The 3Rs, a climate friendly waste management practice for developing Asian countries

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GHG emissions from solid waste management

According to IPCC guidelines, GHG emissions related to waste management can be categorised into different groups

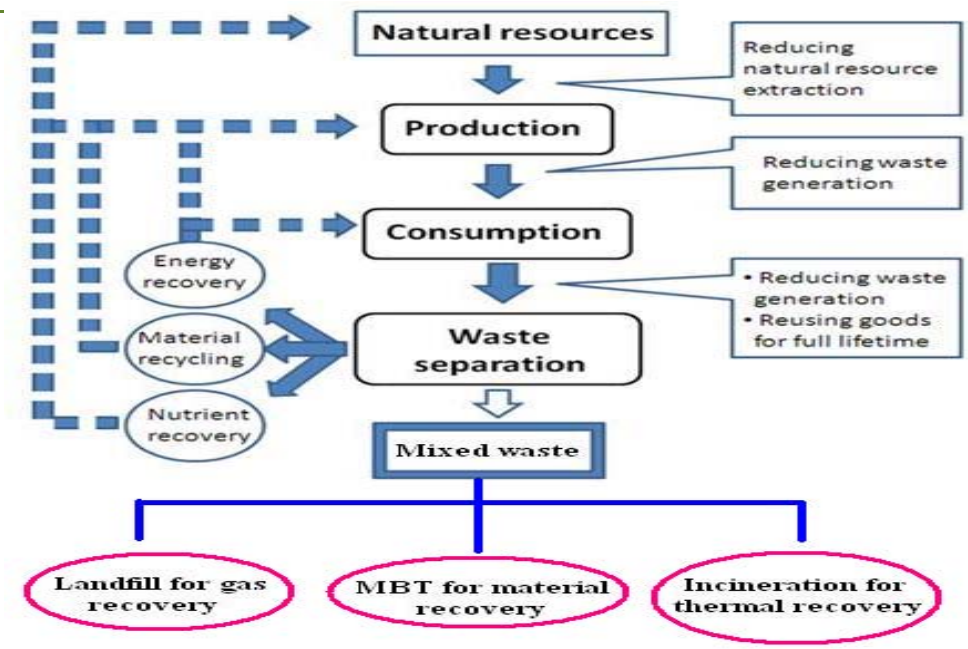
Source of GHG emission	Categorised under waste sector	Categorised under non-waste sector
• CH_4 emission from landfills/open dumping, composting of organic waste	★	
• CH_4 emission from incineration and open burning (minor)	★	
• CO_2 emission from incineration without energy recovery	★	
• CO_2 emission from incineration with energy recovery		★
• N_2O emission from combustion and composting	★	
• GHG emission from utilisation of fossil fuel for waste transportation, operational activities and grid electricity consumption for operational activities and recycling		★
• GHG emission from manure and farm waste management		★

GHG emissions from the waste sector in developing Asia-
mostly based on landfill emissions

Country	GHG emissions in Million ton CO_2 equivalent/year		
	1994*	2000*	After 2000** (estimate)
China	42.6		45.4 – 113.4
India	12.2		9.4 – 23.5
Indonesia	8.44		9.6 – 24.3
Philippines	4.25		3.8 – 9.6
Viet Nam	1.39	5.60	3.0 - 7.4
Bangladesh	1.31		2.1 – 5.1
Thailand	0.41	4.89	5.3 - 13.5
Lao PDR	0.24**		No data
Cambodia	0.124		0.12 – 0.34

Note: * National communications to the UNFCCC, ** Author's estimation

How can the 3Rs reduce GHG emissions and enhance resource efficiency?



Climate co-benefits of 3Rs in various sectors

Sectors	Climate co-benefits
Waste	- Reduced methane emissions from landfill - Reduced carbon dioxide emissions from burning of plastics
Energy and transport	- Reduced emissions from energy use in the process of resource extraction, agriculture, good production and distribution, and waste transportation and treatment - Reduced emissions from fossil fuels by using energy recovered from waste
Industry	- Reduced emissions from industrial processes by reducing product demand - Reduced emissions from chemical fertilizer production
Agriculture	- Avoided nitrous oxide emissions from farmland by reducing use of chemical fertilizer - Increased soil carbon sequestration
Land use change and forestry	- Reduced emissions from mining and deforestation

