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WASTE COLLECTION AND MANAGEMENT

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MOUNTAIN ECOSYSTEMS AND RESOURCE MANAGEMENT
19-28 SEPTEMBER 2021

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Introduction

- Global MSW generation exceeded 1.3 billion tonnes in 2013 to reach **27 billion tonnes in 2050**
- Average of **1.42 kg/cap/day** (ranging at 0.1-0.8 t/cap/yr).
- Crucial need for sustainable waste management
- **Adaptation of waste management hierarchy**
 - workable and effective in many developed nations but unsuccessful in many developing countries

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World Production of Municipal Solid Waste (MSW), 2012-2025



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WASTE COLLECTION

- **Waste collection** is an essential part of in a waste management system.
- Allow the transfer of the waste from the point of its generation to the appropriate routes:
 - Treatment
 - Disposal.



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Storage methods

- Depot
- Enclosure
- Fixed storage bins
- Concrete pipe sections
- Drums
- Portable steel bins



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TYPE OF WASTE COLLECTION

- i) Communal collection (same as bring system)
 - (a) waste is brought to collection point
 - (b) sorting is done by householder

- (ii) Block collection
 - (a) Householder deliver the waste to collection vehicles at predetermined intervals

- (iii) Kerbside collection
 - (a) collected from road side
 - (b) has many disadvantages

- (iv) Door to door collection
 - (a) kerb service,
 - (b) alley service,
 - (c) set-back service,
 - (d) set-out service, and
 - (e) backyard service
- (v) Pneumatic (automatic) collection



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Door-to-door waste collection by private sector, Kathmandu, Nepal.



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Issues of Concern in Waste Management

- SWM problem **gaining prominence** due to public awareness.
- Increased waste **generation**.
- **Ineffective mechanisms** to tackle problem holistically.
- Many associated problems, including lack of space.
- **Lack of public participation**.



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Lack of awareness lead to littering



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Factors that Challenge Efficient Waste Management in Mountain Area

- type of settlement – range from small settlement in remote to large mountain cities
- altitude and climate
 - wide range of altitude and
 - extreme climate
- topography and land availability – citing waste management facilities is difficult due to wide range of surface landscape,
- Seismic activities
 - vulnerable to earthquakes
 - destruction to waste facilities e.g. landfill liners can lead to disastrous environmental pollution.
- remoteness and connectivity,
 - waste management services can be expensive
 - highly dependent on other factors
- accessibility by road – reduce the collection efficiency



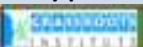
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Typical sight in mountainous cities



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Comparison of challenges in waste management in Mountainous and non-mountainous areas

SWM in all Areas	SWM in Mountain Areas
<ul style="list-style-type: none"> Poor awareness and adoption of SWM practices Lack of waste segregation Inadequate collection and storage facilities Poor or obsolete transportation options Lack of or poorly functioning treatment facilities Improper waste disposal techniques Competing priorities for local governments Lack of institutional coordination Lack of skilled and technical capacity Lack of funding and poor cost recovery 	<ul style="list-style-type: none"> Topography and geology (e.g. steepness, ruggedness, soil stability) Remoteness of settlements Scattered and low-density areas generating low volumes of waste Diverse temperature and weather conditions Sensitive environmental and ecological conditions Vulnerability from seismic activity Lack of road networks making access difficult Special types of waste generated (e.g., mountaineering waste), which require treatment and disposal Waste transport requires vehicles suitable to mountainous regions Limitations of space for waste treatment and disposal Poor socio-economic conditions in general High variability of waste generation due to tourist seasons


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Global MSW Management with Projections until 2022

