Regional 3R Forum in Asia and the Pacific

State of the 3Rs in Asia and the Pacific

-Experts' Assessment of Progress in Ha Noi 3R Goals

Prepared by:
The Drafting Committee of the State of the 3Rs in Asia and the Pacific

Co-ordinated by:
The Secretariat of the Regional 3R Forum in Asia and the Pacific,
United Nations Centre for Regional Development (UNCRD); and
Institute for Global Environmental Strategies (IGES)

Financially Supported by:
Ministry of the Environment, Government of Japan

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IGES
Institute for Global Environmental Strategies

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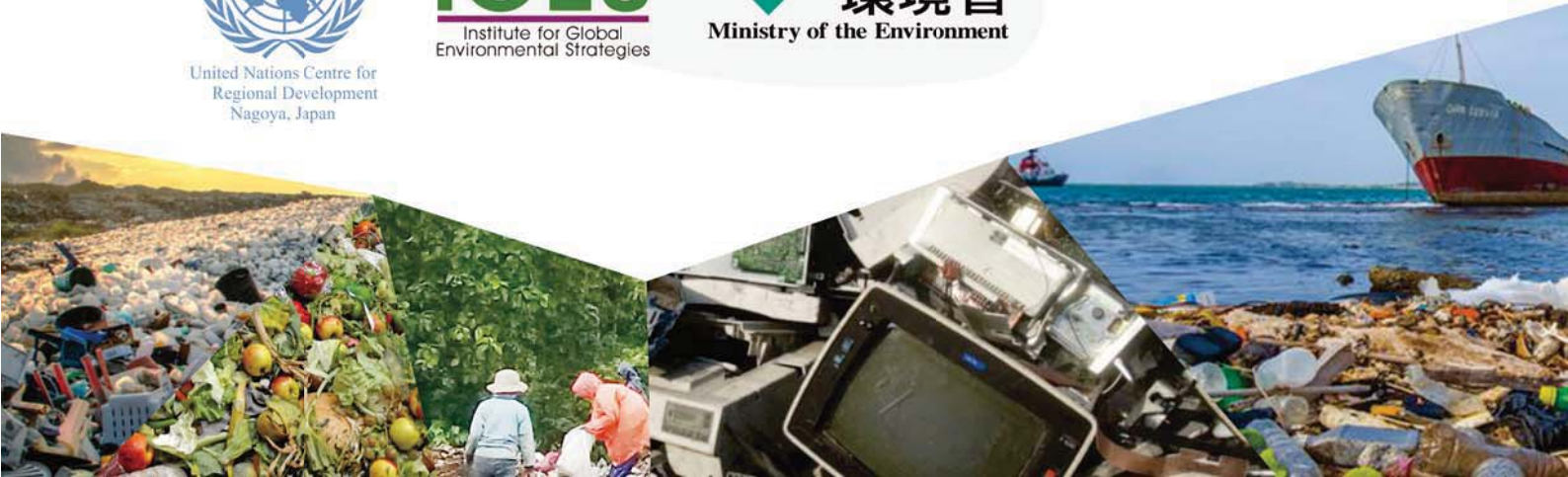
Ministry of the Environment



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Disclaimer

This synthesis report was prepared as an input for the 8th 3R Forum in Asia and the Pacific. The purpose of the report is to assess the status of 3R implementation in Asia and the Pacific and to share knowledge on 3R activities in the region.

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Abbreviations

3R	Reduce, Reuse, Recycle
e-waste	Electronic waste
EMFA	Economy-wide Material Flow Accounting
EPR	Extended Producer Responsibility
GHG	Greenhouse gas
Ha Noi 3R Goals	Sustainable 3R Goals for Asia and the Pacific for 2013-2023
ICZM	Integrated coastal zone management
IGES	Institute for Global Environmental Strategies
MFA	Material Flow Accounting
MOEJ	Ministry of the Environment of Japan
MRF	Material Recovery Facilities
MSW	Municipal Solid Waste
NGO	Non-government organization
OECD	Organization for Economic Cooperation and Development
PICT	Pacific Island Countries and Territories
RDF	Refuse-derived Fuel
SDGs	Sustainable Development Goals
SERI	Sustainable Europe Research Institute
SME	Small- and Medium-sized Enterprises
UNCRD	United Nations Centre for Regional Development
WTE	Waste to energy

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Preface

Almost two decades into the 21st Century, the Asia Pacific region has emerged as the world's largest consumer of natural resources and raw materials. Resource demands continue to expand in line with the region's increasing population, rapid urbanization and continued economic growth. Without appropriate planning, consumed resources and materials may ultimately end up as wastes and pollution, imparting negative impacts to land, water, air, human health and the global environment. It is therefore imperative that the Asia Pacific countries focus and invest on 3Rs (Reduce, Reuse and Recycle) for the improvement of waste management, resource efficiency and public health.

In response to this circumstance, an increasing number of countries in the region have formulated policies and strategies to improve waste management in an environmentally sound manner. A number of questions are raised following the development of the country responses on waste management. How have these policies been developed and are these policies being effectively implemented? What are the results and impacts? Are these results and impacts measurable? What are the next challenges in the 3Rs? Consequently, the Regional 3R Forum in Asia and the Pacific, organized by the United Nations Centre for Regional Development (UNCRD) and supported by the Ministry of Environment of Japan (MOEJ), provided an opportunity to discuss 3R policies, strategies, implementation, achievements and challenges.

Adequate 3R policy implementation is seen as a key measure in the region to prevent waste generation and minimize waste disposal. The Ha Noi 3R Declaration adopted at the 4th Regional 3R Forum in Asia and the Pacific in 2013 demonstrated the commitment of sustainable 3R actions with 33 goals and its indicators as Ha Noi Goals (2013-2023). Following this initiative, the State of the 3Rs in Asia and the Pacific Project was launched in the 6th Regional 3R Forum in Asia and the Pacific in 2015 in Male, Maldives, to measure the regional progress on the Ha Noi Goals (2013-2023) and to provide regional 3R outlook with reliable and policy-relevant data and information. As such, the goal of this publication is to catalyze continuous action in national and local levels towards the Ha Noi Goals (2013-2023) by monitoring 3R progress.

The development of indicators is necessary in monitoring 3R implementation to derive levels, degrees or standards of waste management strategies, status and changes. Each indicator for waste management requires both quantitative and qualitative definition in order to elucidate changes brought about by the implementation of specific policies and strategies. Indicators can vary depending on waste-related policies, challenges and priorities of a country. Scientific indicators provide standardized measures and assessment especially for the challenges of chemicals and hazardous wastes. Considering cultural, linguistic and environmental diversity in the region as well as science-based analytical infrastructures in individual countries, this report attempts to adjust countries' definitions and indicators to common 3R performance indicators.

With this publication, the member countries are encouraged to develop national monitoring reports on the state of the 3Rs with particular focus on applying 3R performance indicators to measure 3R policy practices, technical improvement, forecasting challenges and opportunities including business, socioeconomic and sociocultural aspects for national and regional development and prosperity in consideration of the 2030 Agenda for Sustainable Development.

Executive Summary

Solid waste generation in the Asia Pacific region is projected to increase significantly along with rapid economic development. Without proper technical and institutional capacity for promoting solid waste management and material recycling in an environmentally sound manner, the increasing amount of waste generated is likely to result in environmental pollution.

In order to support environmentally sound waste management, a growing number of countries in the region have begun formulating strategies that include implementing effective mechanisms to introduce the 3Rs (reduce, reuse and recycle): "reduce" means choosing to use things with care to curb waste generation; "reuse" involves the repeated use of items or parts of items which still have functional aspects; and "recycle" implies retrieving and recovering waste as a resource.

Since the launch of the 3R Initiative in 2005 and the first Regional 3R Forum in Asia and the Pacific in 2009, there has been growing consensus among countries about the need for prioritizing the 3R agenda both in national and international discussions. Benefits of applying the 3Rs include saving energy and material resources through improved efficiency, upgrading solid waste management, promoting prosperity through green and circular economies, mitigating and addressing climate change, and supporting the Sustainable Development Goals (SDGs).

In this regard, Ha Noi Declaration, Sustainable 3R Goals for Asia and the Pacific for 2013-2023, was adopted in the 4th Regional 3R Forum in Asia and the Pacific held in Ha Noi, Viet Nam in March 2013 including 33 goals and their indicators, Sustainable 3R Goals for Asia and the Pacific for 2013-2023 (Ha Noi 3R Goals), to assess national level 3R progress. The 6th Regional 3R Forum (Maldives, 2015) endorsed a project proposal, the State of the 3Rs in Asia and Pacific Project, to regularly report "State of the 3Rs in Asia and Pacific" to assist member countries of the forum for 3R progress assessment.

This report reviews the status of 3R policy implementation in 11 countries (Bangladesh, Cambodia, PR China, Japan, India, Indonesia, Malaysia, The Philippines, Singapore, Thailand, and Viet Nam), as well as one sub-region (Pacific Island Countries), based on country inputs to the Regional 3R Forum in Asia and the Pacific with regard to specific Ha Noi 3R Goals (2013-2023). The following observations were noted:

- **3R policy progress** varies widely among countries based on levels of industrialization, geography, and specific social and economic conditions, as reflected by major gaps between the resource availability and the need for investment in waste collection, transportation, recycling and final disposal (*Chapter 3.1*).
- Between 2011 and 2015, **total MSW generation** and **MSW per capita** increased in most countries even with the goal of significantly reducing the quantity of MSW generation (**Goal 1, Hanoi 3R Goals**). At the same time, recycling rates in the region improved between the years 2000 and 2015. This is a promising development in Asia and the Pacific, suggesting that 3R-related efforts focused on waste management are being successfully implemented by a number of countries, both in terms of legislation and policy development, as well as actions taken specifically within large cities (**Goals 1 and 3**; *Chapter 3.1.1* and *Chapter 3.2.1*). It should be noted, however, that recycling activities in many countries are still widely conducted by the informal sector with unsound technologies.

- **Definitions** used for **municipal solid waste** differ between countries, contingent on the particular situation and context (*Chapter 3.1.2*), emphasizing the need for harmonization across the region in the future. The increasing trend of non-biodegradable waste generation such as plastic, e-waste and other difficult-to-manage materials needs a particular policy attention. For this reason, efforts to improve solid waste classification should be considered a key factor in the effective formulation of **3R policies** (*Chapter 3.1.3*).
- **Total direct material consumption** and **waste generation volumes** show an increasing trend across the region (**Goal 1 and 17**; *Chapter 3.2.1* and *Chapter 3.3.1*) whilst resource productivity[1] has been steadily improving in a number of countries (**Goal 17**; *Chapter 3.3.1*). There have been emerging new waste streams including e-waste, food waste/loss, construction and demolition waste and marine litter.
- All countries, being signatories of Basel Convention, have enacted policies and guidelines to address **hazardous waste management** as a national waste management priority, yet important gaps remain, including the development of proper inventories (**Goal 9**; *Chapter 3.2.2*). Actual implementation of legislation and policies on hazardous waste varies widely across countries (**Goal 9**; *Chapter 3.2.2*).
- The definition and composition of **agricultural biomass** generated from the Asia-Pacific region varies from country to country. Most countries have installed laws/ regulations/ policies/ plans to utilize agricultural biomass as a feedstock for renewable energy. However, it is still challenging to have actual estimates of onsite use of agricultural biomass residues and livestock waste. Government policy frameworks/ interventions are thus needed to promote full scale use of agricultural biomass waste and livestock waste through reuse or recycle process to achieve a number of co-benefits, such as GHG emission reduction, energy and resource efficiency. (**Goal 11**; *Chapter 3.2.3*).
- **E-waste** shows an increasing trend in the region due to economic growth, contributing to a rise in domestic consumption of electric devices. Consequently, **e-waste management** has been prioritized and a number of countries have started to apply EPR-based policies for e-waste management. It is also important to monitor e-waste generation and recycling volumes by installing appropriate inventory systems and management programmes such as manifesto to track and ensure environmentally sound treatment. (**Goal 13** and **15**; *Chapter 3.1.4* and *Chapter 3.2.4*).
- **Marine and coastal plastic waste** has been given increasing regional attention. Some estimates suggest certain countries in the region are leading sources of marine and coastal plastic waste. Certain countries, such as Bangladesh and India, have enacted bans on plastic carry bags to prevent flooding resulting from clogged drainage systems and maintain clean cityscapes by reducing waste at source. However, concrete actions taken at the national level remain limited in most countries (**Goal 12**; *Chapter 3.2.5*).
- 3R practices should be prioritized to optimize the circulation of resources, energy saving and landfill diversion. Several countries are advancing **GHG mitigation efforts** through landfill diversion and the use of intermediate waste treatment approaches (Japan, PR China, and Singapore). A careful evaluation of different waste treatment approaches and methodologies is required from not only the perspective of **GHG emission reduction potentials** but also of other environmental, economic and social aspects (**Goal 19**; *Chapter 3.3.2*).

[1] Resource productivity is defined as the quantity of outcome that is obtained through the expenditure of unit resource.

Within the scope the Regional 3R Forum in Asia and the Pacific, several recommendations can be offered with a view to strengthen bilateral and multilateral collaboration for 3R promotion and resource efficiency in the region:

- Waste volumes are increasing proportionately to material consumption across the region, necessitating continued prioritization of resource productivity, waste prevention and reduction activities.
- Infrastructure planning and allocation of appropriate budget for establishing an integrated waste management system comprising source segregation, collection, recycling and treatment of different waste streams is fundamental to ensure successful delivery of 3R policy objectives.
- E-waste, marine litter and coastal plastic waste, micro plastics, food waste and food loss issues require increasing attention both by policy makers and experts in the region due to their high environmental and social impacts. Proper data management for understanding the magnitude of environmental impacts resulting from these emerging waste streams is critical for the effective planning of interventions.
- Stakeholder engagement and consensus-based policymaking are crucial for effective promotion of the 3Rs. Proper public understanding and partnership with local communities is essential for implementation of 3R-related activities such as waste segregation, introduction and operation of appropriate technologies and collection of waste management fees, among others. Collaboration among central and local governments, private sector, civil society and other groups thus represents a vital aspect of 3R policy governance.
- Noting that a number of developing economies examined in this report continue to face challenges with strengthening environmental regulations and enforcing standards, further institutional capacity building will be paramount to ensure that countries maintain steady progress on 3R policy development and implementation, including the setting of appropriate targets, monitoring indicators and incentives.
- Special attention is necessary to address specific challenges faced by small island countries and remote rural areas in the region, including costs associated with logistics for waste management, the relatively low volume and dispersed generation of wastes, availability of technologies and facilities, market access for recyclables, and human and financial capacity constraints of national and local authorities. The selection of appropriate, simple and affordable technologies together with the promotion of decentralized approach is therefore recommended.
- The Regional 3R Forum is instrumental in supporting countries with policy development and implementation of the 3Rs, providing an opportunity for knowledge sharing on good practices and lessons learned, and networking and capacity building for mainstreaming 3R principles into national, local and regional policy making.
- Considering the increasing emphasis placed on long-term policy goal setting and development of corresponding indicators, including among the SDGs and Ha Noi 3R Goals, the State of the 3Rs in Asia and the Pacific Project will continue to work towards harmonizing measurement processes for 3R policy formulation in the region. In this regard, efforts will also be required to ensure comparable and credible data across countries, as this remains an important challenge for 3R policy and implementation in Asia and the Pacific. For this reason, institutional capacity should be strengthened in order to improve data management for evidence-based policy making across all countries; continued technical support from regional

experts will be crucial to carry forward the work initiated under State of the 3Rs in Asia Pacific project.

In summary, the information shared in the following pages can assist regional decision makers and development practitioners in engaging in constructive policy discussions on the ways 3R policies, strategies and actions can be scaled up and successfully delivered to foster resource efficient, circular and low carbon economies across Asia and the Pacific.

1. Background and Scope of Work

1.1. About the State of the 3Rs in Asia and the Pacific Project

The ***State of the 3Rs in Asia and the Pacific Project*** was formulated in the 6th Regional 3R Forum in Maldives in 2015 as a joint initiative between Institute for Global Environmental Strategies (IGES) and United Nations Centre for Regional Development (UNCRD), being the secretariat of Regional 3R Forum in Asia and the Pacific, with the support of the Ministry of the Environment of Japan (MOEJ). The Project has aimed at assessing the progress of 3R-related efforts in the region based on a bottom-up process of policy-relevant data gathering on waste management and resources. This project was established to contribute to the Regional 3R Forum in Asia and the Pacific.

The overall objective of State of the 3Rs in Asia and the Pacific Project is to assist member countries of the Regional 3R Forum in Asia and the Pacific on improved decision making towards effective implementation of 3Rs and environmentally sound waste management at local and national level. This includes analyzing the 3Rs for environmental management, economic opportunities and regional development through the improvement of data, information and the usage of indicators in all waste sectors (e.g. municipal, industrial and hazardous wastes, waste electrical and electronic equipment, agricultural and biological wastes) for achieving a low carbon and resource efficient region. It also aims to contribute to the Sustainable Development Goals (SDGs) in line with the 2030 Agenda for Sustainable Development by providing information on progress associated with the development of 3R policy indicators in the region.

The specific objectives of this project are:

a. To develop a synthesis and assessment report on the current status of 3R policy implementation in the region based on Country Chapters with national level data and information prepared by the experts,
b. To compile data-relevant information aimed at monitoring the progress of 3R policy implementation in the region in relation to the Ha Noi 3R Declaration (2013-2023), and
c. To contribute to the Regional 3R Forum in Asia and the Pacific by providing science-based advice on existing and future challenges and opportunities, including those on business, socioeconomic and sociocultural aspects of the 3Rs, for effective 3R implementation in the region.

Towards this end, the project seeks to provide baseline information and knowledge about waste and 3R status provided by top-experts in the region. In doing so, this project is intended for developing a regional assessment report on 3R policy implementation on a regular manner for the Regional 3R Forum in Asia and the Pacific. This first series of work is based on case studies from 11 countries: the People's Republic of Bangladesh (Bangladesh), the Kingdom of Cambodia (Cambodia), the People's Republic of China (China), the Republic of India (India), the Republic of Indonesia (Indonesia), Japan, Malaysia, the Republic of the Philippines (The Philippines), the Republic of Singapore (Singapore), the Kingdom of Thailand (Thailand), and the Socialist Republic of Viet Nam (Viet Nam); and a sub-region (Pacific Region) for Pacific Island Countries.

1.2. Regional 3R Forum in Asia and the Pacific, Ha Noi 3R Declaration, and 3R Performance Indicators

The Regional 3R Forum in Asia and the Pacific was launched in November 2009, with the objective view of providing strategic policy advice to national government authorities in mainstreaming the 3Rs in overall policy, planning and development. The Forum seeks to address policies, programs, measures, tools and technologies on sustainable production and consumption, and integrated solid waste management in the context of promoting greater resource efficiency, and as a means towards achieving a sound material-cycle, low-carbon and zero waste society. The Forum also provides a knowledge sharing platform for disseminating and sharing 3R best practices, including new and emerging waste management concerns.

Since the launch of the Regional 3R Forum in Asia and the Pacific in 2009, policy issues and priorities in the region have been widely discussed and shared among member countries. It was at the 4th Meeting of the Regional 3R Forum in Ha Noi, Viet Nam in March 2013 that the countries agreed on the Ha Noi 3R Declaration which proposed 33 goals and their indicators – Sustainable 3R Goals for Asia and the Pacific for 2013-2023 (Ha Noi 3R Goals). Corresponding indicators are provided for each goal to support the monitoring and reporting of progress related to the implementation of these goals (*Table 1-1*).

***Table 1-1**. Sustainable 3R Goals for Asia and the Pacific for 2013-2023*

GOALS	MONITORING INDICATORS
I. 3R Goals in Urban/Industrial Areas	
a) 3Rs in municipal solid waste (MSW)	
1) Significant **reduction** in the quantity of **municipal solid waste** generated, by instituting policies, programmes and projects at national and local levels, encouraging both producers and consumers to reduce waste through greening production, greening lifestyle, and sustainable consumption.	- Total generation of MSW per capita. - Total amount of MSW going to landfill. - Number of Integrated Solid Waste Management/3Rs or other relevant policies and programmes introduced at local levels. - Specific policies and mechanisms that lead to reduction of disposable plastic bags, packaging, and other single□use consumer products. - Annual government expenditure per capita on consumer awareness-raising. - Total waste disposed per capita.
2) Full-scale utilization of the **organic component of municipal waste, including food waste,** as a valuable resource, thereby achieving multiple benefits such as the reduction of waste flows to final disposal site, reduction of GHG emission, improvement in resource efficiency, energy recovery, and employment creation.	- Organic waste landfilled per capita, or per amount landfilled. - Amount of organic component of MSW composted. - Amount of organic waste component of MSW treated by anaerobic digestion. - Number of cities that have introduced successful source separation programmes. - Number of jobs in organic waste management (formal/informal). - Amount of organic waste component of MSW treated by waste-to-energy.
3) Achieve significant **increase in recycling rate** of recyclables (e.g., plastic, paper, metal, etc.), by introducing policies and measures, and by setting up financial mechanisms and institutional frameworks involving relevant stakeholders (e.g., producers, consumers, recycling industry, users of recycled materials, etc.) and development of modern recycling industry.	- Overall Recycling Rate (%). - Recycling rate (%) of paper. - Recycling rate (%) of plastic. - Market size of recyclables. - New policy/programme/system/measure introduced, or existing policy/programme/ measure/system strengthened. - Number of state-of-art recycling facilities for key recyclables. - Employment in recycling industries.

GOALS	MONITORING INDICATORS
	- Number of cities that have introduced successful source separation programmes.
4) Build **sustainable cities /green cities** by encouraging "**zero waste**" through sound policies, strategies, institutional mechanism, and multi-stakeholder partnerships (giving specific importance to private sector involvement) with primary goal of **waste minimization**.	- Number of cities adopting zero waste strategies. - National policies and programmes introduced/strengthened to support local authorities in implementing zero-waste programmes. - Number of public-private-partnerships in waste management. - Amount of private sector investment in waste management sector. - Number of registered private sector firms with track record of providing waste management services. - Number of cities that implement inclusive and integrated waste management systems that address the environmental, social, and labour (meaningful work) issues of waste, and include informal workers and organizations in their systems.
b) 3Rs in Industrial sector (including SMEs)	
5) Encourage **private sector**, including small- and medium-sized enterprises (**SMEs)** to implement measures to increase **resource efficiency and productivity**, creation of decent work and to improve environmentally-friendly practices through applying environmental standards, clean technologies, and cleaner production.	- Policy instrument(s) that support resource efficiency and productivity are introduced or strengthened at national and local levels. - Policy instruments are introduced aiming at improving labour conditions and eliminating substandard employment contracts. - Number of SMEs receiving expert advice, training, and other support from the Centre of Excellence for resource efficiency (e.g., Cleaner Production Centre). - Annual government expenditure on cleaner production programmes as a per cent of Gross domestic product.
6) Promote the **greening of the value chain** by encouraging industries and associated suppliers and vendors in socially responsible and inclusive ways.	- Number of companies that have introduced green supply chain management. - Number of companies that have introduced green accounting/voluntary environmental performance evaluation (The International Organization for Standardization, 14000). - Number of companies that have introduced social accounting (SA 8000) in consultation with workers (and through Social Dialogue in the workplace). - Vocational training activities/programmes on skills for green jobs in the waste management value chain incorporated in local/national Technical and Vocational Education and Training policies and programmes.
7) Promote **industrial symbiosis** (i.e., recycling of waste from one industry as a resource for another), by providing relevant incentives and support.	- Number of eco-industrial parks and the like. - Policy instrument(s) introduced or strengthened to incentivize industrial symbiosis. - Recycling rate (%) of industrial waste from selected sectors.
8) Build **local capacity** of both current and future practitioners, to enable private sector (including SMEs) to obtain the necessary knowledge and technical skills to foster green industry and create decent, productive work.	- Number of qualified technical advisors on resource/energy efficiency. - Specific curricula developed and/or introduced for universities, business schools, employers organizations, worker's organizations, and vocational schools aiming at increased productivity including through improved working conditions and decent labour contracts. - Annual government expenditure on building capacity of SMEs in promoting environmentally- friendly technologies and practices.
9) Develop proper **classification and inventory of hazardous waste** as a prerequisite towards sound management of hazardous waste.	- Proper classification and inventory of hazardous waste developed.
II. 3R Goals in Rural Areas	
10) **Reduce losses in the overall food supply chain** (production, post harvesting and	- Percentage of food loss at each stage of food supply chain.

GOALS	MONITORING INDICATORS
storage, processing and packaging, distribution), leading to reduction of waste while increasing the quantity and improving the quality of products reaching the consumers.	
11) Promote full-scale **use of agricultural biomass waste and livestock waste** through reuse and/or recycling measures as appropriate, to achieve a number of co-benefits including GHG emission reduction, energy security, sustainable livelihoods in rural areas, and poverty reduction, among others.	- Amount of agricultural biomass waste and livestock waste recycled. - Number of new projects initiated that use agricultural biomass waste and livestock waste as material inputs.
III. 3R Goals for New and Emerging Wastes	
12) Strengthen regional, national and local efforts to address the issue of **waste, in particular plastics** in the marine and coastal environment.	- Number of coastal cities with complete ban on use of plastics packaging materials. - Issues of plastic waste considered as part of integrated coastal zone management (ICZM) plans. - National policies concerning plastic waste developed or strengthened, taking into consideration the impacts of plastic waste in marine and coastal environment. - Regional initiatives initiated/ strengthened to address the issue of plastic waste in the marine and coastal environment.
13) Ensure **environmentally-sound management of e-waste** at all stages, including collection, storage, transportation, recovery, recycling, treatment, and disposal, with appropriate considerations on working conditions, including **health and safety aspects** of those involved.	- Formal standards, certification system, and licensing procedures established and enforced. - Technical support services made available to informal sector and SMEs involved in e-waste management, that have raised awareness of workers and employers on the hazards of e-waste management and recycling at all stages. - Presence of, and access to, appropriate health-care services for informal sector workers. - Number of state-of-the-art recycling facilities for e-waste (such as mobile phones at their end of life). - Guidelines on environmentally-sound management of e-waste at all stages, including occupational safety and health standards, appropriate work spaces, and infrastructure, and protective working equipment developed and incorporated into local regulatory frameworks.
14) Effective enforcement of established mechanisms for preventing illegal and inappropriate export and import of waste, including transit trade, especially hazardous waste and e-waste.	- Reduction in the number of incidents of illegal export/import of e-waste against a measured baseline in a specific year. - Number of well-trained customs officials tracking illegal export/import.
15) Progressive implementation of **"extended producer responsibility (EPR)"** by encouraging producers, importers, and retailers and other relevant stakeholders to fulfill their responsibilities for collecting, recycling, and disposal of new and emerging waste streams, in particular e-waste.	- New EPR policies enacted, or existing policies strengthened. - List of (or number of) products and/or product groups targeted by EPR nationally.
16) **Promote 3R concept** in health-care waste management.	
IV. 3R Goals for Cross-cutting Issues	
17) Improve **resource efficiency and resource productivity** by greening jobs nation-wide in all economic and development sectors.	- Economy-wide Material Flow Accounting indicators, such as Total Material Requirement, Direct Material Input, and Domestic Material Consumption. - Energy efficiency schemes. - Product standards.

GOALS	MONITORING INDICATORS
	- Guidelines on greening, including waste management businesses and jobs. - Number of green jobs, taking into consideration nationally-defined indicators. - Number of decent jobs, particularly in the areas of waste reduction and recycling, green product design and other green sectors.
18) Maximize co-benefits from waste management technologies for local air, water, oceans, and soil pollution and global climate change.	
19) Enhance **national and local knowledge base and research network on the 3Rs and resource efficiency**, through facilitating an effective and dynamic linkage among all stakeholders, including governments, municipalities, the private sector and scientific communities.	- Policies introduced/strengthened, encouraging interaction between universities and private sector. - Number of collaborative projects, joint conferences and seminars by universities, government, and private sector. - Annual government expenditure in support of research and development on the 3Rs.
20) Strengthen multi-stakeholder partnerships among governments, civil society, and the private sector in raising public awareness and advancing the 3Rs, sustainable consumption and production, and resource efficiency, leading to the behavioural change of citizens and change in production patterns.	- Number of NGOs actively engaged in 3R promotion (e.g., waste reduction, recycling, composting, and green purchasing). - Annual government expenditure on public extension programmes. - Existence of national association of waste management and recycling professionals. - Charge for garbage collection. - Existence of ad-hoc multi-stakeholder committee to promote the 3Rs.
21) **Integrate the 3Rs** in formal education at primary, secondary, and tertiary levels as well as non-formal education such as community learning and development, in accordance with Education for Sustainable Development.	- Number of universities offering courses on the 3Rs and waste management at undergraduate or post graduate levels that include technical procedures, and environmental and social/labour impacts and opportunities. - Waste management, as a social and environmental challenge and the 3Rs and waste issues integrated into school curriculum. - Existence of community-based 3R activities.
22) **Integrate the 3R concept** in relevant policies and programmes, of key ministries and agencies such as Ministry of Environment, Ministry of Agriculture, Forestry and Fisheries, Ministry of Industry, Ministry of Trade and Commerce, Ministry of Energy, Ministry of Water Resources, Ministry of Transport, Ministry of Health, Ministry of Construction, Ministry of Finance, Ministry of Labour, Ministry of Land and Urban Development, Ministry of Education, and other relevant ministries towards transitioning to a resource efficient and zero waste society.	- Existence of a national 3R task force. - Number of sectoral policies and programmes that have integrated 3R concepts. - Number of cities introducing state-of-the-art 3R technologies in various sectors.
23) Promote **green and socially-responsible procurement** at all levels, thereby creating and expanding 3R industries and markets for environmentally-friendly goods and products.	- Number of government ministries that have adopted green procurement policy. - Eco-labels / eco-labeling schemes. - Labour standards, in particular safety of workers, embedded in waste management contracts. - Incentives in place for large-scale contractors to employ and train informal waste workers as needed. - Number of cities that have adopted green procurement policy.

GOALS	MONITORING INDICATORS
24) **Phase out harmful subsidies that favour unsustainable use of resources (raw materials and water) and energy**, and channel the freed funds in support of implementing the 3Rs and efforts to improve resource/energy efficiency.	- Subsidies that favour unsustainable use of resources and energy are phased out. - Policy instruments(s) and programmes are in place in support of 3Rs and resource/ energy efficiency.
25) **Protect public health and ecosystem, including freshwater and marine resources** by **eliminating illegal** activities of open dumping, including dumping into the oceans, and controlling open burning in both urban and rural areas.	- Number of cities with open dumping/open burning. - Number of major rivers with open dumping and direct discharge of untreated domestic waste and industrial effluents. - Biological Oxygen Demand of major rivers, lakes, etc.
26) Facilitate the international circulation of re-usable and recyclable resources as well as remanufactured products as mutually agreed by countries and in accordance with international and national laws, especially the *Basel Convention*, which contributes to the reduction of negative environmental impacts and the effective management of resources.	- Existence of framework for bilateral and multilateral cooperative activities toward efficient, legal, and appropriate trade of circulative resources. - Number of facilities certified by authorized bodies for environmental standard certification. - Market size of waste management and recycling industry. - Number of eco-industrial parks.
27) Promote data collection, compilation, and sharing, public announcements and application of statistics on waste and the 3Rs, to understand the state of waste management and resource efficiency.	- Existence of basic data on wastes and the 3Rs (such as material flow, resource productivity, cyclical use rate, amount of final disposal, and amount of exports and imports of wastes and recycled materials) required for 3R policy-making, planning, implementation, and monitoring. - Number of access to websites providing information on wastes and the 3Rs.
28) Promote heat recovery (waste-to-energy), in case wastes are not re-usable or recyclable and proper and sustainable management is secured.	- Existence of incentives to promote heat recovery. - Number of facilities equipped with heat recovery system.
29) Promote overall regional cooperation and multi-stakeholder partnerships based on different levels of linkages such as government-to-government, municipality-to-municipality, industry-to-industry, (research) institute-to-institute, and NGO-to-NGO. Encourage technology transfer and technical and financial supports for 3Rs from developed countries to less developed countries.	
30) Pay special attention to issues and challenges faced by developing countries including SIDS for achieving sustainable development.	- Number of 3R-related projects implemented. - Number of 3R-related projects linked to Climate Change, Biodiversity, Disaster Management, Tourism, and Industry.
31) Promote 3R + "Return" concept which stands for Reduce, Reuse, Recycle and "Return" where recycling is difficult due to the absence of available recycling industries and limited scale of market in SIDS, especially in the Pacific Region.	- Number of countries that have developed the 3R (+ "Return") strategy. - Number of countries that have developed and implemented economic instruments such as the container deposit programme, etc. - Number of recycling companies/organizations that have been trained on basic technique for recycling (preliminary processing). - Implementation of periodical review on "Return" collaboration between the Asia-Pacific countries through 3R Forum in Asia and the Pacific.

GOALS	MONITORING INDICATORS
32) Complete elimination of illegal engagement of children in the **informal waste sector** and gradually **improve** working conditions and livelihood security, including **mandatory provision of health insurance** for all workers.	- Number of children in hazardous child labour (ILO definition) in waste sector (target set for 0). - Clear policy framework for informal waste sector integration in place. - Effective policy framework for integrating informal waste activities into integrated waste management schemes. - Waste pickers provided with contributory social security. - Landfill sites accessible only to registered waste pickers. - Number of workers in informal and formal sector with access to social security and/or health care services. - Number of labour inspections in waste sector.
33) Promote 3Rs taking into account gender considerations.	

Source: Ha Noi 3R Declaration - Sustainable 3R Goals for Asia and the Pacific for 2013-2023

In setting the Ha Noi 3R Goals (2013-2023) and its indicators, researchers from IGES, Institute of Developing Economies-Japan External Trade Organization (IDE-JETRO), National Institute for Environmental Studies (NIES), University of Malaya (UM), Asia Institute of Technology (AIT), Institute Technology Bandung (ITB), Tokyo Institute of Technology (TOKYO TECH) and UNCRD were assembled to comprise and establish the Asia Resource Circulation Policy Research Group (*Table 1-2*).

***Table 1-2**. Regional 3R Forum and the State of the 3Rs in Asia and the Pacific*

	Regional 3R Forums in Asia and the Pacific	Working Group(s)
2009	**Inaugural Regional 3R Forum in Asia** (November 2009, Tokyo, Japan)	
2010	**2nd Regional 3R Forum in Asia** (October 2010, Kuala Lumpur, Malaysia)	
2011	**3rd Regional 3R Forum in Asia** (October 2011,Singapore)	
2012	Secretariat of the Regional 3R Forum, UNDRD: - Proposed 24 goals with a list of indicators.	Asia Resource Circulation Policy Research Group workshop (December 2012, Bangkok): - Reviewed the 24 goals and sample indicators; - Developed five priority areas;"3Rs in municipal solid waste", "3Rs in the industrial sector (including small and medium sized enterprises)", "3R Goals in Rural Areas", "3R Goals for New and Emerging Wastes", and "3R Goals for Cross-cutting Issues".
2013	**4th Regional 3R Forum in Asia** (March 2013, Ha Noi, Viet Nam) declared: - 33 Goals and its Indicators = Ha Noi Goals (2013-2023) and its indicators (Ha Noi 3R Declaration) - 3R performance indicators (Chair's Summary)	Asia Resource Circulation Policy Research Group workshop (February 2013,Tokyo): - Selected eight top priority goals; - Prepared eight factsheets for 3R policy performance indicators.
2014	**5th Regional 3R Forum in Asia and the Pacific** (February 2014, Surabaya, Indonesia): - Proposed nine core set of 3R policy indicators.	Asia Resource Circulation Policy Research Group (January 2014 Surabaya, Indonesia): - Prepared a core set of indicators.

	Regional 3R Forums in Asia and the Pacific	Working Group(s)
2015	**6th Regional 3R Forum in Asia and the Pacific** (August 2015, Male, Maldives) - Launched the State of the 3Rs in Asia and the Pacific Project	**1st Drafting Committee Meeting** of Asia and Pacific 3R White Paper (January 2015, Cebu, The Philippines) **2nd Drafting Committee Meeting** of Asia and Pacific 3R White Paper (February 2015, Tokyo, Japan) **3rd Drafting Committee Meeting** of "State of the 3Rs in Asia and the Pacific" (November 2015, Tokyo, Japan
2016	**7th Regional 3R Forum in Asia and the Pacific** (November 2016, Adelaide, Australia)	**4th Drafting Committee Meeting** of "State of the 3Rs in Asia and the Pacific" (March 2016, Ha Noi, Viet Nam) **5th Drafting Committee Meeting** of "State of the 3Rs in Asia and the Pacific" (November 2016, Adelaide, Australia)
2017		**6th Drafting Committee Meeting** of "State of the 3Rs in Asia and the Pacific" (June 2017, Tokyo, Japan)
2018	**8th Regional 3R Forum in Asia and the Pacific** (April 2018, Indore, India) Launching "**State of the 3Rs in Asia and the Pacific**"	

Source: Prepared by UNCRD

As a first step in 2012, the group developed tentative goals and sample indicators for the Ha Noi 3R Declaration with five priority areas, namely "3Rs in municipal solid waste", "3Rs in the industrial sector (including small and medium sized enterprises)", "3R Goals in Rural Areas", "3R Goals for New and Emerging Wastes" and "3R Goals for Cross-cutting Issues". As a practical exercise, the group developed factsheets and model indicators to provide an overview, definition, outline the policy goals as well as to monitor effectiveness of implementation, existing guidelines and good practices with references related to specific policy area in the 3Rs (*Table 1-2*).

Next, the group reviewed an initial 24 goals with a list of indicators as proposed by the secretariat of the Regional 3R Forum, UNCRD, prior to the 4th Regional 3R Forum in Ha Noi, Viet Nam in 2013. This was followed by two workshops held in Bangkok in December 2012 and in Tokyo in February 2013, where the group selected eight top priority goals and worked on providing appropriate indicators to monitor these goals. At the 4th Regional 3R Forum in Asia and the Pacific in March 2013, the group presented eight factsheets for 3R policy performance indicators. Subsequently, delegates to the 4th Regional 3R forum in Asia and the Pacific agreed on 33 goals and its indicators, the Ha Noi Goals (2013-23), based on the above mentioned 24 suggested goals with a list of indicators (*Table 1-2*).

The Chair's Summary of the 4th Regional 3R Forum in Ha Noi, Viet Nam, stated that:

> *"It is important to consider indicators that are easy to understand and use for practically monitoring current conditions as well as for assessing future risks to help prevent harmful practices in waste management. For effective promotion of 3Rs in Asia and the Pacific, there is a need to institutionalize 3R information, indicators, and knowledge-base at local, provincial and national levels. Further, these indicators should be linked with national developmental goals and targets. A regional mechanism led by international organizations would be useful to evaluate the progress in this regard. The Forum welcomed the efforts on 3R performance indicators, including a core set of indicators, and further recognized the need to expand the existing collaborative research work on data, information, and indicators in resource-use efficiency and 3Rs."*

Thereafter, the group was re-assembled in Phitsanulok, Thailand in December 2013 and in Surabaya, Indonesia in January 2014 to develop a core set of 3R performance indicators as suggested in the Chair's Summary of the 4th Regional 3R Forum, an outcome of the review of exercises between 2012 and 2013. The core set of 3R performance indicators was aimed to be utilized for the assessment on 3R policy implementation in national and regional levels. Accordingly, the nine core sets of 3R performance indicators proposed by the group at the 5th Regional 3R Forum in Asia and the Pacific (25-27 February 2014 in Surabaya, Indonesia) are as follows:

1. Total MSW generated and disposed MSW, and MSW generation per capita (by weight)
2. Overall recycling rate and target (%) and recycling rate of individual components of MSW
3. Amount of hazardous waste generated and disposed in an environmentally sound manner
4. Indicators based on macro-level material flows
5. Amount of agricultural biomass used
6. Quantity of marine and coastal plastic waste
7. Amount of e-waste generation, disposal and recycling, and existence of policies and guidelines for e-waste management
8. Existence of policies, guidelines and regulations based on the principle of EPR
9. Greenhouse gas (GHG) emissions from the waste sector

In order to conduct an assessment using the 3R performance indicators, experts were called for the Drafting Committee of "Asia Pacific 3R White Paper" at the 1st Meeting in Cebu, The Philippines, in January 2015 and the 2nd Meeting in Tokyo, Japan in February 2015. Following the 6th Regional 3R Forum in Asia and the Pacific in Male, Maldives in August 2015, the committee was renamed as Drafting Committee of "State of the 3Rs in Asia and the Pacific" and the members assembled for the 3rd Drafting Committee Meeting in Tokyo in November 2015. The committee confirmed that the State of the 3Rs in Asia and the Pacific Project aimed to develop a synthesis report based on selected countries' reports in applying the 3R performance indicators to the assessment of current 3R policy implementation.

