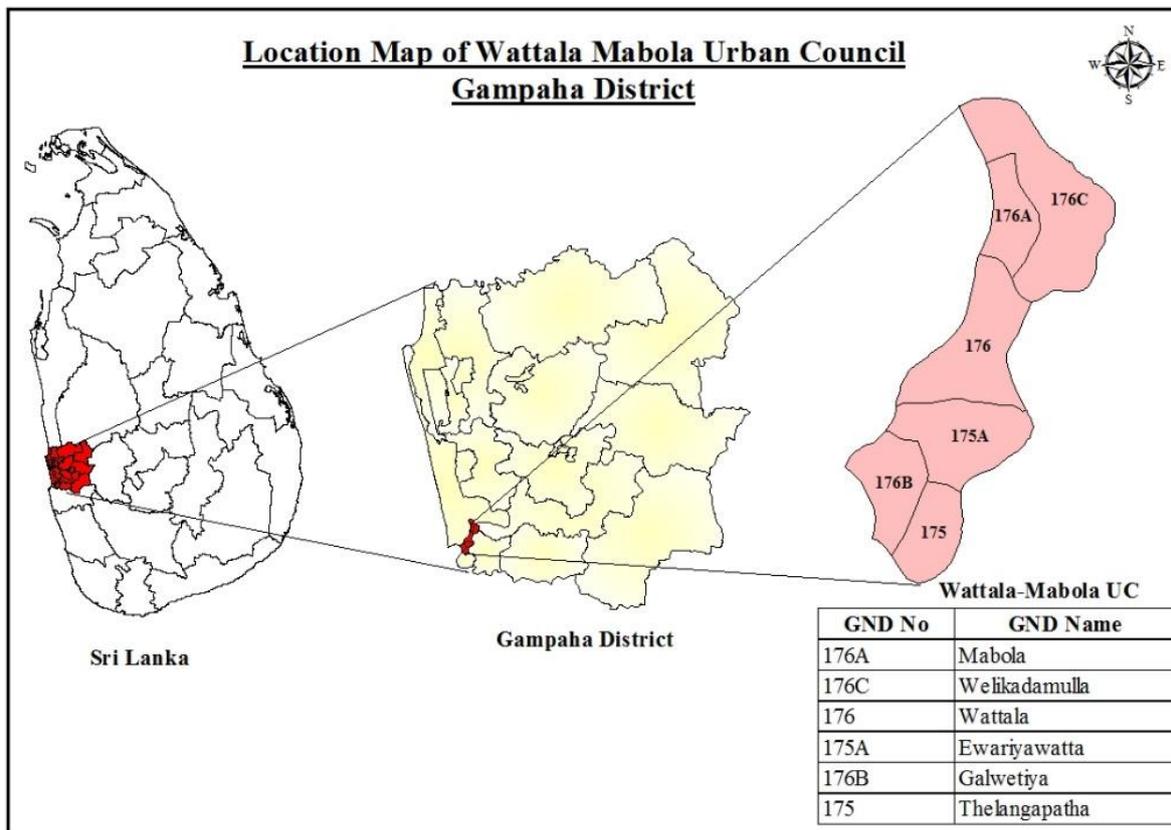

Figure 1. Location map of Wattala-Mabola urban council

Table 1. The population of the Grama Niladhari divisions in the Wattala-Mabola urban council

GN Division	Population
Thelangapatha	5597
Averiwatta	5196

Wattala	3884
Mabola	4858
Galvetiya	4036
Welikadamulla	7346

Source. Statistical report of wattala-mabola urban council – 2020

The geographical extent of the urban council is approximately 9.8 km². It includes six Grama Niladhari divisions. As per the Information retrieved from the Wattala-Mabola urban council, the recorded population of the area is 30,917 in 2021. Table 1 shows the statistic of the people in the Grama Niladhari divisions within the Wattala-Mabola urban council.

This city has a tropical climate. There is significant rainfall throughout the year. The annual temperature is 26.5 °C. Approximately 2668 mm of precipitation drops every year. The Table 2 shows annual atmospheric characteristics such as temperature, rainfall, humidity, and rainy days per month recorded in the study area.

Table 2. Annual atmospheric characteristics of the study area.

Month	Average Temperature (ºC)	Rainfall (mm)	Humidity (%)	Rainy days per month
January	26.2	73	74	6
February	27.0	72	73	7
March	27.5	103	77	12
April	27.3	203	84	19
May	27.1	278	87	21
June	26.7	294	87	21
July	26.5	257	87	21
August	26.3	229	87	21
September	26.3	252	87	20
October	26.1	383	87	21
Novermber	25.9	341	85	17
December	25.8	183	81	12

Source: Department of Meterology, Sri Lanka, 2020

2. 1. Population of the Area

Wattala–Mabola urban council has a population of 30,917 within 9.8 km². It includes Sinhalese as a majority of the community, and it accounts 53% of the population. In contrast, the second-largest community is, Sri Lankan and Indian Tamils, constituting 24.8% of the total. Muslims account for 20%, while other small communities, including Burghers, amount to 3.1%. Therefore it is evident that the Wattala-Mabola population is a diverse community of different groups.