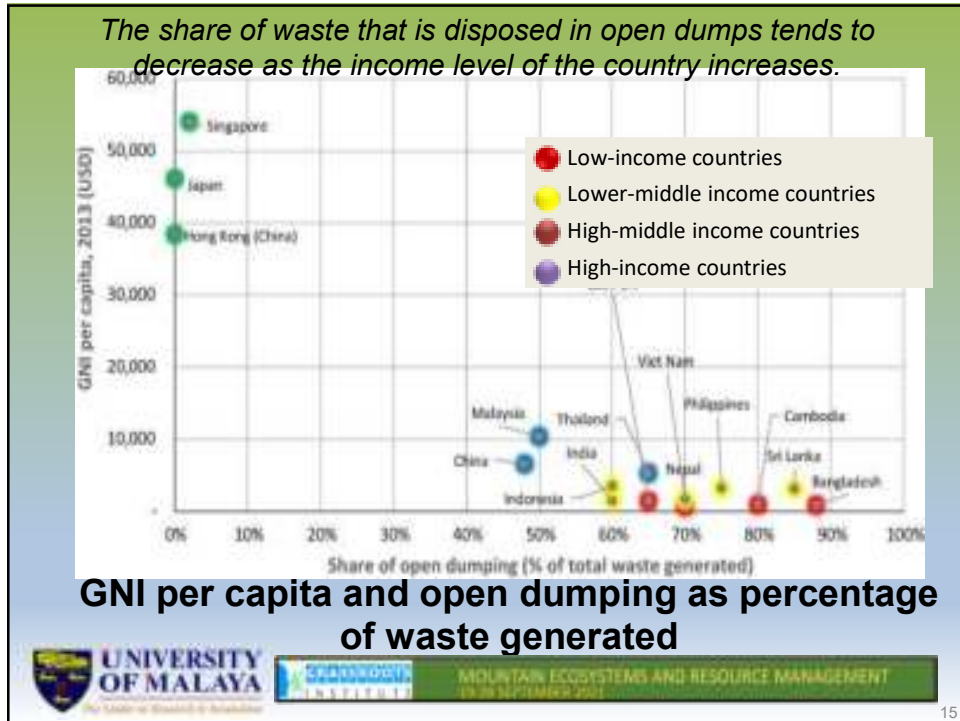



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Disposal of waste in developing countries

- Only **10-15%** of the disposal sites are sanitary landfills
 - In Indonesia and Vietnam, non-engineered landfills.
- **Lack of appropriate technology** applied such as
 - lining system
 - landfill gas collection system
- Source of **environmental pollution**
 - **Leachate, landfill gas**, pest and vermin, **scavengers**
- **Open burning** continues to be the cheapest, easiest, most sanitary means of volume reduction and disposal of combustible materials.



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Pest and Vermin

- **Putrescible waste** attract insects and other animals
- Common insects- flies and mosquitoes
- Common animals – domestic animals (dogs, cow, goat etc), monkeys, birds etc.
- Easy and abundant food sources
- May cause disease outbreak
- Difficult to control



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Scavenging by **Informal Sector**

- Become the livelihood for the low income group
- Additional side-income
- Retrieve valuable/ recyclable materials
- Health hazard
- Also reported to start fire to collect metal-based waste → problem to landfill managers
- No related policies in many developing countries



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Scavenging activities in a disposal site