A series of Drafting Committee Meeting were held: 4th Meeting in Ha Noi, Viet Nam, in March 2016; 5th Meeting in Adelaide, Australia, in November 2016; and 6th Meeting in Tokyo, Japan in June 2017. With the efforts of the committee members supported by related institutes and governments, State of the 3Rs in Asia and the Pacific was developed in two parts, namely, this Synthesis Report for regional 3R progress and Country Chapters of Bangladesh, Cambodia, China, India, Indonesia, Japan, Malaysia, The Philippines, Singapore, Thailand and Viet Nam as well as the Pacific Region (i.e., Pacific Island Countries).

This report is the first output of the research initiative aimed at assessing progress made on 3R-related efforts in the region, with particular reference to the Ha Noi 3R Goals, adopted at the 4th Meeting of Regional 3R Forum held in Ha Noi, Viet Nam in March 2013, and the core set of 3R performance indicators proposed at the 5th Regional 3R Forum in Asia and the Pacific.

1.3. Structure of this Report

This synthesis report presents an experts' assessment of regional 3R progress as of 2017 in using nine 3R performance indicators as a milestone of the Sustainable 3R Goals for Asia and the Pacific for 2013 to 2023 (2013-2033) by implementing the State of the 3Rs in Asia and the Pacific

Project. In the next chapter, the report will discuss the needs and benefits for improving 3R approaches in Asia and the Pacific region. The third chapter, entitled "Major Trends of 3R policy Implementation in Asia and the Pacific", makes up the main part of this summary and describes the status of indicators and their implementation as outlined above. The chapter is built on data from 11 Country Chapters (Bangladesh, Cambodia, China, India, Indonesia, Japan, Malaysia, The Philippines, Singapore, Thailand, Viet Nam) and one sub-regional report (Pacific Island Countries) developed by experts and commented by governmental officials from each country. Furthermore, the chapter includes information on trends in National 3R-Related Policies and Legislation, major treatment and 3R-related technologies, as well as a comparative analysis of future investment plans for waste management and the 3Rs. In the fourth chapter, the report offers conclusions and documents the main lessons learnt by each country. Lastly, we provide recommendations based on analysis of policies and technologies and highlight possible directions for furthering regional cooperation on the 3Rs.

Reference

Ha Noi 3R Declaration - Sustainable 3R Goals for Asia and the Pacific for 2013-2023 (http://www.uncrd.or.jp/content/documents/659Hanoi-Declaration_Eng.pdf)

2. Urgent Needs and Multiple Benefits of Improving 3R Approach in Asia and the Pacific

2.1. 3R Approach in Asia and the Pacific

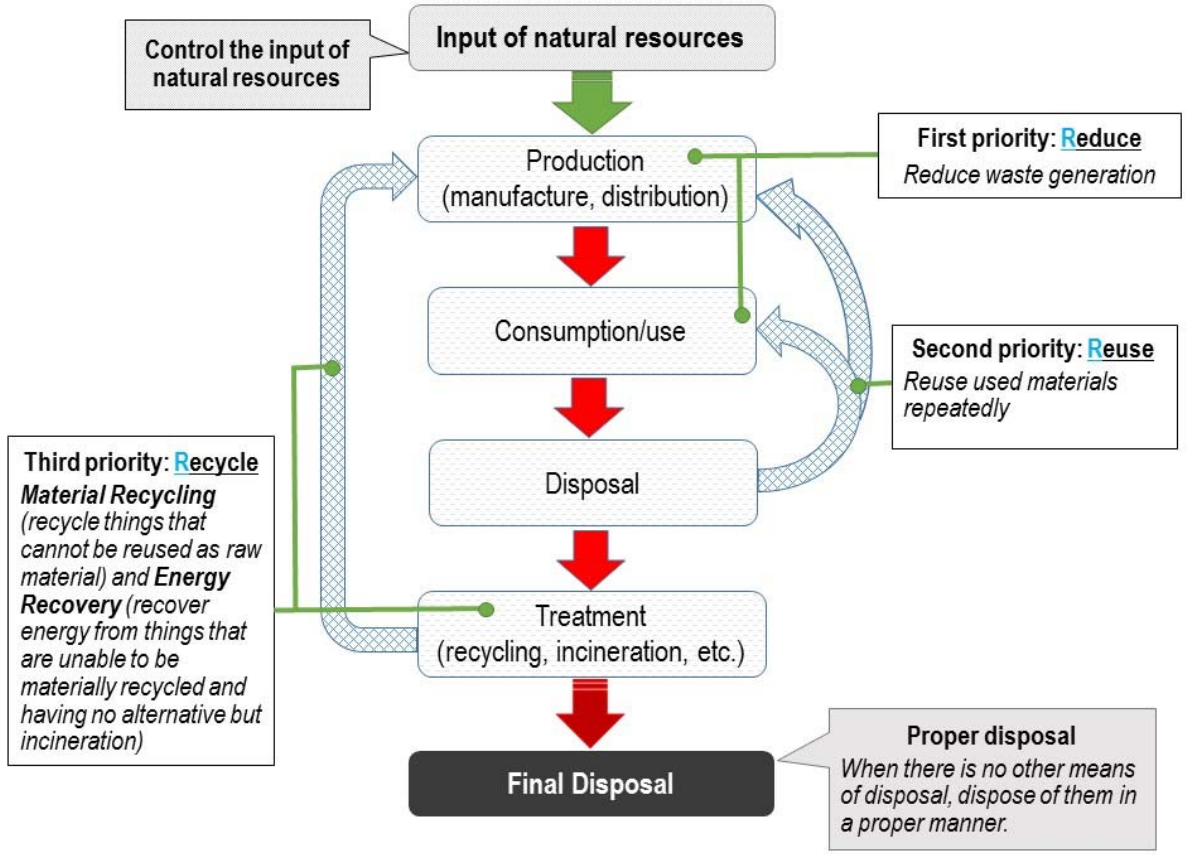
The Asia and Pacific region has witnessed dramatic and widespread changes due to the forces of globalization, industrialization and urbanization. Over the last three decades, the region has shifted from a biomass-based to a minerals-based economy. At the beginning of the 21st century, the Asia and Pacific region has become the world's largest consumer of materials. There exists enormous potential for future expansion of material consumption due to the region's large overall population. Rapidly growing urban population especially among the middle-income population of emerging economies in the region and continued economic growth fueled by industrialization contribute to resource consumption which ultimately becomes waste, imparting negative impacts to land, water, air, human health and the global environment.

With a recognition of the need to conserve resources for a low carbon economy and to properly manage various waste streams for environmental protection, the waste hierarchy presents a preferential or ordered list of management practices that guides the formulation of policies and programmes on waste management. The waste hierarchy prioritizes practices that prevent the generation of waste, followed by the 3Rs (reduce, reuse and recycle) and waste treatment before final disposal. The principle of reducing waste, reusing and recycling resources and products is often referred to as the "3Rs." Reducing means choosing to use things with care to reduce the amount of waste generated. Reusing involves the repeated use of items or parts of items which still have usable aspects. Recycling implies recovering and using waste itself as a resource. Waste minimization can be achieved in an efficient way by focusing primarily on the first of the 3Rs, "reduce," followed by "reuse" and then "recycle" (*Figure 2-1*).

At the Group of Eight (G8) Sea Island Summit in June of 2004, Japan expressed its determination to lead efforts in promoting activities associated with the 3Rs, by hosting a 3R initiative ministers meeting in Tokyo in April 2005. The G8 leaders agreed to the *Kobe 3R action plan* at G8 Kobe Environment Ministers Meeting, and the *Kobe 3R action plan* was reaffirmed in the final declaration at the G8 Summit in 2009.

The 3R approach can be understood in a broader context rather than strictly focusing on waste management. It is intrinsically linked with the concept of resource efficiency across a wide range of sectors with an overarching objective of reducing or eliminating waste load sent to final disposal and of transitioning to a green economy and circular economy. The 3R approach is thus founded upon the promotion of sustainable production and consumption patterns, with the greater aim of achieving a sound material-cycle society or circular economy[2].

[2] http://www.uncrd.or.jp/content/documents/3025Plenary%20Session-1%20Presentation-1=Mohanty.Anupam.pdf



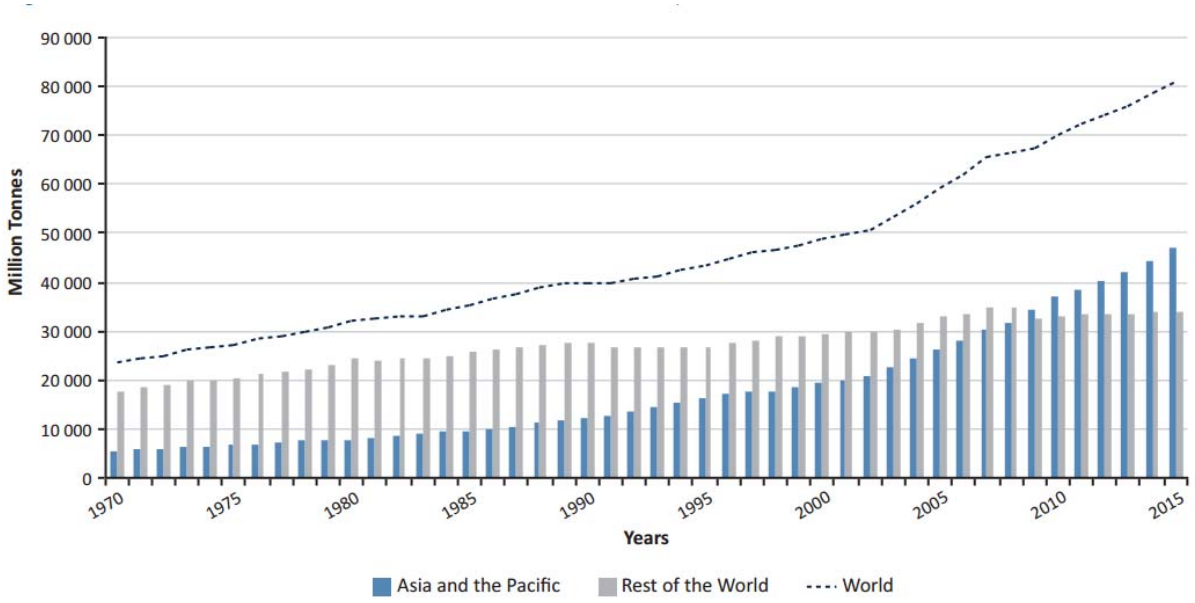
Source: MOEJ, revised by IGES

***Figure 2-1**. Concept of 3Rs*

2.2. Key Factors for Promoting 3R Approaches in Asia and the Pacific

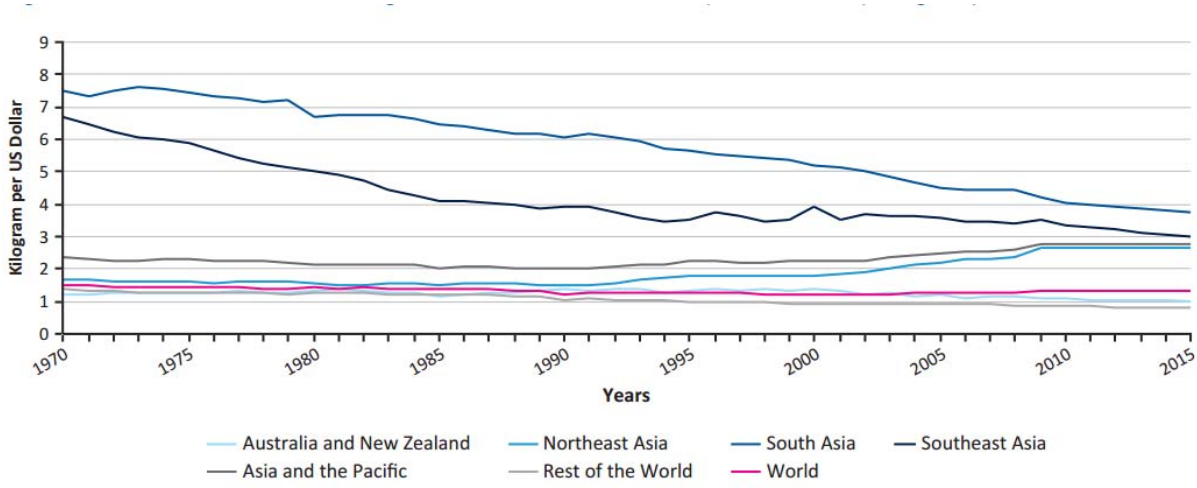
2.2.1. Saving Resources/Energy and Increasing Resource/Energy Efficiency

Asia Pacific region's increasing importance in leading global urbanization and economic development trends emphasize the need for efficient use of resources. Recent data indicates that total resource consumption in the region is rising while resource efficiency is declining, and at the same time, the total amount of material consumption (*Figure 2-2a*) and the amount of material needed to generate one unit of gross domestic product (GDP) (*Figure 2-2b*) has increased over the last two decades (UNEP 2016). This suggests that the region will witness a continuous increase in waste generation and associated environmental impacts due to inefficient material consumption (*Figure 2-2*).



(a) Material consumption

Source: CSIRO 2015; UNEP 2015



(b) Material intensity

Source: CSIRO 2015; UNEP 2015

***Figure 2-2**. (a) Material consumption and (b) Material intensity (domestic material consumption/GDP) for 'Asia and the Pacific', 'Rest of the World', and 'World', for the years 1970-2015*

Global natural resource extraction is predicted to double by 2030 compared to 2005 (Giljum and Polzin 2009). Under a business-as-usual scenario, material consumption in the Asia Pacific region will be at least three times higher in 2050 compared to 2005. Furthermore, countries with large raw material deposits will profit from this situation and will be able to export resources at higher prices, while countries or regions with relative resource scarcity will be negatively affected facing

growing competition for resources in the future and probably paying increasing prices (Giljum and Polzin 2009). Similarly, some analysts highlight that certain resources such as crude oil and natural gas will peak and some precious metals such as indium and tantalum will grow progressively more scarce prior to the year 2030 (European Association of Geochemistry 2014).

In the wider context of continuing economic growth and increasing resource demands, countries in Asia and the Pacific will urgently need to focus and invest more on integrating economic development and environmental conservation, as well as decoupling economic growth and resource use. The 3R approach can play a significant role in helping these countries save natural resources and energy while increasing resource and energy efficiency. This would not only be beneficial in terms of resource management and related environmental objectives, but for promoting economic competitiveness and sustainable economic development both within the region as well at the global level.

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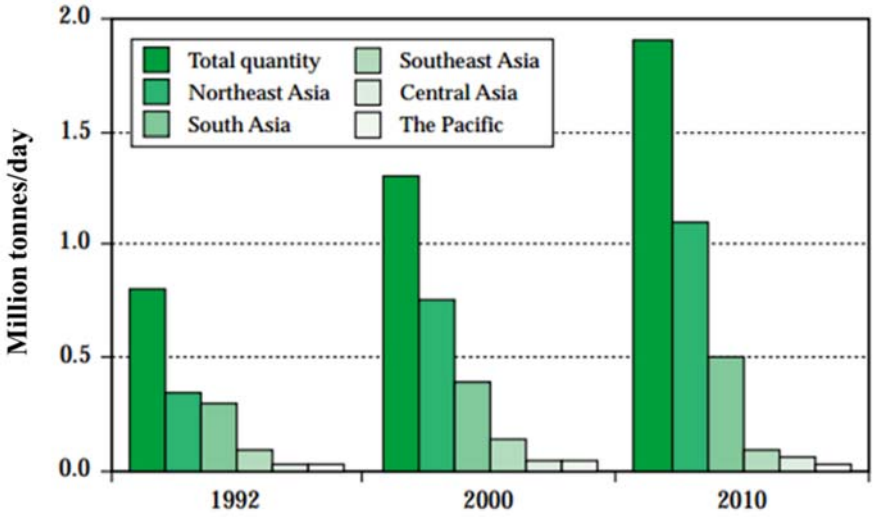
2.2.2. Improving Proper Solid Waste Management for Public Health and Environmental Protection

Figure 2-3 presents an assessment of the current contribution of the various subregions to Asia Pacific's aggregate waste generation. Taken as a whole, the region currently produces some 1.5 million tonnes of MSW each day and this is expected to more than double by 2025. The current estimate for waste generation may be considered as extremely conservative; the actual levels are probably more than double this amount (UNESCAP 2000). Global waste generation is predicted to more than double by 2050, and some estimates indicate that solid waste generation in the Asia and Pacific region will triple by 2050 compared to 2010 (Hoornweg, Bhada-Tata and Kennedy 2013). Furthermore, the growing volume as well as the diversification of different waste streams has become a matter of serious concern. New emerging waste streams such as electronic waste (e-waste), plastics and microplastics in the coastal and marine environment, construction and demolition waste, hazardous and toxic waste, food waste and chemicals are growing in volume. Moreover, with industrialization and economic growth, expansion of the middle-income population and changes in style of consumption and production, the composition of household waste is expected to change; percentage of the biodegradable waste fraction of household waste shows a tendency to decrease, whereas the percentage of dry wastes such as plastic, paper wastes, and intricate waste such as e-waste are likely to increase.



Source: UNESCAP 2000; revised by IGES

***Figure 2-3**. Estimated generation of municipal solid waste in different subregions*

It is certain that not only developing countries but also developed countries are facing problems with limited budget for proper management and limited availability of land for final disposal. Without proper technical and institutional capacity for promoting solid waste management and material recycling in an environmentally sound manner, projected increases in solid waste are likely to result in increasing environmental pollution due to the rapid growth in waste generation and unsound management and recycling practices. With reference to the UN SDG 11 on sustainable cities and communities, UN-HABITAT observes that the safe removal and subsequent management of solid waste is representing one of the most vital urban environmental services (UN-HABITAT 2010).

Conventional waste management largely focuses on waste collection, treatment (composting and incineration) and final disposal (landfills). Only limited attempts have been made to adopt integrated waste management practices involving waste reduction at the source. Advocated by the Regional 3R Forum, the 3R approach is based upon a waste management hierarchy with reduction emphasized as the most important strategy. In order to reduce the amount of waste produced, it is essential to focus on the source of the waste, or its origin. Source reduction involves the design, manufacture, packaging, and use of products in a way that minimizes the amount, recyclability or toxicity of generated waste. Some examples of 3R approaches in reducing solid waste at various stages of the product lifecycle is shown in *Table 2-1*. As greater amounts of items are reduced, reused and/or recycled upstream, the amount of waste for final disposal is reduced downstream, lowering waste disposal costs and landfill space requirements.

Furthermore, the potential for recovering valuable metallic resources derived from the increasing number of waste electrical and electronic products in the region has led to renewed interest from Asia Pacific countries on the concept of the 3Rs and the associated circulation of materials. It should be noted that such type of waste contains a variety of substances that can be characterized either by their potential hazards or utility. For example, e-waste can be a source of various hazardous materials such as oil, chlorofluorocarbons (CFCs) and heavy metals including lead, which can pollute the land, water and air. Improper handling and recycling of these wastes can pose important health and environmental risks over the long-term. Therefore, recycling and reuse

based on 3R policies and sound environmental standards has to reduce and ultimately prevent negative impacts on human and environmental health resulting from the improper handling of waste.

***Table 2-1**. Reducing solid waste through the product lifecycle*

Stage	Measures	Examples
Development & Production	Resource-saving design	Design for repair, reuse, disassembly & recycling; reducing size/thinning of parts; using recycled materials
	Long-life design	Adopting durable materials and structures, upgradeable design
	Resource-saving production system	Reduce byproducts and losses, promote reuse; remanufacture
	Reducing hazardous	Elimination or reduction of hazardous substances content
Distribution & Sales	Reduction of packaging materials in logistics	Use of returnable containers
	Servicing (Product Service System)	Shifting from selling "products" to services that provide "functions"
	Avoid excessive packaging	Reduce plastic bags, promote simple packaging, selling by measure
Purchase & Use	Purchase only the essential goods	Promote 4Rs, including "Refuse"
	Long use of products	Extend life of product by repair and maintenance
	Wise use of second hand goods	Flea market; second hand shops, also online; donation; exchange
	Sharing	Sharing cars, equipment
	Green purchasing	Green purchasing choices by citizens, businesses and governments
Disposal	Source segregation	Segregation at source
	Recycling, reduction of wastes	Composting of organic wastes, at-source waste separation
	Charging waste treating cost	Promote reduction of waste by introducing economic incentives

Source: prepared by IGES

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2.2.3. Promoting Green Jobs, Green Economy, Circular Economy and More Prosperous Living

Twenty years after the first UN Conference on Sustainable Development, the Rio+20 Conference took place in Rio de Janeiro in June 2012. The conference agreed on the notion of a Green Economy and underlined the necessity of defining Sustainable Development Goals (SDGs).

Within this purview, recycling and reuse of wastes based on 3R policies have the potential to create green job opportunities and at the same time promote the transition to a green economy. As recycling continues to grow, more workers will be needed to collect, sort and process recyclables. Reuse centers can also be used as means of creating green job opportunities. Furthermore, these processes have the potential to encourage more green investment opportunities in economic activities such as resource recovery, Waste-to-Energy (WtE) and the promotion of eco-industrial zones. These initiatives can significantly contribute to efforts aimed at encouraging healthier and more livable cities, with increased quality of life.

Implementing the 3Rs presents multiple benefits for sustainability in addition to enhancing the efficiency and implementation of municipal solid waste management systems. For example, the promotion of waste separation at source for material recycling and household or community based organic waste treatment can significantly minimize environmental contamination and local health hazards caused by various emissions and disease carriers; reduce local authorities' waste collection and disposal workload and budget, increasing opportunities for spending elsewhere and broadening government support to the community; save landfill space and extend the lifetime of a landfill; create green jobs and increase opportunities for income generation, leading to enhanced community well-being; circulate resources and contribute to greater resource savings; and reduce GHG emissions, among others. Furthermore, organic waste utilization and material recycling can contribute to a country's national development agenda on matters such as poverty reduction, food and energy security, and promotion of green economy. The 3Rs can also assist citizens toward realizing more sustainable lifestyles and practices, such as encouraging the public to consider the impact of their consumption patterns and resulting production of waste, as well as motivating communities to take actions to reduce waste and its resulting impacts on the environment.

2.2.4. Climate Change Mitigation

Greenhouse gases (GHG) trap heat in the atmosphere which result in increasing the average temperature of the planet. Human activities are responsible for almost all of the increase in greenhouse gases in the atmosphere over the last 150 years (IPCC 2014). GHGs generated by the waste sector are estimated to account for almost 5% of total emissions (Hoornweg and Bhada-Tata, 2012), a percentage which is predicted to increase due to increasing waste generation and upgrading of final disposal sites from open dumps to sanitary landfills without gas recovery system in developing Asian countries (Sang-Arun, Bengtsson and Mori 2011) (*Sang-Arun et al., 2011*). Moreover, the decomposition of waste produces methane (CH_4), which possesses a global warming potential (GWP) effect 20 times greater than that of carbon dioxide (CO_2); methane is the major GHG emitted from the waste sector and comprises approximately 18% of the anthropogenic CH_4 (*Agamuthu and Fauziah, 2013*).

The world's governments have committed themselves in the Paris Agreement in the United Nations Climate Change Conference Conference of Parties (COP 21) in 2015 to make efforts to reduce GHG emissions and therefore, curb global warming. In this context, applying 3R principles has the potential to reduce the amount of air pollution and GHG emissions (Sang-Arun, Menikpura and Agamuthu, 2014). Proper waste management practices can address climate change in five key ways: (1) reduction of methane emissions from landfill, (2) reduction of GHG emission from reduced energy use due to 3Rs of industrial waste, (3) energy recovery from waste; (4) carbon sequestration in forests due to decreased demand for virgin paper, and (5) energy used

in the transport of waste over long distances.

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2.3. The 3Rs and the SDGs: Importance of Indicators to Monitor 3R Implementation in Asia and the Pacific

Given the urgency and challenge of achieving sustainable development, there is increasing interest in establishing a body of international goals and indicators on the 3Rs whereby different countries, international aid agencies and various stakeholders can direct their own initiatives to achieve 3R-related objectives. One of the most significant goal-setting exercises at the global level is the establishment of Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development, which was agreed as an outcome of United Nations Conference on Sustainable Development in 2012 (Rio+20), and adopted by world leaders in September 2015 at a historic UN Summit. SDGs are a set of universally agreed international goals for sustainability established in the context of the challenges faced by both developing and developed countries. This agenda includes 17 SDGs, which set out quantitative targets and indicators across the social, economic and environmental dimensions of sustainable development – all aimed to be achieved by 2030.

Waste management is well embedded within the SDGs, being included either explicitly or implicitly in more than half of the 17 goals underlining the strategic importance of improving waste management, as actions here will contribute to progress for a range of SDG targets. Setting and monitoring global targets for waste management will thus contribute significantly to attaining the SDGs (UNEP 2015).

SDG 12 on Sustainable Consumption and Production include waste-related issues. Many aspects related to sustainable materials management as well as proper waste management have been included as targets within the goal, such as to “achieve sustainable management and efficient use of natural resources (12.2)”, “halve per capita global food waste at the retail and consumer level,

and reduce food losses along production and supply chains (12.3)", "achieve environmentally sound management of chemicals and all wastes throughout their life cycle (12.4)", and "substantially reduce waste generation through prevention, reduction, recycling, and reuse (12.5)".

In this context, a major bottleneck for developing countries has been the collection of quality data for proper planning and implementation of sustainable waste management practices. The absence of planning processes is a major reason that policy priorities for waste management have remained low. However, given that there is a growing consensus on establishing internationally-recognized goals and indicators for policy issues such as climate change, the SDGs, sustainable materials management and sustainable consumption and production, among others, it is expected that waste management will become an increasing area of focus at the global level.

Accordingly, the Regional 3R Forum in Asia and the Pacific is progressively working to promote a shared understanding on issues, challenges and opportunities for 3R policy implementation in the region.

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3. Major Trends of 3R Policy Implementation in Asia and the Pacific

As an initial report aimed at supporting 3R implementation in the region and the Regional 3R Forum in Asia and the Pacific, this section summarized data and information on waste issues, concerns and policy responses and implementation from a total of 11 country reports and one sub-regional report. Observations, trends and baseline information on waste management and 3R policy implementation in the Asia Pacific region and Pacific Island sub-region are presented in the three subsections that follow.

3.1. Trends in 3R and Waste Management Policies and Responses

This section examines 3R and waste management policy trends and responses including national 3R-related legislation and appropriate frameworks, definitions and classification of MSW, major treatment and 3R-related technologies, and existence of policies based on the principle of extended producer responsibility (EPR).

3.1.1. National 3R-Related Policies and Legislative/Institutional Framework

In terms of policies and legislative frameworks, waste management at the very least exists in the basic environmental policy of all the countries, with the developed ones having specific legislation and framework for recycling, take-back schemes and e-waste management. As the countries continue to strengthen legislative and institutional frameworks to address waste management and implement 3R practices, specific strategies backed by data and carefully formulated indicators are seen as key steps in this direction. Furthermore, inter-ministerial coordination and stakeholder collaboration remain important components given the crosscutting nature of waste management considering the waste hierarchy and also of the involvement of local government units in managing waste.

a. Increasing Policy Interest in Waste Management and Need for Improved Legislation

Interest in waste management among policy makers has increased in the Asia Pacific region over the last decade. This is demonstrated by the launch of the Regional 3R Forum in Asia and the Pacific in 2009, as well as various examples of political support from different countries aimed at developing national strategies on the 3Rs with a view to integrate 3R-related initiatives into national environmental policy agendas. Waste management and 3R-related policies/strategies in the Asia Pacific region are summarized in *Table 3-1* and the legal framework of 3R-related policies/strategies in waste management policies is summarized in *Table 3-2*.

In analyzing information presented in the 12 reports documenting 3R practices in the Asia and Pacific region, it was observed that Japan is at an advanced stage with regard to national 3R policy development. The country has comprehensive policies in place ranging from overall framework policies to recycling polices and product-specific legislation in terms of end-of-life management. Progress made with regard to policy implementation has been monitored against various goals and indicators set by the country. Accordingly, the legislative framework in the country evolved towards a waste management policy and practice that combines protection of the environment and human health while capitalizing on the economic and strategic advantages, as well as pursuing the concept of sustainability by introducing and promoting 3R policies.

Similarly, it was noted that emerging market economies such as China, India, Malaysia, The Philippines and Viet Nam have also started to develop 3R-related legislation and policies in recent years. A number of small Pacific Island Countries like Palau have also developed similar legislation and policies. Reference is made to waste management in the basic environmental policies of these countries as well as their overall framework policies on waste management, including recycling and the 3Rs.

However, a number of gaps can be identified in these policies, including the need to improve emphasis on 3R policies. In the case of China, both linkages and coherence among different laws needs to be further considered and addressed. For example, the Environmental Pollution Prevention and Control Law on Solid Waste introduced the application of 3R policies for the municipal solid waste, industrial waste and hazardous wastes, and required "reduction in the amount of waste", "reclamation (recycle) of solid wastes" and "harmless disposal". On the other hand, the Circular Economy Promotion Law introduces the application of 3R policies as reduce, reuse and recycle.

At the same time, about half of the economies in the region do not have specific legislations with regard to construction and demolition (C&D) waste, e-waste, food waste: these gaps needs to be addressed in the near future.

Table 3-1. *Waste management and 3R-related policies/strategies in Asia and the Pacific*

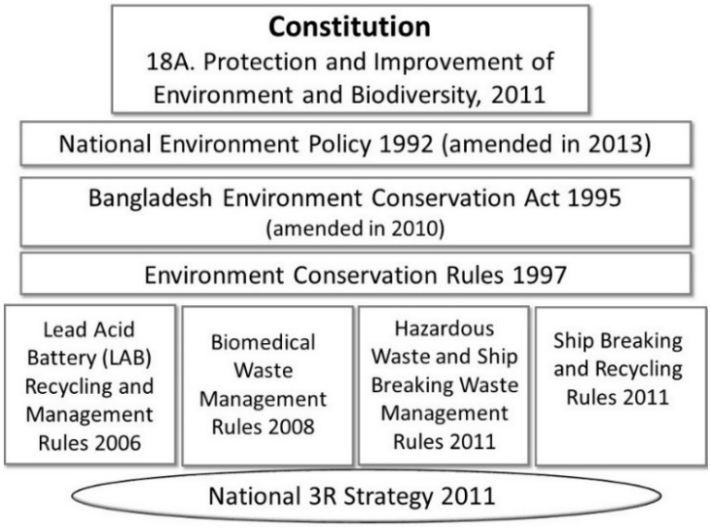
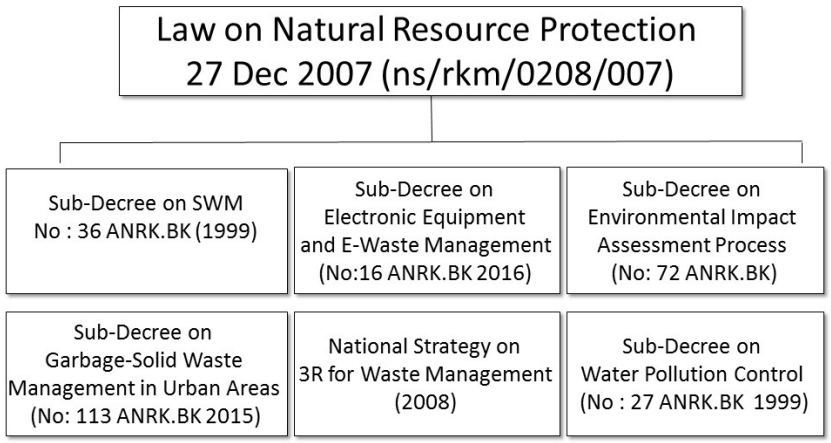
Country	Reference on waste management in its basic environmental policy	Waste management law	Framework strategy and law on resource circulation and the 3Rs	Law for recycling and take-back scheme for specific end-of-life products
Bangladesh	National Environment Policy 1992	--	National 3R Strategy 2010	--
Cambodia	Law on Environmental Protection and Natural Resources Management 1996	Sub-decree on SWM (1999)	--	--
China	Environmental Protection Law of the People's Republic of China (2014 Revision)	Law of the People's Republic of China on the Prevention and Control of Environment Pollution Caused by Solid Wastes (2015Amendment)	Circular Economy Promotion Law of the People's Republic of China (2008)	Regulation on the Administration of the Recovery and Disposal of Waste Electrical and Electronic Products (2009, Order of the State Council of the People's Republic of China (No. 551))

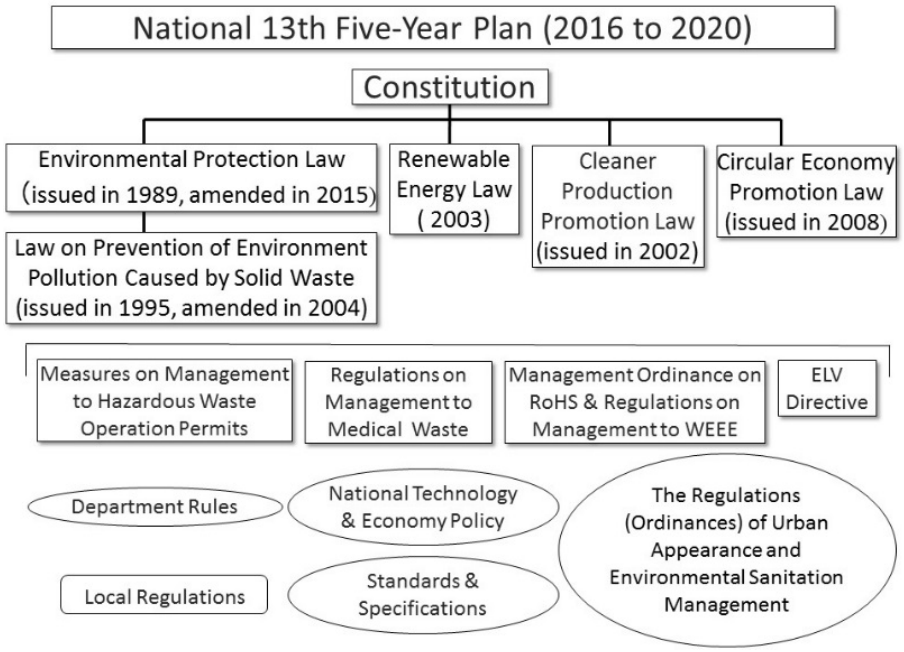
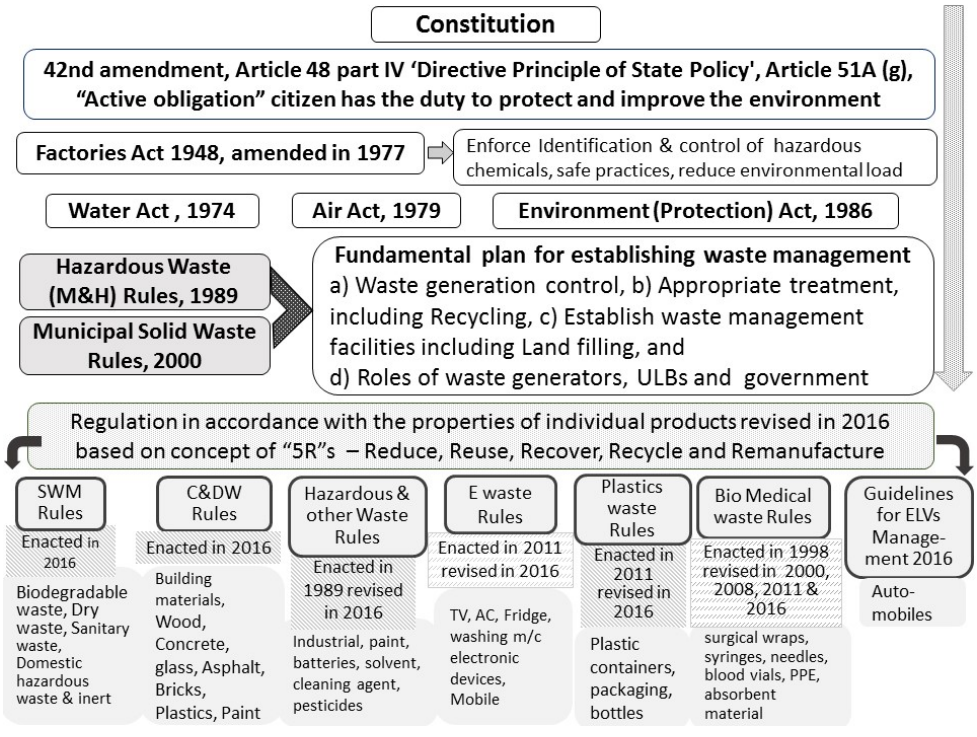
Country	Reference on waste management in its basic environmental policy	Waste management law	Framework strategy and law on resource circulation and the 3Rs	Law for recycling and take-back scheme for specific end-of-life products
India	- Article 48A, directive principle, Part IV and Article 51 A(g), Part IVA, of the amendment of Constitution of India in 1976; - Environmental Protection Act 1986; - Factories Act 1948 and its amendment in 1987 - National Environment Policy (2006)	- Solid Waste Management Rules, 2016; - Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016; - Bio-Medical Waste Management Rules, 2016; - Construction and Demolition Waste Management Rules, 2016 - Plastic Waste Management Rules, 2016	Waste Management Rules are based on 5Rs strategies that include resource circulation and the 3Rs principles.	E-waste (Management) Rules, 2016
Indonesia	Environmental Protection and Management Act No. 32 (EPMA 32/2009)	Law no.18/2008 on MSW Management: 3R as the principle approach for waste management Law no, 32/2009 on Haz. Wastes	The government regulation no. 81/2012 on 3Rs and EPR President Regulation No.97/2017 on Policy and National Strategy of MSW	--
Japan	Basic Environmental Law and Plan	Waste Management and Public Cleansing Law	Basic act and fundamental plan for establishing sound material cycle society	Various recycling laws such as: Container Packaging Resource Recycling Act (1995) and Home Appliance Recycling Act (1998)
Malaysia	Environmental Quality Act 1974	Solid Waste and Public Cleansing Management Act 2007	There are 8 Regulations on 3R within the Solid waste Act	There are 8 Regulations within the Solid waste Act
The Philippines	PD 1152 – Philippine Environment Code (1977) RA 8749 – Philippine Clean Air Act of 1999 RA 9275 – Philippine Clean Water Act of 2004 (2004)	Ecological Solid Waste Management Act of 2000 (RA 9003)	Ecological Solid Waste Management Act of 2000 (RA 9003)	--