In terms of the religious composition, Catholics and Christians amount to 33.4%, while Buddhist, Islam, and Hindu faith account for 27%, 20.9%, and 18.2%, respectively. Each religious group have their places of worship and festivities and co-exist quite harmoniously.

3. METHODOLOGY

A standard questionnaire has been created to obtain the data through the public survey. The questionnaire was prepared in three languages as English, Sinhala, and Tamil. Data were obtained through field discussion from ten-person as each one from six Grama Niladhari divisions.

The study used a random sampling method to obtain quantitative data using a questionnaire. An adequate sample size is essential to avoid sampling errors in the random sampling method. The following equation was used to decide the population size of the study (Taherdoost, 2017).

$$n = p \left(100 - p\right) \frac{Z^2}{E^2} \qquad (1)$$

where:

   n is the required sample size.
   p is the percentage occurrence of a state or condition. The default value is 50.
   E is the percentage of maximum error required or Margin of error. The value is 5.
   Z is the value corresponding to the level of confidence required. The value is 1.96.

As per the equation, the sample size of the study area is calculated as, 384 (P = 50, E = 5, and Z = 1.96) (Taherdoost, 2017). Three hundred and eighty-four questionnaires were divided equally into six Grama Niladhari divisions. Sixty-four questionnaires were issued per each Grama Niladhari division of Thelangapatha, Averiwatta, Wattala, Mabola, Galvetiya, and Welikadamulla of Wattala-Mabola urban council randomly.

The Excel sheet was used to analyze the data; mean, medians, maximum and minimum descriptive statistics were calculated to show the research output.

4. RESULTS AND DISCUSSION

The social character of the respondents was considered Sex, educational qualification, age, and job. Three hundred and eighty-four individuals of the study area were responded to the questionnaire. The percentage of female participants in this questionnaire was 66.66%, and the

rest were male. According to the education level of the participants, 53.12% were completed their advanced level, and 16.92% were graduates.

Table 3. Social characteristic of participants'.

Properties	Variables	Frequency (384)	Percentage (%)
Sex	Male Female	256 128	66.66 33.33
Educational Qualification	Grade 1 to 9 Grade 9 to 11 Advanced Level Graduates	038 077 204 065	09.89 20.05 53.12 16.92
Age	20 to 30 30 to 40 Above 40	092 178 114	23.95 46.35 29.68
Job	Government Sector Private Sector Self-Employed Unemployed	064 167 076 077	16.66 43.48 19.79 20.05

Source: Compiled using survey data, 2020

Most of the people, living in the study area are employed in the private sector. It has been recorded as 43.48% are working in the private sector, 16.66% are working in the government sector, and 19.79% are self-employed. Unemployed was recorded as 20.05%. 46.35% of the participants' were 30-40 years old (Table 3). Richer people consume more than those with lower incomes, leading to a higher rate of waste in the former. Salary and household size are the most important factors affecting the amount of solid waste generation (Richardson and Havlicek, 1974).

The study has found that the 50.26% of the waste is generated in the area by food debris. It was generated by the house where the family members are high and the family which used to cook three times per day. 25.26% of respondents mentioned plastic and polythene were generated frequently by them because both the husband and wife used to go to work. Thus, they buy foods from the hotels and show low interest in cooking. 24.48% of the people mentioned papers and glasses were a disposable waste of them. The frequencies are shown in Table 4. The 10.67% of the people from the 24.48% (who mentioned papers and glasses) follow the burning process to discard the polythene. As per the survey, 56.77% population of the study area frequently dispose of their waste. Especially Wattala, Galvetiya, Mabola, and Welikadamulla Grama Niladhari divisions have a good standard in waste disposal because the urban council has a perfect routine to collect waste in these areas. Thelangapatha and Averiwatta Grama Niladhari divisions show a low amount of frequent waste disposal because of the fewer machinery, and it is not adequate to regularly afford a collect waste.

Table 4. Types of waste generated frequently.

Types of solid waste	Frequency (384)	Percentage (%)
Food debris	193	50.26
Polythene/Plastic	097	13.30
Paper	053	25.26
Glasses	041	10.67

Table 5. Solid waste management practice.

Variables	Response	Frequency (384)	Percentage (%)
Dispose of waste frequently	Yes	218	56.77
	No	166	43.23
Manner of waste collection by LA	Good	228	59.37
	Bad	156	40.62
Categorizing waste	Yes	193	50.26
	No	191	49.73

Table 6. Number of people affected by diseases through poor waste management.