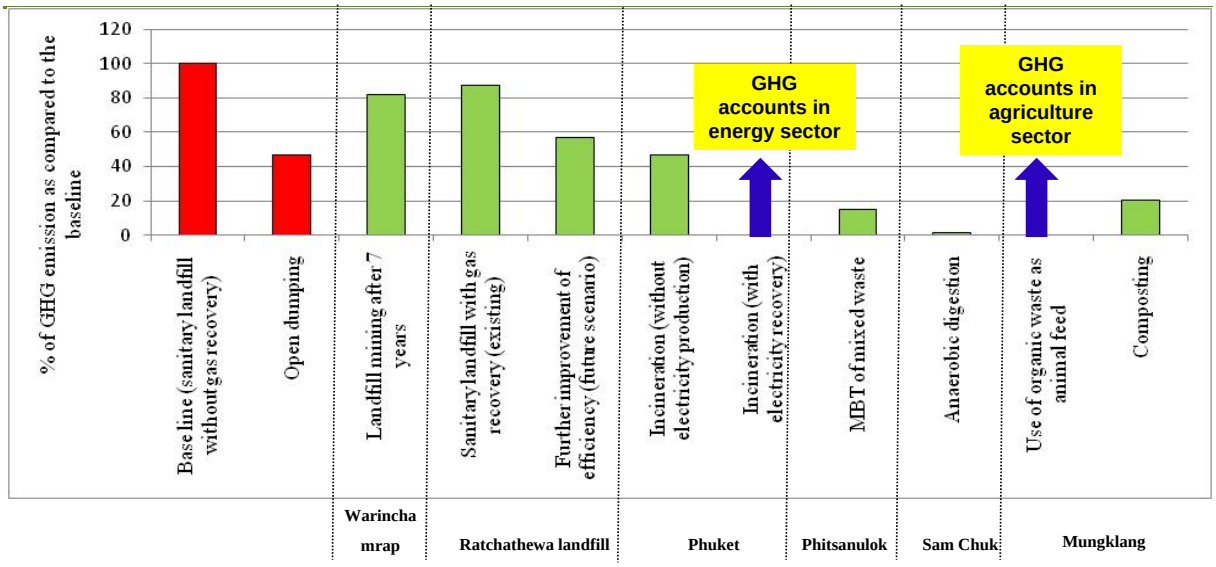
The 3Rs policies in developing Asian countries

- **Improved solid waste management policy**
  - National 3R strategies, integrated solid waste management
  - Philippines, Malaysia, Viet Nam, China, Cambodia, Bangladesh, Indonesia, Thailand, etc.
- **Climate change mitigation action policy**
  - Avoiding GHG emission from the waste sector
  - China, India, Indonesia, Thailand and the Philippines, etc

GHG emissions reduction through improved MSW in Thailand

- **Life cycle approach used as a tool for evaluation**
  - Waste sector → Methane from open dumping and landfill
    → Carbon dioxide from incineration
  - Energy sector → Fuel, incineration (electricity generation)
  - Industrial sector → Production
  - Agriculture sector → Chemical fertiliser use
- **Compared the emission reduction with conventional sanitary landfill (without gas recovery)**

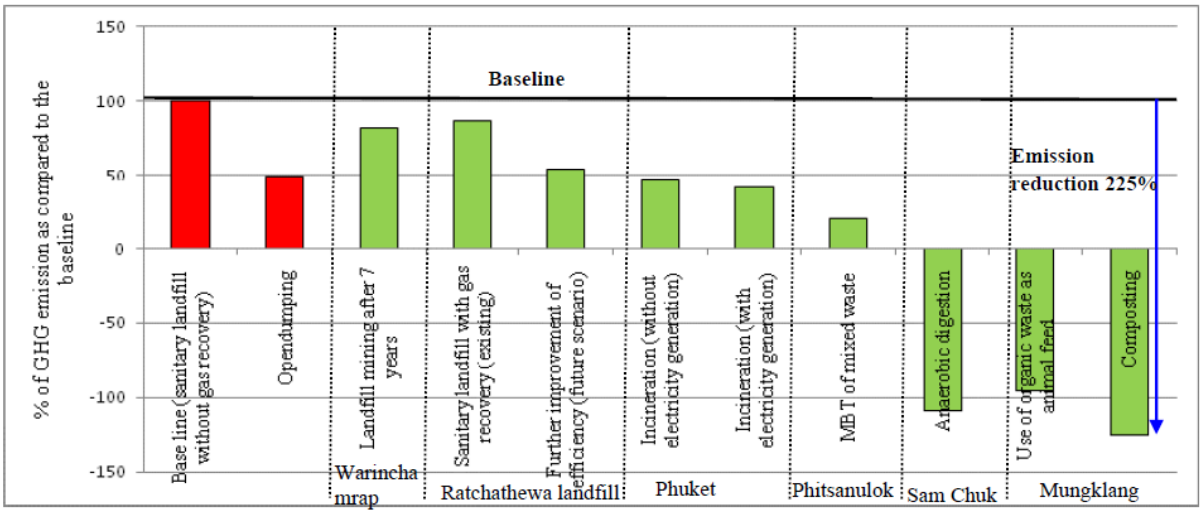
GHG emission on the waste sector of SWM in Thailand- not LCA