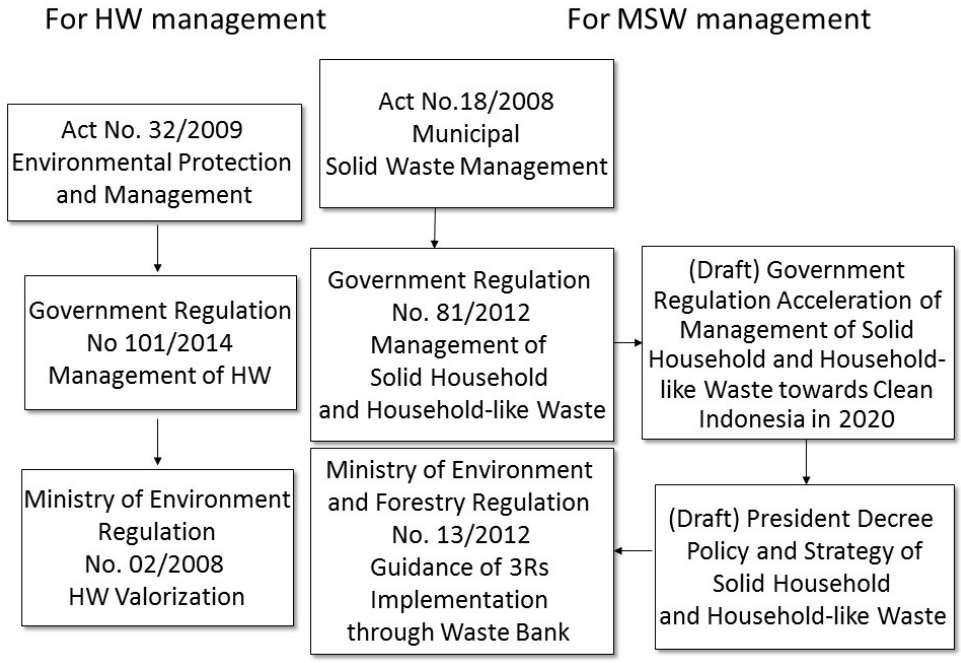
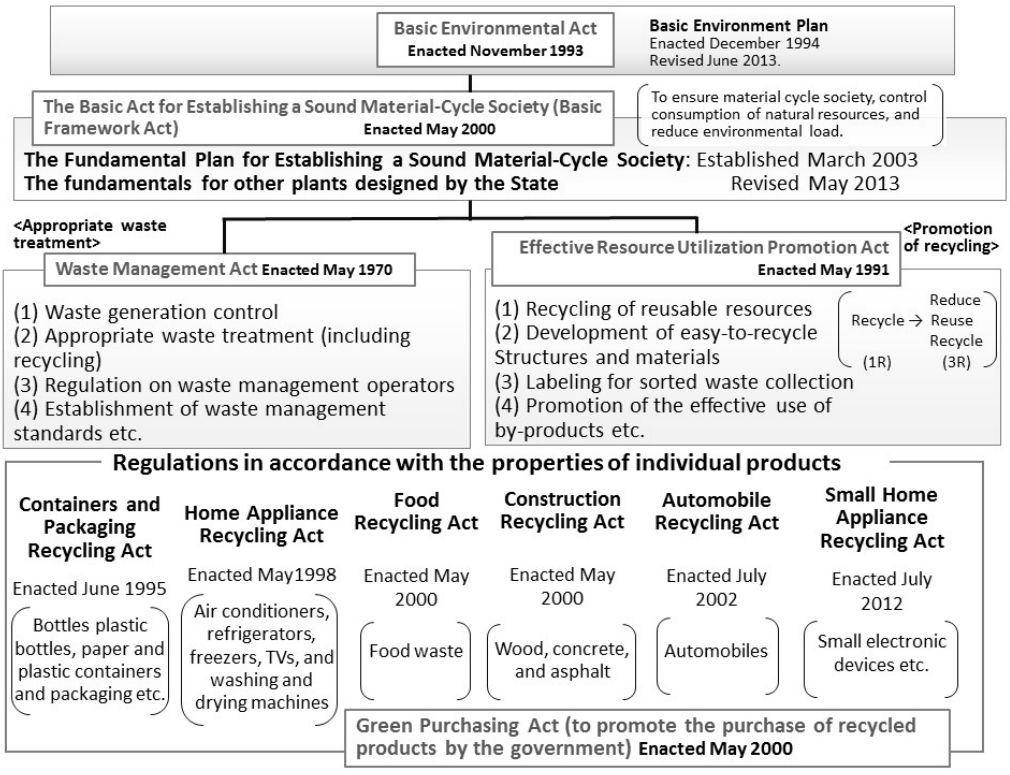
Country	Reference on waste management in its basic environmental policy	Waste management law	Framework strategy and law on resource circulation and the 3Rs	Law for recycling and take-back scheme for specific end-of-life products
Singapore	Environmental Public Health Act	Environmental Public Health (General Waste Collection) Regulations; Environmental Public Health (Toxic Industrial Waste) Regulations	Sustainable Singapore Blueprint setting waste recycling rate target of 70% in 2030 with a goal of becoming a Zero Waste Nation	--
Thailand	Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992), Factory Act B.E. 2535 (1992), Public Health Act B.E.2535 (1992)	Maintenance of Public Sanitary and Order Act. B.E. 2535 (1992) and B.E.2560 (2017)	National Solid Waste Management Master Plan, Action Plan "Thailand Zero Waste, 2016"	Regulation on National Waste Management System 2007, Draft WEEE Act., Draft Waste Management Act, Draft Promotion of 3Rs and Utilization of Waste
Viet Nam	Law on Environmental Protection 2014 (amended in 2014)	Decree 38/2015/ND-CP on management of wastes and scrap	National Strategy on Integrated Solid Waste Management to 2025, vision to 2050 (Being revised)	Regulation for take-back and treatment of discarded products: Prime Minister Decision 16/2015/QĐ-TTg dated 22 May 2015 (Small appliances, home appliances, lubricant oils, used tyres, ELVs)
Pacific Island Countries	The Pacific Regional Waste and Pollution Management Strategy 2016-2025 (Cleaner Pacific 2025) is a comprehensive long-term strategy for integrated sustainable waste management and pollution prevention and control in the Pacific Region. Cleaner Pacific 2025 integrates strategic actions addressing priority waste and pollution issues in the region. Countries within the region are responsible for developing and enforcing specific laws and regulations concerning waste management guided by multi-environmental agreements. Cleaner Pacific 2025 presents the current status of waste, chemicals and pollution policies in the Pacific Island countries and territories. SPREP and J-PRISM are working collaboratively in the development and updating of country waste policies.			

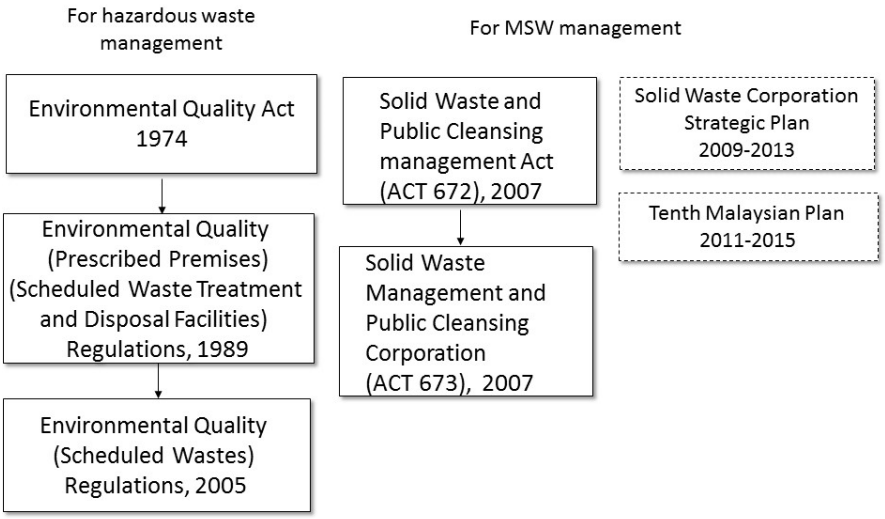
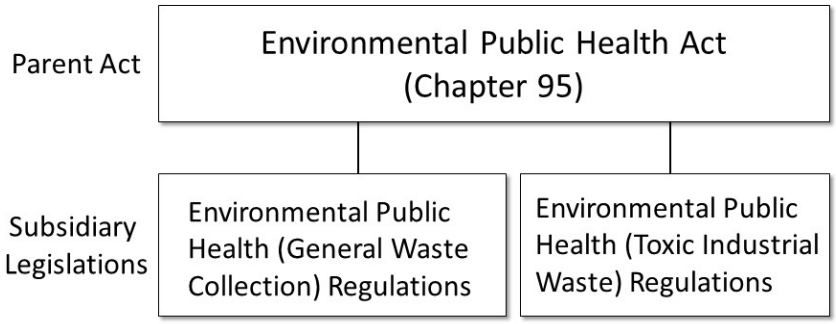
Source: prepared by IGES based on the data and information of Country Chapters, State of the 3Rs in Asia and the Pacific

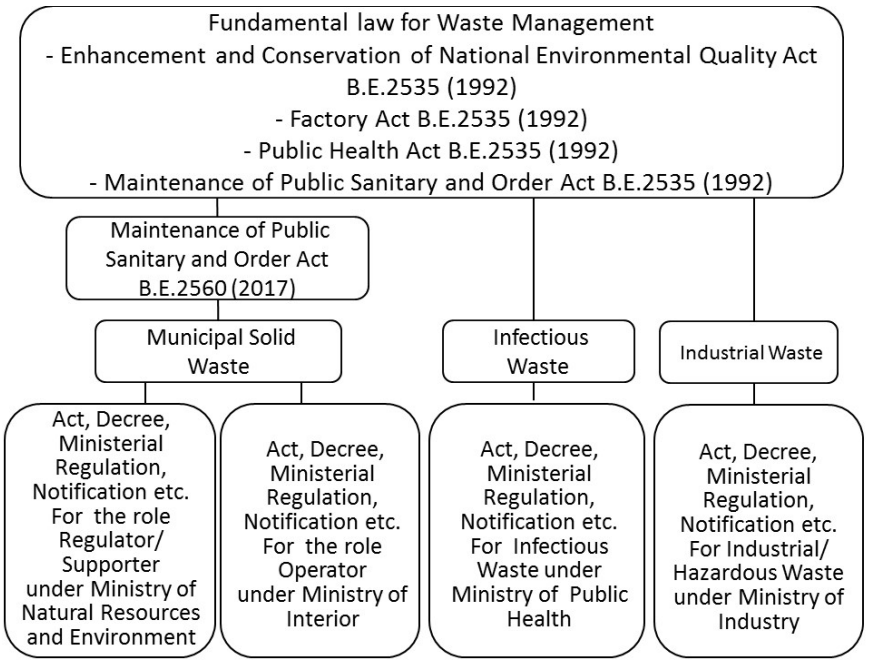
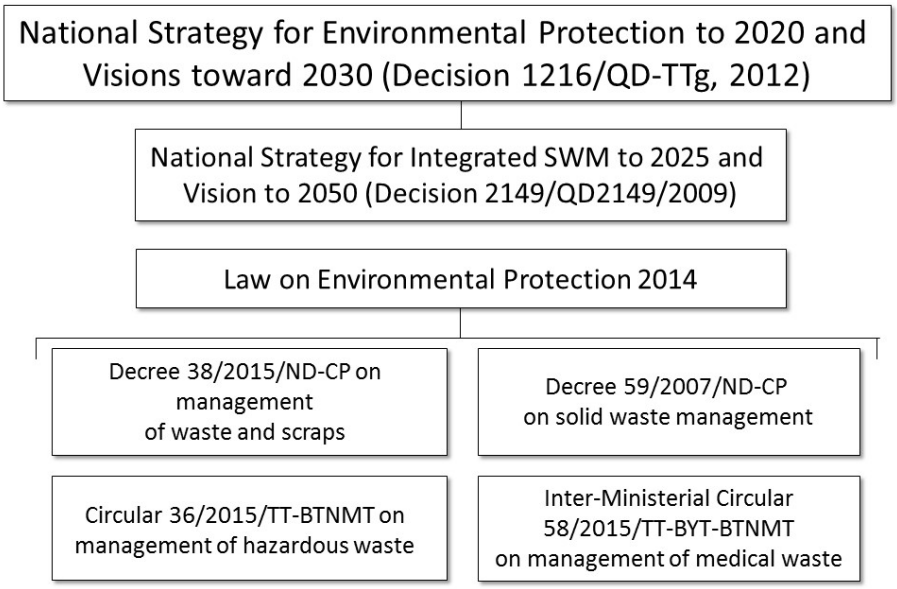
***Table 3-2**. Legislative/institutional framework of waste management and 3R policies and strategies*

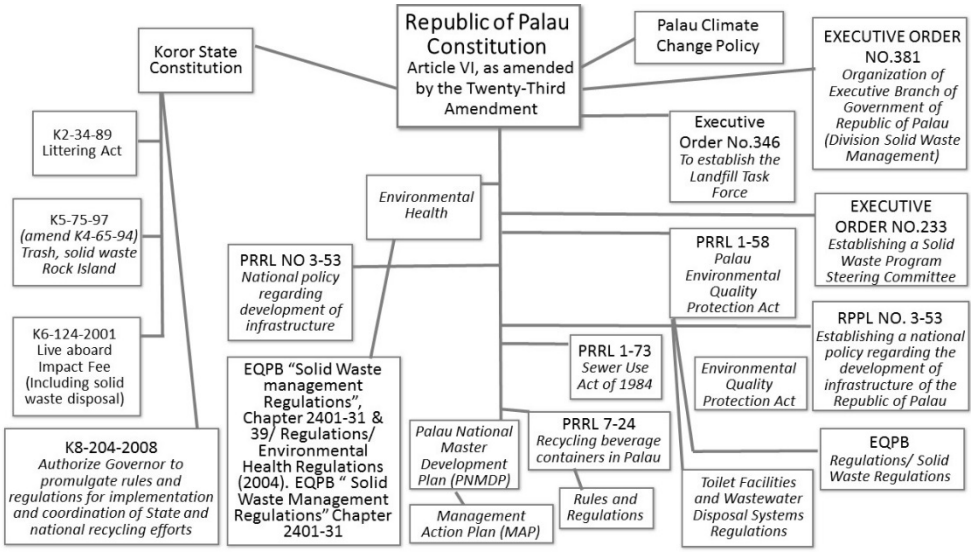
Country	Legislative Framework
Bangladesh	 *Source: Author*
Cambodia	 *Source: Author*

Country	Legislative Framework
China	 *Source: Author*
India	 *Source: Prepared by Ghosh S.K., Author of Country Chapter*

Country	Legislative Framework
Indonesia	 *Source: National working work on MSW management, Ministry of Environment and Forestry Palembang, March 15-17, 2017*
Japan	 *Source: MOEJ*

Country	Legislative Framework
Malaysia	 *Source: Author*
The Philippines	 *Source: Author*
Singapore	 *Source: Author*

Country	Legislative Framework
Thailand	 *Source: Author*
Viet Nam	 *Source: Author*

Country	Legislative Framework
Palau	

Source: prepared by IGES based on the data and information of Country Chapters, State of the 3Rs in Asia and the Pacific. ("Author" on the table refers to the author/s of each Country Chapter.)

b. Importance of Strategy, Target Setting and Monitoring of Progress through Indicators

A strategy which sets clear national objectives for contextualizing recycling policy at the national level, including Japan's Basic Act (2000) and Fundamental Plan (2003) for Sound Material Cycle Society, or the People's Republic of China's Circular Economy Law (2009), or Malaysia's Solid Waste and Public Cleansing Management Act (2007), or the recycling targets under Malaysia's Five Year Plan (2011–2015), or the Philippines' Ecological Solid Waste Management Act of 2000 (RA 9003) or Thailand's Maintenance of Public Sanitary and Order Act (No.2) B.E. 2560 (2017) or the Thailand zero waste target under Five Year Plan (2016-2021) is essential for organizing priorities both in terms of 3R policy and corresponding implementation mechanisms. For instance, Japan has set policy indicators based on Material Flow Accounting (MFA) and other methodologies to monitor the progress of its Sound Material Cycle Society policy and to review the progress of its Fundamental Plan for Sound Material Cycle Society every five years.

Based on its conceptualization of the Circular Economy as a national policy vision, China implements various pilot projects throughout the country, as well as developing various specific recycling laws, such as the Rules on the Administration of the Recovery and Disposal of Discarded Electronic and Electrical Products (promulgated in 2009). China has also developed indicators to monitor the progress of the Circular Economy at the national, local and industrial levels. The Circular Economy Performance Evaluation Technical Guidelines was promulgated by China National Institute of Standardization in 2016.

Malaysia's establishment of its Basic Law for Solid Waste Management in 2007 resulted in the development of guidelines and regulations related to recycling of different products and of implementation guidelines.

As cited in the RA 9003 of the Philippines, all local government units (LGUs) are mandated to divert 25% of their generated waste within five years after the implementation of the Act in 2001

through composting, re-use and recycling activities. It further states that the reduction should be increased every three years (Section 20). Although the 25% waste diversion was not achieved, it is observed that there is an increasing trend in the waste diversion and recycling rate in Metro Manila and in other LGUs since the enactment of the law. There are also several initiatives to promote waste management and recycling in the country such as the Search for the Model Cities and Barangays in eco-waste management, recycling collection events, waste markets and organizing the informal sector to improve the efficiency of recovering recyclable wastes among others.

For Thailand, solid waste management under Maintenance of Public Sanitary and Order Act (No.2) B.E. 2560 (2017) had significant changes from the same act promulgated in 1992 with the inclusion of - unlock, promote and support waste utilization based on 3Rs waste segregation at sources, besides decentralized role of operator to local organization under Ministry of Interior. Meanwhile, the Pollution Control Department (PCD), Office of Natural Resources and Environmental Policy and Planning (ONEP) and Department of Environmental Quality Promotion (DEQP), under the Ministry of Natural Resources and Environment, are involved in waste management as regulators. This integrated waste management approach along with one stop service principle is therefore significant at all levels of stakeholder for policy, strategy, guideline and pragmatic work.

In Viet Nam, targets for waste management are set under the National Strategy on Integrated Solid Waste Management (2009) for the year 2025, including midterm strategic targets by 2015 and 2020. In drafting this strategy, an exceptionally high target of 90% recycling rate and 100% collection rate for large urban areas by 2025 was indicated; this target was later deemed to be impossible to operationalize within the designated time frame. Thus, proper data management and planning are essential considerations in the course of developing an implementable 3R strategy.

As outlined through the above examples, in order to improve governance of recycling policies in developing Asia, it is essential to establish and implement strategic objectives and monitoring mechanisms to evaluate progress. This involves strengthening institutional capacity of key actors and decision makers with a view to ensure the appropriate setting of objectives and indicators.

c. Need for Inter-Ministerial Coordination and Stakeholder Collaboration

Frequently in developing Asia, responsibility and authority for urban waste management, industrial hazardous waste management, promotion of recycling policies, and implementation of the 3Rs tend to be distributed among different ministries, agencies and departments. For example, in China, the Ministry of Construction is in charge of urban solid waste management, while the Ministry of Environmental Protection is tasked with supervising and reporting on hazardous waste management, as well as international collaboration in recycling policies. In addition, the People's Republic of China's National Development Reform Committee is responsible for national promotion of the country's Circular Economy policy.

In Thailand, waste management policy formation and roadmap are the responsibility of the Pollution Control Department, the promotion of recycling activities of citizens and public awareness under the Environmental Quality Promotion Department, and the environmental impact assessment under the Office of Natural Resources and Environmental Policy and

Planning, housed within the Ministry of Natural Resources and Environment which is the main regulator and supporter. On the other hand, the role of waste management operator is decentralized to Local Government (Authorities), which is under the Department of Local Administration within the Ministry of Interior. In addition, the regulation Public Participation B.E. 2548 (2005) upholds people's (stakeholder) right to information/ participation or public participation in any development project based on two-way communication and is under the Office of the Prime Minister. Therefore, Thailand's Waste Management Administration for Operation is stationed within the Ministry of Interior. The responsibility and authority related to regulation, guidelines and public participation in waste management is being regulated and supported by other agencies.

In Viet Nam, the Ministry of Natural Resources and Environment (MONRE) is in charge of promoting waste segregation and the 3Rs. At the same time, it is within the purview of the Ministry of Construction to develop a master-plan and maintain waste management facilities. The Ministry of Agriculture and Rural Development is responsible for agricultural waste, while the Ministry of Industry and Trade is assigned to the development of environmental industry including recycling industry.

The Philippines has encouraged inter-agency collaboration through the establishment of its National Solid Waste Management Commission, which serves as an inter-ministerial and multi-stakeholder coordinating body. It is created to prescribe policies and oversee the overall implementation of the solid waste management programs in the country. Due to limited technical and financial support, it is very difficult for the local government units, the primary units responsible for the implementation of the solid waste management Act (RA 9003, Section 10), to comply with the law. As a country with a strong presence of the NGOs, this sector plays a significant role in the effective implementation of the SWM policies particularly in the provision of trainings and awareness campaigns. Thus, it is important to strengthen collaboration among various sectors towards effective waste management. RA 9003 encourages the participation of the private sector and the community (Section 5q), mandating the inclusion of a representative from the NGO sector, recycling industry, and manufacturing or packaging industries in the SWM Board in every province, city or municipality (Sections 11, 12).

In the Pacific Island Countries, a lot of donor-driven waste management projects are regional in scope. This requires extensive stakeholder collaboration. Also, through the SPREP mechanism, important issues and proposed resolutions are presented to all the member countries.

Setting clear strategies and policy objectives, as mentioned above, would assist in facilitating role-sharing among ministries while at the same time providing necessary incentives for collaboration among different institutional actors, thereby supporting the implementation of policies. Indeed, China has set a target for advancing Circular Economy, which entails close collaboration between the country's National Development and Reform Commission (NDRC), and the Ministry of Environmental Protection (MEP) for developing specific Rules regarding the "Administration of the Recovery and Disposal of Discarded Electronic and Electrical Products". Viet Nam's National Strategy of Integrated Solid Waste Management has also demonstrated a need for enhanced cooperation between the Ministry of Construction and Ministry of Natural Resources and Environment (MONRE).

Various activities related to the 3Rs, such as waste segregation, introduction and operation of

appropriate technologies, and collection of waste management fees, cannot be implemented without proper understanding of the public and specifically, partnership with local communities. Collaboration between central and local governments thus represents a vital aspect of recycling policy governance.

In the context of industrializing Asia, a shift from a centrally-led, command and control type system to a consensus-building approach of policy implementation is crucial for the effective promotion of the 3Rs, including collaboration with stakeholders, information sharing and exchange, and incentive provision, among others.

References

Country Chapter (2017): Bangladesh, Cambodia, China, India, Indonesia, Japan, Malaysia, The Philippines, Singapore, Thailand, Viet Nam and Pacific Island Countries. http://www.uncrd.or.jp/index.php?menu=389

3.1.2. Definition and Classification of Municipal Solid Waste (MSW)

MSW is conventionally understood as solid waste that is collected and disposed of by or for municipalities (JICA 2005). However, the definition of MSW and associated waste streams often varies between countries, and depends on the particular situation and context. For example, Japan and Singapore define MSW as "general waste". However, whereas the category of "general waste" in Japan does not comprise "industrial waste", Singapore's classification of "general waste" includes this waste type. Similarly, "total MSW generation" often encompasses a range of recyclables (papers, bottles, metals, used electronic appliances, etc.) which are frequently considered waste in industrialized countries such as Japan. At the same time, these "recyclables" are regarded as valuable goods in developing countries such as Indonesia, Viet Nam and China. Therefore, it is difficult to suggest a single unified definition that could be applied to all countries. Nevertheless, it is important to clarify the definition and classification of waste in different countries, especially for MSW, prior to discussing potential indicators. *Table 3-3* enumerates the different definitions regarding MSW by laws in each country, and *Table 3-4* displays the varying classifications of solid waste among the 11 representative countries and a sub-region including Pacific Island Countries.

***Table 3-3**. Definition of waste and solid waste by laws*

	Definition of Waste and Solid Waste
Bangladesh	According to the Bangladesh Environment Conservation Act, 1995: "Waste means any solid, liquid, gaseous, radioactive substance, the discharge, disposal and dumping of which may cause harmful change to the environment." The above act then specifies that: Municipal solid waste (MSW), commonly known as trash or garbage and as refuse or rubbish, is a waste type consisting of everyday items that are discarded by the public. In Bangladesh municipal solid waste includes not only household wastes but also other types of solid waste such industrial waste, hazardous wastes, e-wastes, agricultural wastes, etc."

	Definition of Waste and Solid Waste
Cambodia	In Solid Waste Management Sub-decree in Cambodia (established in 1999, Sub-decree No 36 ANRK.BK) "Solid wastes" comprise all the wastes arising from human activities, including animal wastes that are discarded as useless or unwanted. The sub-decree defines the key terms of "solid waste" and "garbage" as following: a. Solid waste refers to hard objects, hard substances, products or refuse which are useless, disposed of, are intended to be disposed of, or required to be disposed of; and b. Garbage is the part of solid waste which does not contain toxin or hazardous substance, and is discarded from dwellings, public buildings, factories, markets, hotels, business buildings, restaurants, transport facilities, recreation sites, and etc."
China	According to the Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Wastes ("中华人民共和国固体废物污染环境防治法", adopted in 1995, and amended in 2004) and related regulations, "**solid waste**" refers to articles and substances in solid, semi-solid state or gaseity in containers that are produced in the production, living and other activities and have lost their original use values or are discarded or abandoned despite not having yet lost their use value, and articles and substances that are included into the management of solid wastes upon the strength of administrative regulations. "Solid waste" is classified into three types: industrial solid waste ("工业固体废物", IW), **municipal solid waste** ("生活垃圾", MSW), and hazardous waste ("危险废物", HW). **MSW** means solid waste discharged from everyday life or from services provided to everyday life as well as the solid waste that is regarded as municipal solid waste under laws and administrative regulations. It usually includes residential, institutional, commercial, street cleaning, and non-process waste from industries. In some cases, construction and demolition waste is also included.
India	According to the Solid Waste Management Rules, 2016 (MoEF&CC, 2016), "Solid Wastes" is defined as the solid or semi-solid domestic waste, sanitary waste, commercial waste, institutional waste, catering and market waste and other non-residential wastes, street sweepings, silt removed or collected from the surface drains, horticulture waste, agriculture and dairy waste, treated bio-medical waste excluding industrial waste, bio-medical waste and e-waste, battery waste, radio-active waste generated in the area under the local authorities. Wastes are materials that are not products or by-products, for which the generator has no further use for the purposes of production, transformation or consumption. (i) waste includes the materials that may be generated during, the extraction of raw materials, the processing of raw materials into intermediates and final products, the consumption of final products, and through other human activities and excludes residuals recycled or reused at the place of generation; and (ii) by-product means a material that is not intended to be produced but gets produced in the production process of intended product and is used as such. The regulated categories of wastes in India are as follows. a. Solid Wastes are the Solid or semi-solid domestic waste, sanitary waste, commercial waste, institutional waste, catering and market waste and other non-residential wastes, street sweepings, silt removed or collected from the surface drains, horticulture waste, agriculture and dairy waste, treated bio-medical waste excluding industrial waste, bio-medical waste and e-waste, battery waste, radio-active waste generated in the area under the local authorities. b. Hazardous Wastes are the wastes which by reason of characteristics such as physical, chemical, biological, reactive, toxic, flammable, explosive or corrosive, causes danger or is likely to cause danger to health or environment, whether alone origin contact with other wastes or substances, and shall include waste specified under column Schedule I, Schedule II and Schedule III of the Rules. c. Biomedical Wastes are the wastes generated during the diagnosis, treatment or immunisation of human beings or animals or research activities pertaining thereto or in the production or testing of biological or in health camps. d. Electronic Waste are the electrical and electronic equipment, whole or in part discarded as waste by the consumer or bulk consumer as well as rejects from manufacturing, refurbishment and repair processes. e. Demolition and construction waste comprising of building materials, debris and rubble resulting from construction, re-modeling, repair and demolition of any civil structure. f. Plastic Waste is any plastic discarded after use or after their intended use is over. g. Battery Wastes are the used Lead Acid batteries after their intended use is over.

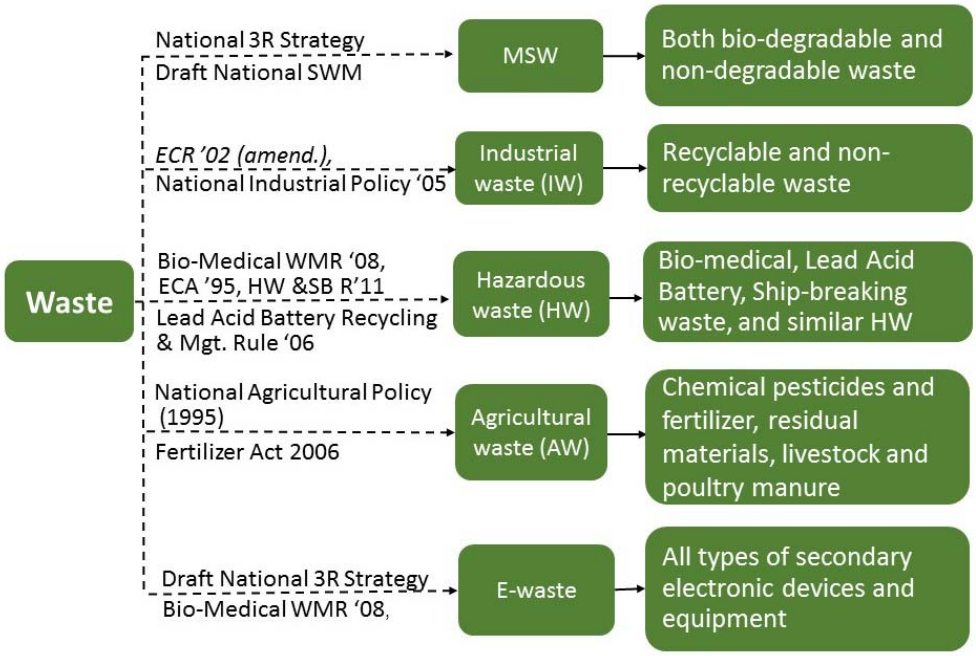
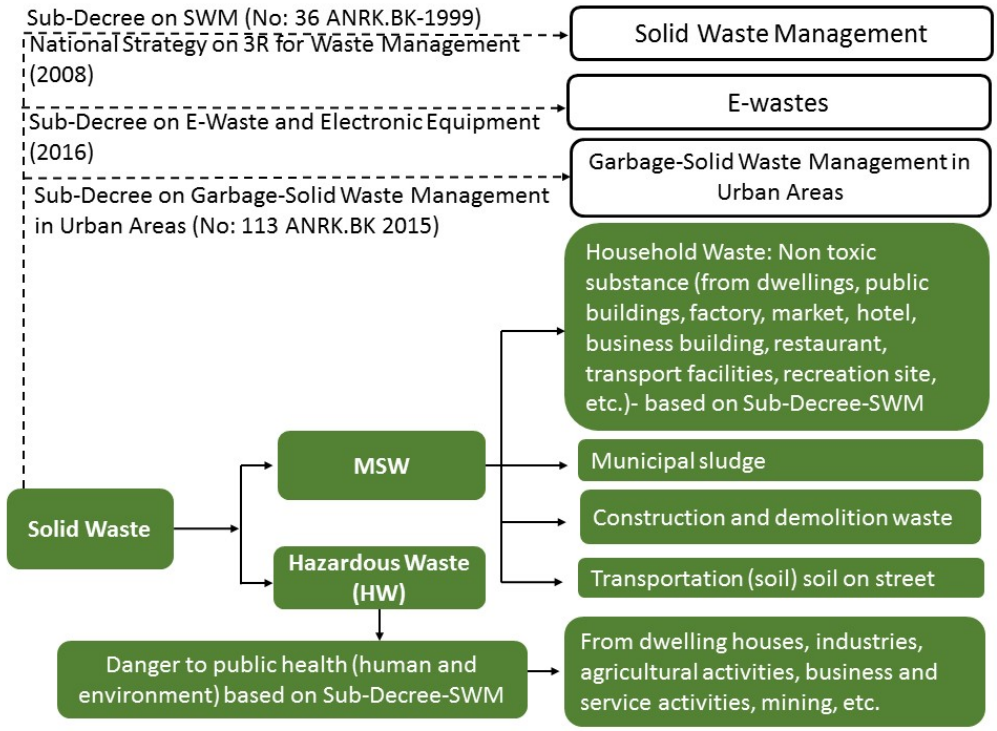
	Definition of Waste and Solid Waste
Indonesia	**Wastes** are broadly classified as **domestic wastes** and **non-domestic wastes**. Domestic waste consist of household waste and household-like waste and wastewater Non-domestics wastes furthermore are grouped into non-hazardous wastes and hazardous wastes. There are two laws that regulate waste management namely Law no. 18/2008 concerning household and household-like waste (municipal solid waste), and Law no. 32/2009 concerning Environment Protection and Management, regulates industrial and HW. Law no. 18/2008 defines household and household-like waste as the residues of human daily activities and/or residues of natural processes in solid forms. Government Regulation (GR) no. 81/2012 explains more specific regarding municipal solid waste management and its technical handling, 3Rs and EPR approach. Management of this type of waste is the responsibility of municipality or other governmental authorities. Wastes specified under this law are: a. **Household wastes** are generated by daily activities performed within households, but not include feces and specific wastes; b. **Household-like waste** are generated from commercial zones, industrial estates, special zones, social facilities, public facilities and any other facility; c. **Specific wastes** are wastes require special management due to their properties, concentrations and/or volumes, in forms of hazardous materials contained wastes, HWs, wastes generated by disasters, demolition wastes, un-processable wastes due to availability of technology and non-periodical generated wastes.
Japan	In Wastes Management and Public Cleansing Law (1970), "**Waste**" refers to refuse, bulky refuse, ashes, sludge, excreta, and other filthy and unnecessary matter, which are in solid or liquid state. "Waste" also refers to the things that cannot be used by the possessor or the things that cannot be handed over to others with compensation. Waste is widely divided into two types that are "**general waste (municipal solid waste)**" and "industrial waste". "Industrial waste" refers to the 20 types of waste material defined in Enforcement Ordinance of the Wastes Management and Public Cleansing Law among all the wastes generated from business activities and imported waste. On the other hand, general waste (municipal solid waste) refers to waste other than industrial waste. It consists of household garbage mainly generated from home other than human waste and business-related garbage generated from the offices and restaurants (household and business waste, and raw sewage).
Malaysia	The laws of Malaysia (Act 672 Solid Waste and Public Cleansing Management Act 2007) define "**solid waste**" as a. Any scrap material or other unwanted surplus substance or rejected products rising from the application of any process; b. any substance required to be disposed of as being broken, worn out, contaminated or otherwise spoiled; or c. any other material that according to this Act or any other written law is required by the authority to be disposed of, but does not include scheduled wastes as prescribed under the Environmental Quality Act 1974 (Act 127), sewage as defined in the Water Services Industry Act 2006 (Act 655) or radioactive waste as defined in the Atomic Energy Licensing Act 1984 (Act 304). Solid wastes are generally categorized into five groups namely municipal wastes, industrial wastes, hazardous wastes, agricultural wastes and e-wastes. **Municipal waste** is part of solid waste, including the following; a. any scrap material or other unwanted surplus substance or rejected products arising from the application of any process; b. any substance required to be disposed of as being broken, worn out, contaminated or otherwise spoiled; or any other material that, according to Solid Waste and Public Cleansing Management Act 2007 (Act 672) or c. other written law, is required by the authority to be disposed of. This includes public solid waste, imported solid waste, household solid waste, institutional solid waste and special solid waste such as waste from commercial, construction, industrial and controlled activities.
The Philippines	**Municipal wastes** refers to wastes produced from activities within local government units which include a combination of domestic, commercial, institutional and industrial wastes and street litters; **Solid wastes** refers to all discarded household, commercial waste, nonhazardous institutional and industrial waste, street sweepings, construction debris, agriculture waste, and other non-hazardous/non-toxic solid waste.

