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Morphology of household waste on the example of Sri Lanka and Poland — case study

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Original article

Abstract

Household waste is a global problem that many countries cannot cope with and deal with difficulty. In many regions of the world, a dynamic increase in the amount of waste generated is observed, which causes significant environmental pollution and excessive use of non-renewable resources. In the case of household waste, important indicators are not only its quantity per person but also its morphology.

This study compares the amount of waste generated and its morphology by a household in Sri Lanka (Colombo) and Poland (Tarnów). The presented data comes from 2022, during a time of economic crisis caused initially by the COVID-19 pandemic and then due to the war between Russia and Ukraine. Currently, Sri Lanka is going through one of the greatest economic crises in its history. Poland is currently experiencing high inflation and reduced demand for many consumer goods due to continuous price increases. These events significantly affect the demand for various types of consumer goods and, paradoxically, this may reduce the amount of waste generated. It is important to identify and implement new strategies to recycle or optimize the usage of waste and develop value added products that would, in turn, have a positive impact on the domestic waste awareness. The results of the conducted research indicate a significant share of biodegradable waste in the stream of generated waste, especially in Sri Lanka. The vast majority of generated waste can be recycled, but sorting is required. Comparing the data obtained from this case study, 71% of food waste is generated in Sri Lanka, whereas 22.1% is generated in Poland. This indicates that Poland produces a significant amount of processed food. Moreover, the recorded plastic waste produced by Polish families is twice that of Sri Lanka. Furthermore, both countries indicate a positive trend to generate more waste in the future despite economic challenges faced locally as well as globally. Therefore, it is vital to understand the amount and morphology of waste as well as to implement more efficient and economical strategies to eliminate negative impacts.

Keywords

- plastic
- garbage
- glass
- metals
- disposal

Authors contributions

A – Preparation of the research project
B – Assembly of data for the research undertaken
C – Conducting of statistical analysis
D – Interpretation of results
E – Manuscript preparation
F – Literature review
G – Revising the manuscript

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Conflict of interest

None declared.

Introduction

In the case of many countries in the world, the management of municipal waste is one of the most vital problems. Many countries are unable to cope with the growing waste stream, which results in a significant increase in fees charged for waste management. The rapid development of the economy in recent years and the consumption lifestyle of modern society, especially in developed countries, are the main reasons for the generation of an increasing amount of both municipal and industrial waste. According to the data of the Central Statistical Office, in 2018 a Polish resident produced 325 kg, in 2019 it was 335 kg, while in 2020 each citizen generated an average of 0.9 kg of municipal waste per day. The above data shows that the amount of municipal waste generated in Poland is increasing [1].

In comparison, each Sri Lankan individual generates around 1 to 0.4 kg of waste per day within the country, where an estimated 3500 Mg (MT) of waste is collected per day in Sri Lanka [2]. It is expected to reach an average of more than 1.0 kg/person/day by 2025 [3].

From August 2022, the fees charged for waste collection in Tarnów (Poland) is 30 PLN per capita per month (6.13 USD), and this amount is gradually increasing. Unfortunately, the planned waste incineration plant in Tarnów has not been built yet. The creation of such an installation is incomprehensible because such a facility, apart from the thermal transformation of waste, provides system heat [4]. The production of system heat is important not only from an ecological point of view but also mitigates the effects of the fuel crisis and CO_2 emission. Both in Poland and Sri Lanka there is a traditional model of collecting waste from individual properties (Figure 1).

Figure 1. Collection of waste from the property in Sri Lanka (phot. E.C.J. Perera)

In Sri Lanka, daily waste collection service arranged by the municipal councils are free of charge for non-industrial sources. (Figure 1). The cost for the services will be covered mainly through annual Assessment tax. Other tax types collected by the nation, as well as treasury funding, charity funding, and other income also sometimes will be utilized for this purpose. In 2017 Sri Lanka experienced a disaster when a garbage dump situated in the western province of the country collapsed [5]. This incident directed respective authorities to initiate projects to cope with the issue more sustainably and to find corrective actions [6]. With Sri Lanka being an example, many countries face major challenges in supporting citizens' waste management practices and the incentive aspects are clearly fundamental in these efforts. While research shows that audience-driven communication initiatives can support a change in waste behaviour, more recently a literature review reveals greater challenges to the participation of residents in lower-income economies [7]. Despite the functioning of a well-developed waste collection and management system in Poland, illegal landfills are still a serious problem (Figure 2). The study aims to compare the amount and morphology of waste generated in selected households in Sri Lanka and Poland.

Figure 2. Illegal landfill in Poland (phot. J. Zygadło)

In 2020, 9,946 illegal dumps were liquidated, of which approximately 72,200 Mg was municipal waste. At the end of 2020, 2,025 existed illegal landfills were recorded in Poland [1]. This is because new landfills are created in place of liquidated landfills.

Materials and methods

As part of the research, waste was collected in two households for 7 days. The research was conducted in a manner that is analogous to those previously conducted by other researchers on this topic [8,9]. The mass of individual fractions was determined using an electronic technical balance. The study is considered a case study due to the fact that the study was conducted only on a small research group, and the study duration was only one week.

Result and discussion

Table shows the test results obtained in Sri Lanka, location Pannipitiya, western province, Sri Lanka. The duration of the experiment was from 14th August to 21st August 2022 (7 days). The number of inhabitants of this household was four individuals. The waste obtained in Poland (location Tarnów, Małopolska). The duration of the experiment was from 12th August to 19th August 2022 (7 days). The number of inhabitants of this household was three individuals. Figure 3 shows waste being collected during the experiment in Sri Lanka and Figure 4 – waste collected in Poland.

