

Impact of university waste management practices on greenhouse gas emissions at landfill sites

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Abstract

The amount and the variety of waste material generated in the country is increasing fast making a considerable damage to the natural environment. The waste generated at various institutions makes a significant, but typically ignored, contribution to GHG emissions. Landfills are the predominant type of solid waste disposal sites in the Sri Lanka which have a significant contribution to the climate change due to production of methane (CH₄). The waste disposed in a landfill site undergoes biological transformation to produce carbon dioxide (CO₂) under aerobic conditions and a mixture of CH₄ and CO₂ under anaerobic conditions. The estimation of GHG emissions at the landfill sites will be key in finding solutions to climate change as the landfills plays an important role by emitting large quantities of CH₄ which has a higher global warming potential compared to CO₂. This study was an attempt to evaluate the greenhouse gas (GHG) emissions at landfill sites against the recent waste management practices adopted at University of Colombo, Sri Lanka. A waste survey was conducted and different waste types were weighed separately during week days and weekends, and the impact was evaluated for the time before and after making the university a polythene-free zone. GHG emissions from waste categories and disposal methods were also examined. Calculations were made using IPCC revised guidelines (2006) in estimating emissions. Results show that the contribution of university waste towards landfill GHG emissions is moderate at the moment. But proper waste management strategies could help further mitigate the GHG emissions. Waste minimization and sustainable waste management at institutional level could play a key role in minimizing GHG emissions at landfill sites.

Introduction

- The amount and the variety of waste material generated in the country is increasing fast making a considerable damage to the natural environment.
- Understanding the damage and obedient to the policies implemented in the country industries pay attention in managing their waste as a step to reduce the GHG emissions.
- The waste generated at various institutions makes a significant, but typically ignored, contribution to GHG emissions.
- Landfills are the predominant type of solid waste disposal sites in the Sri Lanka which have a significant contribution to the climate change due to production of methane (CH₄) which has a higher global warming potential compared to CO₂.
- The waste disposed in a landfill site undergoes biological transformation to produce carbon dioxide (CO₂) under aerobic conditions and a mixture of CH₄ and CO₂ under anaerobic conditions. Therefore estimation of waste generation and their contribution in GHG emissions in institutional level will be key in controlling GHG emission.
- Besides quantifying institution's waste generation, this type of analysis will provide a comprehensive greenhouse gas (GHG) inventory under the waste sector, allowing it to identify and target the reductions of emissions from waste sources.
- Waste minimization and sustainable waste management at institutional level could play a key role in minimizing GHG emissions at landfill sites.

Materials and Methods

- A waste survey was conducted at university of Colombo during week days and weekends to obtain data on waste generation inside the university.
- Prior and during the waste survey the current waste management practices at the university were studied by the discussions with canteen staff and cleaning staff.
- Waste categorization was done in to different waste types (food, garden waste, paper, polythene/ plastic, mixes waste, other) and they were weighed separately during survey period.
- GHG emissions from waste categories were examined considering the predominant type of solid waste disposal method in the Sri Lanka.
- Calculations were made using IPCC revised guidelines (2006) in estimating emissions.
- A policy to stop the use of polythene lunch sheets at the canteen were implemented at the university in making university a polythene-free zone.
- The impact was evaluated for the time before and after making the university a polythene-free zone considering the current waste management practices at the university.

Results

- Total waste generation considering the current waste management practices at university of Colombo (Table 1),
 - food waste contribute more than 57% for the total waste generation.
 - more than 43% from the total waste generation sent to the piggery
 - from the total waste generate more than 39% contribute to the GHG emissions at landfill sites
- Biodegradable waste (food and garden waste) generate at the university contribute 85% for the GHG emissions from the total generation at the landfill sites (Figure1)

Table 1: Waste generation due to current waste management practices

Waste category	Total generation (Mg)	(Mg)				
		Open dumping	Open burning	Com-posting	Recycling	Piggery
Garden waste	79.883	47.929	23.965	7.988	-	-
Food waste	216.669	54.167	-	-	-	162.502
Paper	38.443	17.299	3.844	-	17.299	-
Polythene/	38.578	27.004	11.573	-	-	-
Mixed waste	3.566	3.566	-	-	-	-
Total Bulk waste	377.139	149.967	39.382	7.988	17.299	162.502

Table 2: Green house gas emissions at landfill sites

Waste category	Open dumping (Mg)	CH ₄ emissions due to anaerobic digestion (Mg CO ₂ /yr)	CO ₂ emission due to aerobic digestion (Mg CO ₂ /yr)	Total GHG emissions at landfills (Mg CO ₂ /yr)	Total GHG emissions at landfills (tpy CO ₂ e)
Garden waste	47.929	4.8006	0.7684	5.569	6.126
Food waste	54.167	7.5747	1.212	8.787	9.666
Paper	17.299	2.079	0.333	2.412	2.653
Polythene/ Plastics	27.004	0	0	0	0
Mixed waste	3.566	0.2058	0.033	0.239	0.263
Bulk waste(before)	149.967	8.7234	1.396	10.119	11.131
Bulk waste (after)	148.215	8.6226	1.255	9.878	10.866

- Current GHG emissions at landfills due to the waste generate in the university is 11.131 tpy CO₂e
- The reduction of polythene waste goes into the landfills after making university a polythene-free zone was 1.752 Mg.
- Due to the policy implemented it was reduced the GHG emissions by 0.265 tpy CO₂e