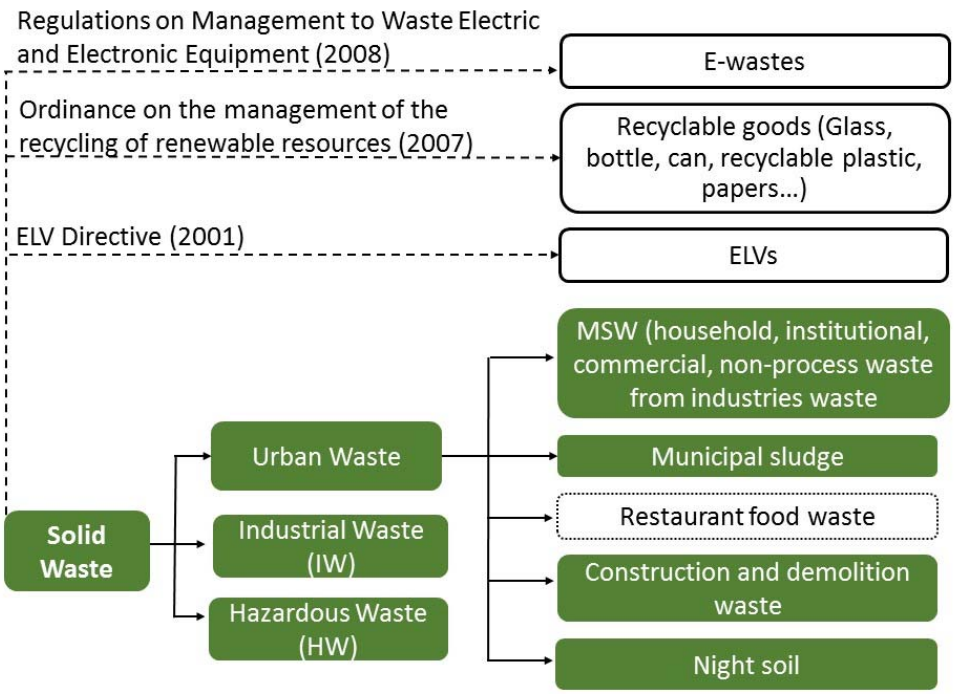
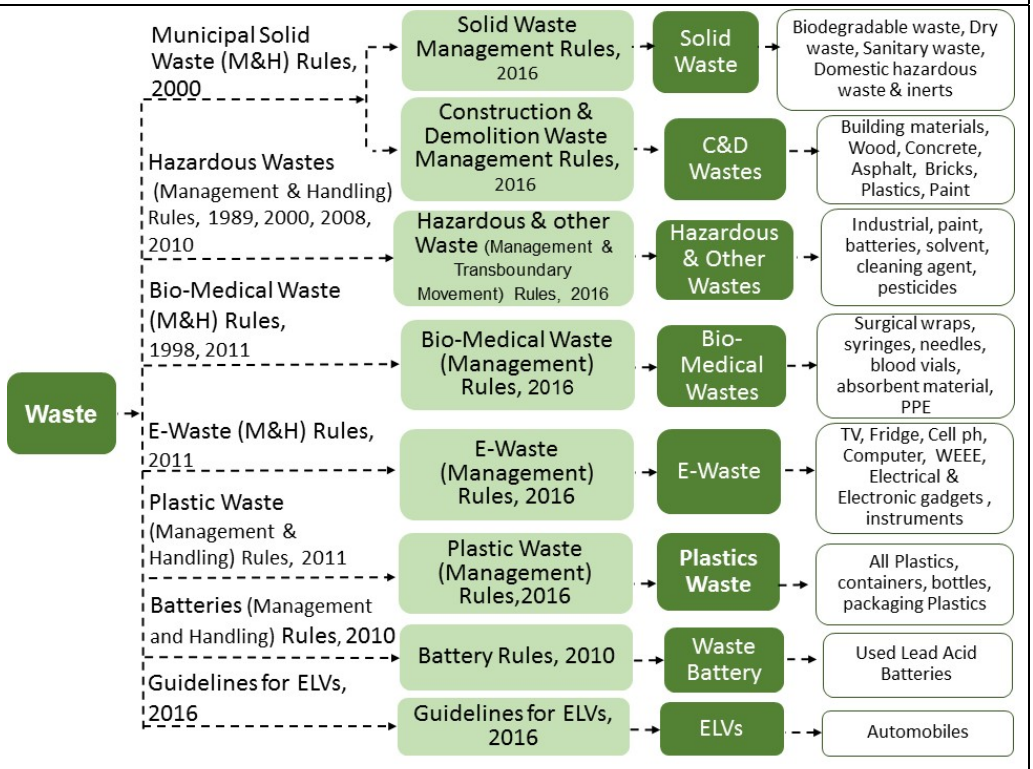
	Definition of Waste and Solid Waste
Singapore	According to the Environmental Public Health (General Waste Collection) Regulations, **General wastes** means — a. refuse or industrial waste, excluding any toxic industrial waste specified in the Schedule to the Environmental Public Health (Toxic Industrial Waste); b. waste from grease interceptors; c. waste from sewerage systems, including waste from sewage treatment plants, septic tanks and water-seal latrines; d. waste from sanitary conveniences not part of a sewerage system, including waste from sanitary conveniences which are mobile or in ships or aircraft; e. dangerous substances that have been treated and rendered harmless and safe for disposal [S 562/2008 wef 01/11/2008]; f. toxic industrial waste that has been treated and rendered harmless and safe for disposal and [S 562/2008 wef 01/11/2008]; g. recyclables waste [S 585/2016 wef 01/12/2016].
Thailand	**Waste** means refuse, garbage, filth, dirt, wastewater, polluted air, polluting substance or any other hazardous substances which are discharged or originate from point sources of pollution, including residues, sediments or remainders of such matters, either in a solid, liquid or gas state [National Environmental Quality Act, B.E. 2535 (1992)] **Solid waste** means used paper, worn out cloth, discarded food, waste commodities, used plastic bag and food container, soot, animal dung or carcasses, including other matters swept from roads, market places, animal husbandry or other places including municipal infectious waste, hazardous or toxic waste [Section 3, Public Health Act, B.E. 2550 (2007)] **Municipal solid waste** means solid waste created by municipal activities e.g. residence, shop, business, service provider, marketplace, and institutes, i.e. organic and food waste, leaf and grass, etc., recyclable waste e.g. glass, paper, metal, plastic, aluminum, rubber, etc. and general waste e.g. fabric, wood, and material debris, excluding municipal hazardous waste [Pollution Control Department, Ministry of Natural Resources and Environment, B.E. 2550 (2007)] **Infectious waste** means body parts or carcasses of human and animals from surgery, autopsies and research; sharp items such as needles, blades, syringes, vials, glassware; discarded materials contaminated with blood, blood components, body fluids from humans or animals, or discarded live and attenuated vaccines and items such as cotton, other cloths and syringes; waste from wards [Regulation of the Ministry of Public Health, B.E.2545 (2002)] **Hazardous waste** means waste having hazardous constitutions, being contaminated with hazardous substance, or having hazardous characteristics as prescribed in annex 2 of the notification e.g. flammable, corrosive, toxic substances [Notification of the Ministry of Industry, B.E.2548 (2005) under Factory Act B.E. 2535 (1992)] **Marine waste** means a manmade product littered or washed into the sea, or waste from any production carried to the sea or marine environment by one way or another. Most types of marine debris are made of long lasting materials e.g. plastics, glass, wood, metal, and rubber [department of Marine and Coastal Resource, Ministry of Natural Resources and Environment, B.E. 2552(2009)]
Viet Nam	With regards to waste management, there have been definitions on different terms on waste and 3R such as: waste; scraps; discarded products; waste management and waste reuse, and recycling. These terms have been defined by the following legislations: a. Law on Environmental Protection 2014 (LEP 2014); b. Decree 38/2015/ND-CP on waste and scrap management; c. Decision 16/2015/QD-TTg on take-back and treatment of discarded products; d. Circular 36/2015/TT-BTNMT on management of hazardous waste; e. Inter-ministerial Circular 58/2015/TTLT-BYT-BTNMT on medical waste management. Based on a review of existing legislation it has been observed that **there is no clear definition of municipal solid waste (MSW)** in Viet Nam as is usually defined in other countries. Instead, **waste** has been classified into: (i) ordinary (non-hazardous) and; (ii) hazardous and can also be categorised as household/domestic, industrial or medical. In the national environment reports, however, the MSW has also been mentioned and addressed although there is not any clear definition. It is understood **unofficially** that **MSW** means waste generated from the urban area and includes: domestic/household waste; street waste; construction and demolition (C&D) waste; generated waste from office, hospital, industries, markets in the urban area. More often used is the concept of urban domestic waste (UDW), which means waste generated from urban households. It is estimated that the UDW accounts for around 60-70% of MSW in Viet Nam (MONRE, 2011).

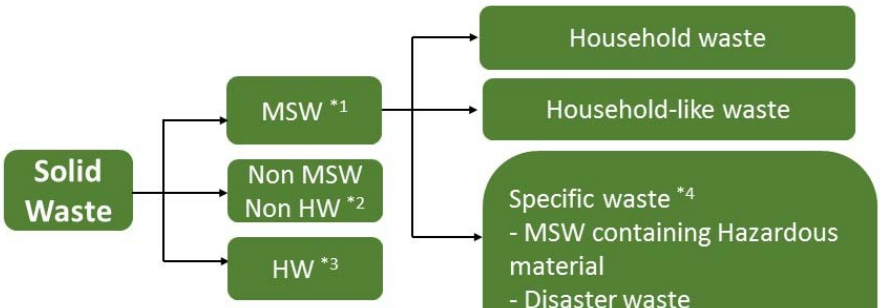
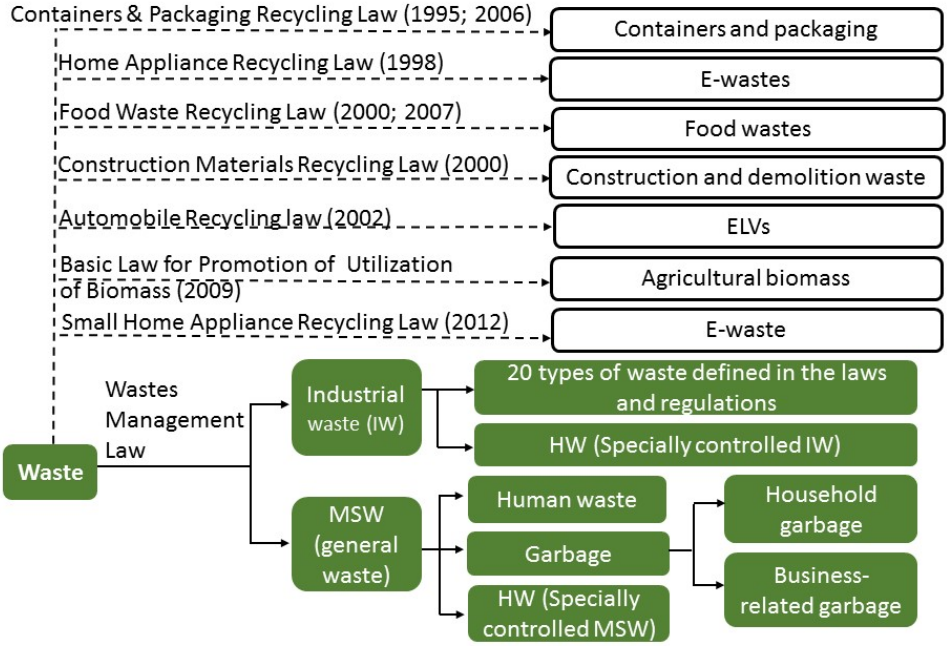
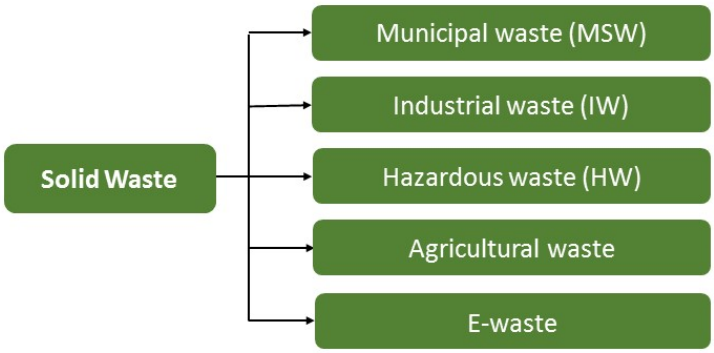
	Definition of Waste and Solid Waste
Pacific Island Countries	There is no generic consistent definition of wastes in most Pacific Island regulations, policies and strategy documents. The first Solid Waste Management Strategy for the Pacific Region (SPREP, 2005) defines solid waste as any solid or semi-solid garbage, refuse or rubbish, sludge and other discarded material including any contained liquid or gaseous material remaining from industrial, commercial, institutional activities and residential or community activities.

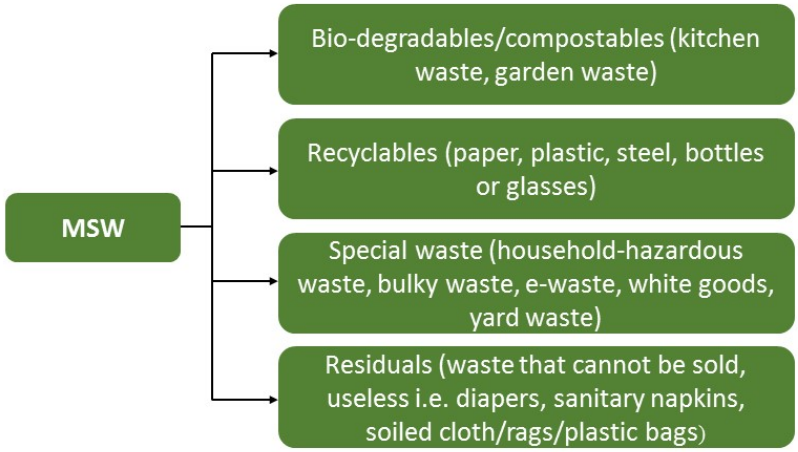
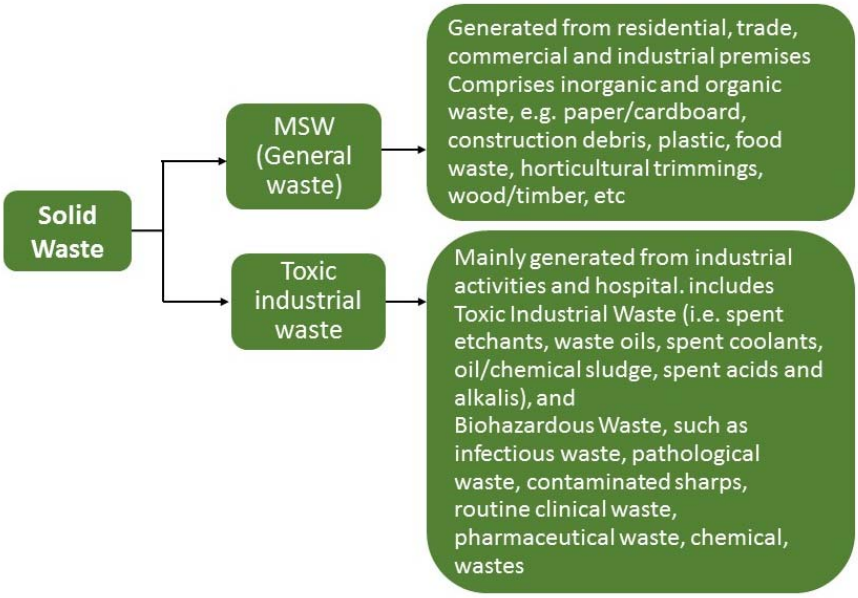
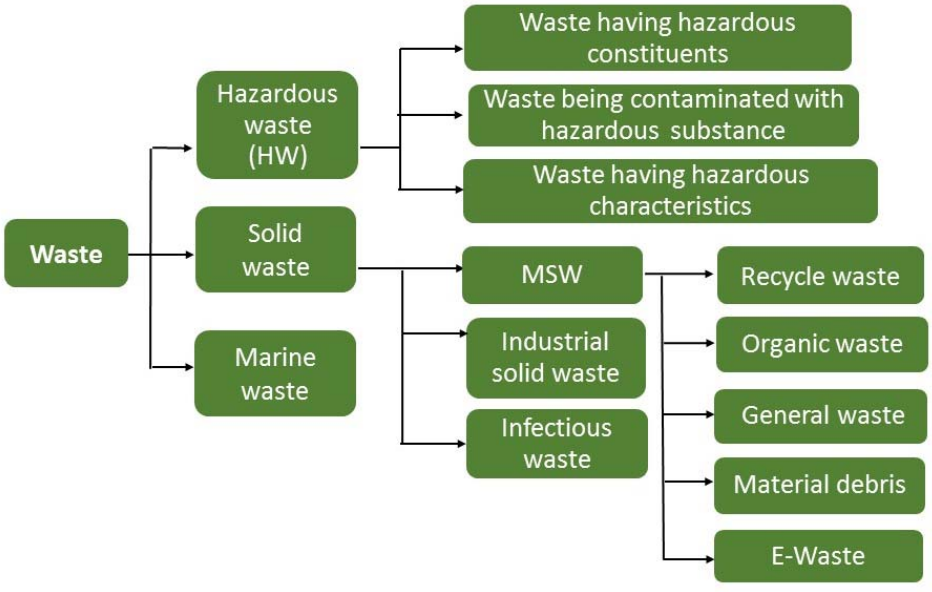
Source: prepared by IGES based on the data and information of Country Chapters, submitted to State of the 3Rs in Asia and the Pacific

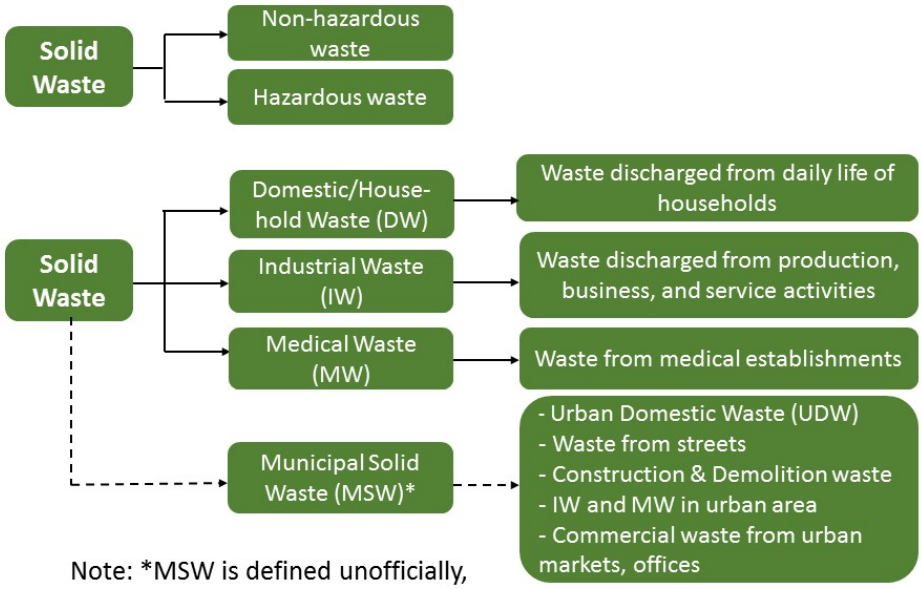
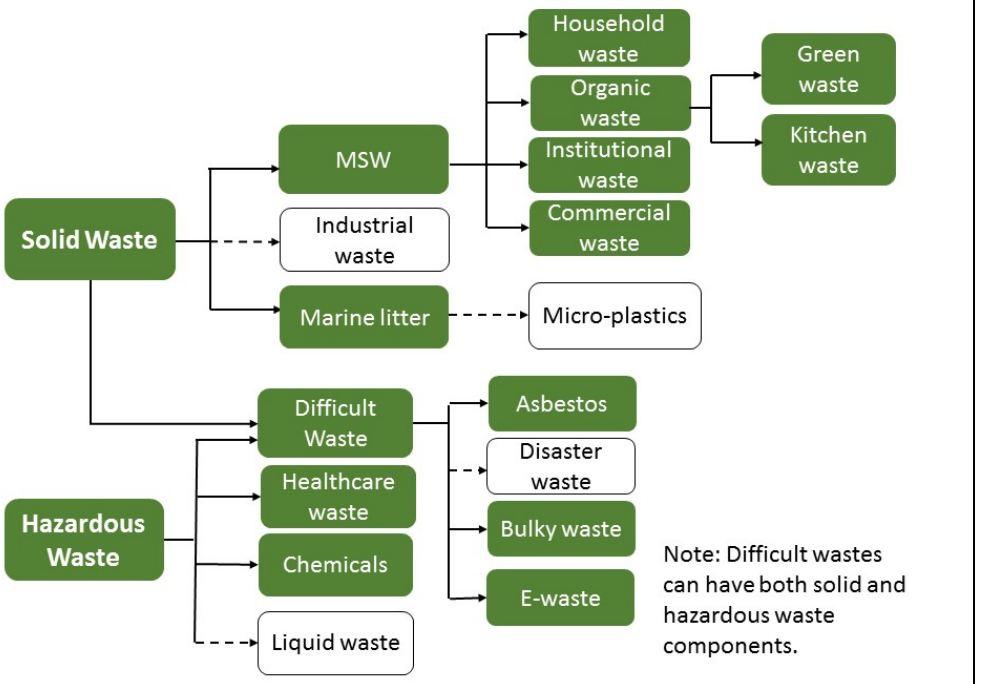
***Table 3-4**. Classification of waste and MSW*

	Classification of waste and MSW
Bangladesh	
Cambodia	

	Classification of waste and MSW
China	
India	

	Classification of waste and MSW
Indonesia	 *1 Law 18/2008; Gov. Reg. 81/2012 *2 Law 32/2009 *3 Law 32/2009; Gov. Reg. 101/2014 *4 If it is not containing hazard material: Regulated by Law 18/2008 and GR 81/2012 If it is containing hazard materials: Regulated by Law 32/2009 and GR 101/2014
Japan	
Malaysia	

	Classification of waste and MSW
The Philippines	
Singapore	
Thailand	

	Classification of waste and MSW
Viet Nam	
Pacific Island Countries	

Source: prepared by IGES based on the data and information by authors of Country Chapters, State of the 3Rs in Asia and the Pacific

References

Country Chapter (2017): Bangladesh, Cambodia, China, India, Indonesia, Japan, Malaysia, The Philippines, Singapore, Thailand, Viet Nam and Pacific Island Countries. http://www.uncrd.or.jp/index.php?menu=389

3.1.3. Major Disposal and 3R-Related Technologies for MSW

The selection of waste management technologies can be influenced by multiple factors. For instance, while different trends with regard to waste generation and composition may have a bearing on applicable technology options, the availability of public finance, national environmental standards, and expectations of the general public can affect the quality of service provided, and then influence the type of technologies or approaches employed. Thus, in addition to physical constraints, economic, socio-political, cultural, institutional, and environmental considerations are also fundamental in understanding the country's rationale for certain technologies and processes, the investment trends underlying these options, as well as potential for transitioning towards more sustainable waste management practices.

Diverse range of technologies, methods and approaches being applied at different waste management stages in countries across the Asia Pacific region[3] (*Table 3-5)*. A clear picture that emerges is that developed economies with established waste management systems tend to rely on capital-intensive technologies, while developing and less-developed economies are often found to rely on more basic, labor-intensive methodologies in the processing and treatment of waste, if at all. As is often the case, many industrializing countries may simply rely on environmentally unsound methods such as open dumping and burning to address waste issues. Some developing countries focusing on intermediate treatment processes utilize composting because of the high organic composition and moisture content of a large percentage of generated waste. Similar trends can also be observed in the urban-rural context within different countries, especially in developing and less-developed economies where large cities make use of high-end technologies and rural areas depend on more rudimentary technologies.

Accordingly, it is important to highlight that development of a sound waste management system is largely an issue of public management: technologies will only deliver their expected function when they are supported by sound institutional framework, an enabling policy environment, adequate financial resources, capable staff and well managed organizations that can sustain effective and efficient service operations (*JICA 2005*).

3.1.3.1. Waste management practices and technologies in the region

Different technologies and practices utilized in the Asia Pacific region are evident based on Country Chapters with respect to their order in the waste management chain.

a. Source Segregation

Due to the general absence and/or limited implementation of source segregation practices, waste in developing and less-developed economies is often found to be largely of mixed composition, which constrains the introduction of technologies and approaches that would help support mainstreaming of the 3Rs. Among the countries examined for this paper, only Japan reported

[3] The table was developed based on the Country Chapters as well as additional inputs from authors.

segregating waste at source on a wide scale. China[4], Viet Nam and The Philippines[5] reported several pilot examples of areas conducting source segregation of waste. Similarly, Bangladesh, Indonesia, and India have emphasized the separation of waste at source as a priority area for policy development.

b. Collection and Transportation

Technologies and practices employed for waste collection and transportation vary widely between countries in the Asia Pacific region. Many developed economies such as Japan and Singapore are making use of capital and/or technology-intensive solutions at large scale, including motorized vehicles and compactor transfer stations, usually under established and functioning waste management systems.

On the other hand, in many developing and less-developed economies, waste collection is often conducted through the combination of different capital-intensive technologies of limited scale and/or manual or labor-intensive approaches such as use of handcarts, lorries or midsize trucks. Waste collection service coverage and efficiency remains moderate to low in many of these countries, sometimes due to the unavailability and/or inoperability of certain technologies, and in other instances due to inadequate coordination of stakeholders, service planning or absence of public service. For instance, in Bangladesh, approximately 55% of generated waste is collected by public service; an estimated 10-15% of this waste is collected by informal sector, while the remainder is either self-disposed or illegally dumped.

In these countries, service and technology gaps are often observed in urban-rural context. The reported waste collection rate is approximately 70% and 90% in major cities in Indonesia and India, respectively and lower in other municipalities. Cambodia, China and India report wide use of regular trucks in rural areas, while compactor trucks are limited to major cities.

Some countries are introducing market-based approaches to MSW to enhance the collection of waste. Malaysia, Indonesia and Thailand make use of waste banks in line with national waste minimization strategies being directed by their respective governments. Indonesia's *Bank Sampah* programme (waste bank), for example, seeks to raise public awareness about the importance of waste management through savings or earnings from the exchange of waste materials in such banks.

Market-based collection of recyclable or valuable wastes is more widely observed in countries across different income levels. In countries or cities where waste management system is still at its inception or development stage, recyclable/valuable waste contents are often separated and/or collected by informal waste-pickers. While generally unrecognized, these people play an indispensable role in the provision of waste management service. Bangladesh, Cambodia, China, India, Indonesia, Malaysia, Pacific Island Countries, The Philippines, Thailand and Viet Nam all reported the existence of an active informal sector with regard to waste collection and management.

[4] In June 2016, the National Development and Reform Commission and Ministry of Housing and Urban-Rural Development promulgated the Mandatory Classification System for Waste (Draft for Soliciting Opinions)", which aims for a source separation rate of MSW of over 90% in key cities of China by the end of 2020.

[5] The Philippines' RA 9003 mandates the segregation of solid waste at source (Section 21). Thus, many local government units (LGUs) have already started practicing waste segregation at source.

c. Intermediate Treatment Processes

Intermediate treatment processes applied in Asia Pacific countries vary both in scale and type, and are increasingly being accepted as viable approaches to waste management with associated socio-economic and environmental benefits.

Material Recovery Facility

Separation of collected waste at designated facilities are becoming increasingly commonplace in countries where wide-scale waste segregation is not observed. For instance, mechanical sorting of waste in Material Recovery Facilities (MRF) and Mechanical-Biological Treatment (MBT) plants remain rare but are observed in several areas of the Philippines, Viet Nam, Indonesia, Thailand, India and China. Conversely, less-capital intensive MRFs, such as secondary collection points that facilitate the manual sorting of waste, are widely employed in many countries. Indonesia reports 200 MRFs known as "TPS-3R" are in operation in 150 cities where collected wastes are manually sorted. In the Philippines, MRFs are created and mandated for every *barangay* or cluster of barangays (the lowest governance unit) as provided in RA 9003 (Section 32). Based on NSWMC Report as of 2014, there are 8,656 MRFs in the country serving 10,327 barangays (DENR/EMB/NSWMC 2015).

Recycling

Recycling of various materials is being practiced widely across the region. However, there is a wide divergence in terms of the relative amounts, type of waste and technology employed in the process. Whereas developed economies, such as Japan and Singapore have achieved high rates of recycling (approximately 20.6%[6] and 20% respectively) — facilitated both through supportive institutional mechanisms and the utilization of different methodologies for the extraction/conversion of valuable resources — many developing countries continue to face structural and systemic challenges with the implementation of recycling.

In industrialized economies, established public administration procedures and protocols often dictate how sorting, collection and recycling is to be conducted for each material category, including how packaging wastes such as aluminum, steel, cardboard and paper are to be treated. These countries may employ a diverse range of recycling technologies, including but not limited to materials recycling, chemicals recycling, refuse derived fuel (RDF) and gasification, depending on specific composition and characteristics of item in question. Several low and middle income countries report making use of capital-intensive technologies although these remain at the pilot/ experimental stage. For instance, Malaysia, Thailand, The Philippines and India have introduced RDF plants; India and The Philippines both utilize gasification systems.

On the other hand, in many countries where material-specific recycling regimes have not been institutionalized, recycling is carried out largely as a market-based activity; this spans from collection to processing, and is often conducted by the unregulated informal sector — frequently by workers who are exposed to acute health and safety risks. As described in section 3.1.3.2 above, all surveyed countries with the exception of Japan report the existence of informal recycling practices. Although not frequently documented, the role of informal sector is

[6] See *section 3.2.1.3. Overall Recycling Rate and Target (%) in the representative countries* and each Country Chapter for the precise definitions of recycling rate.

considered to be of high importance in terms of the recovery and recycling of resources. In Malaysia, the overall recycling rate is estimated to be roughly 5%, while recycling by informal sector is estimated to comprise more than 15% of waste generated nationwide.

In Pacific Island Countries and Territories (PICT), in situ recycling is not widely observed due to absence of recycling policy as well as their considerable distance from mainland markets, posing challenges for business-based recycling both in terms of cost and scale. Accordingly, countries report varying degree of collection rate: Tonga (9%) Tuvalu (15%) report relatively low rate; Fiji (58%), Samoa (36%), Vanuatu (37%) and French Polynesia (39%) all report high recycling rate based on reverse logistics (collection, compaction, and shipping to off island) or back loading concept. Currently investigations are underway for the establishment of a recycling network in the region considering logistical requirements.

A general trend that can be observed is that recycling is more widely practiced in urban than in rural areas, especially among developing countries. For example, in Cambodia, an estimated 86 tons of material are recycled per day, with collected recyclables in Phnom Penh comprising as high as 39.7 tons/day. Secondly, because waste in lower and middle-income countries is largely comprised of organic material, much of the waste can be recovered and recycled. Bangladesh estimates that as much as 80-90% of waste in Dhaka City can potentially be recycled.

Biological Treatment

Biological treatment of waste, such as composting and anaerobic digestion, is observed in most of the surveyed countries, but seen to be more widely practiced in low and middle income countries, as well as in rural and household context; it can be inferred that this is largely due to the greater percentage of organic waste in the overall waste mix, as well as the demand in rural regions for economic and decentralized waste management technology options providing alternatives to the more complex solutions often adopted in major cities.

In terms of composting, a reported 7% of collected waste in Indonesia is composted, while all other countries report varying degrees of organic waste utilization for composting. Bangkok Metropolitan Authority has introduced the Takakura Home Composting method in all of its 50 districts, and home scale vermicomposting is also gaining popularity in the country. The use of anaerobic digestion systems for biogas generation is also well documented across Asia and the Pacific, often as an alternative source of energy. Viet Nam reports 158,500 biogas facilities from livestock waste throughout the country. One outlier among the countries evaluated is India, whose cites make use of landfill mining of organic materials to support bioremediation efforts.

Government initiatives for promoting composting are prominent in some countries such as China, India and Indonesia. In India more than 600 composting plants are currently operational. India reported that unstable waste quality (and thus product quality), difficulty of sustaining source segregation, high associated operational cost and low market demand among end users remain a challenge. The Indian SWM Rules 2016 have now put more emphasis encouraging waste segregation at source. The government has also launched initiatives and supporting schemes to strengthen the quality of compost, and marketing channels integrating demand side supply chain with fertilizer manufacturers and farmers to develop business models with composting initiatives. These measures will help establish cost recovery and overall sustainability of the business model associated with industrial-scale composting. In Viet Nam, only a reported 28 out of 31 composting facilities remain operational in 2013 due to technical and financial bottlenecks.

Similarly, a large scale composting plant at Onnuch transfer station (capacity of 1,000T/day) in Bangkok also suffers from low quality final product due to improper segregation of MSW.

Incineration

Industrial-scale incinerators are often considered the technology of choice in many industrialized or developed countries, not only because of its advantages with regard to the hygienic management of waste, but also due to its capacity to resolve geographical constraints associated with final disposal and its potential to provide a viable source of energy and/or heating (WtE). In the Singapore, Japan and China, for example, land constraints necessitate the recycling and incineration of materials in order to optimize available space for final disposal. In 2011, Singapore recycled 59% of generated waste, incinerated 38% and the remaining 3% of non-incinerable waste was sent to landfill. In Japan, 79% of generated municipal solid waste is treated by incineration. In China, MSW incineration rate increased from 20% in 2010 to 35% in 2015.

At the same time, the use of waste incineration is increasing in many developing countries, especially in larger cities. In Cambodia, for example, six incineration plants are currently in operation in the capital city of Phnom Penh. In Thailand, eight small scale incinerators are active throughout the country; two with pollution control systems in place, and one with WtE capability. Thailand presently hosts 12 integrated system facilities where a combination of incineration, biological treatment and recycling are being used.

However, countries also present challenges in employing incinerators, namely, low calorific value of waste, treatment of gaseous emissions and bottom ash, and occasional land restrictions and NIMBYism in the form of community opposition. Consequently, some countries have introduced limitations to the use of incineration as a method of waste treatment unless such concerns are properly addressed. For instance, in the Philippines, the Clean Air Act of 1999 (RA 8749) prohibits the operation of incinerators without introducing proper treatment measures for hazardous gas emissions.

d. Final Disposal Processes

On the whole, sanitary/engineered landfills are not as prevalent as open and controlled dumping in lower and middle income countries. In Cambodia, there exists only one engineered landfill site in Phnom Penh, whereas majority of municipal as well as industrial wastes are disposed at 72 open dumpsites across the country without any intermediate treatment. In Malaysia, where 165 dumpsites are currently in operation nationwide, indicated that it utilizes eight engineered landfill sites. In Indonesia, 10% of collected waste is disposed in engineered landfill sites, 35% in controlled dumping and 55% in open dumping.

Some countries are gradually making a transition to more environmentally-sound final disposal approaches as exemplified by the law RA 9003 of the Philippines[7], which further states that all open dumpsites should be converted into controlled dumpsites after three years and that all controlled dumpsites should be closed within five years of the implementation of the Act (Section 37). As an alternative, the construction of sanitary landfill (SLF) is allowed as a final disposal site for residual wastes, but it should be in accordance with the criteria provided by the Act (Sections 40, 41, and 42). Similarly, landfill gas recovery is reported to be utilized in Viet Nam and India.

[7] RA 9003 prohibits the operation and establishment of open dumpsites upon the coming into force of the Act

On the other hand, open dumping is found to be much less prevalent in advanced economies and economies in transition. Sanitary/ engineered landfill treatment is commonplace in countries like China, Singapore and Japan. The China Statistical Yearbook (2016) reported that 64% of collected waste in 2015 was sent to a sanitary/ engineered landfill. Landfill gas recovery is reported to be utilized in Viet Nam, India and Japan. In Japan, 1.1% of collected waste in 2015 was directly sent to landfill after waste to energy treatment, and 8.9% of treated waste in 2015 was sent to landfill. In India, more than 1,285 sanitary, engineered landfill and dumpsites are in operation. The Indian SWM Rules 2016 have now placed more emphasis on encouraging least amount of waste for landfilling and more for material and energy recovery (recycling and waste treatment).

3.1.3.2. Illegal Waste Management Practices

From open burning to open dumping, illegal environmentally unsound waste management practices are widely observed in many Asian and Pacific countries, particularly in less developed and developing economies. Open burning in developing countries can primarily be attributed to poor waste management services and infrastructure stemming from a general lack of access to technological solutions and/or insufficient financing options. Indonesia reports that 5% of collected waste is combusted; Bangladesh, Cambodia, Pacific Island Countries, the Philippines, Thailand and Viet Nam also indicate a reliance on the burning of waste. Similarly, many countries report the existence of open dumping in varying degrees such as Bangladesh, Cambodia (37 sites), Indonesia, Pacific Island Countries, the Philippines (341 sites) and Thailand, as well as rural areas of China and India. In Viet Nam, there are total of 660 landfills by 2016; of which, 457 open dump sites are in operation, which account accounts for approximately 69% of country's final disposal sites.

With the sound waste management system and environmental regulations and/or standards in place, these practices are kept at minimum in countries such as Japan and Singapore as well as in major cities in developing countries.

3.1.3.3. Waste Management System Patterns

Based on the above, waste management systems in the Asia Pacific region can be categorized into three representative models depending on the type of technologies employed, practices introduced and observed waste streams (*Figure 3-1*).

Model 1 represents waste management system in many less developed economies and in rural areas. The system is still at inception stage where generated wastes are often collected on a limited scale and without source segregation, and directly reach final disposal sites with minimum or without control or engineering. Because the coverage of waste management service is low, illegal disposal/ treatment is widely observed. Recyclable wastes are recovered by a vibrant informal sector, performing an imperative role for resource circulation within the system. In these countries, legal and policy frameworks for the 3R are still non-existent, under development or existent but with limited implementation.

Model 2 represents waste management system in developing countries and cities. The system is characterized by the emergence of segregated waste collection, intermediate treatment options,

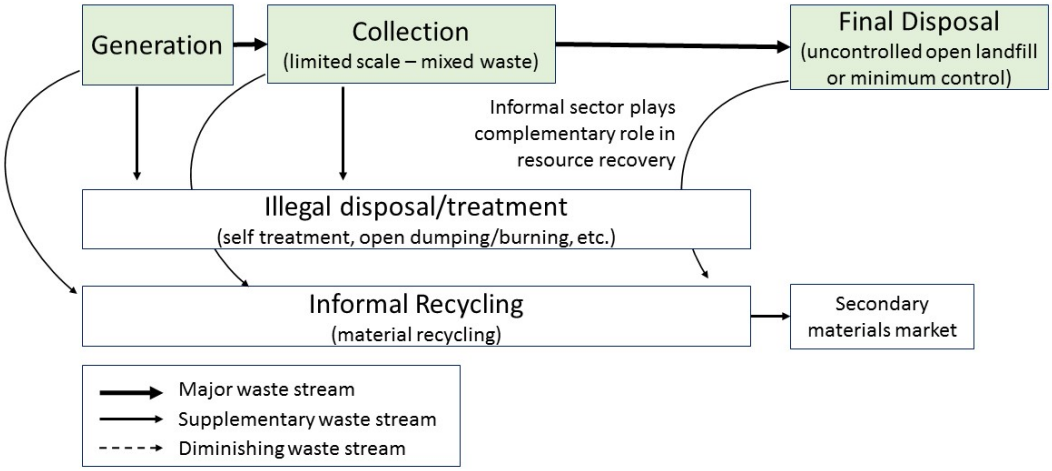
and controlled landfill sites. Collection service coverage is improved, sometimes with the involvement of private sector contractors. Recycling industry begins to take root with legal/ policy support. Although gradually diminishing in scale, informal sector still plays a complementary role in resource recovery.

Model 3 represents waste management systems in developed economies, which can be characterized as an Integrated Waste Management System where all waste sources and management aspects are strategically addressed to minimize the health risk and environmental burden, and improve resource efficiency. Waste segregation and treatment based on material and/or quality are optimized with diverse intermediate treatment options supported by sound institutional foundation. Waste/recycling sectors are regulated (formalized) and illegal disposal/treatment are kept at minimum by standards and regulations.