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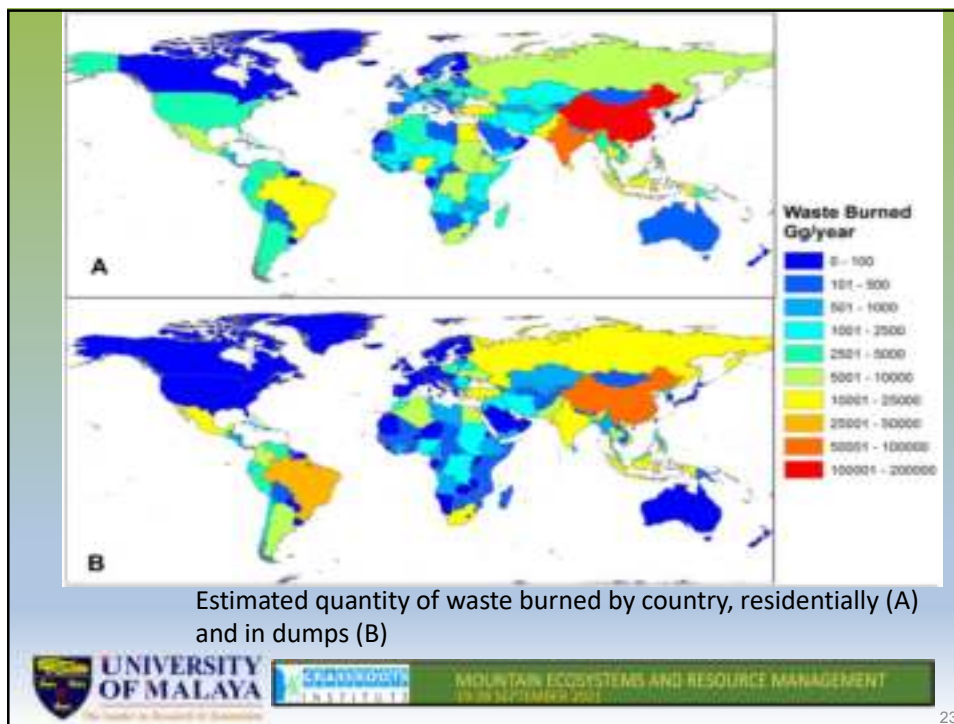
Soil contamination is very expensive to be remedied. Thus, in most cases, illegal dumping areas are left unattended or developed into parks etc.

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Open Burning of Waste

- A global phenomenon, most prevalent in developing countries.
- Releases six times more black carbon equivalent CO₂ compared to CH₄ from disposing waste at the landfill.
- **620 million tons** of waste per year are burned openly.
- **Mostly occurs in landfill/dumpsites** that have been filled far beyond their maximum capacity.
- **Poor collection coverage and poor waste disposal methods** lead to incidence of open waste burning.

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Challenges in Establishing An Efficient Waste Management

- **Absence of the formalised waste diversion sector.**
- **Lack of enforcement of waste management legislation.**
- **Multiple government departments are assigned overlapping responsibilities in waste management activities.**
- **Lack of recycling.**



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Issues of 3R

- A **livelihood for the urban poor community** in many developing countries.
- Plastic recycling in India and Bangladesh reaches approximately 47% and 51%, respectively.
- The trend will change with the improvement in the standard of living
 - Recycling not worth practicing
 - Recycling rate will reduce



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Existing facilities in some countries may not be sufficient to promote 3R

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Factors that influence 3R practice

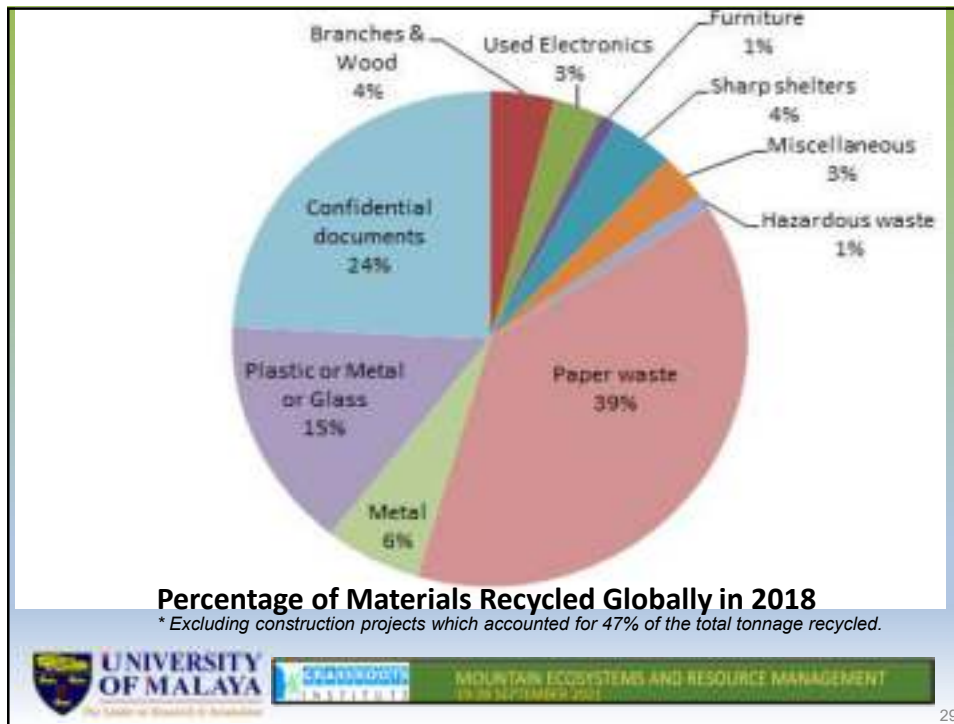
- impracticality of recycling due to the **absence of waste separation**
- **lack of a clear policy and necessary enforcement**
- **non-supportive local facilities**
- **issues of trans-boundary movement of waste**
- **absence of public participation**
- low levels of **awareness** on the benefits of practicing the 3Rs
- Consideration of **informal recycling** activities (scavengers and waste pickers)

