Ministry of the Environment

3R Policy Indicators
Factsheets Series

Co-benefits of the 3Rs (reduce, reuse and recycle) of municipal solid waste on climate change mitigation

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01 Outline of indicator

Greenhouse gases (GHG) from the waste sector are estimated to account for almost 5% of total emissions (Hoornweg and Bhada-Tata, 2012), and this amount is predicted to increase due to increasing waste generation and upgrading of final disposal sites from open dumping to sanitary landfill without gas recovery system in developing Asian countries (Sang-Arun et al, 2011). Methane (CH_4) is the major GHG from the waste sector and it makes up approximately 18% of the anthropogenic CH_4 (Bogner et al, 2008; Agamuthu and Fauziah, 2013)

The amounts of GHG emissions from municipal solid waste can be minimised through the 3Rs (reduce, reuse and recycle). However, it is very difficult to quantify the contribution from "reduce" and "reuse". Therefore, the discussion on GHG emissions reduction from solid waste management generally focuses on how to avoid landfilling of organic waste, maximise the use of organic waste (e.g. as animal feed, soil amendment, biogas for alternative energy), capture landfill gas for energy use, and avoid burning of plastic waste, etc. (Sang-Arun et al, 2011; Menikpura et al., 2013). Good examples of local actions on mitigating climate change from solid waste management can be seen in most of the countries but mainly on a voluntary basis (see Figure 1 for examples). Furthermore, many of those cities do not have a clear understanding about their contribution to climate change mitigation.

Factsheets Series on 3R Policy Indicators
This project is conducted by the Asia Resource Circulation Policy Research Group, a collaborative research group focused on policy research on 3R promotion in Asia; coordinated by IGES with the participation of researchers from IGES, IDE-JETRO, NIES, University of Malaya, Asia Institute of Technology, Bandung Institute of Technology, Tokyo Institute of Technology and UNCRD.

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The indicator "co-benefits of the 3Rs (reduce, reuse, recycle) of municipal solid waste on climate change mitigation" aims to maximise the use of resources which can significantly contribute not only to reducing GHG emissions but also to receiving other co-benefits. These benefits include creating green jobs, improving social well-being, reducing health risks, enhancing economic development, saving landfill space and minimising environmental loads from landfill of fresh waste or incineration.

Figure 1: Some examples of 3Rs-climate friendly waste management practices

02 Type of indicator

Quantitative indicator.

03 Policy goals to be monitored by this indicator

This indicator can monitor the achievement of Goal 2 and Goal 18 proposed under the draft Ha Noi 3R Declaration on Sustainable 3R Goals for Asia for 2013-2023. The quantitative indicators selected for this integrated Goal are:

- Amount of annual GHG emissions from municipal solid waste management
- Amount of annual GHG emissions reduction from municipal solid waste as compared to the base year – based on direct emissions reduction
- Amount of annual GHG emissions reduction from municipal solid waste compared to base year – based on a lifecycle perspective

In light of the potential GHG emissions reduction through the utilisation of waste, the following quantitative indicators would also be useful to identify the magnitude of the GHG emission reduction based on the type of technology:

(1) Annual direct GHG emissions from each type of technology: open dumping, landfill, composting, anaerobic digestion, incineration, material recycling

(2) Annual GHG avoidance potential through resource recovery based on a lifecycle perspective for each technology

(3) Annual net GHG emissions (calculated by subtracting the GHG avoidance potential from direct GHG emissions) for each technology

04 Definition and scope

- Municipal solid waste refers to waste that has been discarded from households or business entities, and that falls under the responsibility of local governments. Detailed definitions of each country's municipal solid waste may be different.
- Organic waste refers to discarded waste that can be easily biodegraded. This often refers to food, plants, animal residues and products that are made of these materials, such as paper and biodegradable plastic.