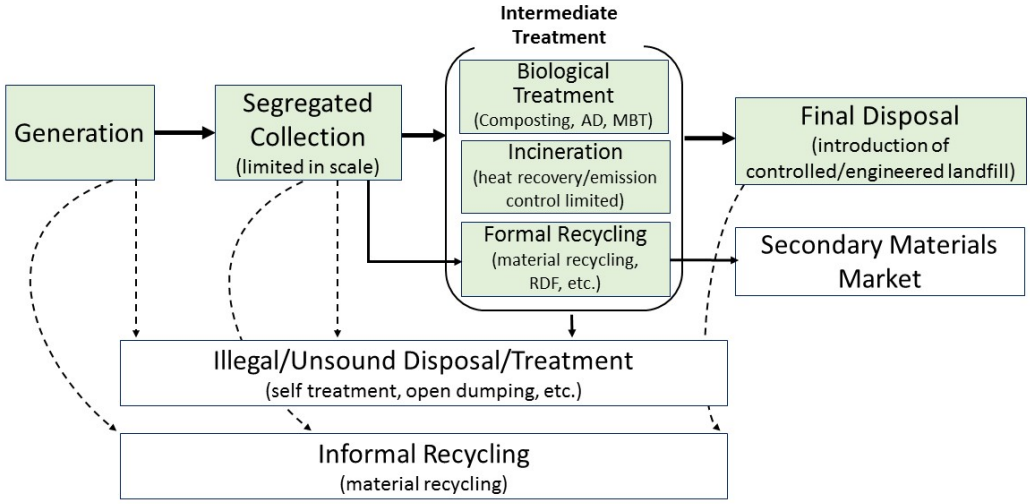
Model 1: Emergence of simple waste management system
- No segregation
- Minimum collection coverage
- Valuable resources recovered by informal sector
- Limited/virtually no options for intermediate treatment
- Final disposal at open landfill or landfill with minimum control
- Illegal disposal/treatment widely observed

Model 2: Waste management system in transition
- Segregation introduced where appropriate treatment options exist
- Improved collection coverage
- Valuable resources are collected through informal and formal sector
- Different intermediate treatment options are explored and introduced, including incineration and other 3R technologies
- Prevalence of controlled landfills
- Illegal disposal/treatment still exist while preventive measures take effect

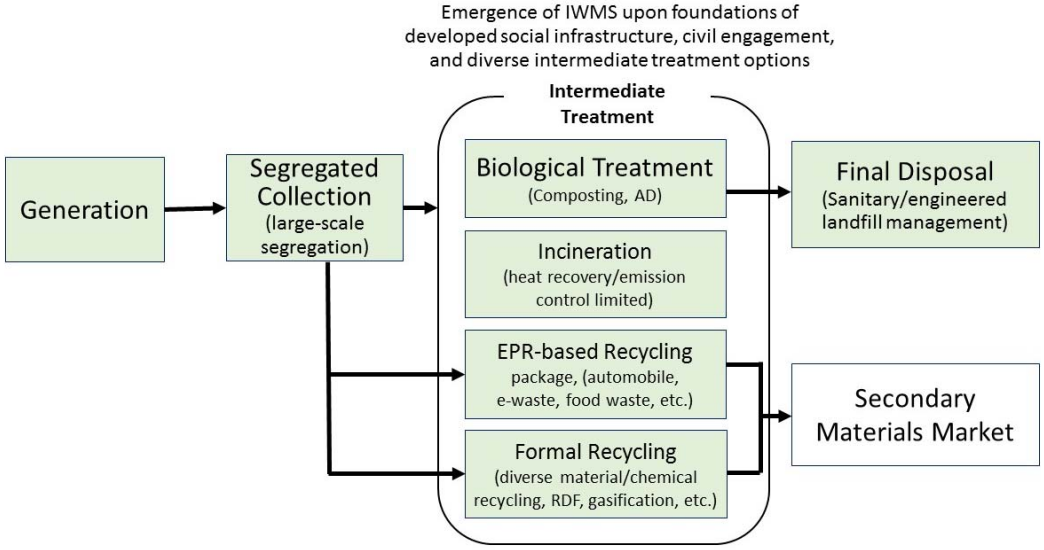
Model 3: Development of integrated waste management systems
- Segregation practices widely practiced and tailored to available treatment options
- Approaching full waste collection coverage
- Recyclable waste collection conducted by formal sector (government or community group)
- Incineration with heat recovery representing the major treatment option while diverse options also exist.
- Sanitary landfill
- Illegal disposal/treatment are kept minimum



(a) Model 1 Emergence of simple waste management system



(b) Model 2 Waste management system in transition



(c) Model 3 Development of integrated waste management systems

Source: prepared by IGES

Figure 3-1*. Waste management system patterns in Asia and the Pacific*

3.1.3.4. Challenges and Future Directions

The current status of waste management and 3R-related technologies in the Asia Pacific region presents some challenges with regard to the future directions national and local governments can pursue towards improving waste management systems:

a. Strengthening Institutional Foundation – legislations, policies, strategies, and standards

As detailed in section 3.1.1., waste management and 3R-related legislations, policies and strategies are indispensable for establishing the appropriate mandate and authority of responsible organizations. This has a direct influence on ensuring effective service delivery, clarifying roles and responsibilities among different stakeholders, and setting clear objectives, priorities and built-in-mechanisms for implementation, monitoring, feedback and improvement. For the technologies to function as intended, governments also need to develop clear standards on technology specifications, indicating, for instance, performance criteria and pollution requirements (*Visvanathan 2010*).

b. Securing Finance and Promotion of Private Sector Investment

Provision of adequate financial resources for the introduction of appropriate technologies is critical for improving the effectiveness and efficiency of waste management systems. Different funding modalities include foreign direct investments and public-private-partnerships as well as bilateral and multilateral official development assistance (AIT/IGES 2010). To this end, as AIT and IGES (2010) suggested, a multitude of "financial incentives such as subsidies, soft loans, for tax benefits for sound recycling technologies" can be introduced, while disincentives such as pollution fees and/or withdrawal of license for malpractices can also be considered (AIT/IGES 2010). The "polluter pays principle" should be applied through introduction of "pay-as-you-throw" or volume-based fee system, and a roadmap for increasing of solid waste collection/treatment charge to cover investment cost as well. These measures will help mobilize financing for waste management and achieve reductions in waste generation.

c. Filling Implementation Gaps between Rural and Urban Areas

The development of sound waste management systems in metropolitan areas and large cities is being addressed in almost all countries in the Asia Pacific region. On the other hand, many countries also reported either an absence or deficiency of waste management services in rural locations. In this context, countries need properly plan a balanced urban-rural waste management and expand resource mobilization efforts with a view to promote more sustainable waste management systems in rural areas, including identification and investment in appropriate technologies tailored to specific local conditions.

d. Promoting Capacity Development for Operation and Maintenance

While the importance of capacity development among waste management professionals and organizations is widely understood in every country, addressing skills gaps remains particularly important in most developing economies. For instance, in many emerging and less developed economies, the degree to which new waste management technologies can be harnessed is

inherently built upon the ability to effectively operate and maintain pre-existing technologies and facilities. Lacking capacities at the individual and organizational levels, selected technologies cannot be managed sustainably. For these reasons, the development and dissemination of guidelines and tools are critical in enhancing operational capacity and service performance.

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DENR/EMB/NSWMC (2015) National Solid Waste Management Status Report 2008-2014. Available at: https://ja.scribd.com/document/325470994/National-Solid-Waste-Management-Status-Report-2008-to-2014

JICA (2005) Supporting Capacity Development in Solid Waste Management in Developing Countries -Towards Improving Solid Waste Management Capacity of Entire Societies.

Table 3-5. *Cross-country comparison of Asia-Pacific Countries major treatment options and 3R technologies/practices*

	Separation at source	Collection (Note 1)				Intermediate Treatment Processes															Final Treatment / Disposal Methodologies						Notes (Sampling Year etc.)
						Separation	Recycling				Biological Treatment			Incineration														
		Regular Truck	Compactor Truck	Waste Banks	Remarks (Note 3)	Mechanical Sorting (MBT/ MRF)	Informal Recycling (Note 2) (paper, metal, bottles, glasses and etc.)	RDF	Gasification	Remarks (Note 3)	Com-posting	Anaerobic Digestion (bio-gas)	Remarks (Note 3)	Open Burning	Small Scale Incineration (without pollution control system)	Incineration (with pollution control system)	WtE (thermal energy recovery)	Remarks (Note 3)	Open Dumping	Controlled Dumping	Sanitary/ Engineered Landfill without Gas Recovery	Sanitary/ Engineered Landfill with Gas Recovery	Landfill Mining (LFMR)	Remarks (Note 3)	
Bangla-desh		✔			✔ 55% (G)		✔ 15% (G) Dakha City			✔	✔	✔	✔	✔	✔				✔							
Cam-bodia	✔ For valuable wastes for selling only	✔ Widely accepted	✔ Only in capital and tourist cities		Only in major cities		✔ 39.7 t/day = 4.3% (Phnom Penh, 2004) Private recyclers and NGOs.			✔	✔	✔	✔	✔	✔ 6 units for IW 3,525 t/year (5 units WtE in garment industry)				✔ 72 units		✔ 1 unit (Phnom Penh)				2012

The table describes the existing waste management and the 3R related technologies/practices in the waste management system of Asia Pacific countries, based on the Country Chapters and expert assessment. Upper cells are marked as "✓" for "active" treatment options (BLANK means "inactive"), while lower cells provide the percentage of the generated (or collected) waste being treated by the treatment option and/or any relevant information where such data is available.
(G) = of generated ; (C) = of collected; IW= industrial waste
Note 1: Collection service provided under municipal responsibility. Note 2: Includes range of market-based processes from collection to processing/treatment by informal sector.
Note 3: Marked "✓"if practice/technology is observed but the specific technology type(s) is unknown.

	Separation at source	Collection (Note 1)				Intermediate Treatment Processes												Final Treatment / Disposal Methodologies						Notes (Sampling Year etc.)
						Separation	Recycling				Biological Treatment			Incineration					Open Dumping	Controlled Dumping	Sanitary/ Engineered Landfill without Gas Recovery	Sanitary/ Engineered Landfill with Gas Recovery	Landfill Mining (LFMR)		
		Regular Truck	Compactor Truck	Waste Banks	Remarks (Note 3)	Mechanical Sorting (MBT/ MRF)	Informal Recycling (Note 2) (paper, metal, bottles, glasses and etc.)	RDF	Gasification	Remarks (Note 3)	Com-posting	Anaerobic Digestion (bio-gas)	Remarks (Note 3)	Open Burning	Small Scale Incineration (without pollution control system)	Incineration (with pollution control system)	WtE (thermal energy recovery)	Remarks (Note 3)							
China	✔	✔	✔			✔	✔			✔	✔	✔	✔		✔	✔	✔		✔	✔	✔	✔	✔		
	Pilot city	Rural area	Urban area			Pilot city					2% (C)					16% (C) Incl. all types of incinerators			Rural area	Small-city		Mega-city	Pilot	83% (C) incl. all types of landfill	
India	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔		2015-16
	Pilot city	Rural area	Urban area		Major Cities 90%	200 manual MRF in 100 cities	15 % (C) in 3000 small Urban Local Bodies	12 RDF plants	4831 MW Biomass Power/ Cogen. for agricultural waste mainly (11% of RES)		8,542 units of all types of com-posting	2 mil cubic meters in 2014-15 gas; 645 units	More than 0.5 mil small and micro bio-gas plants operating			6 % (C) incl. all types of incinerators (127MW)		8 wte plants in pipeline	Rural area	1380 in big & small city	4,515 TPD	One		73% incl. all types of landfill	

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Indonesia		✔	✔	✔	✔	✔	✔			✔	✔	✔	✔	✔	✔				✔	✔	✔				2006
					70% in major cities	200 MRF in 150 cities manual sorting		Planned in Bogor area in 2018	For agricultural waste only		7.19% (C)			4.79% (C)	6.59 (C)		Planned in 7 cities (but: cancelled for a moment)					6 units		71.85% (C)	
Japan	✔		✔					✔	✔	✔	✔	✔				✔	✔				✔				2010
																	306 units								
Malaysia		✔		✔			✔	✔		✔	✔		✔		✔	✔					✔			✔	
				1 unit			15%≦x (G)	1 unit (integrated power plant)		Green chemical, bio-polymers, bio-composites	1.0% (G)					5 units					8 /165 units			93.5% (G) 165 /296 units (operational/ total)	

The table describes the existing waste management and the 3R related technologies/practices in the waste management system of Asia Pacific countries, based on the Country Chapters and expert assessment. Upper cells are marked as "✓" for "active" treatment options (BLANK means "inactive"), while lower cells provide the percentage of the generated (or collected) waste being treated by the treatment option and/or any relevant information where such data is available.
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	Separation at source	Collection (Note 1)				Intermediate Treatment Processes												Final Treatment / Disposal Methodologies						Notes (Sampling Year etc.)
						Separation	Recycling				Biological Treatment			Incineration										
		Regular Truck	Compactor Truck	Waste Banks	Remarks (Note 3)	Mechanical Sorting (MBT/ MRF)	Informal Recycling (Note 2) (paper, metal, bottles, glasses and etc.)	RDF	Gasification	Remarks (Note 3)	Com-posting	Anaerobic Digestion (bio-gas)	Remarks (Note 3)	Open Burning	Small Scale Incineration (without pollution control system)	Incineration (with pollution control system)	WtE (thermal energy recovery)	Remarks (Note 3)	Open Dumping	Controlled Dumping	Sanitary/ Engineered Landfill without Gas Recovery	Sanitary/ Engineered Landfill with Gas Recovery	Landfill Mining (LFMR)	Remarks (Note 3)	
Pacific Island Countries		✔	✔				✔	✔	✔	✔	✔	✔		✔		✔			✔	✔	✔				
							Public re-demption in Palau, Kiribati, New Caledonia, FSM and Samoa	Paper briquettes in RMI	Plastic to oil in Palau	Not very extensive; mainly return	Pilot scale	Pilot scale (Tuvalu and Samoa)		In some schools - paper		Healthcare wastes only					Fukuoka method				
The Philip-pines	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔			✔		✔	✔	✔	✔		✔	2016
				Few	Collection by IWS	Few		Few				Few					Few		341 units	215 units	114 units	Few		9,794 units	

The table describes the existing waste management and the 3R related technologies/practices in the waste management system of Asia Pacific countries, based on the Country Chapters and expert assessment. Upper cells are marked as "✓" for "active" treatment options (BLANK means "inactive"), while lower cells provide the percentage of the generated (or collected) waste being treated by the treatment option and/or any relevant information where such data is available.
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		Regular Truck	Compactor Truck	Waste Banks	Remarks (Note 3)	Mechanical Sorting (MBT/ MRF)	Informal Recycling (Note 2) (paper, metal, bottles, glasses and etc.)	RDF	Gasification	Remarks (Note 3)	Com-posting	Anaerobic Digestion (bio-gas)	Remarks (Note 3)	Open Burning	Small Scale Incineration (without pollution control system)	Incineration (with pollution control system)	WtE (thermal energy recovery)	Remarks (Note 3)							
Singapore	✔		✔				✔	✔		✔	✔						✔			✔			✔	
								Wood chip and rubber chips		60%	Composting of horticultural waste						38% (C) MSW, Agricultural biomass				No landfilling of organic and incinerable waste			2% (C)	
Thailand	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔			2013
						3 units		Experi-mental	Experi-mental			Experi-mental 1 unit			8 units	2 units	1 unit			367 units	73 units	1 unit			

The table describes the existing waste management and the 3R related technologies/practices in the waste management system of Asia Pacific countries, based on the Country Chapters and expert assessment. Upper cells are marked as "✓" for "active" treatment options (BLANK means "inactive"), while lower cells provide the percentage of the generated (or collected) waste being treated by the treatment option and/or any relevant information where such data is available.
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						Separation	Recycling				Biological Treatment			Incineration					Open Dumping	Controlled Dumping	Sanitary/ Engineered Landfill without Gas Recovery	Sanitary/ Engineered Landfill with Gas Recovery	Landfill Mining (LFMR)		
		Regular Truck	Compactor Truck	Waste Banks	Remarks (Note 3)	Mechanical Sorting (MBT/ MRF)	Informal Recycling (Note 2) (paper, metal, bottles, glasses and etc.)	RDF	Gasification	Remarks (Note 3)	Com-posting	Anaerobic Digestion (bio-gas)	Remarks (Note 3)	Open Burning	Small Scale Incineration (without pollution control system)	Incineration (with pollution control system)	WtE (thermal energy recovery)	Remarks (Note 3)							
Viet Nam	✔	✔	✔			✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔		✔	2014, (ISPONRE & IGES 2013, VNEEP 2016, N.H.Tien, MOC)
	Few pilot scale imple-menta-tion only					Normally part of com-posting plants	8-15% (c)				28/31 units Opera-tional Not prevalent (a)	500,000 units mostly house-hold scale units in rural area (b)				44 units plus 25 units in inter-mediate treatment centres			337 units 50% of landfilled waste		121/458 units (c)			458 units 76-82% (c)	

(a) ISPONRE/IGES (2013) Review the composting activities in Viet Nam.
(b) http://tietkiemnangluong.com.vn/tin-tuc/pho-bien-kien-thuc/t13304/biogas-o-viet-nam-trien-vong-trong-tam-tay.html.
(c) MOC/JICA (2014) Workshop on Integrated Solid Waste Management in Viet Nam.

Source: prepared by IGES based on the data and information from Country Chapters and additional inputs by the Author

The table describes the existing waste management and the 3R related technologies/practices in the waste management system of Asia Pacific countries, based on the Country Chapters and expert assessment. Upper cells are marked as "✓" for "active" treatment options (BLANK means "inactive"), while lower cells provide the percentage of the generated (or collected) waste being treated by the treatment option and/or any relevant information where such data is available.
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Note 1: Collection service provided under municipal responsibility. Note 2: Includes range of market-based processes from collection to processing/treatment by informal sector.
Note 3: Marked "✓"if practice/technology is observed but the specific technology type(s) is unknown.

3.1.4. Existence of Policies, Guidelines, and Regulations Based on the Principle of Extended Producer Responsibility (EPR) (Indicator VIII)

Extended Producer Responsibility (EPR) is considered as one of major policy approaches to promote take-back and recycling of end-of-life products that are usually considered difficult to be treated and managed by municipalities, including used plastic and paper containers, electronic wastes and batteries. The Organization for Economic Cooperation and Development (OECD) defines EPR as "an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle". Practically, this promotes a shift in financial and physical responsibility to collect, take-back and treat (including recycling) used products from public entities such as municipalities to the original producers of such products. Since the launch of "Extended Producer Responsibility: A Guidance Manual for Governments" in 2001 (OECD 2001), EPR has been widely applied and implemented in recycling policy development both in OECD and non-OECD countries. In 2016, OECD launched an updated guidance (OECD 2016) to support its expanded application in developing countries.

The Ha Noi 3R Declaration also identifies EPR as one of policy developments to be promoted in the region. Goal 15 of Ha Noi 3R Declaration emphasizes that "Progressive implementation of 'extended producer responsibility' by encouraging producers, importers and retailers and other stakeholders to fulfill their responsibilities for collecting, recycling and disposal of new and emerging waste streams, in particular e-waste".

Combining various instruments, EPR-based legislation aims at achieving at least one of the following three distinct objectives:

1) Improved waste management and resource recovery: To establish effective collection of end-of-life (EoL) products from consumers, promote environmentally sound treatment and efficient recycling, and reduce the amount of wastes from landfills.
2) Changing allocations of cost for waste management and recycling: To reduce financial and physical burdens of waste management on the public sector, necessary costs for recycling are collected and utilized from various stakeholders related to waste generation in certain product categories.
3) Design for the environment: To provide economic incentives for producers to make design changes towards easier recycling.

3.1.4.1. Expanded application in developing economies

One of the recent prominent developments in the region is increasing adoption of EPR principles to waste management policies, especially those on e-waste management and packaging waste management (*Table 3-6*).

In the state of the 3Rs in Asia and the Pacific project, we have reviewed the status of EPR implementation in 11 countries (Bangladesh, Cambodia, China, Japan, India, Indonesia, Malaysia, The Philippines, Singapore, Thailand and Viet Nam) and a sub-region (Pacific Island Countries).

Among the selected 11 countries and one sub-region, Japan leads the implementation of EPR-based policy in the region. Emerging economies such as China, Malaysia and Indonesia have started to incorporate EPR principles in their basic waste management policy. In addition, China and India have already started to implement EPR-based take-back scheme of end-of-life products such as e-waste. For example, China introduced the Rules on the Administration of the Recovery and Disposal of Discarded Electronics and Electrical Products (promulgated in 2009, effective in 2011). India introduced e-waste management and Handling Rules (promulgated in 2010, effective in 2012 and revised in 2016). Viet Nam is at the beginning of implementation, passing the Decision titled 50/2013/QD-TTg (later replaced by Decision 16/2015/QD-TTg) that targets the recovery and treatment of discarded products including batteries, electronics, lubricant oils and end-of-life vehicles. Thailand has a WEEE policy as a part of National Integrated Strategies approved by the cabinet on 24 July 2007. EPR mechanisms in general and the proposed buy-back system financed by product fee have a strong potential to consolidate WEEE collection for the formal recycling with monetary incentive for the end user. In 2017, the draft WEEE Act is in the consideration process under the council of state before enactment and promulgation. Malaysia has specific articles on take-back and deposit refund in Solid Waste Management and Public Waste Management Act 2008. In 2012, Indonesia developed a specific regulation on EPR for packaging under its Solid Waste Management Act of 2008.

Table 3-6. *Status of implementation of EPR-based legislations and policies in the selected countries in Asia and the Pacific*

	Fully implemented	Postponement period before full implementation	Specific legislations are under preparation	Existence of provisions supporting EPR principle	Based on voluntary approach/ agreement
Bangladesh	National 3R Strategy 2010	--	--	Lead Acid Battery Recycling and Management Rules 2006	--
Cambodia	--	--	--	--	--
China	WEEE regulation (E. 2009, FI 2011) Recycling technology policy of automobile (E. 2006) Recycling method of scrap cement bag (E. 1989)			The 12th 5-year plan Law of prevention and control of environmental pollution caused by solid waste (E. 1995) Law of cleaner production promotion (E. 2003) The law of circular economy promotion (E. 2008)	

	Fully implemented	Postponement period before full implementation	Specific legislations are under preparation	Existence of provisions supporting EPR principle	Based on voluntary approach/ agreement
India	E-waste Management Rules (IT products and home appliances, E. 2011 revised in 2016) Guidelines for environmentally sound management of ELV, 2016 Battery rules 2001(lead acid batteries, E. 2010)	--	Specific legislations on environmentally sound management of ELVs are under preparation	E-waste Management Rules (IT products and home appliances, E. 2011 revised in 2016) Guidelines for environmentally sound management of ELV, 2016 Batteries (Management and Handling) Amendment Rules, 2010 (lead acid batteries, E. 2010).	--
Japan	Law for promotion of effective utilization of resources (Revised 2000, FI. 2001) Container and packaging recycling act (E.1995. FI. 2000) Home appliance recycling act (E. 1998, FI. 2001) End-of-life vehicles recycling act (E. 2000, FI. 2005)	--	--	Basic Act for Establishing Sound Material Cycle Society	voluntary take-back under Law for promotion of effective utilization of resources
Indonesia	--	GP101/2014 (Packaging) under Law 18/2008	Governmental regulation (e-waste) under Law 39/2009	Law on Rubbish Management (Law No. 18, 2008) "Article 15. Producers shall mange the produced package and/or products which could not decompose or difficult to decompose by natural process."	--

	Fully implemented	Postponement period before full implementation	Specific legislations are under preparation	Existence of provisions supporting EPR principle	Based on voluntary approach/ agreement
Malaysia	-- .	--	DOE and JICA has initiated another TC project from August 2015 through January 2018 to develop nationwide regulatory framework and the mechanism to channelize the household e-waste to the formal collection and recycling.	Environmental Quality Act (1974), Solid Waste and Public Cleansing Act (2007), Master Plan of National Waste Minimization (2006), 10th Malaysian Plan (2011)	National Strategic Plan for Solid Waste Management (2002)
The Philippines	-- .	--	The guidelines on the Environmentally Sound Management (ESM) of Waste Electrical and Electronic Equipment (WEEE)	--	Philippine Energy Efficiency Project (2009-2013) Lighting Industry Waste Management Guidelines (2013)
Singapore	--	--	--	--	Singapore Packaging Agreement (2007)

	Fully implemented	Postponement period before full implementation	Specific legislations are under preparation	Existence of provisions supporting EPR principle	Based on voluntary approach/ agreement
Thailand	--	--	The draft act on the management of WEEE and other end-of-life products approved by cabinet on 19 May 2015 and on process of enactment and promulgation The draft Royal decree on product fees from used products e.g. electronic waste under draft Act on Economic Instruments for Environmental Management	The national integrated strategic 5 years plan (2014-2021) on management of WEEE approved by cabinet on 17 March 2015	WEEE Can Do campaign (2011-2012)
Viet Nam	--	16/2015/QD-TTg (batteries, electronics, lubricant oils and end-of-life vehicles)	Guiding circular is being developed	Law on Environmental Protection 2014	--
Pacific Island Countries	Container deposit legislation (Kiribati, FSM, New Caledonia, and Palau)	--	--	--	Informal agreement with a brewery/ bottling company.

E: Enactment year. FI: Fully implemented year
--.: Either policy does not exist or not under preparation as of September 2016
Note— voluntary approach/agreement shown in this table is not an exhaustive list

Source: prepared by IGES based on the data and information of Country Chapters, State of the 3Rs in Asia and the Pacific

Before the introduction of EPR-based legislations for take back and treatment of end-of-life products, some pilot projects are often implemented as collaborative voluntary initiatives between national government and the private sector, including for selected household or office hazardous items such as fluorescent lamps (The Philippines and Thailand) or batteries (Thailand). Some countries in the Pacific Island Region have implemented deposit and refund schemes applied to used packaging and containers such as beverage cans and bottles.

Although they have guidelines for proper handling of difficult-to-treat wastes such as e-waste, Least Developed Countries are generally not at a stage where EPR principles can be introduced

to waste management policies for compulsory take back and recycling. This may be related to the existence of producers in the countries.

3.1.4.2. Key issues for adopting EPR-based Policy

Some of key issues associated with EPR adoption in emerging countries are:

1) Interpretation of EPR: The purpose of introducing EPR varies by country. For example, EPR can be interpreted as a voluntary environmental management initiative or voluntary recycling and take-back activity similar in concept to Corporate Social Responsibility as seen in the case of Singapore Packaging Agreement.

2) Difficulty of identifying producers: When non-brand, counterfeit, secondhand or repaired products are common in the market, it is often very difficult to identify who are the producers in the context of EPR.

3) Infeasibility of take-back scheme: Some products preclude the use of the physical responsibility take-back scheme due to the transportation distance between country of origin and sale as seen in the case of Pacific Island Countries.

4) Competition with the informal waste management sector: The informal recycling sector has low operating costs and can therefore offer higher cash payments for end-of-life products compared to formal government-approved recycling businesses. Thus, OECD updated guidance in 2016 recommends collaboration with informal sector especially in the stage of collection and sorting.

5) Infrastructure for waste collection and treatment: Many cities have no established collection system for recyclables and are purely market-based. This means recyclables are recycled under market mechanisms, which is not problematic except that the existing infrastructure for recycling is often small-scale and unsafe for workers and the environment. Thus, once EPR-based recycling mechanisms are up and running, substantial investments in physical infrastructure as well as human and institutional capacity for collection and treatment will be needed.

6) Import and export of recyclables: Policy intervention in the collection of recyclables would release a huge amount of recyclables on to the market. In combination with strong demands for resources outside the country, this would lead to an economic driver for export of recyclables for those introduced under EPR-based legislation.

3.1.4.3. Lessons from EPR application into recycling policies and way forward

EPR is not a single policy instrument rather it is an important approach to package different policy strategies and instruments to promote collection, recycling and proper treatment of end-of-life products.

Among the most significant guidance for EPR application and effective recycling policy is the crucial need to set discrete policy objectives and strategy for EPR introduction and its follow-up. This corresponds with the longstanding OECD guidance, provided both in 2001 and 2016.

Another important aspect is to identify and collaborate with relevant stakeholders including producers (manufactures and importers), relevant central ministries and agencies, local governments, consumer groups and recycling industries including informal sectors. At the same time, this is not an easy task, since there are often a lack of relevant stakeholders and organizations such as industrial and business associations. Involvement of stakeholders from the policy making stage through to the follow-up and review stage would encourage clear ownership of the policy among stakeholders, thereby enhancing the efficiency of policy implementation.

The effective implementation of an EPR scheme requires a core group of industrial sectors and business enterprises that should be identified and nurtured to promote more sound recycling practices, especially within the conventional informal recycling sector. The creation of a strong industrial base for recycling can effectively encourage the production of easy-to-recycle products and the construction of new, more resource-efficient business models. Promotion of design for the environment together with innovative business models are efforts that can specifically be undertaken by developed economies.

Establishing a proper market for recycled materials should be considered along with collection and treatment of end-of-life products. Otherwise, the country may encounter certain market distortions, such as the outflow of recyclables or end-of-life products to other countries which make use of environmentally unsound, low cost recycling practices.

Accordingly, important keys for successful implementation of 3R policies include evaluating areas of intervention for developing governmental capacity, establishing recycling infrastructure, and shaping a stable recycling economy in collaboration with stakeholders. This would necessitate investing considerable time and resources to develop the requisite institutional capacity, mechanisms and infrastructure as well as influencing stakeholder attitudes and markets for full-scale implementation of EPR. Priorities should therefore be identified and sequenced for each scenario, with a view towards guiding policy development at the local and national levels and facilitating more effectively stakeholder collaboration. Thus, as Akenji, et al. (2011) discusses, in order to encourage the transition to a circular economy, a phased approach should be introduced at different levels of development.

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3.2. Trends of Waste Streams of Key Concern

3.2.1. Indicators for 3Rs in Municipal Solid Waste (Indicator I/II)

The quantitative indicators selected for 3Rs in MSW are (i) total MSW generation and MSW generation per capita, and (ii) overall recycling rate and target (%).

The use of total MSW generation and MSW generation per capita indicators would enhance governmental decision-making capacity in MSW management (Kawai and Tasaki 2013). On the other hand, MSW generation and MSW generation per capita refer to indicators of environmental pressures humankind exerts on the environment (OECD 2003), and by extension, environmental pressures caused by the use of natural resources.

The total MSW generation can help identify the required capacity of waste management facilities and personnel, and aid in designing countermeasures. On the other hand, MSW generation per capita represents the intensity of waste generation and can be used to assess progress in waste prevention activities and shifts in consumption patterns towards resource efficiency, and also can be used to make projections of total MSW generation in the future.

The recycling rate is one of the representative and most widely used indicators for monitoring progress in resource-saving and waste recycling, as well as 3R policy performance, and thus many governments have incorporated it into national targets.

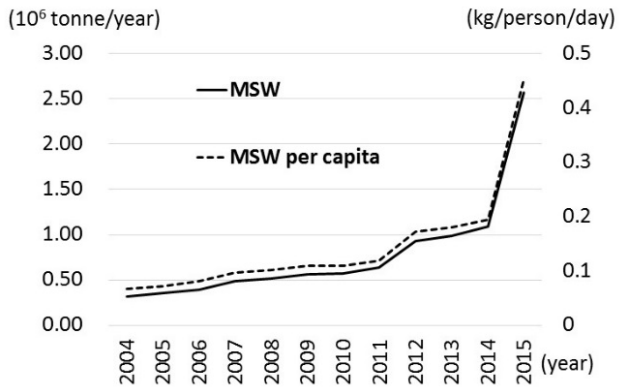
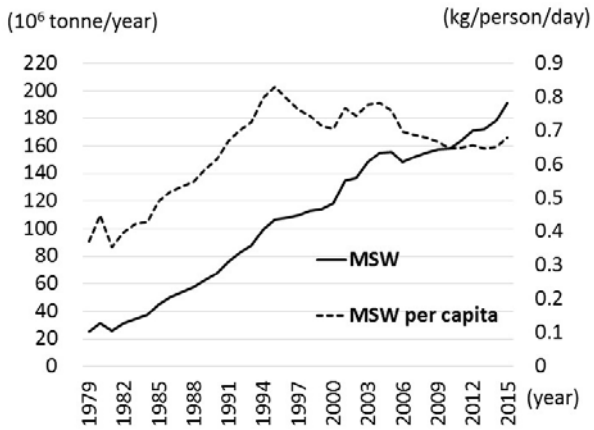
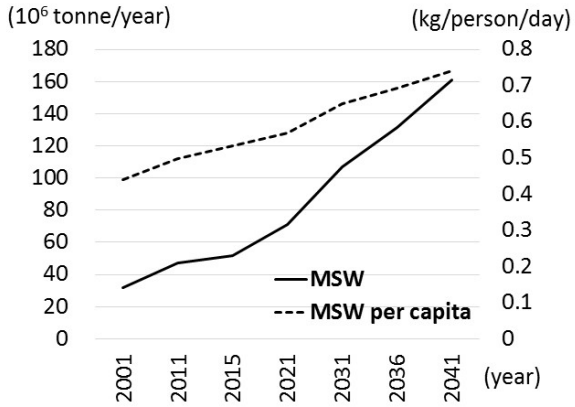
The recycling rate and target are often presented as a proportional value (%) and this reflects the proportion of materials recycled or recovered from waste or the ratio of inclusion of recycled materials in products. High figures usually imply progress in recycling activities. However, many countries define and calculate the recycling rate in many different ways according to the different policy needs, such as recovery rate, collection rate, diversion rate and cyclic use rate. Disparities in defining the recycling rate are even more pronounced in the Asia Pacific region. This is mainly because of the prevalent presence of informal recycling sector, which often go unrecorded.

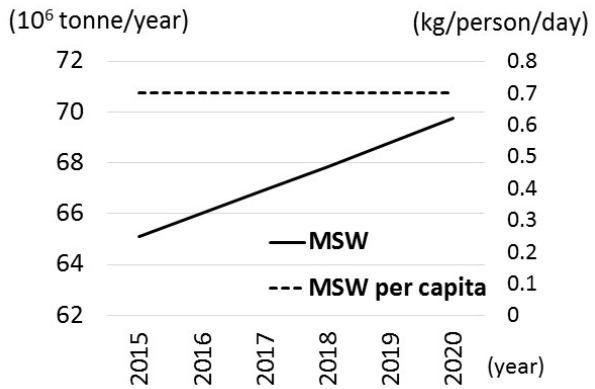
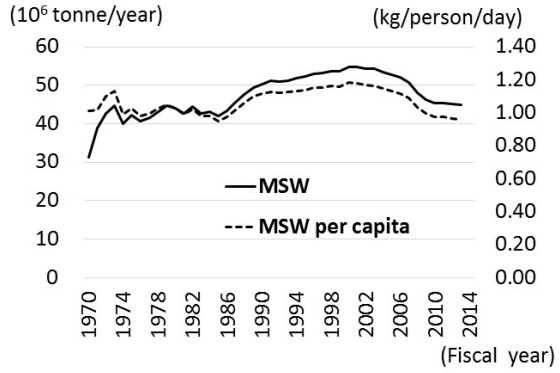
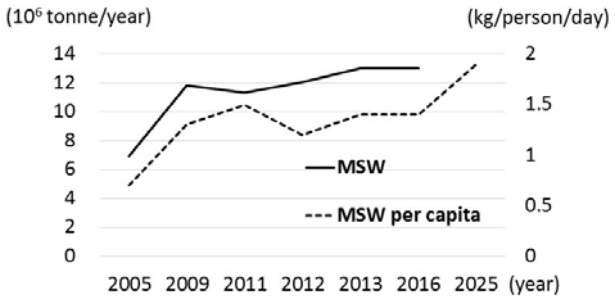
The policy goals related to these indicators are to achieve, via policies and measures, waste minimization before final disposal (such as incineration and landfill) as well as reducing amounts of virgin materials used through the increasing usage of recyclables (e.g., plastic, paper, metal). This is usually achieved via financial mechanisms and institutional frameworks involving relevant stakeholders.

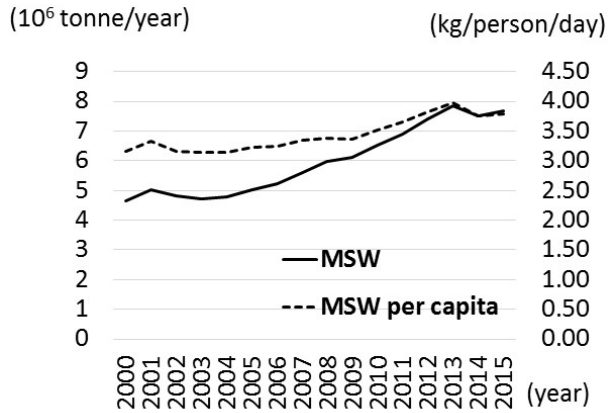
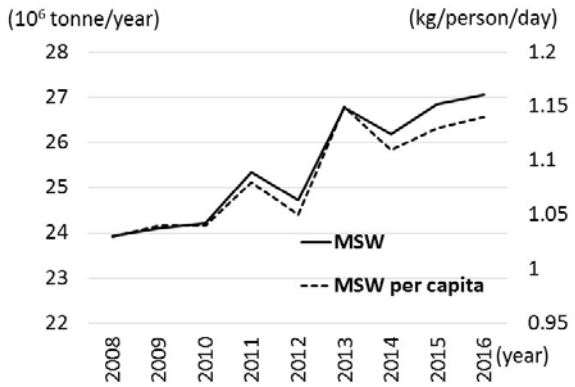
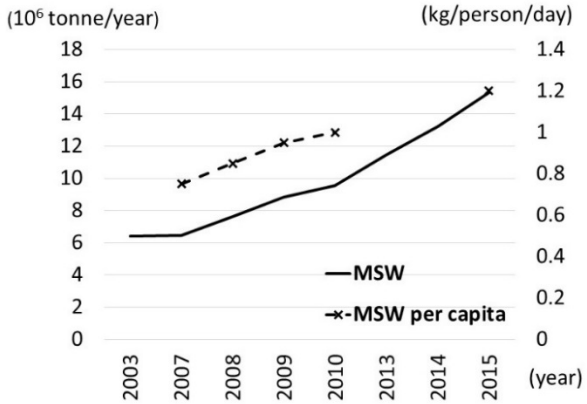
3.2.1.1. Total MSW Generation and MSW Generation per Capita in the Representative Countries

Following OECD's definition of municipal waste as waste collected and treated by or for municipalities, *Table 3-7* shows the total MSW generation and MSW generation per capita based on each countries' published data. Total MSW generation in five-year increments from 2000 to 2015 and percentage increase or decrease within the time frame are summarized in *Figure 3-2*, and total MSW per capita per day values are presented as well in *Figure 3-3*.

Table 3-7. *Total MSW generation and MSW generation per capita*

Country	Trend	Notes
Bangladesh	Approximately 4.86 million tons are generated annually in urban Bangladesh. It is projected that this amount will grow by 47,000 tons/day and will reach close to 17.2 million tons per year by 2025. Per capita waste generation amount for urban area is 0.41 kg/per/day and for Dhaka city it is 0.56 kg/per/day (GoB, 2010).	
Cambodia		Amount of waste collected and transported to landfill and dump sites. Source: Ministry of Environment, Cambodia. MSW per capita is divided MSW by total population.
China		Collected/transported waste by municipality. Weighted data at waste transfer center. Not include recyclable goods (paper, cans, etc). MSW per capita is divided by urban population (However the waste collection service expanded from urban area to rural area since 2000). Source: Statistical yearbook.
India		Available data of waste generated (2001, 2011 and 2015) and the predicted data (2015-), Source: CPCB report.

Country	Trend	Notes
Indonesia		The availability of data is currently limited. For the purpose of setting-up the policy and strategy of MSW management, the MEF assumed that the average generation rate of MSW was 0.7 kg/capita/day (constant), and yearly population increasing rate was 1.4%.
Japan		Includes all waste except industrial waste. Survey data at source. Total population. Source: MOEJ statistics.
Malaysia		All waste except for scheduled waste. Total population. The data is a combination of real time data collected at source and also data estimated. *The data source of 2025: Agamuthu & Tanaka (2014)
The Philippines	With the increasing population particularly in the urban areas, the amount of solid waste generated per day also increases. The waste generation per person is 0.70kg/day in highly urban city, 0.60kg/day in urban city and 0.30 kg/day in rural areas.	Aguinaldo 2010

Country	Trend	Notes
Singapore		Data of waste generation. IW is included in MSW. Total population. Source: NEA website.
Thailand		Municipal solid wastes generation from Survey data at source. Total population data from National Statistical Office Source: PCD, MONRE; Thailand State of Pollution Report 2016, published in 2017. *(http://infofile.pcd.go.th/waste/wsthaz_annual59.pdf?CFID=2563806&CFTOKEN=77342514)*
Viet Nam		MSW Source: MONRE, 2011 ; Tien N.H., 2014 ; Wada H., 2016
Palau	Annual Waste Generation: 7,244 tonnes in 2000 8,104 tonnes in 2005 8,969 tonnes in 2010 9,939 tonnes in 2015 11,019 tonnes in 2020 12,251 tonnes in 2025	Report on Integrated Solid Waste Management Plan, October 1999, Golder Associates *Data & Information from the Author, Pacific Island Countries, SPREP

Source: prepared by IGES based on the data and information of Country Chapters, State of the 3Rs in Asia and the Pacific

Country	Total amount of MSW (generated/ collected/ disposed of; x 10^6 tonnes/year)				Trend of MSW (% increase or decrease)		
	2000	2005	2010	2015 (or nearest year)	2000-2005	2006-2010	2011-2015
Bangladesh[a]		4.85	6.97	8.65		↑ 44	↑ 24
Cambodia		0.35	0.57	2.57		↑ 63	↑ 351
China	118.19	155.17	158.12	191.42	↑ 31	↑ 2	↑ 21
India	31.63		47.30	51.50	↑ 50		↑ 9
Indonesia		38.50		65.09		↑ 69	
Japan	54.83	52.72	45.36	44.87 (2013)	↓ -4	↓ -14	↓ -1
Malaysia		6.94	11.30	13.00 (2013)		↑ 63	↑ 15
The Philippines[b]			13.66 (2012)	14.63 (2016)		↑ 7	
Singapore	2.80	5.02	6.52	7.67	↑ 79	↑ 30	↑ 18
Thailand			24.22	26.19 (2014)			↑ 8
Vietnam			9.57	15.33			↑ 60
Palau[c] (Pacific Island Countries)	0.0072	0.0081	0.0089	0.0099	↑ 13	↑ 10	↑ 11

Note: The reported value beside the trend of MSW, represented by block arrows in the last three columns, indicate the change in MSW generation (% increase or decrease) for the period.

a. *Annual amount of MSW is estimated by multiplying daily MSW in the appropriate year (Country Chapter, Bangladesh, with data of Waste Concern) with 365 days.*
b. *Annual amount of MSW is estimated by multiplying daily MSW in the appropriate year (Country Chapter, The Philippines, with the data of MSWMC) with 365 days.*
c. *Annual amount of MSW is estimated by multiplying daily MSW in the appropriate year (Using an example of Palau, with the data of SPREP) with 365 days.*

Source: prepared by IGES based on the data and information of Country Chapters, State of the 3Rs in Asia and the Pacific

Figure 3-2. *Trend of the indicator of the total MSW generation during 2000 and 2015*

Country	Total amount of MSW per capita (generated/ collected/ disposed of; kg/capita/day) 2000	2005	2010	2015 (or nearest year)	Trend of MSW per capita (% increase or decrease) 2000-2005	2006-2010	2011-2015
Bangladesh		0.41	0.47	0.56		↑ 15	↑ 19
Cambodia		0.07	0.11	0.19		↑ 57	↑ 73
China	0.71	0.76	0.65	0.68	↑ 7	↓ -14	↑ 5
India	0.44 (2001)		0.50 (2011)	0.53	↑ 14		↑ 6
Indonesia				0.70			
Japan	1.19	1.13	0.98	0.96 (2013)	↓ -5	↓ -13	↓ -2
Malaysia		0.7	1.5	1.4		↑ 114	↓ -7
The Philippines							
Singapore	3.16	3.22	3.52	3.8	↑ 2	↑ 9	↑ 8
Thailand			1.04	1.11 (2014)		↑ 7	
Vietnam		0.75 (2007)	1	1.6		↑ 33	↑ 60
Palau							

Note: The reported value beside the trend of MSW/capita, represented by block arrows 2 in the last three 3 columns, indicate the change in MSW/capita (% increase or decrease) for the period.