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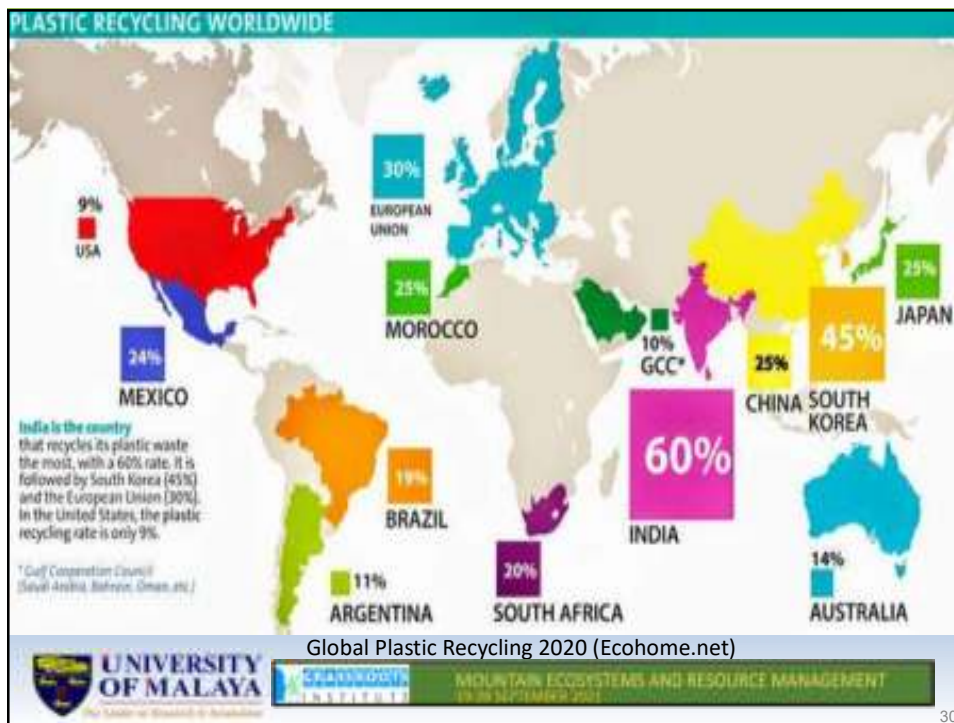
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Backyard recycling in India

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Workers at work in a composting plant that earn carbon credit trading in Bangladesh

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Aluminium cans ready for shipping





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1996-2016


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Challenges of 3R implementation