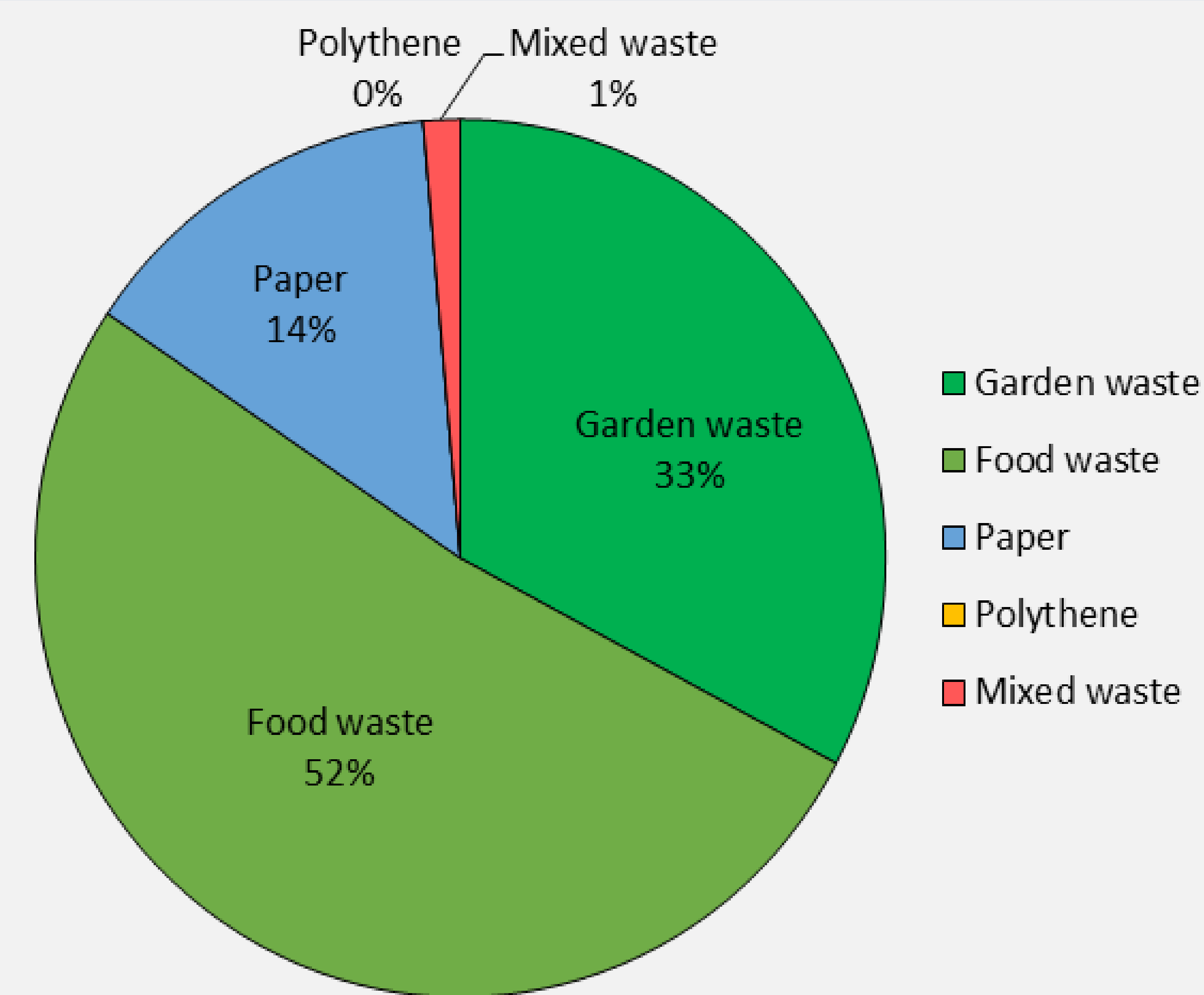


Figure 1: GHG emissions considering waste categories at landfill sites

Discussion

This study was conducted to show the GHG emissions from institutions, which plays a significant but typically ignored role at currently in Sri Lanka. The waste categorised and weighted during the waste survey were sent to the landfills to dispose as a bulk waste so that the bulk waste emission parameters were used in estimating the GHG emissions. Results shows that there is a slight decrease in GHG emissions after making the university a polythene-free zone indicating that the implementation of that policy contribute towards the reduction of GHG emission. It was found GHG emissions from different waste types and it clearly showed that biodegradable waste contribute more than 85% to the GHG emissions at landfills. Beside the identification of GHG emissions it demonstrate the landfill GHG emissions can be reduced by managing biodegradable waste onsite without sending them to the landfills. Bio-gas facilities and composting facilities may be a solution to manage these biodegradable waste goes in to the landfills. Even the polythene and other inert waste types didn't contribute to GHG emissions in short term they are more dangerous as they emit chemical substances, hindrance the natural biodegradation, damage soil fertility, clog the drains and so on which can cause severe damage to the human and natural environment. An annual waste survey will be conducted in future to identify the trends in waste generation and GHG emissions from the waste generate under different waste management practices in the university of Colombo

Conclusion

The implementation of green policy at institutional level can contribute towards the reduction of GHG emission anyhow the best solution as a whole and in institutional level is to minimize the production of waste and to implement sustainable waste management practices in minimizing GHG emissions at landfill sites.

Reference

IPCC (Intergovernmental Panel on Climate Change). 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5. Waste. Report and associated Excel® waste model are available at http://www.ipcc-nggip.iges.or.jp/public/2006gl_vol5.html.

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