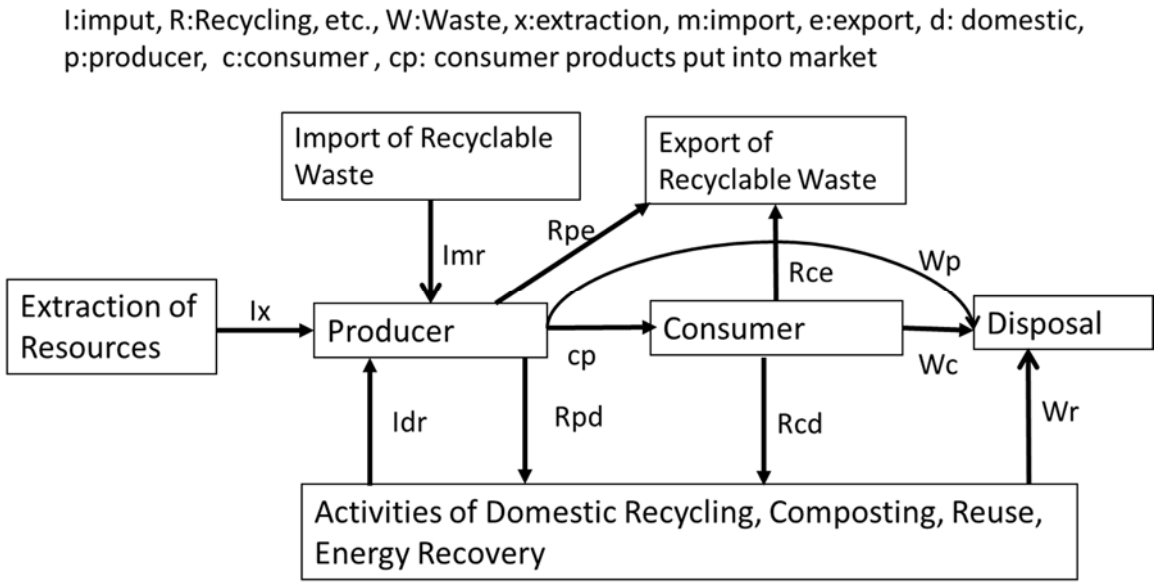
Source: prepared by IGES based on the data and information of Country Chapters, State of the 3Rs in Asia and the Pacific

Figure 3-3. *Trend of the indicator of the total MSW generation per capita during 2000 and 2015*

3.2.1.2. Overall Recycling Rate and Target (%) in the representative countries

Based on the life cycle of materials and products, the definition of recycling rate and target may differ quite extensively according to the policy goals that have been set. The different types of recycling rate can be labeled as (*Figure 3-4*):

- Recycling rate emphasizing the input side: cyclical use rate or ratio of recycled materials used in a certain product;
- Recycling rate emphasizing resource recovery: ratio of materials recycled or recovered from end-of-life or waste products (recovery rate);
- Recycling rate emphasizing proper collection: ratio of collected materials for recycling purpose (collection rate), and
- Recycling rate or percentage of a potentially recyclable material that has been diverted out of the waste disposal stream and therefore not entering landfills (waste diversion rate).



Source: Hotta, Visvanathan and Kojima 2016

Figure 3-4. *Material flow and recycling targets*

$$Cyclical\ Use\ Rate = \frac{Idr + Imr}{Ix + Imr + Idr}$$

$$Recovery\ rate = \frac{Idr}{Rpd + Rcd}$$

$$Collection\ rate = \frac{Rcd}{cp}$$

$$Waste\ Diversion\ Rate\ in\ post-consumer\ stage = \frac{Rce + Rcd}{Rce + Rcd + Wc}$$

Such diverse definitions and lack of standardized measurements for the recycling rate often require careful treating of the recycling rate value to avoid incorrect or confusing comparison and interpretation. Current situation of recycling rates and targets in representative countries is summarized in *Table 3-8*.

Table 3-8. *Current situation of recycling rates*

Country	Recycling rate in common	Definition	Past		Future target for 2020
			2000	2015	
Bangladesh	*Recycling rate*	(Recovered MSW for reuse and recycling) / (Total amount of MSW generation)	4% (2005)	12%	15%
Cambodia	*Recycling rate*	(MSW reuse and recycling) / (Total amount of MSW generation)	10% (estimated)	15% (estimated)	60 %
China	*Recycling rate*	N.A.	N.A.	N.A.	N.A.
	Industrial Solid Waste (ISW) Compre-hensively Utilization rate	(ISW comprehensively utilized amount) / (Total amount of ISW generation + Stock in the previous year)	45.9%	62.8% (2013)	73%
India	*MSW Recycling rate*	(MSW reuse and recycling) / (Total amount of MSW generation)	12.45% in 2010	27 %	N.A.
	Industrial Hazardous Waste Recycling rate	(*Hazardous Waste* reuse, recycling & incineration) / (Total amount of *Hazardous Waste* generation)	19.73 %	44.94 %	N.A.
Indonesia	*Recycling rate*	(MSW reuse and recycling) / (Total amount of MSW generation)	N.A.	10% (estimated)	30% (Based on President Regulation No. 97/2017)
Japan	*Recycling rate*	(Direct recycling amount + Recycling amount after intermediate processing + Group collection amount) / (Total amount of processing waste + Group collection amount)	14.3%	20.6% (2013)	27%
	Cyclical use rate	Amount of cyclical use (i.e. reuse and recycling) / (Amount of cyclical use + natural resources input)	10%	14-15%	17%
Malaysia	*Recycling rate*	Collecting and separating solid waste for the purpose of producing products	5%	12.5%	22%
The Philippines	*Recycling rate*	The amount of waste materials that were processed for beneficial use or transformed into new products or used as raw materials for the production of other goods.	28% (2006, in Metro Manila) (Aguinaldo, 2009 as cited in Atienza, 2012)	31% (2009, in Metro Manila) (Aguinaldo, 2009 as cited in Atienza, 2012)	N.A.

Country	Recycling rate in common	Definition	Past		Future target for 2020
			2000	2015	
The Philippines	*Diversion rate*	The amount of waste diverted from waste disposal facilities through re-use, recycling and composting activities and other resource recovery activities. Each LGU plan shall include an implementation schedule which shows that within five (5) years after the effectivity of this Act; the LGU shall divert at least 25% of all solid waste from waste disposal facilities through re-use, recycling, and composting activities and other resource recovery activities: Provided, That the waste diversion goals shall be increased every three (3) years thereafter (Section 20, RA 9003).	25% (target as cited from RA 9003) 22.22% (in Metro Manila) (MMDA, 2011)	32.46% (in Metro Manila) (MMDA, 2011)	50% SW diversion rate target for 2016, as cited in the Philippine Development Plan 2011-2016 (NEDA, 2014)
Singapore	*Recycling rate*	Total Waste Recycled / (Total Waste Disposed + Total Waste Recycled)	40%	61%	65% (70% by 2030)
Thailand	*Recycling rate*	(Annual total waste utilized amount) / (Annual total waste generation)	19.55% (2003)	25.79% (2010)	30% (2016)
Viet Nam	*Recycling rate*	(Collected recyclable waste for recycling from MSW) / (Total amount of collected MSW)	N.A.	8–15%	85%
	Recovery rate (for paper, plastics, metal)	(Waste amount, which had been recycled) / (Total amount of collected recyclable waste)	N.A.	90%	N.A.
Pacific Island Countries	*Recycling rate*	Total amount of Recycled Waste Materials (RWM[*5]) / Total amount of Recyclable Waste Goods (RWG[*6])	N.A.	47 (2014)	60 (2020) 75 (2025)
	Recycling rate	Amount reused, recycled, returned / Amount recyclable			

Source: prepared by IGES based on the data and information of Country Chapters, State of the 3Rs in Asia and the Pacific

3.2.1.3. General Assessment

Between 2011 and 2015, total MSW generation and MSW per capita increased in most countries, with the exception of Japan, which has been on a downward trend since 2000. Considering that many of these countries are at a developing stage and that middle-income consumers are increasing as well, consumption is bound to grow along with waste generation.

Such data highlights the need for proactive measures, specifically in the "Reduce" part of the waste hierarchy and also the need to strengthen strategies for resource efficient consumption. In contrast, recycling rates in the region significantly improved from 2000 to 2015. This is a promising development in Asia and the Pacific, suggesting that 3R-related efforts focused on waste management are being successfully implemented by a number of countries. It should be noted, however, that recycling activities in many countries are still widely conducted by the informal sector with unsound technologies.

The time-series data presented in *Table 3-7* is useful to observe trends in MSW and MSW per capita in the Asia Pacific region. However, it should be noted that country comparisons may warrant caution as definitions of MSW differ among countries, and hence, irregularities in the reported amount based on the inclusions and exclusions on how MSW is defined nationally. The amount of MSW per capita varies widely from 0.5 kg/capita/day in Cambodia to 3.8 kg/capita/day in Singapore in 2015 (*Table 3-7*) not only due to the different social and economic conditions found in these countries, but because of how the volume of waste generation is calculated between them. Officially published data from Cambodia comprises estimates of final waste disposal volumes reported from landfill sites. In the case of Singapore, both MSW and industrial waste is included in general waste generation figures.

At the same time, it appears that some countries have also set overly ambitious targets for recycling, such as Cambodia (12% in 2015 to 60% in 2020) and Viet Nam (8-15% in 2015 to 85% in 2020). This may be a result of a lack of waste management data that is crucial for evidence-based policymaking.

Future efforts to carry out sustainable MSW management would thus be greatly enhanced by understanding material flows via the development of indicators such as waste generation rate at source, waste collection and recycling rates, as well as waste disposal volumes.

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3.2.2. Hazardous Waste Generated and Disposed of in Environmentally Sound Manner (Indicator III)

Based on (Kojima and Agamuthu 2013), the basic qualitative indicator Hazardous Waste refers to the existence of regulations controlling hazardous waste. The presence of regulations themselves should also promote environmentally sound management of hazardous waste. Amounts and rates of generation of hazardous waste are the main quantitative indicators. To assess a country's hazardous waste treatment and disposal capacity, imports and exports of hazardous waste should be taken into account. Many Asian countries have ratified the Basel Convention and compile the required data for submission to the Convention Secretariat every year. Such data covers information on hazardous waste regulations, existing facilities, generation and import and export.

With regard to disposal, it is preferable to dispose non-recyclable hazardous waste at the location of its generation. However, in the absence of appropriate domestic treatment or disposal facilities, it should be exported to an environmentally sound facility through the 'prior notice and consent' procedure. Environmentally sound management is also a prerequisite for the export of recyclable hazardous waste[8]. Considering economies of scale of certain recycling technologies, potential for pollution prevention of these technologies and the fragmentation of associated production processes, resource efficiency may be improved through the establishment regional recycling centers.

3.2.2.1. Hazardous Waste Regulations

The first step towards managing hazardous waste in a given country is to develop national regulations governing waste generation, storage, transport, treatment and final disposal. A review of the status of policy and implementation *(Table 3-9*) revealed wide gaps among Asia Pacific countries.
Table 3-10 provides a summary of the main regulations concerning hazardous waste management and the definition of hazardous waste across the region, based on the provided Country Chapters, State of the 3Rs in Asia and the Pacific. As indicated, Japan, China, Malaysia, Thailand, Singapore and The Philippines have fully implemented their respective regulations. China and Malaysia reported a recycling rate of 54% and 95%, respectively. Indonesia maintains regulation on hazardous waste management, but lacks the necessary data to ensure its effective execution. Viet Nam and Bangladesh are observed to have directly followed the model set by guidelines in the Basel Convention. India has a robust control on hazardous waste management and implemented the control on hazardous chemical and wastes through the Factory Act 1948 and subsequently focused control on hazardous waste through Hazardous Wastes (Management) Rules, 2008; these were subsequently revised as Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and Bio-medical Waste (Management & Handling) Rules 2016.

[8] "Guidance Document on the Preparation of Technical Guidelines for the Environmentally Sound Management of Wastes Subject to the Basel Convention" (1994) stated that the Self-sufficiency Principle, the Proximity Principle and the Least Transboundary Movement Principle should be considered in relationship and balance. In addition, it states "it should also be recognized that considerations for disposal may be different from those for recovery, which, if soundly managed, can provide environmental and economic benefits and should be encouraged".

Table 3-9. *Status of hazardous waste management policy*

Regulation on hazardous waste management		Countries
Specific legislations fully implemented	Hazardous waste managed in the country including formulation of regulations governing hazardous waste generation, storage, transport, and treatment/disposal facilities.	Japan India China Malaysia Thailand Singapore The Philippines
Specific legislations partially implemented	Specific regulation formulated, hazardous waste managed but data are not well collected and manifest system not fully functioning.	Viet Nam, Indonesia Cambodia
No specific legislations	Model national legislation informed by the Basel Convention yet disposal and recycling facilities remain limited.	Bangladesh Pacific Island Countries

Note: All the countries are signatories of the Basel convention.

Source: prepared by IGES based on the data and information of Country Chapters, State of the 3Rs in Asia and the Pacific

Table 3-10. *Existence of regulations of hazardous waste management and the definition*

Country	Policy/ Regulations on hazardous waste management	Definition	Waste type					Existenc of Manife system
			Hazardous Industrial waste	Medical Waste	Asbestos	PCB	Others	
Bangladesh	Bio-Medical WMR 2008, ECA 1995, HW &SB R 2011, Lead Acid Battery Recycling & Management Rule 2006	Hazardous substance means the substance which by reason of its chemical or bio-chemical properties is such that its manufacture, storage, discharge or unregulated transportation can be responsible for the damage of environment. The country fact sheet also states "Hazardous substance" means a substance, the chemical or biochemical properties of which are such that its manufacture, storage, discharge or unregulated transportation can be harmful to the environment.	Yes (e.g. from textile, tannery, and pesticide sectors)	Yes	N.A.	N.A.	N.A.	No

Country	Policy/ Regulations on hazardous waste management	Definition	Waste type					Existence of Manifestos system	Management system of designated treatment/ disposal facilities		Recycling Rate (%)
			Hazardous Industrial waste	Medical Waste	Asbestos	PCB	Others		Situation	Capacity	
Cambodia	Solid Waste Management Sub-decree in Cambodia (established in 1999, Sub-decree No 36 ANRK.BK)	Hazardous waste refers to radioactivity substances, explosive substances, toxic substances, inflammable substances, pathogenic substances, irritating substances, corrosive substances, oxidizing substances, or other chemical substances which may cause the danger to human (health) and animal or damage plants, public property and the environment. The hazardous waste may be generated from dwelling houses, industries, agricultural activities, business and service activities, mining, etc. The type of hazardous waste is listed here[9].	Yes	Yes	Yes	Yes	N.A.	No	Not so well developed	Medical waste from large city is basically incinerated.	N.A.

[9] 1. Fibrous and clothing wastes from textile and garment industry; 2. Paper waste from paper-mill industry; 3. Sludge waste from factory waste water treatment and product manufacturing processes; 4. Combustion residues from coal-fired power plants; 5.Plastics waste from production or use of plasticizers; 6. PCB waste from use of PCB contained in discarded air conditioners, TVs and microwaves; 7. Rubber waste from production or use of resins and latex; 8.Oil waste from oil refinery, use of lubrication oils, washing oils; 9.Acid waste; 10.Alkalis waste; 11. Metal waste and their compounds (Zn, Se, Sn, V, Cu, As, Ba, Co, Ni, Sb, Be, Te, Pb, Ti, U, Ag; 12. Soot and dust waste from incineration facilities, treating exhaust gas; 13.wastes from used or discarded electricity lamp; 14. Wastes from production or use of battery; 15. Wastes from production and use of paints, lacquers and pigments; 16. Wastes from production and use of inks and dyes; 17. Explosive wastes; 18. Infectious diseases wastes; 19.Agriculture drugs wastes; 20. Ask wastes from incinerators; 21. Wastes from expired products; 22. Wastes from production and use of film; 23. Waste from treatment of polluted soil; 24. Waste from production of drugs and medicines, and expired drugs; 25. Inorganic fluorine wastes; 26.Cyanide wastes; 27. Asbestos wastes; 28. Phenols wastes; 29.Ethers wastes; 30. Wastes from production and use of solvents; 31. Wastes from production and use of dioxin and furan; 32. Radioactive wastes; 33. Wastes produced as a result of treating above item 1-32.

Country	Policy/ Regulations on hazardous waste management	Definition	Waste type					Existence of Manifestos system	Management system of designated treatment/ disposal facilities		Recycling Rate (%)
			Hazardous Industrial waste	Medical Waste	Asbestos	PCB	Others		Situation	Capacity	
China	Prevention and Control of Environmental Pollution by Solid Wastes	Hazardous Waste usually refers to industrial hazardous waste generated as a by-product of the manufacturing process, medical waste, small-scale generation of hazardous waste from households, institutions and commercial establishments, and occasionally small amounts of radioactive waste, e.g. smoke detectors and medical process waste	Yes	Yes	Yes	Yes	49 categories of hazardous waste & 498 types of waste hazardous chemicals (National Hazardous Waste Catalogue)	Yes	Designated facilities are existed	Treatment Capacity: 23,250,000 tonne	54% (2013)
India	Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. Bio-medical Waste (Management & Handling) Rules 2016 The Batteries (Management and Handling) Rules, 2001 amended in 2010	Any waste which by reason of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances, and shall include- - wastes listed in column (3) of Schedule-1of the Rule - wastes having constituents listed in Schedule-2 of the Rule if their concentration is	Yes	Yes	Yes	Yes	18 categories of hazardous waste, 50 constituents listed shall be considered as hazardous, and 38 processes are listed generating hazardous wastes;	Yes	Designated facilities are existed but not enough capacity to meet the disposal of the hazardous waste	40 Common Hazardous Waste Treatment, Storage and Disposal Facilities (TSDFs) available in 17 States/UTs. About 1080 registered recyclers of hazardous waste; 47 cement plants permitted for co-processing; About 108 industries	N.A.

Country	Policy/ Regulations on hazardous waste management	Definition	Waste type					Existence of Manifestos system	Management system of designated treatment/ disposal facilities		Recycling Rate (%)
			Hazardous Industrial waste	Medical Waste	Asbestos	PCB	Others		Situation	Capacity	
		equal to or more than the limit indicated in the said Schedule; and - wastes listed in (Part-A) and Part-B of Schedule-3 of the Rule applicable only in case(s) of import or export of hazardous wastes if they possess any of the hazardous characteristics listed in Part C of Schedule 3 of the Rule								permitted for utilisation of hazardous waste. (http://pib.nic.in/newsite/PrintRelease.aspx?relid=138521). For the treatment of bio-medical waste, there are 226 common bio-medical treatment facility to providing 131,837 Health Care Facilities. Also there are 22,245 Health Care Facilities own on site treatment facilities.	
Indonesia	Law no. 32/2009 concerning Environment Protection and Management, regulates industrial and HW Note: radioactive waste is regulated by specific regulation	GR no. 101/2014 defines a waste to be hazardous under legislation if it meets one or more of the following conditions: - Exhibits characteristics such as being explosive, ignitable, reactive, toxic by Toxicity Leaching Characteristics Procedure (TCLP),	Yes	Yes	Yes	Yes	List-1 (64 items): halogenated-non halogenated solvent, acids-basics, POPs, PCBs, asbestos, waste from laboratories, spent CA, refrigerant	Yes, called "Dokumen Limbah B3"	Designated facilities are existed but in some provinces only. Small industries and informal sectors are not able to use these facilities due to transportation	(Until 2007) 491 HW treatment and recycling facilities Additional 225 HW utilization facilities for waste oils, fly and bottom ash, ashes from the metallurgical process,	N.A.

Country	Policy/ Regulations on hazardous waste management	Definition	Waste type					Existence of Manifestos system	Management system of designated treatment/ disposal facilities		Recycling Rate (%)
			Hazardous Industrial waste	Medical Waste	Asbestos	PCB	Others		Situation	Capacity	
		infectious, corrosive, and/or toxicity by Lethal Doses-50 (LD50) tests; - Is a non-specific source which includes generic wastes generated by a variety of general process; - Is a specific source which is generated from specific industrial process; and - Is a specific commercial chemical product or intermediate, discarded commercial chemical products, off-specification species, container residues, and spill residues.					and e-waste, etc. List-2 (376 items): used and out of spec chemicals List-3 (57 items): List of industries and its wastes List-4 (17 items): wastes that can be delisted by request		and treatment cost.	chemical wastes, sludge paper, etc. The first centralized HW treatment plant in Indonesia had been in operation since 1994 in Cileungsi - Bogor (West of Java Province). More than 90% of waste entering to this facility are dispose off in double-liner landfill. This facility was meant initially to accept all wastes categorized as hazardous from industries in the surroundings of Jakarta, Bogor, Tangerang and Bekasi. Since this facility is the only certified HW landfill in Indonesia, nearly all the	

Country	Policy/ Regulations on hazardous waste management	Definition	Waste type					Existence of Manifestos system	Management system of designated treatment/ disposal facilities		Recycling Rate (%)
			Hazardous Industrial waste	Medical Waste	Asbestos	PCB	Others		Situation	Capacity	
										HW generated by middle and large scale industries that are not recycled are transported to this facility.	
Japan	Waste Management and Public Cleaning Law; Law for the Control of Export, Import and Others of Specified Hazardous Wastes and other Wastes	Specially Controlled Waste are considered as hazardous waste. "Specially controlled municipal solid waste" refer to those municipal solid waste specified by a Cabinet Order as wastes which are explosive, toxic, infectious or of a nature otherwise harmful to human health or the living environment. These are (parts used in PCB, dust, ash, mud, and infectious municipal waste). Specially controlled industrial waste" refer to those industrial wastes specified by a Cabinet Order as wastes which are explosive, toxic, infectious or of a nature otherwise harmful to human health and the living environment. These are waste oil, waste acid, waste alkali, infectious	Yes	Yes	Yes	Yes	waste oil, waste acid, waste alkali, specified sewage sludge, slag, waste ash, dust, mud etc	Yes	Designated facilities are existed	N.A.	N.A.

Country	Policy/ Regulations on hazardous waste management	Definition	Waste type					Existence of Manifestos system	Management system of designated treatment/ disposal facilities		Recycling Rate (%)
			Hazardous Industrial waste	Medical Waste	Asbestos	PCB	Others		Situation	Capacity	
		industrial waste, waste PCB, PCB related things, specified sewage sludge, slag, waste asbestos, ash, dust, waste oil, mud etc.									
Malaysia	the environmental quality regulations 2005	Hazardous Waste is defined as any waste falling within the categories of waste listed in the First Schedule of the Environment Quality (Scheduled Wastes) Regulations 2005. They are a special group of wastes and could contain substances posing substantial danger or hazards to human, plant, or animals as well as the environment. The wastes are categorized as such due to their ignitability, corrosivity, reactivity, toxicity or infectivity. Usually clinical waste (causing infectivity) is categorized separately. Sometimes it could also be categorized as radioactive wastes, chemical wastes, biological wastes, flammable wastes and	Yes	Yes	Yes	Yes	N.A.	Yes Called "Consignment Note"	Designated facilities are existed	In 2012, total of 446 off-site recovery facilities have been licensed. The most issued licensed are for e-waste (153), oil/mineral sludge / spent coolant (58), heavy metal sludge / rubber (37), used container/contaminated waste/ink/paint/lacquer (34), solvent (31), and acid /alkaline (27)	95%

Country	Policy/ Regulations on hazardous waste management	Definition	Waste type					Existence of Manifestos system	Management system of designated treatment/ disposal facilities		Recycling Rate (%)
			Hazardous Industrial waste	Medical Waste	Asbestos	PCB	Others		Situation	Capacity	
		explosive wastes.									
Pacific Island Countries	An Asbestos-Free Pacific: A Regional Strategy and Action Plan 2011 (SPREP, 2011)	Hazardous waste is a waste with properties that make it dangerous, or capable of having a harmful effect on human health and the environment. These wastes require special measures in handling and disposal due to their hazardous properties (e.g. toxicity, ecotoxicity, carcinogenicity, infectiousness, flammability, chemical reactivity) and are generally not suitable for direct disposal in a landfill.	N.A.	N.A.	Yes	N.A.	N.A.	No	No	N.A.	N.A.
	Pacific e-waste: A Regional Strategy and Action Plan 2012 (SPREP, 2012)		N.A.	N.A.	N.A.	N.A.	e-waste	No	No	N.A.	
	Pacific Health Care Waste: A Regional Management Strategy and Action Plan 2013-2015 (SPREP, 2013)		N.A.	Yes	N.A.	N.A.	N.A.	N.A.	Designated facilities are existed		
The Philippines	RA 6969: Toxic substances and Hazardous and Nuclear Waste Act of 1990	Hazardous waste10 refer to solid waste or combination of solid waste which because of its quantity, concentration, or physical, chemical or infectious	Yes	N.A.	Yes	Yes	Toxic substances, hazardous and nuclear waste	Yes	Yes (Treatment, Storage, Disposal/ TSD Facilities)	Depends on the size of the TSDs	N.A.
	DAO No. 81 Series of 2000		N.A.	Yes	N.A.	N.A.	N.A.	Yes	No	N.A.	

[10] A: Waste with Cyanide, B: Acid Wastes, C: Alkali Wastes, D: Wastes with Inorganic Chemicals, E: Reactive Chemical Wastes, F: Inks/Dyes/Pigments/Paint/Latex/Adhesives/Organic Sludge, G: Waste Organic Solvent, H: Putrescible Organic Wastes, I: Oil, J: Containers. K: Immobilized Wastes, L: Organic Chemicals, M: Miscellaneous Wastes

Country	Policy/ Regulations on hazardous waste management	Definition	Waste type					Existence of Manifestos system	Management system of designated treatment/ disposal facilities		Recycling Rate (%)
			Hazardous Industrial waste	Medical Waste	Asbestos	PCB	Others		Situation	Capacity	
	DENR-DOH Joint Administrative Order No.2, Series of 2005	characteristics may: (1) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.	N.A.	Yes	N.A.	N.A.	N.A.	Yes	Designated facilities are existed	N.A.	
	DENR Administrative Order 2013-22		Yes	N.A.	Yes	Yes	e-waste	Yes	Designated facilities are existed	N.A.	
	DENR-DOE Administrative Order No. JAO 2013-09-0001		N.A.	N.A.	N.A.	N.A.	Lamp waste	Yes	Designated facilities are existed	N.A.	
Singapore	Environmental Public Health (Toxic Industrial Waste) Regulations	Toxic Industrial Waste is defined as industrial wastes which by their nature and quality may be potentially detrimental to human health and/or the environment and which require special management, treatment and disposal.	Yes	Yes	Yes	Yes	spent acids, spent solvents, spent etchants, waste oil and other waste sludge	Yes, E-tracking system	Designated facilities are existed	There are approximately 200 TIW collectors which are licensed to collect specific types of TIW. Of the 200 collectors, about 10 have a wide range of TIW treatment facilities	N.A.
Thailand	The Hazardous Substance Act B.E. 2535 (1992)	Hazardous Waste means waste that contains or is contaminated with	Yes	Yes (as Infectious waste)	Yes	Yes	-Radioactive waste -Laboratory	Yes[12]	Yes	40% of 1.8 MT 65%,	N.A.

[12] The Notification of the Ministry of Industry on Disposal of wastes or Hazardous Waste Definition by Thai Laws, Industrial HW unusable materials B.E. 2548 (2005), HW means. Wastes that contain or contaminate with hazardous materials or exhibit the hazardous characteristics including flammable, corrosive, reactive, toxic, or having the specified constituents.

Country	Policy/ Regulations on hazardous waste management	Definition	Waste type					Existence of Manifestos system	Management system of designated treatment/ disposal facilities		Recycling Rate (%)
			Hazardous Industrial waste	Medical Waste	Asbestos	PCB	Others		Situation	Capacity	
	HW National Policy and Plan11	hazardous substances or exhibits hazardous characteristics including being flammable, corrosive, reactive, toxic or having specified constituents e.g. explosive substance, flammable substance, oxidizing substance, peroxide substance, toxic substance, infectious substance, radioactive and genetic mutation causing substance, corrosive substance, irritating substance, and other chemical substance or substance of harm to human, plant, property, or environment.					waste -Community HW	The Notification from MOI	- HW: Proper managed disposal - Inf.Waste : Hospital Incinerator, LAO, private	28%, 7% of 0.02 MT	
Viet Nam	Law on Environmental Protection 2014 Circular	Hazardous Waste means a waste that contains any of toxic, radioactive, infectious,	Yes	Yes	Yes	Yes	N.A.	Yes on VEA (Viet Nam Environment	Designated facilities are in place with technologies	There are 83 licensed enterprises for hazardous waste	N.A.

[11] Hazardous Waste National Policy and Plan including 4 strategies:

1) Social Strategies: To promote participation between public sectors private sectors and public awareness to reduce waste and to increase the utilization of organic wastes and recyclable wastes
2) Economic Strategies: To promote the investment of private sectors in using clean technology for goods production, waste treatment and disposal management. In addition, taxation might be used (if necessary) as a tool for reducing wastes generated from production process
3) Legal Strategies: Establish laws and revise existing laws and regulations as well as emphasize on law enforcement in order to make various steps of waste management more effective
4) Supportive Strategies: To support the research and development of appropriate technology for producing environmental friendly products and products made from recycled materials

Country	Policy/ Regulations on hazardous waste management	Definition	Waste type					Existence of Manifestos system	Management system of designated treatment/ disposal facilities		Recycling Rate (%)
			Hazardous Industrial waste	Medical Waste	Asbestos	PCB	Others		Situation	Capacity	
	36/2015/TT-BTNMT on hazardous waste management Inter-ministerial circular 58/2015/BYT-BTNMT on management of medical solid waste management	flammable, explosive, corrosive, poisonous, and other hazardous characteristics (LEP 2014). Hazardous Waste are classified into 19 categories.						Administra-tion) website	of incineration, incineration with cement kiln, landfill, solidifying, oil recovery and etc.	treatment with capacity around 1,300,000 tons/year * (June 2015)	

Source: prepared by IGES based on the data and information of Country Chapters, State of the 3Rs in Asia and the Pacific

3.2.2.2. Hazardous Waste Generation and Disposal

While many countries in Asia and the Pacific have enacted regulations on hazardous waste management due to environmental pollution concerns, data availability in the region remains quite limited (*Table 3-11*). The Basel Convention, which has been ratified by most of Asian countries, defines hazardous waste as the category of wastes listed in Annex I of the Convention and exhibits one of the hazardous characteristics contained in Annex III such as possessing explosive, flammable, toxic or corrosive properties. Annex VIII also lists typical hazardous wastes. Because the Convention allows countries to formulate their individual definitions, the classification of hazardous waste varies and poses difficulties for comparison. At the same time, a clearly shared aim of all countries is the recognized importance of managing medical waste. In the case of Japan, addressing polychlorinated biphenyl (PCB) remains an issue.

Furthermore, comparing rates of hazardous waste disposal is not always a straightforward exercise as the generation of hazardous waste is sometimes also considered as the disposal amount. Appropriate data management is required for further improvement of this indicator by introducing a tracking/manifest system.

Table 3-11. *Amount of hazardous waste generation*

Country	Waste type	Data (year)	Reference
Bangladesh	Hazardous Industrial Waste (textile, hospital clinics, tannery, pesticides, fertilizer, oil refinery and paper and pulp)	(actual data in 2008) 109,470,000 m^3 (Wastewater) 113,000 tonne,(sludge) 26,884 tonne (solid waste) (estimation 2025) 2,472,470,000 m^3 (Wastewater) 2,810,000 tonne,(sludge) 53,874 tonne (solid waste)	Waste concern and ADB, 2008
	Medical Waste (infectious waste, sharp waste, recyclable waste, other)	2,720 kg (2008) 1,448 kg (2007) 426 kg (2006) 56kg (2005)	PRISM Bangladesh, 2009
Cambodia	Hazardous waste	11,000 m^3 (2011) 74,948 m^3 (2010)	DoPC (2011),
China	industrial waste generated as a by-product[13]	31,570,000 tonne (2013) 34,652,400 tonne (2012) 34,312,200 tonne (2011) 15,870,000 tonne (2010) 14,300,000 tonne (2009) 13,570,000 tonne (2008) 10,790,000 tonne (2007) 10,840,000 tonne (2006) 11,620,000 tonne (2005) 9,950,000 tonne (2004) 11,700,000 tonne (2003) 10,000,000 tonne (2002) 9,520,000 tonne (2001) 8,300,000 tonne (2000)	China Statistical Yearbook

[13] Industrial waste generated as a by-product of manufacturing process, medical waste, small-scale generation of hazardous waste from households, institutions and commercial establishment, and radioactive waste.

Country	Waste type	Data (year)	Reference
India	Hazardous Waste	7,467,000 tonne (2016) 6,232,507 tonne (2009) 7,243,750 tonne (2000)	CPCB Bulletin Vol.- I, July 2016, Govt. of India National Inventory of HW Generating Industries & HW Management in India, CPCB, 2009 Report of MoEF 2000
Indonesia	Hazardous Waste	65,970,612 tonne (2012) 50,000,000 tonne has been treated for three years after 2011	Press Release of Ministry of Environment (June 18, 2013), regarding the amount of hazardous waste treated
Japan	Specially controlled industrial waste	In total 2,261,000 (2012) 2,490,000 (2013) 2,821,000 (2014) Among them - waste oil : 468,000 tonne (2012) 413,000 tonne (2013) 410,000 tonne (2014) - waste acid : 467,000 tonne (2012) 533,000 tonne (2013) 606,000 tonne (2014) - waste alkali : 241,000 tonne (2012) 293,000 tonne (2013) 390,000 tonne (2014) - infectious industrial waste : 349,000 tonne (2012) 347,000 tonne (2013) 450,000 tonne (2014) - Specific hazardous industrial wastes[14] : 735,000 tonne (2012) 903,000 tonne (2013) 965,000 tonne (2014)	Data obtained from the Office of Sound Material Cycle Society, MoEJ
Malaysia	Heavy metal sludge, fly & bottom ash, gypsum, glue, petroleum, waste containing formaldehyde, discarded pharmaceutical product, ash of paper sludge, spent mixed oil	1,387,861 tonne (2013) 1,708,708 tonne (2012) 1,659,537 tonne (2011) 1,880,928 tonne (2010) 1,705,308 tonne (2009) 1,304,899 tonne (2008) 1,138,839 tonne (2007) 1,103,457 tonne (2006) 548,916 tonne (2005) 469,584 tonne (2004) 460,865 tonne (2003) 363,071 tonne (2002) 420,198 tonne (2001) 344,550 tonne (2000)	DOE Environment Report and Annual Report 2000 to 2012 ENVIRON Australia Pty Ltd, 2014

[14] Specific hazardous industrial wastes in the specially controlled industrial waste are segregated by contaminated substances such as polychlorinated biphenyl (PCB), trichloroethylene (TCE), heavy metals etc.

Country	Waste type	Data (year)	Reference
Malaysia	Clinical Waste	19,500 tonne (2013) 18,100 tonne (2012) 17,800 tonne (2011) 16,800 tonne (2010) 16,600 tonne (2009)	
Pacific Island Countries	Healthcare waste	Average generation rate 0.8 (kg/ occupied bed/day) in all Pacific islands Total estimation 76 tonne as stock piled in all Pacific islands	ENVIRON Australia Pty Ltd, 2014
	Asbestos as asbestos containing materials such as cement water pipes, corrugated roof sheets, floor tiles, wall claddings, and insulation (e.g. boiler insulation)	285,784 m^2 and 267 m^3 of asbestos containing materials based on the pac waste estimation	Contract Environmental Ltd, Geoscience, 2015
The Philippines	Hazardous waste[15]	1,712,505 tonne (2014) 8,976,959 tonne (2013) 780,523 tonne (2012) 4,979,340 tonne (2011) 1,346,506 tonne (2010)	Extracted from the Reports submitted by the EMB Regional Offices to DENR
Singapore	Toxic Industrial Waste (spent acids, spent solvents, spent etchants, waste oil and other waste sludge) Hazardous waste	1,136,240 m^3 (2014) 1,142,000 m^3 (2010)	NEA
Thailand	Industrial hazardous waste,	2,065,000 tonne (2014) 2,690,000 tonne (2013) 2,810,000 tonne (2012)	PCD, MONRE, 2015
	Municipal hazardous waste	567,000 tonne (2014) 560,000 tonne (2013) 710,000 tonne (2012)	PCD, MONRE, 2015
	Infectious waste	52,000 tonne (2014) 50,000 tonne (2013) 40,000 tonne (2012)	PCD, 2015
Viet Nam	Collected and treated hazardous waste which can be classified into 19 categories.	320,275 tonne (2014) 186,657 tonne (2013) 165,624 tonne (2012)	Hien et al, 2015

Source: prepared by IGES based on the data and information of Country Chapters, State of the 3Rs in Asia and the Pacific

3.2.2.3. General Assessment

All countries, being signatories of the Basel Convention have enacted hazardous waste management policy, laws and regulations to varying degrees. Some countries such as Bangladesh, Cambodia and Pacific Island Countries do not have specific legislation, but follow Basel Convention guidance in their efforts to manage and treat hazardous waste. The effectiveness of hazardous waste management and treatment available differs between countries based on level of economic development and industrialization; significant gaps with regard to both waste collection and transportation as well as supporting infrastructure for recycling and final disposal can be noted.

[15] A: Waste with Cyanide, B: Acid Waste, C: Alkali Wastes, D: Wastes with Inorganic Chemicals, E: Reactive Chemicals Wastes, F: Inks/ Dyes/ Pigments/ Paints/ Latex/ adhesives/Organic Sludge, G: Waste Organic Solvent, H: Putrescible Organic Waste, I: Oil, J: Containers, K: Immobilized Wastes, L: Organic Chemicals, M: Miscellaneous Waste

Hazardous waste generation and disposal data is available for individual countries, but is not comparable across the region largely because of the different classifications of hazardous waste, making it difficult to assess total volumes in an equivalent manner. In addition, implementing a manifesto system can improve the effectiveness of monitoring hazardous waste streams as well as improving safe treatment and disposal.

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3.2.3. Amount of Agricultural Biomass Used (Indicator V)

In many countries across Asia and the Pacific, especially in rural areas, agricultural biomass residues and livestock waste have traditionally been reused for various purposes including fuel for cooking, soil enrichment, feed/bedding for animal husbandry, household energy generation and so on. Indeed, up until the 19th century, biomass in the form of firewood and charcoal constituted the main source of energy for nearly all countries, which in turn was replaced by coal, oil, gas, and afterwards, widespread electric power transmission in the 20th century. As of the 21st century, the use of biomass is showing a resurgence, particularly as a new and important source of alternative energy. Accordingly, the sustainable utilization of agricultural biomass for energy and materials through reuse and recycling has the potential to produce a range of benefits for the Asia Pacific region, including strengthened energy security, offsetting GHG emissions, supporting green jobs and livelihoods, alternative energy source, poverty reduction, regional economic gains and public health improvements, most notably in rural communities.