- Material recycling refers to the recovery of materials from any kind of recyclables, excluding organic waste.
- Direct GHG emissions refers to the amount of GHG emissions that may be released during the biodegradation, combustion or processing of waste (utilisation of fossil fuel or fossil based electricity) under different treatment options, such as the transportation of waste, landfill, composting, anaerobic digestion and incineration (Figure 2).
- The lifecycle perspective refers to the accounting for both direct GHG emissions (e.g. those released during the biodegradation of organic waste, combustion or utilisation of fossil fuel for waste processing) and indirect, downstream GHG savings (e.g. avoided GHG emissions from landfill of organic waste, avoided chemical fertiliser usage due to the production of compost) throughout the life cycle (Figure 2).

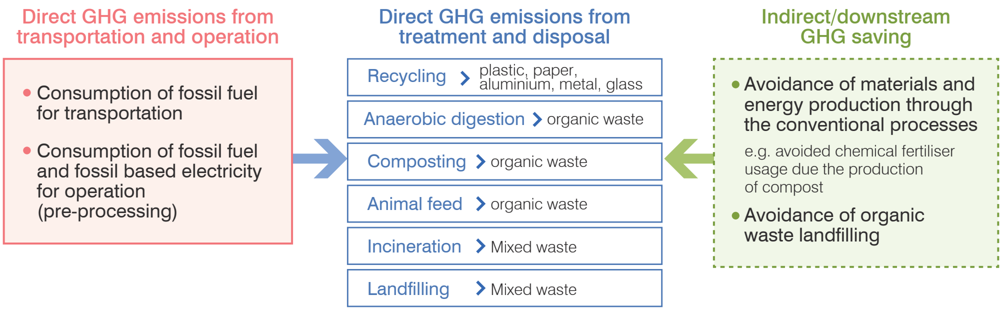

Figure 2: Outline of direct and indirect GHG emissions from different treatment options in the life cycle perspective

05 Policy instruments useful for promoting 3R implementation for climate change mitigation from municipal solid waste management

- Economic instruments are important for promoting 3R implementation for climate change mitigation from municipal solid waste management at the local level. Creating market demand for products or recovered resources from solid waste such as compost, biogas, electricity and recycled materials is important to encourage the implementation of the 3Rs. In addition, the use of a feed-in tariff and use of the carbon market would act as key drivers to encourage residents, communities, entrepreneurs and investors to implement the 3Rs.
- Introduction of appropriate cost-effective technologies, applicable at the local level, and their effective integration.
- Encouraging local investment and private businesses to make use of organic waste and carry out material recycling nationwide. Intervention from national governments, private sectors, NGOs and academia would increase awareness and the capacity of local governments and communities to implement the 3Rs and minimise the waste that is sent to landfills.
- Public education on improper waste management and its impact on climate change. Awareness-raising and capacity building on the benefits of sustainable waste management, including climate change mitigation as a reward for promoting the 3Rs. Introducing such education into school programmes and the media could also motivate social movement on the 3Rs for climate change mitigation.

06 Merits of implementation

- Increasing the utilisation of waste by diverting organic waste and recyclable materials from the final disposal site can significantly reduce GHG emissions and also generate several other benefits. These benefits include saving landfill space, reducing the budget for disposal site management, extending the lifetime of a landfill, reducing environmental contamination, reducing local health hazards caused by various emissions and disease carriers, creating green jobs and income based community well-being, circulating resources to fulfil social needs and contributing to world finite resource savings.
- The promotion of waste separation at source for material recycling and household or community based organic waste treatment can significantly reduce local authorities' waste collection and disposal workload so that they can provide more satisfactory service to the community.
- The use of organic waste for composting or anaerobic digestion can contribute to the national agenda on food and energy security as well as enhancing organic farming practice. Furthermore, organic waste utilisation and material recycling can contribute to the national agenda on poverty reduction, green economy development and resource circulation.