Baseline for mixed waste management is sanitary landfilling of mixed waste without gas recovery.

The baseline of organic waste utilisation is sanitary landfilling of organic waste without gas recovery

GHG emissions from SWM in Thailand- LCA perspective



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GHG emissions from material recycling in Thailand- LCA perspective

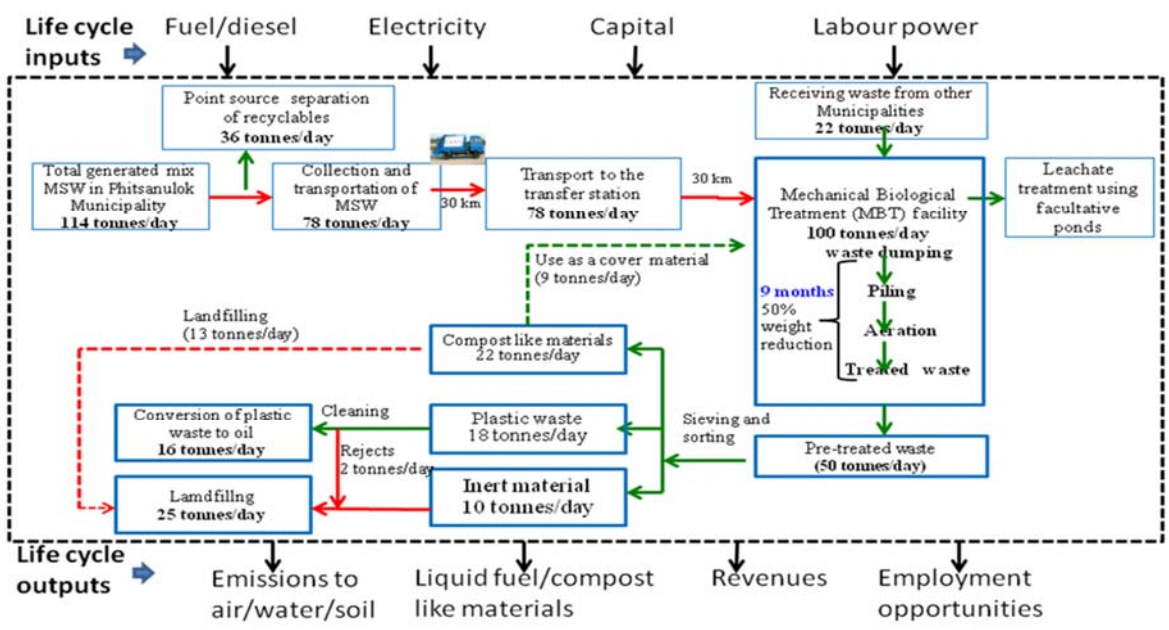
Type of recyclables	GHG emissions from recycling[1] (A)	GHG emissions avoidance from virgin process[1] (B)	GHG emissions avoidance from sanitary landfill (C)	Net emissions from recycling (D) = (A)-(B)-(C)
	Unit : (tCO_2-eq/tonne of waste)			
Paper	1.27	0.97	2.38	-2.08
Plastic	2.15	1.90	0	0.25
Aluminium	0.39	12.47	0	-12.08
Steel	1.10	2.95	0	-1.85
Glass	0.57	1.03	0	-0.46