This indicator can be used to monitor progress made on Goal 11 proposed under the draft Ha Noi 3R Declaration on Sustainable 3R Goals for Asia and the Pacific for 2013-2023. The quantitative indicators selected from Goal 11 are:

- Amount of agricultural biomass residue and livestock waste used, and
- Number and capacity of new projects initiated that use agricultural biomass residue and livestock waste as material input.

Taking into consideration the numerous benefits that can potentially be achieved, the following quantitative indicators would also be useful in measuring the overall socioeconomic and environmental progress made by effective utilization of agricultural biomass: (1) Annual biomass generation, (2) Annual biomass utilization through the recovery of energy and materials, (3) Annual GHG reduction via effective utilization of agricultural biomass, (4) Total renewable-energy production using agricultural biomass, (5) Quantity and number of facilities for renewable energy production from agricultural biomass, (6) Number of employment opportunities created, (7) Annual income generation via agricultural biomass based projects at regional level, (8) Annual country's currency savings (due to avoided imports of fossil fuel and materials), (9) Quantity of compost production from agricultural biomass, and (10) Prevalence of policies prohibiting burning of unutilized agricultural biomass, organic farming policy (Sang-Arun and Menikpura, 2013).

3.2.3.1. Definition

There is still no strict definition of 'biomass' and 'agricultural biomass'. The following presents some consensus definitions of biomass at the European and international level:

- United Nations Framework Convention on Climate Change (UNFCCC) Definition of renewable biomass: The 'biomass' is the non-fossil fraction of an industrial or municipal waste.
- Organization for Economic Co-operation and Development (OECD) Definition of solid biomass: 'Biomass' is defined as any plant matter used directly as fuel or converted into other forms before combustion.
- EU's Waste Framework Directive: 'bio-waste' means biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants.

- International Energy Agency (IEA) Definition of Biomass: Solid biomass products, gas and liquids derived from 'biomass' and the renewable part of municipal waste.
- European Biomass Association (AEBIOM) Definition of Biodegradable Waste: Biodegradable waste is the 'biomass' that can cover several forms of waste such as organic fraction of municipal solid waste, wood waste, refuse-derived fuels, sewage sludge, etc.

Based on the above examples, it can be noted that biomass comprises a wide variety of organic materials including but not limited to agricultural crops, timber, marine plants, conventional agricultural and forestry products and fisheries resources, as well as manufacturing byproducts, such as pulp sludge, black liquor, alcohol fermentation stillage and other organic industrial waste, municipal waste (e.g., food waste, kitchen garbage, paper waste and sewage sludge). The composition and component of biomass generated from Asia Pacific varies from country to country.

3.2.3.2. Agricultural Waste Utilization in Representative Countries

According to the background paper prepared for the Sixth Regional 3R Forum in Asia and the Pacific[16], agricultural waste estimations for each country is based on the assumption that 15% of total waste generated per capita per day comprises agricultural waste (*Table 3-12*).

Table 3-12. *Amount of agricultural waste generation*

Country	Agricultural Waste Generation (kg/cap/day)
Bangladesh	0.065
Cambodia	-
China	0.153
India	0.105
Indonesia	0.010
Japan	0.257
Malaysia	0.228
The Philippines	0.075
Singapore	0.224
Thailand	0.264
Viet Nam	0.219
Pacific Island Countries	-

Source: background paper prepared for the Sixth Regional 3R Forum in Asia and the Pacific

The following provides a summary of the status of biomass use in Asia Pacific countries based on the data and information of Country Chapters, State of the 3Rs in Asia and the Pacific.

Bangladesh

As a developing country, the most common fuel source in rural Bangladesh is biomass (more than 80% of energy is accounted by agricultural biomass), which is comprised of livestock and poultry manure, agricultural residual materials (straw, rice husk, jute sticks, bagasse, twigs and leaves) in liquid or solid form generated from the production and marketing of crops, agricultural inputs (chemical fertilizers, pesticides, herbicides, etc.). Poultry, livestock and furbearing animals are some of the potential sources of agriculture waste. Agricultural waste

[16] http://www.uncrd.or.jp/?page=view&nr=905&type=13&menu=198

per capita 1.68 kg/day.
Of the 65 million tons of agricultural waste generated in the country, 90% are used as domestic fuel in an inefficient manner. There is no clear government policy or guideline on the efficient use of agricultural waste for production of energy or fertilizer.

Cambodia
The Government of Kingdom of Cambodia is an agricultural country, with a majority of the population practicing agriculture and living in rural areas. However, data on agricultural wastes are very limited. No specific study focuses on agricultural waste. Agricultural waste includes all leaves, straw and husks left in the field after harvest, hulls and shells removed during crop processing at the mills, as well as pesticide and herbicide bottles and animal dung. Leaves and straw are normally re-used for cattle grazing. Annual statistics on animal populations are provided by the Ministry of Agriculture, Forestry and Fishery (MAFF), and three-year average estimated 2.8 million non-dairy cattle, 0.7 million buffalo, 2.1 million swine and 13.8 million poultry. Populations of horse, sheep and goat are not recorded in Cambodia, but their numbers are assumed to be low.

According to MoE, agricultural residues burned in fields were maize/corn (101 Gg), rice (3,862 Gg), beans (13 Gg), soya (30 Gg) and peanuts (8 Gg). As there are no national statistics on crop residues, default values are used for the residue-to-crop ratio. Field burning of agricultural residues was estimated to have emitted 75.91 $GgCO_2$-equivalent in the year 2000.

Several projects have supported the biomass program in Cambodia. DoPC, 2011, stated that there are 2,895 biomass places in only five provinces as follows:
- 42 biomass places in total in Battambang; 28 of which is in Banon District supported by National Biomass Program, 10 in Thmal Kor District supported by SNV NGO, and 4 in Battambang municipality built by COMPET.
- 881biomass places are supported by Wild Aid (NGO) and a composting program implemented by Provincial Department of Environment in Kampot province.
- In Kampong Speu Province, 1,437 Biomass places were located in only 8 districts of the province supported by the MAFF of Cambodia in cooperation with SNV (NGO) funded by the Netherlands.
- In Kratie province, there are 6 biomass places supported by CRDT (NGO).

China
With rapid economic development, energy supply constraints represent an important bottleneck to sustainable development in China. Therefore, accelerating the promotion of biomass-based energy sources to relieve natural resource and environmental pressures is crucial. China issued its Renewable Energy Law in 2005. According to the Country's *Mid and Long Term Development Plan of Renewable Energies* released in 2007, the percentage of biomass energy consumption is likely increase to 15% by 2020. Similarly, annual consumption of fuel ethanol is projected to reach 10 million tons, and biodiesel 2 million tons by 2020.

China has also set ambitious targets for renewable energy such that by 2020, generation will include 30GW for wind; 1.8GW for solar power PV; 300 million m^2 for solar heaters; 30GW for biomass power; 2Mt for biomass diesel; 10Mt for ethanol; 44 billion m^3 for biogas; 50 million tonnes for biomass solid fuel; 75GW for small hydro; and 300GW for hydro.

India

The government of India has an ambitious target to achieve the renewable energy capacity of 175 GW by 2022; the sectoral capacity targets include 100 GW for solar (57%), 60 GW for wind (34%), 10 GW for biomass and 5 GW for small hydro power plants. Recently, India has submitted its intended Nationally Determined Contribution (NDC) to the UNFCCC that reinforces the commitment of increasing power generation from renewable energy sources. India is implementing one of the World's largest programs in renewable energy. The country ranks second in biogas utilization. Biogas plants provide three-in-one solution of gaseous fuel generation, organic manure production and wet biomass waste disposal/management. In India, 23% of rice straw residue produced is surplus, and it is estimated that 97.19 Mt of rice straw residues are produced in India annually. It has been observed in recent years that the production of bio-diesel, biogas and ethanol are the most attractive components among the energy produced from biomass and bio wastes. Biomass availability in India is estimated at upwards of 915 million metric tons (MMT) which covers both agricultural (657 MMT/year) and 'forestry & wasteland' residues (260 MMT/year). The combined power potential from both resources is estimated at 33,292 MWe (agro: 18,730 MWe and forest and wasteland: 14,562 MWe).

India's biofuel policy will strengthen India's energy security by encouraging use of renewable energy resources to supplement motor transport fuels. An indicative 20% target for blending of biofuel in both biodiesel and bioethanol is proposed by end of 12th Five-Year Plan (fiscal year 2012/13 through 2016/17). The Cabinet Decisions that Ethanol produced from other non-food feedstock's besides molasses like cellulosic and lingo-cellulosic materials and including petrochemical route may be allowed to be procured subject to meeting the relevant standards of the Bureau of Indian Standards (BIS). In January 16, 2015, the Indian Union Cabinet decided to suitably amend the national biofuel policy for allowing consumers of diesel to procure biodiesel directly from private biodiesel manufacturers, their authorized dealers and joint ventures (JVs) of OMCs authorized by the Ministry of Petroleum and Natural Gas (Mo PNG), GoI.

In March 2017, the administrative sanction has been given for the enhancement of capacity from 20,000 MW to 40,000 MW for the "Development of solar parks and ultra mega solar power projects" for setting at least 50 solar park each of 500 MW capacity by 2019-20 with an investment of 81 billion INR. In May 2017, a scheme was made for setting up 1,000 MW wind power project to provide a framework to be connected to interstate transmission system (ISTS) and to facilitate the sale of wind power in the non-windy states/ UTs to fulfill their non-solar RPO obligations.

Indonesia

Indonesia has abundant biomass from various sources. In general, the two important sources of biomass residues in Indonesia are from agricultural (crops) activity and from forest. Primary agricultural residues from crops include palm oil (empty fruit bunches and palm shells), coconut (shells and fibre), rubber (small logs from replanting), sugar (bagasse), rice (husk) and corn (corn cobs). Currently, Indonesia's agriculture sector is a significant producer of rice, palm oil, coffee, rubber and spices. Forestry waste can also be used as source of bioenergy, such as waste generated from cutting of trees in forest and saw timber. However, having the world's second largest expanse of tropical forest, deforestation remains a matter of great concern in the country.

The potential biomass energy sources include the plantation sector, as well as agricultural waste,

wood and organic fractions of industrial and household waste. Over the last few years, the Government of Indonesia has made strong efforts to optimize the renewable energy resources widely spread across the country. In addition to other supporting policies, a feed-in tariff (FIT) has been applied to encourage the promotion of renewable energy. According to the Ministry of Energy and Mineral Resources, Regulation No. 4 (issued in 2012) concerning FIT for biomass/biogas electricity is currently under revision. Moreover, the national government also provides incentives to the private sector aimed at stimulating investment and development of renewable energy projects, specifically biomass/biogas. Accordingly, the Indonesian Government places priority on locating alternative energy sources and improving value added of raw materials to further develop the country's downstream industries, which is also in line with the implementation of National Energy Policy (Law no. 4/ 2009). The government expects for renewable energy to contribute approximately 17% of the national primary energy mix by 2025.

However, the country also faces challenges in achieving these goals. In 2012, an energy map was prepared highlighting the potential of biomass waste from three potential commodities, namely, rice, corn and cassava. Indonesia's total biomass energy potential is estimated to be approximately 49.81 GW; however, only 445 MW has been utilized and connected to PLN network (i.e., on grid), making up just 0.89% of total installed capacity.

Japan

In December 2010, Japan's *Basic Plan for Promotion of Utilization of Biomass* was passed by its Cabinet based on *Basic Law for Promotion of Utilization of Biomass*. Biomass considered under the plan is not limited to agriculture and livestock industries alone; biomass instead refers to "organic resources derived from plants and animals (excluding fossil resources)".

In the *Basic Plan for Promotion of Utilization of Biomass*, the amount of biomass generated and utilization rate for FY 2009 were identified along with utilization goals (targets) for different types of biomass for FY 2020 (*Table 3-13*).

Table 3-13. *Amount of Generation, Utilization Rate and Goal of Each Type of Biomass*

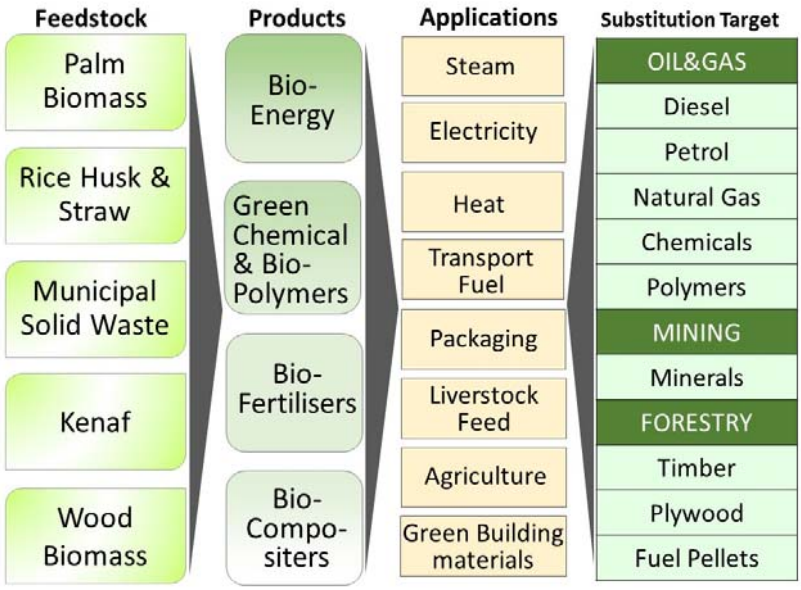
Type of biomass	Amount generated (FY2009) approx.	Utilization rate (FY2009) approx.	Goal of FY 2020 approx.
Domestic animal wastes	88 million ton	90%	90%
Sewage sludge	78 Million ton	77%	85%
Black liquor (*1)	14 million ton (*2)	100%	100%
Paper	27 million ton	80%	85%
Food waste	19 million ton	27%	40%
Remainder material of saw mill etc.	3.4 million ton (*2)	95%	95%
Construction generated wood	4.1 million ton	90%	95%
Non-food part of agricultural crops	14 million ton	30% (Except plowing)	45%
		85% (Including plowing)	90%
Remainder material of forest	8 million ton (*2)	Almost unused	above 30%

*1 Black liquor is a resin in liquid form which comes out when extracting a fiber from weed chip in a manufacturing process of weed pulp and is considered as a main ingredient.
*2 Dry weight for black liquor and sawmill open forest remainder. Other biomasses indicate wet weight.

Source: Country Chapter, Japan, State of the 3Rs in Asia and the Pacific

Malaysia

Biomass in Malaysia mainly originate from plantation industries, including agricultural residues from palm oil, rubber and rice. Palm, specifically palm oil production, comprises the largest plantation crop in Malaysia and generates a significant amount of biomass waste. Malaysia's lack of suitable landfill space, together with the government's prohibition on the open burning of agricultural waste and the existence of a sizable number of palm oil mills located throughout the country, palm waste has been identified as having strong potential for biomass utilization. Current biomass utilization in Malaysia (where biomass is mainly used for bio-energy, green chemical and bio-polymers, bio-fertilizer and bio-composites products) as well as the development/processing stages of each type of biomass from different sectors is presented in *Figures 3-5 and 3-6*. The Malaysian government has passed a number of strategies, policies and actions involving biomass utilization mainly focused on renewable energy, but continue to face many implementation challenges (Tang 2014).



Source: Country Chapter, Malaysia, State of the 3Rs in Asia and the Pacific

Figure 3-5. *Current biomass utilization*

	PELLETS	BIOFUELS	BIOGAS	GREEN CHEMICAL	BIOFERTI-LISERS	BIOCHAR	BIOCOM-POSITES	OTHERS
EFB	EFB Pellets	Bioalchols	Syngas	Industrial Sugars/ Chemical	Organic compost	Carbon Fibers	Fireboard	Pulp Fibremat
PKS	Coal substitute					Activated Carbon		
OPT	OPT Pellets	Bioalchols	Syngas	Industrial Sugars/ Chemical	Organic compost	Biochar	Engineered lumber	Phyto-chemicals
OPF	OPF Pellets	Bioalchols	Syngas	Industrial Sugars/ Chemical	Organic compost	Biochar		Animal feed
PKC	PKC Pellets			Biopolymers				
POME		Bioalchols	Methane	Biopolymers	Organic compost			
SAW DUST	Wood Pellets	Bioalchols	Syngas	Industrial Sugars/ Chemical	Mushroom Cultivation	Biochar	Fireboard	
RICE HUSK							Bio-composite	Silica Aerogel
PADDY STRAW	Straw Pellets							
KENAF							Bio-composite	
SAGO WASTE	Fuel Pellets	Bioalchols	Methane	Biopolymers				Animal Feed
MSW	RDF Pellets		Methane		Organic compost			
SEWAGE								Phosphate recovery

LEGEND Commercialized Development Stage Potential

Source: Country Chapter, Malaysia, State of the 3Rs in Asia and the Pacific

Figure 3-6. *Developing stages of each types of biomass*

The Philippines

Agriculture, which is made up of four sectors (crops, livestock, poultry and fisheries), is the main source of livelihood for about 31% of the total labor force (FAO of the UN, 2016). In 2014, it was reported that the Gross Value Added (GVA) of agriculture and fishing went up by 1.60 percent. This sector accounted for 10 percent of the country's GDP (PSA, 2016), indicating that a significant amount of biomass is coming from the agricultural sector. The agricultural waste generation in the country is 0.075 kg/cap/day (see *Table 3-12*).

As cited in the Philippines' National Solid Waste Management Strategy (2012-2016), it was estimated that the country's agriculture sector was expected to reach a biomass supply potential of 323.1 million barrels of fuel oil equivalent (MMBFOE) by 2012 (NSWMS 2012-2016). The most common agricultural wastes in the Philippines include rice husk, rice straw, coconut husk, coconut shell and bagasse. Filipinos are among the world's biggest consumers of rice, being the staple food in the Philippines (Zafar, 2015). One of the concerns cited in the NSWMS (2012-2016) is the lack of inventory of agricultural waste.

The Department of Energy (DOE) reported that geographically, there is abundant supply of bagasse in Regions III, IV, VI and VII of the country; coconut residues in Regions IV, VIII and IX, and rice hull in Regions II, III, IV and VI. Currently, the biomass technologies being utilized in the country include: (i) bagasse as boiler fuel for cogeneration, (ii) rice/ coconut husks dryers for crop drying, (iii) biomass gasifiers for mechanical and electrical applications, and (iv)

fuelwood and agri-wastes for oven, kiln, furnace and cook stoves for cooking and heating purposes.

Singapore

Urbanization and industrialization in Singapore have diverted increasing amounts of land away from productive agricultural activities. In 2000, approximately 3.3% of land area was classified as forest, with about 3% of the land area being used for farming, primarily for vegetables. Based on 2014 waste statistics, approximately 201,300 tonnes of wood/timber and horticulture wastes were utilized as a feedstock for biomass power plants. As a highly urbanized city-state, agriculture does not comprise a major economic sector in Singapore, with perhaps the exception of small scale vegetable farming. As such, utilization of domestic biomass waste as feedstock for energy generation is relatively low, and it remains unlikely that further biomass development will have a major impact on the productivity of the country's energy sector.

Thailand

Biomass in general means living things excluding fossil fuel or natural organic materials as energy storage source and power generation including agricultural residues, by-product and organic material from industry, organic municipal waste, manure, sludge.

The Ministry of Energy has defined the definition of 'biomass' in the report on "Biomass Database Potential in Thailand" as the production of industrial-agricultural waste that could be used for biomass energy such as rice husk, bagasse fiber and palm shell.

A study was conducted in 2012 by Department of Alternative Energy Development and Efficiency (DEDE) in order to determine the amount of biomass available in different areas (3 regions: northeast, north and south of Thailand, covering 51 provinces) as well as to examine the potential use of biomass for energy production. The report found that the maximum potential achieved from biomass utilization could be harnessed from 9 types of plants, comprising 19 types, namely, rice straw, rice husk, sugar cane leaves and tops, bagasse, stems and leaves of corn, corn cobs, cassava roots, palm trunk, palm leaves and branches, palm empty branches, palm fiber; palm shell, roots and leaves of rubber tree branches, swarf rubber wood, slab rubber wood, rubber wood chips and sawdust, soybean leaves and stems, leaves and stems of mung bean, and leaves and stem of peanuts. The result indicated that the total amount of agricultural biomass generation in Thailand was estimated to be 145,853,073 tonnes/year and the total amount of agricultural biomass waste was 59,539,905.20 tonnes/year, with a biomass utilization rate of around 50%.

At present, Thailand has integrated Energy Blueprint 2015-2036 based on energy security, economy and ecology. Alternative energy development plan is one of the five master plans as the pillars of energy development is expected to achieve a 30% target conventional energy replacement in total energy consumption by 2036. The alternative energy considered consists of bio-energy (biomass, biogas, municipal solid waste/industrial waste), biofuel, solar, wind, hydro and others (e.g. used tire and tidal wave). The government encourages private-led investment by supporting information, funding R&D, incentivizing feed-in-tariff (FIT) guaranteed for fix period of time, and investment promotions by the board of investment (BOI) (e.g. the exemption of corporate income tax for up to 8 years, exemption from import duties on machines and raw materials, as well as the possibility for foreigners to own land and to facilitate the employment of foreign expert).

Viet Nam

It has been estimated that there are about 76 million tons of rice straw and 80 million tons of livestock waste annually. Biomass waste is widely reused and recycled in Viet Nam. For instance, stubble and husk are used for soil enrichment and cooking fuels, and livestock production waste has been promoted as a feedstock for biogas. Since 2003, Viet Nam has been implementing the National Biogas Program, supported by Netherlands SNV, which has constructed 158,500 biogas digesters nationwide and reduced nearly 800,000 tonne CO_2-e till 2016. Although the country is not yet at a stage where 100% of biomass is re-used or recycled, good progress has been made in encouraging the reuse and recycling of agricultural biomass and livestock waste.

Pacific Island Countries

The waste composition in the Pacific Island Countries constitute about 43.6% organic waste generally reflected as food and yard waste. In some countries like Vanuatu and Fiji, more than 70% of wastes are organic. Unfortunately, waste characterization in the PICs only involves wastes generated by households. There has been no effort, by far, to determine the amount of wastes generated specifically by the agricultural sector.

3.2.3.3. General Assessment

The definition and composition of agricultural biomass generated from the Asia Pacific region varies from country-to-country. Although actual estimates of onsite use of agricultural biomass residues and livestock waste remains challenging, the potential amount of available agricultural biomass waste among Asia Pacific countries can be estimated by population size, GDP growth rates, agricultural production and consumption ratios, and area dimensions of farmland, plantations and forests, among others. Considering human population growth, energy and resource scarcity and climate change, sustainable production and consumption of agricultural biomass is key to meeting basic human needs while simultaneously safeguarding the environment; co-benefits of sustainable use of agricultural biomass include GHG emissions reductions, enhanced energy security, and improving access to more sustainable livelihoods in rural areas.

Most countries have installed laws/regulations/policies/plans to utilize agricultural biomass as a feedstock for renewable energy. However, especially in rural areas of developing countries, most agricultural biomass is traditionally used as domestic fuel. Government policy frameworks/interventions are thus needed to promote efficient and sustainable 3R practices with regard to agricultural biomass waste.

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3.2.4. Amount of e-waste Generation, Disposal and Recycling. Existence of Policies and Guidelines for e-waste Management (Indicator VII)

Based on Herat (2013), global sales of electrical and electronic equipment (EEE) have been rising significantly over the last few years. The rapid uptake of information technology around the world coupled with frequent design and technology updates in the EEE manufacturing sector is causing the early obsolescence of many of these EEEs, resulting in a rise in electrical and electronic waste (e-waste). The generation of reliable data on the exact amount of e-waste generated in different regions of the world is difficult to achieve as the amount of used EEE reaching its end-of-life cannot be measured directly with some reliability. The Global E-waste Monitor 2014, published by the United Nations University (*UNU 2014*) estimates that the global quantity of e-waste generation in 2014 was around 41.8 million tonnes (Mt). This amount is estimated to reach 50 Mt by 2018, with an annual growth rate of 4 to 5 percent. The study also found that the Asian region produced the highest amount of e-waste (16 Mt or 38% of total), followed by Americas (11.7 Mt) and Europe (11.6 Mt). The top three Asia Pacific countries with the highest e-waste generation in absolute quantities are China (6 Mt), Japan (2.2 Mt) and India (1.7 Mt).

The issue of environmentally sound management (ESM) of e-waste is a global problem arising from transboundary movement among all countries and regions, and thus requires global solutions. Large amounts of e-waste/ nearly end-of-life electric devices are currently being exported to developing countries for the purpose of reuse, refurbishment, recycling and recovery of precious materials. Many recycling and recovery facilities in these countries operate in an environmentally unsound manner causing significant environmental and health impacts. Significant amounts of unrecyclable parts of e-waste containing hazardous materials can be seen dumped in open lands and waterways. The major environmental and health impacts occur during open burning of e-waste to recover precious metals. In spite of these significant environmental and health impacts, recycling and recovery operations have generated a huge informal employment sector in these countries. In addition to receiving e-waste from developed countries, developing countries are also emerging as significant generators of e-waste themselves. Two of the main problems faced by developing countries is the lack of funds and investment to finance formal recycling infrastructures, and the absence of appropriate legislation to deal with the issue. EPR is seen globally as one of the most effective ways of dealing with the e-waste management. However, unlike in the developed world, implementing EPR in developing countries is a major challenge for policy makers. The competition between the formal and informal recycling sectors to gain access to e-waste is also a major problem.

Although e-waste is usually regarded as a problem, it is easy to overlook the opportunities associated with e-waste, especially at a time where resource use and depletion is also a global issue. Strictly speaking, it can be argued that the problem with e-waste is not due to the materials that are contained in them but due to the inappropriate ways that they are dealt with at the end-of-life. EEE manufacturing consumes many precious metals and therefore an important resource for the world's demand for metals. Mining of used EEE to recover the metals contained in them needs only a fraction of energy required to mine them from natural ores. E-waste contains many valuable materials such as iron, copper, aluminum and plastics in addition to many precious metals such as gold, silver, platinum and palladium. Global Waste Monitor 2014 (UNU 2014) reports that the gold content of total e-waste generated in 2014 is roughly 300 tonnes, which represents 11% of the global gold production from mines in 2013.

Although the resource value of materials such as metals in EEE is well known and availability of technologies to recover these materials are increasing, only a small percentage of valuable metals is currently recovered. There are a number of reasons why this is the case. Firstly, end-of-life EEE often is not fully recycled in industrialized countries as certain components are often stored at home. Secondly, among e-waste that is collected, some disassembled parts may be recycled to recover valuable materials, while the remaining elements may be reused and subsequently recycled, or exported to receiving countries where environmentally sound recycling facilities may not exist. Moreover, even in the context of environmentally-friendly recycling, some components can be mishandled resulting in a failure to recover 100% of the materials. In point of contrast, rudimentary recycling processes employed in developing and transition economies achieve far less recovery yields especially with valuable metals. Whereas an advanced integrated smelter could recover over 95% of the gold, recycling practices in developing countries may achieve only around 25% (*Business and Economic Potential of Resource Recovery and Recycling from E-waste*[17]).

3.2.4.1. Existence of Policies and Guidelines for e-waste Management

Policies for e-waste management vary widely between countries in Asia and the Pacific (*Table 3-14*). For instance, Japan and China have fully implemented the e-waste related policies and established e-waste recycling systems that comprise collection, transportation, recycling and final disposal. Thailand has a handbook for implementation about e-waste management since 2008, but the law supporting the whole process of e-waste management is still a draft act (on management of Waste Electrical and Electronic Equipment and other End-of-Life products) under consideration process of the council of state before enactment and promulgation. Viet Nam has enacted e-waste management in the EPR policy, in the consideration process under the council of state before enactment and promulgation. However, these countries face difficulties with implementation resulting from factors ranging from lack of collection systems, inadequate recycling/treatment facilities, absence of industry support, etc. Due to the high level of concern about pollution associated with e-waste recycling, The Philippines and Cambodia have formulated guidelines on the environmentally sound management of e-waste. At the same time, whereas some Asian countries have launched initiatives on e-waste management, others have not formulated any responses to address e-waste. These countries basically categorize it as hazardous waste under existing waste management regulations.

[17] Background Paper for Parallel Roundtable 4 of the Programme:
http://www.uncrd.or.jp/content/documents/2665Final-BG-Parallel%20Roundtable-4_merged.pdf

Table 3-14. *Status of policies and guidelines for e-waste management in selected countries*

Policy Status		Countries
Full implementa-tion	Full implementation of e-waste related policy for its recycling.	- **China**: Administration Regulation for the Collection and Treatment of Waste Electric and Electronic Products - National Old-for-new Home Appliance Replacement Scheme **Japan**: Home appliance recycling law and Small Home Appliances Recycling Law **India**; EPR based E-Waste (management& Handling Rules) 2011 and revised as E-Waste Management Rules, 2016 has been initiated and old-for-new Home Appliance Replacement Scheme and take back system by the business houses are implemented.
Partial implementa-tion	E-waste management policy exists but actual implementation is limited.	- **Pacific Island Countries (only New Caledonia)**; EPR scheme is executed by a non-profit environmental organization (TRECODEC) that collects e-waste through voluntary drop-off receptacles and from authorised dumps. - **Thailand**; e-waste policy as a part of National Integrated WEEE Management Strategy was approved by the cabinet on 24 July 2007. Draft Act on the Management of WEEE and Other End-of-Life Products, B.E has been drafted in 2014 and Cabinet approval on 19 May 2015 is now being reviewed by the Council of State before enactment and promulgation - **Viet Nam:** Decision 16/2015/QD-TTg on EPR regulated e-waste such as TV, refrigerates, washing machines, computers… as discarded products that must be collected and treated by producers/importers.
Guideline	There is no e-waste management policy but there are available guidelines for management.	- **Cambodia**; Guideline on Environmentally Sound Management of Waste Electrical and Electronic Equipment is established currently. - **The Philippines**; Guidelines on the Environmentally Sound Management (ESM) of Waste Electrical and Electronic Equipment (WEEE) under RA9003. E-wastes are classified under special waste, and usually handled separately from other residential and commercial wastes (Section3) - **Pacific Island Countries:** The Pacific e-waste: A Regional Strategy and Action Plan 2012 (SPREP, 2012) identified strategic actions for e-waste management which are also considered in the Cleaner Pacific 2025 for sustainable management.
Managed by the existing regulations	E-waste is managed by existing regulations , therefore; no particular response against e-waste management	- **Bangladesh**; The Bangladesh Environment Conservation Act of 1995, the Environmental Court Act of 2000, and The Environmental Conservation Rules of 1997 provide a basic regulatory framework that can be the basis of deriving rules for e-waste management - **Indonesia**; e-waste regulation follows the HW Management (Law no.32/2009) - **Malaysia**; following the regulations stipulated under Environmental Quality (Scheduled Wastes) Regulations 2005 (DOE, 2006) particularly of SW110 - **Singapore**; There is currently no formal regulatory framework dealing with the management of e-waste in Singapore. Reportedly, Singapore has an active second-hand market and effective recycling initiatives, resulting in minimal e-waste ending up in its disposal facilities.

Source: prepared by IGES based on the data and information by authors of Country Chapter, State of the 3Rs in Asia and the Pacific

3.2.4.2. Amount of E-Waste Generation, Disposal and Recycling

Data availability on the amount of e-waste generation, disposal and recycling in the region is limited due to the general absence of e-waste management systems in most countries. As such, the data on e-waste generation is diverse (*Table 3-15*); however, it is clear that the region's economic growth is contributing to a positive trend in the rate of e-waste production. Data related to disposal and recycling of e-waste is only available from certain countries where e-waste management policies are in place (e.g. Japan, China and India). In most countries, informal recycling and disposal of e-waste is widely practiced to retrieve precious metals which is a matter of increasing concern to the health and safety of both humans and the environment. Consequently, it remains difficult to collect comprehensive data on estimated generation amounts.

Table 3-15. *Amount of e-waste generation, disposal, and recycling*

Country	Generation/ Disposal/ Recycle	Data (year)	Trend	References
Bangladesh	Generation (estimation)	2,800,000 tonne (2009) (2,500,000 tonne of e-waste may from ship breaking)		ESDO (2009)
Cambodia		N.A.		
China	Generation (estimation)	109,801,800 tonne (2013) 75,850,100 tonne (2012) 66,707,200 tonne (2011) 58,540,300 tonne (2010) 51,540,000 tonne (2009)	⬆	White Paper on Current Situation and Trend of WEEE Recycling Industry in China
	Disposal/ Recycle (actual amount at formal facilities)	41,730,000 tonne (2013) 25,840,000 tonne (2012) 56,330,000 tonne (2011) 19,170,000 tonne (2010) 2,960,000 tonne (2009)	⬆	
India	Generation (estimation)	1,700,000 tonne(2016) 1,410,000 tonne (2014) 800,000 tonne (2012) 146,000 tonne (2005)	⬆	MoEF annual report 2011-12; STEP Global Monitor 2015; CPCB bulletin 2016
	Disposal/ Recycle	121,381 tonne (2013-2014) recycled by registered dismantlers & recyclers (178 e-waste recyclers/dismantlers, capacity – 438,086 tonne) as of Dec. 2016	⬆	www.cpcb.nic.in/List_of_E-waste_Recycler_as_on_29.12.2016.pdf
Indonesia		N.A.		
Japan	Disposal/ Recycle[18] (actual amount at formal facilities)	10,877,000 unit (2015) 10,860,000 unit (2014) 12,730,000 unit (2013) 11,196,000 unit (2012) 16,800,000 unit (2011) 27,700,000 unit (2010)	since 2010 ⇩	MOEJ Note: High value of e-waste generation between 2009 and 2011 due to

[18] Data only from home appliances (air-conditioner, television, refrigerator and freezer, washing machine and cloth dryer.)

Country	Generation/ Disposal/ Recycle	Data (year)	Trend	References
Japan		18,786,000 unit (2009) 12,899,000 unit (2008) 12,112,000 unit (2007) 11,614,000 unit (2006) 11,620,000 unit (2005) 11,216,000 unit (2004) 10,462,000 unit (2003) 10,150,000 unit (2002) 8,549,000 unit (2001)	before 2010 ⇧	replacement demand and subsequent discharge of TV due to the digital TV broadcasting
Malaysia	Generation (estimation)	78,278 tonne (2012) 152,722 tonne (2011) 163,340 tonne (2010) 134.036 tonne (2009) 102,809 tonne (2008) 52,718 tonne 2007) 40,275 tonne (2006)	since 2010 ⇩ before 2010 ⇧	DOE 2006-2012
Pacific Island Countries		N.A.		
The Philippines	Generation (estimation)	70 tonne (2014) 269,816 tonne (2013) 29,982 tonne (2012) 283,644 tonne (2011) 77,169 tonne (2010)		Extracted from the Reports submitted by the EMB Regional Offices to DENR
Singapore	Generation (estimation)	60,000 tonne[19] (2014)		*NEA,2014*
Thailand	Generation (estimation)	393,070 tonne (2015) 376,801 tonne (2014) 365,842 tonne (2013)	⇧	PCD, MONRE, 2016
Viet Nam	Generation (estimation)	1,609,775 tonne (2006)[20] 1,412,543 tonne (2005) 896,612 tonne (2004) 767,182 tonne (2003) 648,448 tonne (2002)	⇧	MONRE, 2011

Source: prepared by IGES based on the data and information of Country Chapters, State of the 3Rs in Asia and the Pacific

3.2.4.3. General Assessment

E-waste in the region shows an increasing trend due to the economic growth in the region, contributing to a rise in domestic consumption of electric devices; this underlines the need for the sound management of post-consumption of EEE/e-waste in Asia and the Pacific.

Introduction of EPR for e-waste management is gaining increasing attention among different countries and involving collaboration between producers, consumers and government. However, a lack of coordination among stakeholders often results in implementation challenges for e-waste management systems. It is also common among countries without an EPR based policy to classify e-waste as hazardous waste. In practice, however, e-waste often mixes with MSW or is destined for informal recycling.

[19] 50 per cent are common household IT products and home appliances while the rest are ICT equipment generated from the commercial and industrial sectors

[20] Data based on total of TV, PC, mobile phone, refrigerator, air-conditioner, and washing machine

It is necessary to have recycling infrastructure in place to ensure sound management of e-waste, or in the absence of or limited recycling capacity at the national level, further international cooperation may be beneficial to promote recycling and safe disposal of e-waste. Some e-waste may be better handled or treated for disposal in countries or by producers with the appropriate infrastructure. Moreover, it is important to monitor e-waste generation and recycling volumes by installing appropriate manifesto/ reporting and inventory systems.

As a way forward, policy makers in Asia Pacific countries may find the following proposed activities useful for informing their efforts to promote sustainable e-waste management, specifically with regard to fostering the enabling conditions for enhancing the business and economic potential of resource recovery and recycling of e-waste:

- *Designing well defined national e-waste management strategies based on 3R concepts*: instituting regulatory procedures aimed at addressing environmental and health impacts, green design and supporting business opportunities focused on recovering valuable materials from e-waste;
- *Enhancing technical abilities* to collect data and inventory on e-waste generation, including transboundary movements;
- *Mandating* EEE exporting countries to formally assess equipment prior to shipment as well as prohibiting the import of e-waste to countries that do not possess adequate capacity for managing e-wastes in an environmentally sound manner; and
- *Identifying organizations or institutions* with the potential to develop innovation hubs and centers of excellence for developing and promoting environmentally sound e-waste recycling technologies by conducting R&D on innovative technologies and assessing relevant applications of technology transfer. This will be enhanced through developing human resource capacities to better examine the environmental and human health impacts as well as resource potentials of e-waste.

References

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3.2.5. Marine and Coastal Plastic (Indicator VI)

Marine and coastal plastic wastes together make up what is commonly referred to as marine litter. Marine litter is becoming a major cause for alarm due to its impacts on both terrestrial and aquatic ecosystems. One recent study concluded that upwards of 8 million tonnes of plastic waste reached the world's oceans in 2010, roughly equivalent to five grocery bags filled with plastic for every foot of coastline in the world (Fauziah, Liyana and Agamuthu 2015). Similarly, another study estimated that between 4.8 and 12.7 million tonnes of plastic waste entered into the ocean in 2010, based on examining rates of waste mismanagement and plastic waste generation in 192 coastal countries (Jambeck, et al. 2015). These studies warn that marine litter has the potential to increase more than tenfold in the next decade unless the international community works together to improve waste management practices. In this context, some countries have begun identifying ways to enhance the management of plastic waste through cost-effective and environmentally friendly solutions.

Compiling data on marine and coastal plastic waste can contribute to developing a roadmap for the elimination of marine debris, which includes reducing the waste at source, changing the behaviors that cause it, and supporting better policies to prevent marine debris from causing further harm to ocean ecosystems.

3.2.5.1. Definition and Estimation of Marine and Coastal Plastic at Global Level

Although there are no conventional definitions for “plastic marine debris”, or “marine and coastal plastic”, these items comprise a large component of marine litter. Marine Litter has been defined as any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment. Marine litter consists of items that have been made or used by people and deliberately discarded into the sea, rivers or on beaches; brought indirectly to the sea via rivers, sewage, storm water or winds; accidentally lost, including material lost at sea in bad weather (fishing gear, cargo); or deliberately left by people on beaches and shores (UNEP 2015).