Aspect	Challenges	
	<i>Developed Nations</i>	<i>Developing Nations</i>
Population growth	<ul style="list-style-type: none"> ▪ Increase in waste generation. ▪ Improvement in waste management technology 	<ul style="list-style-type: none"> ▪ Increase in waste generation ▪ Higher waste complexity ▪ Premature closure of disposal sites ▪ Larger number of waste pickers
Policy implementation	<ul style="list-style-type: none"> ▪ Stringent regulations ▪ Effective 	<ul style="list-style-type: none"> ▪ Implementation of adapted policy ▪ Lack of enforcement ▪ Ineffective ▪ Illegal activities
Changes in waste composition	<ul style="list-style-type: none"> ▪ Introduction of suitable approaches such as, incineration, composting, pyrolysis etc. 	<ul style="list-style-type: none"> ▪ Failure in existing waste management system. ▪ Disturb the waste management facilities.
Public participation	<ul style="list-style-type: none"> ▪ High due to high awareness ▪ Active participation-daily habits 	<ul style="list-style-type: none"> ▪ Low due to low awareness ▪ Indifferent habits and refusal to change current habits. ▪ Retaliate with illegal waste disposal





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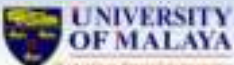

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Challenges of 3R implementation

Aspects	Challenges	
	<i>Developed Nations</i>	<i>Developing Nations</i>
Informal recycling such as scavenger etc.	<ul style="list-style-type: none"> Absence due to safety and hygiene factors. 	<ul style="list-style-type: none"> An importance aspect that promote recycling Unavoidable due to economic drivers. Number will increase with non-improved nations' GDP Health concern
Recycling strategies	<ul style="list-style-type: none"> Practical , inline with governmental policy 	<ul style="list-style-type: none"> Mainly white papers and not applicable for the implementation to the current waste management system.
Existing waste management system	<ul style="list-style-type: none"> Promote 3Rs 	<ul style="list-style-type: none"> Mainly serve to dispose waste.

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Community participation can enhance 3R activities



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Source: Website of The Government of Netherlands (n.d.) 38

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Viable Options for Waste Collection and Transport in Mountain Areas



Option	Mountain cities and towns	Rural areas with road access	Remote areas not connected by road	High-altitude areas (mountaineering/trekking waste)
Collection and Transport				
Use of pack animals to collect non-biodegradable waste			✓	✓ (base camps)
Use of non-motorized options (e.g. bicycles, animal-drawn carts)		✓	✓	
Use of locally available motorized options (e.g. three-wheelers, tractors)	✓	✓	✓	
Use of containerized handcarts, three-wheelers for segregated waste	✓	✓		
Use of dump trucks and waste transport vehicles suitable to mountain regions	✓	✓		
Workers collect non-biodegradable waste in back-packs provided by service provider*			✓	✓ (base camps)
Drop-off waste at specific collection points	✓	✓	✓	✓
Pooling resources through inter-municipal cooperation to improve service delivery and reduce costs	✓	✓	✓	
Special non-biodegradable wastes (e.g. waste, climbing equipment): Ensure collection through EH4helipool fees, which factor in costs of transportation to nearest processing/depot center	✓	✓	✓	✓

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Viable Options for Waste Treatment in Mountain Areas

Option	Mountain cities and towns	Rural areas with road access	Remote areas not connected by road	High-altitude areas (mountaineering/trekking waste)
Biodegradable waste: Composting at source (e.g. pit, bin, vermicomposting, pile)	✓	✓	✓	
Biodegradable waste: Composting at community level (e.g., bin, vermicomposting, black soldier fly larvae)	✓	✓	✓	✓ (base camps)
Biodegradable waste: Medium- to large-scale composting	✓	✓		
Biodegradable waste: Community-scale biomethanation, to be used output as cooking or energy source	✓	✓	✓	✓ (base camps)
Biodegradable waste: Combine household and animal/ livestock waste to improve biomethanation		✓	✓	
Biodegradable waste: Large-scale composting facilities	✓			
Non-biodegradable, recyclable waste: Sorting and minimal processing for value addition at transfer stations	✓	✓	✓	
Non-biodegradable, non-recyclable waste: Conversion to RDF/SRF for use in nearby cement, WTE plants	✓	✓		
Non-biodegradable waste: Upcycling waste for local use and tourists	✓	✓	✓	



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