Grama Niladhari Division	Frequency (384)	Percentage (%)
Thelangapatha	15	3.90
Averiwatta	14	3.64
Wattala	12	3.12
Mabola	08	2.08
Galwetiya	10	2.60
Welikadamulla	04	1.04

Source: Compiled using survey data, 2020

As per the result of the survey (Table 5), it was noted as 59.37% of people stated local authority collects waste properly, and 40.62% comments are against that statement. As per the primary data, 70% of the people categorize waste before disposal. People of the Wattala–Mabola urban council organize waste into organic waste, plastic, and paper. However, the rest of the people were mentioned that they do not categorize waste. Also, 50.26% of the people

categorize their waste as food debris, plastic, and paper, though 49.73% do not classify them. It is the main reason for the waste dump on the roadside and other surrounded areas because the local authority does not accept waste without categorizing correctly.

Primary information is used to find about diseases that occurred by the poor waste management system. Commonly uncollected waste cause placed on the ground will result in unsanitary conditions, especially during the rainy season. Flies and mosquitoes breed in some constituents of solid wastes; flies and rates are very effective vectors that spread diseases. Notably, in the study area breed of mosquitoes causes dengue.

The study recorded that dengue fever is mostly occurring disease in the area due to poor waste management. According to all information obtained from the Averiwatta area, most of the people are affected by dengue. Comparatively, fewer people were affected by dengue in the Welikadamulla area. This observation is directly correlated with the waste management process of the area (Table 6).

Respondents were asked to list up main issues that are facing by them. The main problems determined in order of priority are:

1)   There is an unpleasant smell when transporting garbage.
2)   Landfills breed mosquitoes, and garbage on both sides of the main roads falls from garbage trucks
3)   Loss of property value
4)   The landfill produces an unpleasant smell
5)   Garbage trucks and garbage cause traffic jams Tractor
6)   The garbage bag fell from the garbage truck on both sides of the main road
7)   Floods increase during the rainy season.
8)   Local children affected by various diseases such as dengue
9)   Worm and insect rearing these reactions can be divided into three subgroups.

However, the study confirmed, the public is aware that waste management is essential, and they mentioned some reasons as; better waste collection by the local authority, regular collection of waste, and reducing useless packages by own self practices will help to protect the environment, avoid flooding, decrease the spread of disease.

The study reported in this paper clearly shows that the current waste disposal practices in the urban council of Wattala-Mabola is causing severe environmental and social problems.

5. CONCLUSION

As per the study, it can be concluded that food debris and plastic are the leading waste formed by the people. According to the research outcome, the Wattala-Mabola urban council is the lawful authority for waste management in Thelangapatha, Averiwatta, Wattala, Mabola, Galvetiya, and Welikadamulla GramaNiladari divisions. The local authority area faces poor waste management, which brings an unhealthy situation to the people. As per the primary data collection, some people categorize their domestic waste before the dumping stage. However, the local authority fails to collect the waste regularly in a categorized manner because of the insufficient working force and lack of local authority machinery. Public surveys revealed that the worst impacts of current solid waste disposal practices are social impacts such as odor, breeding of pests, and loss in property values. Hence, residencies of the area are affected by

dengue, and they are uncomfortable walking through the roads. Another major problem is debris causing clogging in the drain. In the rainy season, this is the reason why the streets in the area are flooded. The dumping of solid waste in lowlands and carrying out the constructions in low land shows significant contribution in flood, and it will pose a high health risk.

Rubbishes are the main pollution factors of water, air, and soil. The waste mixed with water source cause loss of water quality which leads demand of pure water. Water pollution will affect all living organisms, including humans, animals, and plants. Polyethylene entering the soil will not quickly combine with the earth. It will affect the minerals in the ground. Thus the proper waste management practice is essential to protect the environment and human health.

6. RECOMMENDATION

There is an increasing demand for waste collection as economic conditions and standards of living improvement. The environmental issues as a result of landfills are numerous. Saving our environment indicates those tips, instead of dumping human waste into unique landfills, an awful lot of our waste may be recycled or incinerated to reduce pollutants. Governments want to design, enforce, and manage first-class methods to cope with home waste. Plant-primarily based pesticides need to be utilized by farmers, and with greater inexpensive pricing, we can be aware the public to follow tips to reduce waste as below:

- Practice reusable bags for marketing.
- Reduce or cast off the usage of paper plates and cups.
- Store leftover meals in reusable boxes rather than single-use plastic luggage or polystyrene foam boxes.
- Take benefit of the various curbside and drop-off recycling opportunities.
- Reduce the usage of plastic bags.
- Compost backyard waste which additionally allows enhancing the soil and decreases water run-off.
- Landscape yard with native plants and non-watering landscapes.
- Donate unwanted, barely used clothing, furniture, and different family objects to nearby non-earnings organizations.
- Purchase foods in bulk or those which use less packaging.
- Buy vegetables and fruits without packing.

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