Table 1. Morphology of waste collected by a family in Sri Lanka and Poland

Type of waste	Amount [kg/7 days/ person]		Fraction [% of total mas]	
	Sri Lanka	Poland	Sri Lanka	Poland
Kitchen waste	5.675	1.043	71.6	22.1
Garden waste	0.475	1.403	6.0	29.8
Paper and cardboard	0.138	0.317	1.7	6.7
Plastic	0.459	0.987	5.8	20.9
Textile	0.155	0.042	2.0	0.9
Rubber and leather	0.126	0.000	1.6	0.0
Metal	0.026	0.011	0.3	0.2
Glass	0.245	0.319	3.1	6.8
Ceramics	0.093	0.000	1.2	0.0
Hazardous waste	0.028	0.000	0.3	0.0
E-waste	0.050	0.004	0.6	0.1
Cooking oil	0.186	0.079	2.3	1.7
Miscellaneous	0.275	0.510	3.5	10.8
Total	**7.929**	**4.714**	**100.0**	**100.0**

Figure 5 (A) shows the fractions of waste collected in the experiment in Sri Lanka. The analysis of the obtained data shows that biodegradable waste (kitchen, garden waste, and cooking oil) has the highest share.

Figure 3. Waste collected by a family (4 persons) during the 7-day experiment in Sri Lanka (Western Province) (phot. E.C.J. Perera)

Figure 4. Waste collected by a family (3 persons) during the 7-day experiment in Poland (Małopolska) (phot. M. Chyc)

Figure 5 (B) shows the fractions of waste collected in the experiment in Poland. The analysis of the obtained data shows that biodegradable waste (kitchen, garden waste, and cooking oil) has the highest share. However, a large proportion of plastic appears in the waste stream.

The above data shows that the Sri Lankan who participated in the study produces 7.92 kg of municipal waste per week. This is 3.215 kg more than the participant from Poland generated at that time. This means that the participant from Sri Lanka produces 68% more waste per person than the participant from Poland. However, the waste produced by the Sri Lankan family is largely biodegradable waste from the meal preparation process. In Europe, including Poland, food is highly processed, which means that waste is largely generated by food producers and not in households. This indicates that Sri Lanka might be having significant opportunities, as

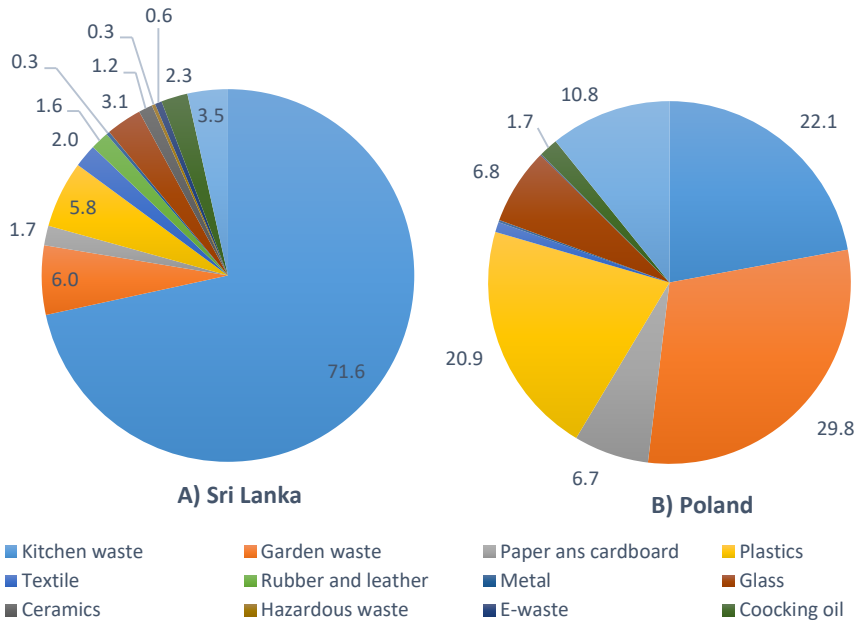

Figure 5. Morphology of waste collected in: A) Sri Lanka and B) Poland [in %]

well as challenges in initiating projects to minimize biodegradable waste / kitchen waste and maximize conversion of waste into useful substances, such as production of high-quality compost, biogas, biodiesel, ethanol, biodegradable fibers, extraction of colors, polymers, etc. Moreover, it is important to implement a food waste management framework in order to achieve economic and environmental goals [10].

In the case of the participant from Poland, the amount of plastic produced is twice as much as in the case of the participant from Sri Lanka. The data obtained in the experiment are consistent with the literature data on the morphology of waste in the area of Sri Lanka [11]. The data obtained from participants from Poland indicate that these people generate much less municipal waste than it results from the statistical data from the Central Statistical Office in Warsaw, Poland. After calculating the values obtained from the Central Statistical Office, was founding that municipal waste output in Poland is 6.56 kg/person/week (2019) [1]. The data obtained in the described experiment and collected in a household in Sri Lanka do not differ significantly from previously published data from this country [9]. The results obtained on the household scale described in this paper are also consistent with the results obtained by other authors conducting studies on a larger scale [8].

Conclusion

Nowadays, waste management should be a priority of every state, region, and commune. The observed increase in the amount of generated waste is a highly worrying phenomenon. However, the size of the waste stream is not always the most important. An important qualitative factor in relation to waste is the share of the biodegradable fraction. A very important element in the problem of waste is the prevention of its formation. This aspect should be realized by both consumers and producers of consumer goods. In the case of countries where the share of biodegradable waste is as large as Sri Lanka, it is very important to properly manage this type of waste, with particular emphasis on agricultural applications. The obtained results indicate that the same types of waste are generated in both cases covered by the research. Since a Polish household consumes more highly processed food than a family from Sri Lanka, the share of individual waste fractions is strongly differentiated.

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