07 Similar indicators and supporting indicators

- Reduction of waste generation per capita
- Reduction of the annual amount of waste sent to open dumping and landfill
- Quantity of compost production that is available for soil amendment from municipal solid waste
- Quantity of recovered recyclable materials available to recyclers
- Amount of energy (bio gas or electricity) recovered from solid waste
- Number of employment opportunities created in organic waste utilisation and material recovery business
- Numbers of material recovery centres including composting, anaerobic digestion, waste separation facilities, recycling facilities etc.

08 Methodology of data collection and calculation

- The amount of annual GHG emissions and reductions from municipal solid waste management can be estimated by using the IPCC (IPCC, 2006) and Life Cycle Assessment (LCA) guidelines (Guinée, et al., 2001; Gentil et al, 2009). For this estimation, local authorities or designated stakeholders need systematic data collection. The basic data that is needed is the amount of waste by weight sent to each treatment facility; waste composition; amount of fossil energy used for waste collection, transport and processing; and amount of products recovered from each treatment or material recovery centre. Other data requirements, such as the emissions factors required to estimate the direct emissions, are listed in the IPCC Guidelines. Additionally, a list of the required data for lifecycle GHG estimation from individual treatment technologies is available in the IGES manual for the GHG calculation tool (Menikpura and Sang-Arun, 2013).

09 Challenges and concerns

- Many local authorities do not pay attention to proper data collection. Many of them do not have an on-site scale to measure the amount of waste that is received at the facility. Visual estimations, made by each authority, of the amount and composition of waste are subjective and without any scientific or experimental support. For an accurate estimation it is essential to have an accurate account of the amount of waste received at facilities. Training on measuring and estimating the amount and composition of waste is necessary to improve the accuracy of data collection. These GHG emissions estimation results can then be used when selecting proper waste management practices.
- In addition, local authorities are not aware of the importance of record keeping on the use of other resources, such as fossil fuel and electricity consumption for different treatment options and the types and amount of recovered resources. Such information is very important for accurately estimating GHG emissions and therefore local authorities should pay attention to recording such data systematically.
- It is best to keep collecting and recording data every day. However, this practice may not be possible in small cities due to a lack of budget and human resources. Therefore, the infrequency of data collection can be justified as being necessary to minimise the burden on local authorities but, consequently, the accuracy will be decreased.

10 Appropriate data management by stakeholders

- Generally, the local authorities should collect and maintain the data on a systematic basis. Data from each local authority should then be submitted to the regional and national authorities (which vary among countries) on an annual basis in order to develop a country’s inventory database. Such frameworks can be developed based on a national administrative system.
- Estimation of GHG emissions can be carried out based on a monthly or annual basis depending on the capacity of local authorities. The national authority or designated stakeholders may take this role in countries where the local authorities do not have the necessary capacity to carry out these estimations. Local authorities could reduce their burden of time management and skill development for such assessments by using tools that have already been developed (e.g. IGES GHG calculator).

11 Direct and indirect impacts

- Improper practice at the material recycling facility or organic waste treatment facilities may become a public nuisance and cause environmental impacts, such as air, water and soil pollution. Standards or guidelines are required to ensure the proper handling of waste and the management of these facilities.

12 Existing practices on GHG accounting and mitigating targets

- All countries need to submit national communications of national GHG inventories to the United Nations Framework Convention on Climate Change (UNFCCC)
- Development of a joint credit mechanism between Japan and developing countries
- Clean development mechanism (CDM)
- Nationally appropriate mitigation actions of developing countries (NAMAs)

13 Conclusion

Implementing these quantitative indicators for climate co-benefits would be an important step in sustainable waste management since this initiative can directly contribute to improved waste management as well as targeting GHG reductions. However, the local authorities need to collect and maintain data systematically to estimate GHG emissions. Furthermore, this activity can directly contribute to the mandatory requirement of the UNFCCC regarding national communications and international negotiations on climate change.

Reference documents and existing guidelines

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For Further Information

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