Source: [1]Menikpura, 2011

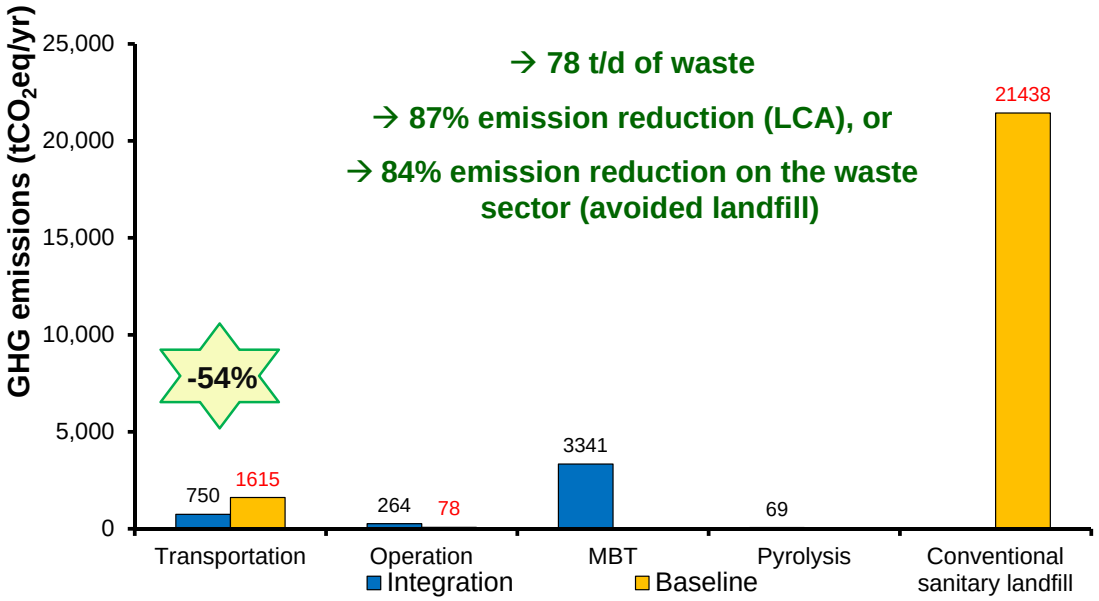
Best practice on SWM and climate change mitigation in Thailand: Phitsanulok Municipality

- **Public participation → Community based management**
  - Residents separated recyclables for sale
  - Residents conduct household and community organic waste management
    - Composting, anaerobic digestion, animal feed
    - Municipality applies the Mechanical Biological Treatment (MBT) prior to landfill disposal
    - Municipality uses of NGV to minimise cost of fuel consumption
    - Municipality introduces the Polluter Pay Principle

Flowchart of solid waste management in Phitsanulok Municipality



Summary of GHG emissions from integrated waste management system in Phitsanulok Municipality



GHG emissions from material recycling (rough estimation)

Recyclables	Weight (t/d)	GHG emissions per tonne (tCO_2eq)	Total emissions (tCO_2eq/d)
Paper	8.7	-2.08	-18.0
Plastic	5.4	0.25	1.4
Aluminium	1.4	-12.08	-17.4
Steel	5.0	-1.85	-9.3
Glass	15.5	-0.46	-7.1
Net	**36**		**-50.5**

Phitsanulok Municipality contributes to avoidance 50.5 tCO2eq/day when compare with non-recycling

If this emission is included, the Municipality can achieve zero GHG emissions (LCA).

Note: Suchada et al., (2003), approximate composition of collected recyclables by various participants in the municipality is 24% paper, 15% plastic, 43% glass, 4% aluminum and 14% steel.

Recommendations

- 3Rs (reduce, reuse, recycle) is a climate friendly waste management policy that should be adopted for National Solid Waste Management Plan, Nationally Appropriate Mitigation Actions (NAMAs), the 3R law, etc.
- Some municipalities practice 3Rs for minimising the waste to final disposal site, however most municipalities do not understand the linkage of the 3Rs and global warming. Therefore, capacity building and awareness raising are important to achieve the GHG emission reduction goal.
- In addition, subsidies to landfill development should be minimised, unless the 3Rs is integrated to the project.

IGES further activities (proposal)

- **Simulation of a zero GHG emission waste management system via an integrated waste management and lifecycle approaches**
- **Evaluation of GHG emissions and resource recovery potentials from packaging plastic treatment technologies in Japan**
- **Piloting organic waste separation and utilisation in Cambodia**
- **Developing a policy framework for NAMA on municipal solid waste management in developing countries based on a lifecycle and co-benefits approaches**

Thank you very much for your attention

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for further information, progress and final reports.