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Assessment of Environmental Impacts of Municipal Solid Waste Disposal Options using Life Cycle Assessment Methodology: A Case Study in Matara Municipality

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Abstract

Municipal solid waste is growing problem in Sri Lanka. Improper waste management practices cause harmful impacts to the environment. High population density of Matara municipality generates reasonable amounts of wastes creating disposal problems. Life cycle assessment was conducted to determine the environmental impacts associated with existing waste management practices and compare it with other scenarios in Kotawila waste management centre, Sri Lanka. Three waste management scenarios were considered for the assessment process. Baseline scenario (S_1) indicates the existing waste management practices which are open dumping 30 tons, recycling 3 tons and composting 1.5 ton. In the second scenario (S_2) the amount of waste that goes to the open dumping is 15 tons, recycling 4.5 tons and composting 15 tons. In the third scenario (S_3), open dumping further reduced to 4.5 tons, recycling was 7 tons, and 23 tons were used for anaerobic digestion. Field studies were conducted to gather data of each element of the municipal solid waste management system. The waste collection rate (ton/day), waste transportation, waste composition, fuel consumption, human resources engagements in waste collection, etc. were identified and quantified. Several calculation methods according to IPCC guidelines, open LCA software ELCD Greendelta databases, ReCipe 2016 Midpoint (H) Impact Assessment method were used for the impact assessment. The impacts of present waste management process are quite high compared to other scenarios studied. The Global Warming (772.652 kg CO_2eq), Ozone Formation (0.00565kg NO_x eq), Terrestrial Acidification (0.19903 kg SO_2eq), Fine Particulate matter formation (0.09494 kg PM 2.5eq), Freshwater Eutrophication (0.14266 kg P eq), Terrestrial Eco Toxicity (0.7125 kgL,4-DCB), Human non-carcinogenic Toxicity (0.0350 kgL,4-DCB) are comparatively higher than that of other scenarios. The scenario 3 was found to be the option with the highest mitigation potential of most impacts. It is the suitable scenario to manage these harmful impacts. Global Warming (247.24876 kg CO_2 eq), Ozone formation (0.00190 kg NO_x eq), Terrestrial Acidification (0.09964 kg SO_2 eq), Fine particulate matter formation (0.03088 kg PM 2.5 eq), Freshwater Eutrophication (0.050 kg P eq), Terrestrial Ecotoxicity (0.22280 kgL,4-DCB), Human non-carcinogenic Toxicity (0.01121 kg 1,4-DCB) can be reduced to 68%, 66%, 50%, 67%, 65%, 69%, 68% respectively. It can be concluded that existing waste management practices cause harmful impacts to bio system. The use of anaerobic digestion reduces the amount of waste that goes to open dumping, and it has a significant mitigation potential of harmful environmental impacts.

Keywords: Environmental impacts, Life Cycle Assessment, MSW disposal