Data availability on marine litter remains quite poor. Jambeck et al. (*2015*) estimated the mass of land-based plastic waste entering the ocean by linking worldwide data on solid waste, coastal population density (within 50 km. from the coast) and economic status, indicating that of the 275 million metric tons (MMT) of plastic waste generated in 192 coastal countries in 2010, as much as 4.8 to 12.7 million tonnes entered the ocean. Based on this study, it can be observed that the size and the quality of a country’s waste management system largely determines the volume of untreated waste that consequently becomes marine litter.

The study also documented the extent to which plastic waste enters the ocean and highlighted a number of countries where such waste originates from Asia: China, Indonesia, The Philippines, Viet Nam, Sri Lanka, Thailand, Malaysia and Bangladesh have all been identified as leading countries contributing to the accumulation of plastic waste in the ocean (*Table 3-16*), which is attributed both to their large populations residing in coastal areas and high mismanagement rate of plastic waste, as opposed to the average waste generation rate per capita in these countries.

Short of massive improvements to waste management infrastructure, the total quantity of

potential plastic waste likely to reach the ocean is projected to increase exponentially by 2025.

Table 3-16. *Estimation of the mass of land-based plastic waste entering the ocean*

Country	**Waste Generation Rate** (Kg/ person/ day)	**Costal Population** (million)	**Mismanaged waste** (%)	**Mismanaged plastic waste** (million tonnes/year)	**Mismanaged plastic waste** (%)	**Plastic marine debris** (million tonnes/ year)
Bangladesh	0.43	70.9	89	0.79	2.5	0.12-0.31
China	1.10	262.9	76	8.82	27.7	1.32–3.53
India	0.34	187.5	87	0.60	1.9	0.09-0.24
Indonesia	0.52	187.2	83	3.22	10.1	0.48-1.29
Malaysia	1.52	22.9	57	0.94	2.9	0.14-0.37
The Philippines	0.5	83.4	83	1.88	5.9	0.28-0.75
Vietnam	0.79	55.9	88	1.83	5.8	0.28–0.73
Thailand	1.2	26.0	75	1.03	3.2	0.15-0.417

Source: Data extracted from Jambeck et al. (2015)

3.2.5.2. Marine and Coastal Plastic Waste Management in Representative Countries

Table 3-17 summarizes the current conditions with regard to marine and coastal plastic waste management in selected Asian countries. Generally, there is limited data availability on the generation of marine and coastal plastic from individual countries. Despite these constraints, some countries have implemented marine litter related policies as part of their overall approach to waste management, specifically with regard to addressing land based activities. The table also displays information on relevant plastic reduction policies such as bans on disposable plastic bags.

Table 3-17. *Current situation of marine and coastal plastic in representative countries*

Country	Current situation of marine and coastal plastic
Bangladesh	Plastic shopping bags have been introduced in the early 1980s and quickly became widespread. The plastic shopping bags is one of major causes of flooding due to clogged rivers and drains. In 2002, the government introduced a ban on the manufacture and use of plastic bags in Dhaka, which was subsequently expanded nationwide. However, due to a lack of enforcement, there has been no significant reduction in the use of plastic shopping bags.
Cambodia	At present, study on marine and coastal plastic waste is very limited, but some activities such as public awareness to reduce the use of plastic bags at the ministry, city, and community level and media have been undertaken by government and NGOs. However the waste-particularly plastic bags and food wrappers still found at the beach of Cambodia. Three sub-decrees are applied in implementing in SWM in Cambodia that they include: (1) the sub-decree on SWM in 1999 states the disposal of waste including plastic in public sites or anywhere that is not allowed by the authorities shall be strictly prohibited; and (2) In 2015, Inter-Ministry between Ministry of Environment (MoE) and Ministry of Interior (MoI) established a sub-decree on garbage management and solid waste management at urban areas. The sub-decree aims improving proper waste management including storage, collection and disposal at urban areas. In 2017, MoE also established a draft sub-decree on plastic management to reduce plastic import, production, distribution, and uses to ensure preventing public health, aesthetics, and environment. This sub-decree also states that city and province must support, facilitate and

Country	Current situation of marine and coastal plastic
	lead to organize any event to reduce plastic waste. It also said that any super market and commercial centre must include cost for plastic users. This sub-decree will be implemented after governmental signature during this year respectively.
China	There have been some activities undertaken at the city level such as the campaign to reduce the use of plastic bags during the time of the Beijing Olympic Games. A set of national laws limiting the production and consumption of plastic bags came into effect in 2008, which mandated that all retailers stop providing complimentary heavy plastic bags or charge a fee for these plastic bags. This law has had a positive result even after the conclusion of the Olympic games.
India	As per available information, consumption of plastics in the country during 2013-14 was 11 million tonnes. Plastic Waste (Management) Rules 2016 bans plastic carry bags with a thickness of less than 50 micron. The total quantity of plastic waste generated in the country from 60 major cities is estimated to be 3501 tonnes/day. The cities of Delhi, Chennai, Kolkata, Mumbai, Bengaluru, Ahmadabad and Hyderabad are generating maximum quantities of plastic waste. No primary or secondary data is available on marine and coastal plastic waste.
Indonesia	Based on Kellen (2014), research shows that of the 285 million tonnes of plastics produced in 2014, 4.76 million tonnes entered the marine environment as beach litter, depositions on the seafloor and microplastics in the gyres. The main flows towards the gyres were identified as 0.4 million tonnes/year extra-gyral input of beach litter as well as 0.3 million tonnes/year inflow from anthropogenic pre-and postconsumer plastic stocks in the case of a tsunami. The flow of litter towards the beach stemmed mainly from uncollected plastics, amounting to 0.56 millon tonnes/year, and dumpsite leaking, equaling 4.19 million tonnes/year as of 2014.
Japan	Japan's *Law concerning the Promotion of Handling of Coastal Drift, etc. related to the Maintenance of Good Landscape and Environment in the Coastal Areas to Preserve the Rich and Beautiful Nature* entered into effect in July 2009. The quantity of coast flotsam (quantity at the beginning of the year) in Japan has estimated by calculating the consumption rate based on the recovery performance by clean-up activities according to the study carried out by the Ministry of the Environment, the Secretariat at the Promotional Council. Japan's Ministry of Environment also conducted a survey on marine litter in 7 power plants across the country in the five year period spanning FY 2010 and FY2014. In addition, the Ministry of Environment conducted a survey in FY 2014 on the buoyant density by visual inspection of the drifting garbage and compared to the average values in each ocean for the total density of plastic films, polystyrene foam and other petrochemical products. Micro plastics were also collected with a plankton net and those of sizes 1~5mm were compared with the buoyant density for each ocean. A levy system for plastic shopping bags collected at grocery stores, super market, drug stores etc. is becoming an increasingly common approach to reduce the consumption of plastic bags.
Malaysia	In 2009, it was found that 44.50% of the collected marine litters in Malaysia were comprised of plastics. The number of plastic wastes in marine and coastal areas increased to 62.76% in 2012. Specific marine and coastal plastic wastes collected include plastic bags, food wrappers, bait packaging, plastic tarps, beverage bottles, straws, cleaner bottles, tobacco packaging, caps/lids, toys and oil bottles. The high level of marine and coastal plastic waste detected can likely be attributed to human activities such as picnic. Some local municipalities have made efforts to encourage reductions in the use of plastic bags. For example, the state of Penang implemented the levy system of 20 Sen (6¢) per plastic bag to shoppers.
The Philippines	Plastics released to the marine environment are of increasing concern because of its negative effects on the oceans, wildlife, and humans. Plastic bags are the most common type of garbage found in Manila Bay. Of the1,594 liters of garbage collected, 23.2% are plastic bags. Consistent with this finding, the same environmental groups found that 75.5% of wastes in the bay were plastic discards in 2010. Of this, 27.7% were plastic bags. Given this situation, several NGOs and decision makers in the Philippines have called for the banning the use of plastics in the country. Many LGUs have started creating local ordinances banning the use of plastics in households and commercial establishments.

Country	Current situation of marine and coastal plastic
Singapore	There is less statistical data on marine litters readily available. In 2013, the non-profit organization International Coastal Cleanup Singapore (ICCS) conducted its annual beach and mangrove cleanup and published the resulting data on marine trash in Singapore. For the ICCS 2013 study alone, 3,473 volunteers covered 19,476 meters of coastline and collected 14,448 kg (153,147 pieces) of marine trash. Examining this data, the average weight of marine trash collected by each volunteer increased by 32% from 3.1 kg/person in 2002 to 4.2 kg/person in 2013. The average weight of marine trash collected for each meter of coastline also increased by 194% from 0.25 kg/m in 2002 to 0.74 kg/m in 2013. In addition, the data indicated that the majority of the waste, other than cigarette butts, are related to plastic products. Marine plastic waste in Singapore waters and along Singapore's coastline could be caused by both tidal conditions and inland sources. The Maritime and Port Authority of Singapore (MPA) enforces strict regulations on pollution of the sea from ships within its port waters for ships visiting Singapore. MPA also monitors the ships in port to ensure compliance to the regulations. Under Singapore's Prevention of Pollution of the Sea Act, it is an offence for any person to throw or deposit into Singapore waters any refuse, garbage, plastics or waste matter. If convicted, offenders are liable to be fined up to a maximum of S$10,000 or imprisoned for up to 2 years or both. The MPA also employs a contractor to collect garbage from ships to ensure proper disposal and flotsam retrieval. This ensures that the waters are clean and safe for navigation. Garbage collection and flotsam retrieval operations are conducted on a daily basis by a fleet of nine craft (four for garbage collection, 5 for flotsam retrieval). In 2015, a total of 4257.89 tonnes of flotsam and garbage waste was collected.
Thailand	According to Central Database System and Data Standard for Marine and Coastal Resource, Department of Marine and Coastal Resource, MONRE, the accumulative number of marine and coastal trash collected in Thailand from 2009 to 2012 was 216,691 pieces, weighing 20,947.16 kilograms. There were 29,994 pieces of plastic (13.84 %), secondly 24,416 pieces of rope (11.27 %), and thirdly cover and lid (10.15%).
Viet Nam	There are no official statistics on marine and coastal plastics waste in Viet Nam at present. At the same time, there has not been much effort and progress on controlling waste in the marine and coastal environment, most especially for plastics. In 2010, the Law on Environmental Tax imposed taxation on plastic bags. There is also a program on control of waste from plastic bags issued by the Decision 582/QD-TTg in 2013. A Law on Marine and Islands Natural Resources and Environment was adopted by the National Assembly in 2014. The Law contains a chapter outlining regulations on pollution control, oil spill responses and sea dumping. According to the Law, discharged sources are required be controlled, with all wastes effectively treated to meet environmental standards before being discharged into the sea, instructing that all floating waste should be collected and treated in a proper manner. However, plastic waste was not specifically mentioned in the regulations.
Pacific Island Countries	While marine litter can be found everywhere in the Pacific region, there is often very little awareness of this problem as an environmental and socioeconomic issue or about its impacts upon local communities. Raising awareness of the marine litter issue among Pacific islanders can create incentives for greater investment in, and prioritization of this issue among a variety of stakeholders including governments, industry, academia, NGOs and citizens. Very little research has been done on land- and sea-based sources, outcome and impacts of marine litter in the Pacific region, which can be used to inform regional and national strategies and policy making. Of particular relevance is the need for modelling and monitoring; investigations into ALDFG including Fish Aggregating Devices; and identification of major marine litter accumulation and hot spot areas in the region to allow for targeted recovery and clean-up efforts.

Source: prepared by IGES based on the data and information of Country Chapters, State of the 3Rs in Asia and the Pacific

3.2.5.3. General Assessment

Marine and coastal plastic waste together make up what is commonly referred to as marine litter. Marine litter is a new policy issue but relates to conventional waste management as the main source of marine litter derives from land-based activities. Despite having a large shoreline, only a few countries in the Asia Pacific region monitor marine litter generation at present. Marine and coastal plastic waste has been receiving increasing regional attention; some estimates suggest certain countries in the region are leading sources of marine and coastal plastic waste. However, concrete actions taken on the national level remain limited in most countries.

Plastic waste is one area of concern and certain countries, such as Bangladesh and India, have enacted bans on plastic carry bags with a view to prevent flooding resulting from clogged drainage systems and maintain clean cityscapes. These policies were not intended for addressing marine litter issues but, if effectively implemented, can also serve to reduce waste at source.

Marine and coastal plastic waste issues can largely be addressed by improving waste collection and enhancing recycling of plastic and residual waste, activities which are important in preventing such waste from entering oceans and waterways.

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3.3. Trend of Global Waste Issues

Waste management has both local and global dimensions. In this section, material flow accounting/ analysis (MFA) is used as a tool to derive representative indicators to analyze natural resource consumption as well as sustainable resource management. In addition, GHGs from waste generation are used as a representative indicator to assess linkages between climate and waste issues.

3.3.1. Greenhouse Gas Emission (Indicator IX)

Climate change is recognized as a serious global issue necessitating international cooperation from all sectors to achieve GHG mitigation and strengthen adaptation responses. It is inevitable that GHGs will increase if no efforts are made to address their generation. It has been reported that GHG emission from waste management are increasing as a result of various factors including growing waste generation and upgrading of open dumping to sanitary landfill. Thus far, waste emissions have received scant attention as they have remained marginal compared to other sectors.

Applying the 3Rs has the potential to significantly reduce GHG emissions from the waste sector both by reducing waste sent to landfill and increasing overall resource circulation. Good examples of local actions focused on mitigating climate change through the 3Rs can be identified in many Asia Pacific countries despite a limited general understanding on waste and climate change mitigation. To illustrate the climate benefits of the 3Rs, the Regional 3R Forum in Asia and the Pacific included a GHG emission indicator to more effectively monitor the progress of 3R implementation with regard to the international climate agenda, better document climate co-benefits resulting from the application of 3Rs, and raise the awareness of relevant stakeholders on climate impacts resulting from unsustainable waste management.

3.3.1.1. Definition

According to the IPCC guidelines, GHG emissions from waste management are calculated on the basis of emissions from solid and liquid waste (including sewage) treatment. For MSW, this includes emissions from solid waste disposal (e.g. open dumping and sanitary landfill) biological treatment of solid waste (e.g. composting and leakage from anaerobic digestion), thermal treatment of solid waste (e.g. open burning and incineration without electricity generation), and wastewater treatment (*IPCC 2007*).

CO_2 from waste transport and incineration equipped with power generation are commonly reported by the energy sector; such classifications are necessary to avoid double counting in the National Communications submitted to the UNFCCC. It is also recommended that emissions from entire waste management chain are regularly monitored and reported to both the general public and the Regional 3R Forum in Asia and the Pacific to best document government efforts aimed at reducing GHG emissions from the waste sector. Furthermore, a standard template with disaggregated emissions data from waste treatment, transport and waste-to-energy (WtE) should be applied to most effectively report GHG emissions associated with waste management and to best as certain potential areas for continued GHG emission reductions.

In this regard, it is suggested that the latest IPCC Guidelines are applied to estimate GHG

emissions. In case IPCC Guidelines may be difficult for local and national government to operationalize, it is advisable to utilize more user-friendly calculation tools and methodologies, based on IPCC Guidelines to better reflect local conditions. Accordingly, one such calculation tool developed by IGES based on Excel spreadsheet analysis may be applied to conduct an approximate quantification of their mitigation potentials from solid waste management, where local or specific tools are not available.

3.3.1.2. GHG Emissions from Waste Sector in Representative Countries

There is still limited quantitative data on GHG emission from the waste sector in developing Asian countries. Based on available secondary data sources such as the first and second National Communications to the UNFCCC and other publications, GHG emissions from waste management in representative countries are summarized in *Table 3-18*.

Table 3-18. *Trends of GHG emissions in representative countries*

Country	GHG emission (Mt CO_2eq)								
	1990	1994	1995	2000	2005	2007	2010	2011	2014
Bangladesh							2.19[a]		
Cambodia		0.27[b]		0.23[a]					
China		162.12 [c]			110.78[a]				
India		49.84[a]				57.73[a]			
Indonesia		8.44[d]		157.33[e]	166.83[e]				
Japan	37.9[a]		42.7[a]	45.0[a]	42.0[a]	39.8[a]	36.6[a]	36.2[a]	37.4[a]
Malaysia		26.92[f]		26.36[g]					
The Philippines									
Singapore							1.18[a,1]		
Thailand		0.74[h]		9.32[a]			9.99[a]		
Viet Nam		2.57[i]		7.9[a]	8.29[a]		15.35[a]		
Pacific Island Countries									

Note: Mt = Million tonnes

Source: [a]Country Chapter; [b]MOEC, 2002; [c]SDPC, 2004; [d]Sugandhy, et al., 1999; [e]SME, 2011; [f]MSTEM, 2000; [g]MONREM, 2011; [h]MSTET, 2000; [i]MONREV, 2003; [1]By waste incineration

In Cambodia, there has not been any significant change in total GHG emissions from the waste sector between the years 1994 and 2000. However, it was identified that the emissions associated with solid waste disposal increased from 0.12 Mt CO_2eq in 1994 (*MOEC 2002*) to 0.20 Mt CO_2eq in 2000 (*MOEC 2016*). In addition, it was reported that the majority of GHG emissions from land disposal of solid waste was equivalent to 93% of emissions from the waste sector in 2000 (*MOEC 2016*). Overall, the emissions from the waste sector represented only three percent of total GHG emissions (*IPCC 2007*).

In China, GHG emissions from the waste sector made up 1.5% of total emissions in 2005 (NDRC, 2012). Approximately 62% of GHG emissions from the waste sector in China were attributed to solid waste management, primarily from final treatment, with the remainder from wastewater treatment. China has sought to install more advanced waste incineration technology as an alternative to developing more landfills, and made efforts to recover landfill gas for energy generation. Consequently, it is projected that GHG emissions from solid waste management

will decline in China over the coming years.

In Indonesia, there is a large notable difference in the amount of GHG emissions generated by the waste sector between the years 1994 and 2000. Our review indicated that this variation is likely associated with the inclusion of wastewater treatment to its national inventory in 2000, whereas the country's estimation in 1994 only included solid waste. In 2000, wastewater treatment has contributed to 86% of GHG emissions from the country's waste sector. In the same year, the emissions from solid waste treatment was 21.18 Mt CO_2eq, about 2.5 times higher than that in 1994 (*SME 2011*). Furthermore, it predicted that the GHG emissions from solid waste disposal would rise to 43 Mt CO_2eq in 2010. Overall, the share of GHG emissions from the waste sector in 2000 comprised 11% of the country's total emissions. Accordingly, the Government of Indonesia has prioritized GHG emissions reduction from the waste sector by introducing 3R approaches. A new law on waste management aligned with the 3Rs has been in force since 2008 to mandate such practices.

Annual GHG emissions data are available in Japan, which is useful in tracking overall emissions trends over time. The majority of GHG emissions from the waste sector in Japan comprise CO_2 from incineration. However, because many incineration facilities generate electricity, emissions associated with this activity are reported under the energy sector. Since 2000, Japan's promotion of its Sound Material Cycle Society policy has worked to promote continuous reductions in waste generation, while at the same time increasing the overall recycling rate and minimizing waste sent for incineration. Taken together, these efforts have moderately contributed to reducing GHG emissions.

The World Bank has reported that GHG emissions in Malaysia continued to increase between the period of 1970 and 2000 (*World Bank 2014*). However, as *Table 3-18* shows, there was not any significant change of GHG emissions associated with the waste sector between years 1994 to 2000. GHG emissions from the waste sector contribute to 11.8% of national GHG inventory in 2000 (*MONREM 2011*).

In Singapore, GHG emissions from the waste sector are mainly attributed to waste incineration. In line with IPCC Guidelines, GHG emissions from WtE are reported under the energy sector. As a result, the share of GHG emissions from Singapore's waste sector appears lower than other countries. However, the country reports that GHG emissions from WtE contributed 1.18 Mt CO_2eq in 2010. The Government of Singapore has aimed to further reduce GHG emissions by setting a target for increasing its recycling rate to 70% by 2030.

In Thailand, GHG emissions from the waste sector significantly increased between 1994 and 2000, influenced both by rapid economic growth and upgrading of waste disposal and treatment sites for solid and liquid waste. In 2000, GHG emissions from solid waste (59%) was slightly higher than wastewater (49%). Overall, GHG emissions from the waste sector comprised approximately 4% of the country's total GHG emissions in 2000 (*ONEP 2011*).

In Viet Nam, GHG emissions from the waste sector have progressively increased. In addition, the waste sector's contribution to overall emission increased from 5.3% in 2000 to 6.2% in 2010 (DMHCC/MONREV and JICA, 2014). In 2000, the main source of GHG emissions from the waste sector was associated with solid waste disposal (70.6%). It was noted that the method and data used for the estimation of emissions from waste was inconsistent. Therefore, a

comparison of GHG emissions over respective years may not be accurate, instead just demonstrating a general trend. Nevertheless, it is likely that data availability on the country's first National Communication would be limited. This situation may also be similar to other countries where data collection with accurate measurement is not routinely practiced. Consequently, any assessment of GHG emission trends in each country should be analyzed together with those of waste generation, waste composition and waste treatment for each respective year. It will also be beneficial for monitoring measures and planning actions/ responses in the future to calculate total GHG emissions based on different categories of waste treatment, such as landfill, composting, incineration and waste water treatment.

As a whole, changes in the global warming potential (GWP) among IPCC published guidelines should be noted. For the first and second National Communication to the IPCC, the GWP for 100-year time horizons is applied; as per the second assessment report: 21 for CH_4 and 310 for N_2O (*IPCC 1996*). However, the value of 25 for CH_4 and 298 for N_2O were recommended in the fourth assessment report (*IPCC 2007*), and the value of 28 for CH_4 and 265 for N_2O were recommended in the fifth assessment report (*IPCC 2014*).

3.3.1.3. General Assessment

It has been observed among the Asia Pacific countries that for advanced economies (such as Japan, Singapore, Malaysia and China), GHG emissions from waste sector has been declining since 2000, while it is increasing in other developing economies except Cambodia (India, Indonesia, Thailand and Viet Nam). It might be explained by the introduction and implementation of 3Rs practices in these advanced countries, and the absence or limited application of these measures in developing economies. 3R practices should be prioritized to optimize resource circulation, energy savings and landfill diversion. Doing so requires a careful evaluation of different waste treatment approaches and methodologies (i.e., material recovery, composting, anaerobic digestion, incineration, sanitary landfill, etc.) from not only the perspective of GHG emission reduction potentials but other environmental, economic and social aspects as well. In this regard, it is important to remember that the sustainable operation of various treatment technologies largely depend on factors such as waste composition and characteristics, proper segregation and collection practices, as well as long term operational costs.

Data on GHG emissions from the waste sector in Asia and the Pacific remains limited and is still in the process of being compiled. Continued efforts are necessary for the proper collection and reporting on GHG emissions as well as mitigating emissions through landfill diversion and promotion of the 3Rs.

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3.3.2. Indicators based on macro-level material flows (Indicator IV)

The global consumption of natural resources is soaring, especially in rapidly industrializing economies. This increasing demand is depleting natural resource stocks and is also a major driver for other environmental problems, including climate change and biodiversity loss. Therefore, promoting sustainable resource management and enhanced resource efficiency including the 3Rs have become an important policy agenda for realizing sustainable development. Accounting and analyzing rates of resource extraction and consumption, as well as waste and emissions is essential for the effective planning of resource efficiency policies. Material Flow Analysis/Accounting (MFA) is an analytical method of quantifying flows and stocks of materials in a system. MFA can be applied at several levels, such as product, regional and national economy level and be directed at selected substances and materials, or at total material input, output and throughput (*Bringezu and Moriguchi 2002*). In principle, MFA can show not only types and amounts of natural resources flowing into the economy, but also determine how material-efficient an economy is and assess the environmental burden due to resource use associated with economic activities.

When applied to a national/regional level, MFA is referred to as economy-wide material flow accounting (EW-MFA), the most widely used to assess national resource consumption trends and resource efficiency at the macro level.

Several countries (Japan, Germany, China, EU and some European countries) have utilized the indicators derived from EW-MFA to evaluate and monitor progress of policies with regard to the 3Rs and resource efficiency. For instance, Japan, Germany and other countries have set targets for resource productivity to promote 3Rs practices and resource efficiency activities. OECD (*2016*) emphasizes the importance of indicators and setting targets to facilitate policies, focusing on its effectiveness such as providing a future vision, coordinating actions among actors, providing benchmarks to encourage public engagement, and communicating metrics of success as a signal of action on certain issues. The International Resource Panel (*UNEP/IRP 2016*) report for G7 Toyama Environment Ministers' meeting also strongly recommends the setting of targets in order to offer incentives for policy makers and business to prioritize resource efficiency; it suggests that such targets can be effective in driving performance, as well as establishing a common view of the future between government, industry and society.

OECD has developed a comprehensive set of guideline documents called "Measuring Material Flows and Resource Productivity" on EW-MFA[21]. Eurostat also has developed the guideline of EW-MFA "Economy-wide material flow accounts and derived indicators - A methodological guide, 2001 edition" and "Economy-wide Material Flow Accounts (EW-MFA), Compilation Guide 2013" for EU countries to report their status at annual basis[22].

3.3.2.1. Definition

The following indicators are commonly used in EW-MFA to measure the resource efficiency at the national level. A correlation of indicators is shown in *Figure 3-7*. These indicators are reported in terms of weight (i.e. tonnes):

[21] Available at: http://www.oecd.org/env/indicators-modelling-outlooks/resourceefficiency.htm
[22] Available at: http://ec.europa.eu/eurostat/web/environment/methodology

(1) Input Indicators

- **Domestic extraction used** (DEU): **DEU** measures the flows of materials that originate from the environment and physically enter the economic system for further processing or direct consumption.
- **Direct Material Input** (DMI): **DMI** comprises all materials which have economic values and are directly used in production and consumption activities with in a country.
  - DMI = DEU + import.
- **Raw Material Input** (RMI): **RMI** measures DMI comprises all materials which have economic values and are directly used in production and consumption activities with in a country with embedded raw material equivalents of imported products.
  - RMI=DMI+ Raw Material Equivalents of Imported Products
- **Total Material Requirement** (TMR): **TMR** includes the indirect (used and unused) material flows associated with the extraction of resources.

(2) Consumption Indicators

- **Domestic Material Consumption** (DMC): **DMC** represents the total quantity of materials used within an economy.
  - DMC = DMI – Exports.
- **Raw Material Consumption** (RMC): **RMC** measures the raw material equivalent materials used within an economy.
  - RMC=RMI- Raw Material Equivalents of Exported Products.
- **Total Material Consumption** (TMC): **TMC** measures the total material use including indirect flow[23] associated with domestic production and consumption activities.
  - TMC = TMR- exports and its indirect flows.

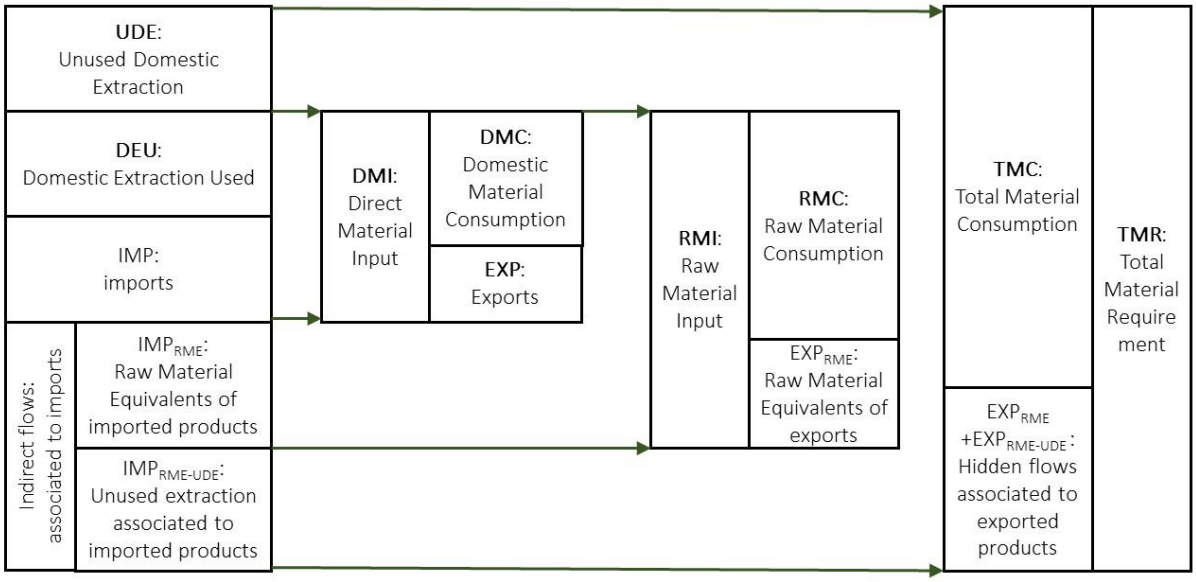
(3) Balance Indicators

- **Physical Trade Balance** (PTB): **PTB** expresses whether imports exceed exports of a country, and to what extent domestic material consumption is based on domestic resource extraction or on imports from overseas.
  - PTB reflects the physical trade surplus or deficit of an economy.
  - PTB = Imports-Exports.

(4) Resource Efficiency Indicators

- GDP/DMI, DMC or RMC: economic production per unit of resource input or consumption.
  - Japan uses GDP/DMI to measure its resource productivity to monitor the progress of its Fundamental Plan for Sound Material Cycle Society.
  - Germany uses raw material productivity: GDP/DMI-biomass for its National Sustainable Development Strategy.
  - The EU employs GDP/DMC as a headline indicator for the assessment of its resource efficiency policy.
  - UK employs GDP/RMC as a part of Sustainable Development Indicator.

[23] Indirect (Hidden) Flows: materials that are extracted or moved, but do not enter the economy such as unused materials from mining operations. OECD defines the flow as the "displacement of environmental assets without absorption into the economic sphere".



Source: EC (2012)

Figure 3-7. *Correlation chart of material flow Indicators*

Table 3-19. *Material flow indicators*

Category	Indicators		Accounting rule
Input	DEU	Domestic Extraction used	
	DMI	Direct Material Input	DMI= DEU + Imports
	RMI	Raw Material Input	RMI=DMI+ Raw Material Equivalents of Imported Products
	TMR	Total Material Requirement	TMR=DMI+HF(unused extraction and IF)
Consumption	DMC	Domestic Material Consumption	DMC=DMI-exports
	RMC	Raw Material Consumption	RMC=RMI- Raw Material Equivalents of Exported Products
	TMC	Total Material Consumption	TMC=TMR-Exports-hidden or indirect material flows of exports
Balance	NAS	Net Addition to Stock	NAS=DMI-DPO-Exports
	PTB	Physical Trade Balance	PTB=Imports-Exports
Output	DPO	Domestic Processed Output	DPO=emissions + waste + dissipative flows
	DMO	Direct Material Output	DMO=DPO + Exports

Source: added by author based on Eurostat (2001)

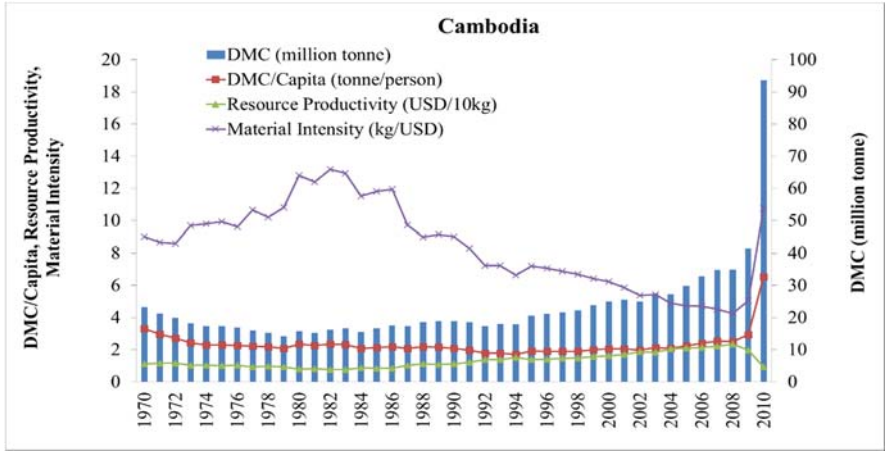
3.3.2.2. Situation in Representative Countries

A time-series data of domestic material consumption, material intensity and resource productivity (GDP/DMC) is presented in *Figure 3-8* based on the data of UN Environment Live,[24] with the following observations to note:

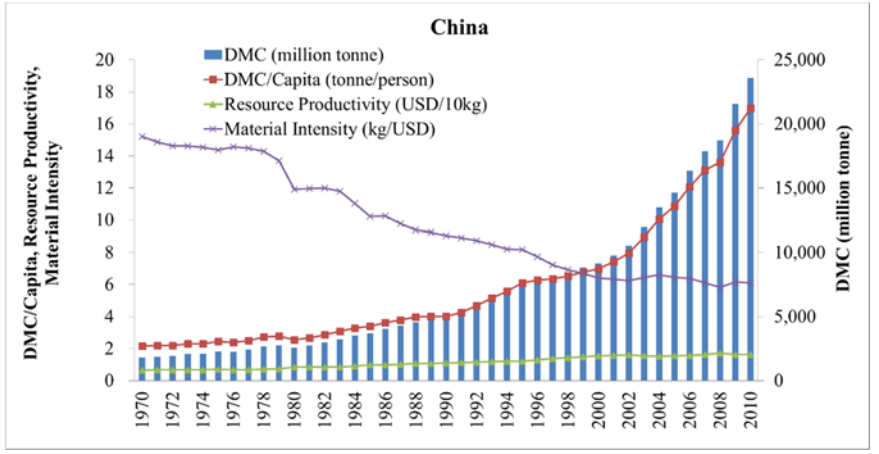
[24] UNEP with the cooperation of CSIRO (Commonwealth Scientific and Industrial Research Organisation) provides estimates of national total domestic extraction, DMC, and PTB or most countries in the Asia and Pacific region. These databases include indicators related to resource efficiency (GDP/DMC etc.) as well as four major and eleven detailed different categories of material-related data for extraction, DMC, and PTB

- ***Cambodia***
  DMC, DMC per capita and material intensity dramatically increased in 2010.
- ***China***
  DMC has increased due to increasing use of construction materials in particular. DMC per capita is the highest among Asian countries. But, material intensity has been decreasing despite continued economic growth.
- ***India***
  DMC Per capita in India is still relatively low. However DMC is likely to increase rapidly. Material intensity has also been decreasing considering its economic growth.
- ***Indonesia***
  DMC steeply increased from the late 1990s. Changes in DMC per capita remains relatively small. Material Intensity/ Resource productivity (RP) has been stagnant since late 1980s.
- ***Japan***
  DMC and DMC per capita has been on the decreasing trend since the 1990s. RP has been improved steadily.
- ***Malaysia***
  DMC steeply increased after 1990. Material intensity/RP has been static, with slight improvement from the 2000s.
- ***The Philippines***
  DMC shows increasing trend, but DMC/capita has been roughly at the same level since 1970. Resource productivity has been slightly increasing.
- ***Singapore***
  DMC shows a decreasing trend in early 2000, but increased as of late. Material intensity has been kept relatively low.
- ***Thailand***
  DMC steeply increased from late 1980s, but decreased drastically in late 1990s, and has been stagnant after 2003. Material intensity shows a decreasing trend in general.
- ***Viet Nam***
  Resource consumption is at a very high level compared to other countries. Resource intensity increased particularly after the late 1990s.

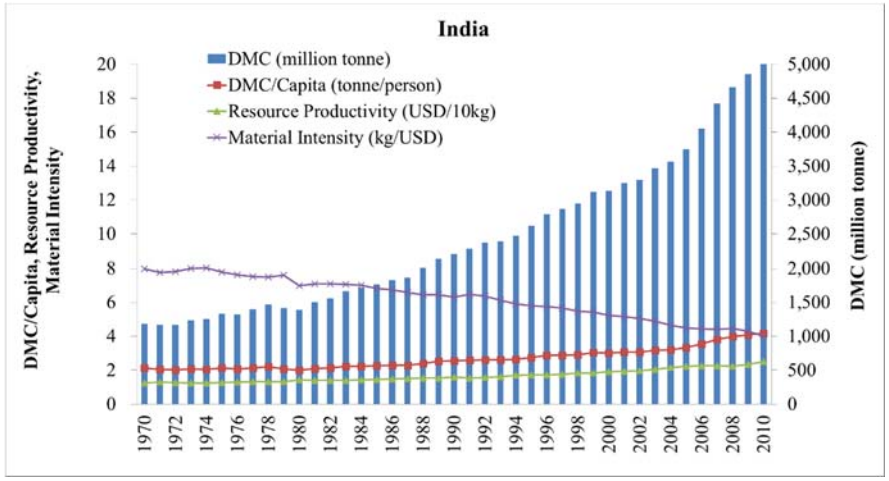
between 1970-2008 Available at CSIRO and UNEP Asia-Pacific Material Flows online database http://www.cse.csiro.au/forms/form-mf-start.aspx or
UN Environment Live: http://uneplive.unep.org/search/result/natural%20resources#



Cambodia



China



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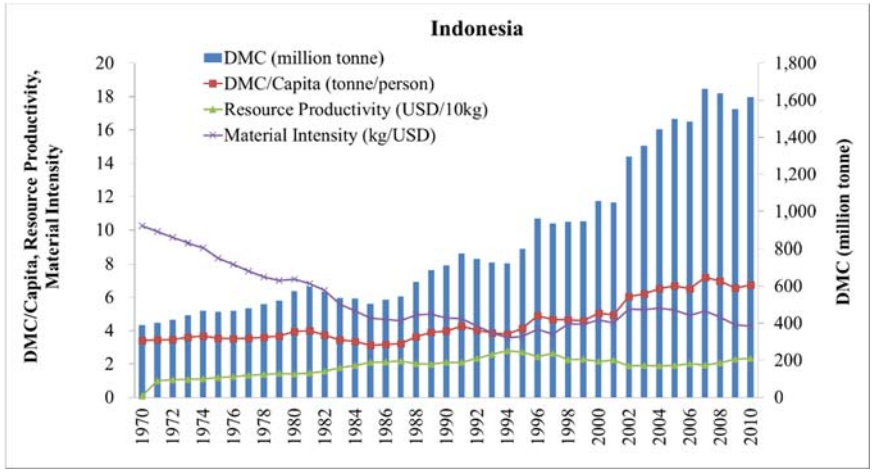
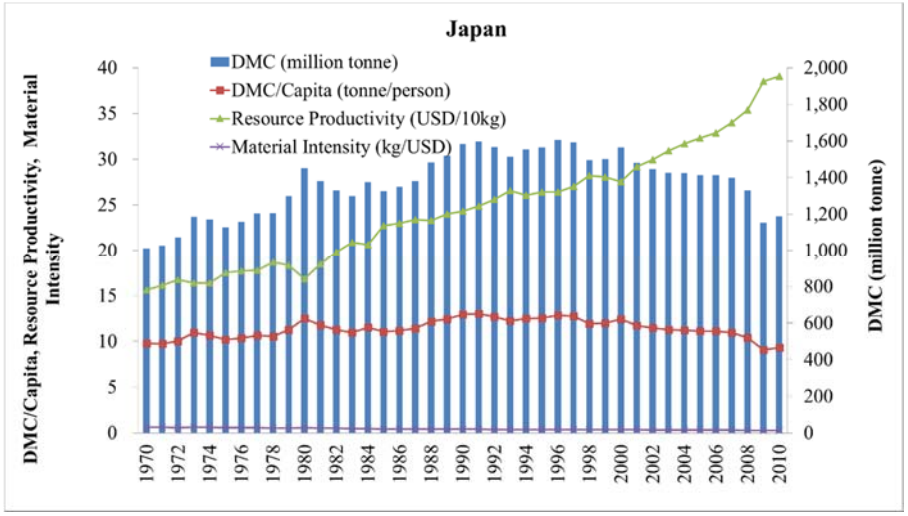
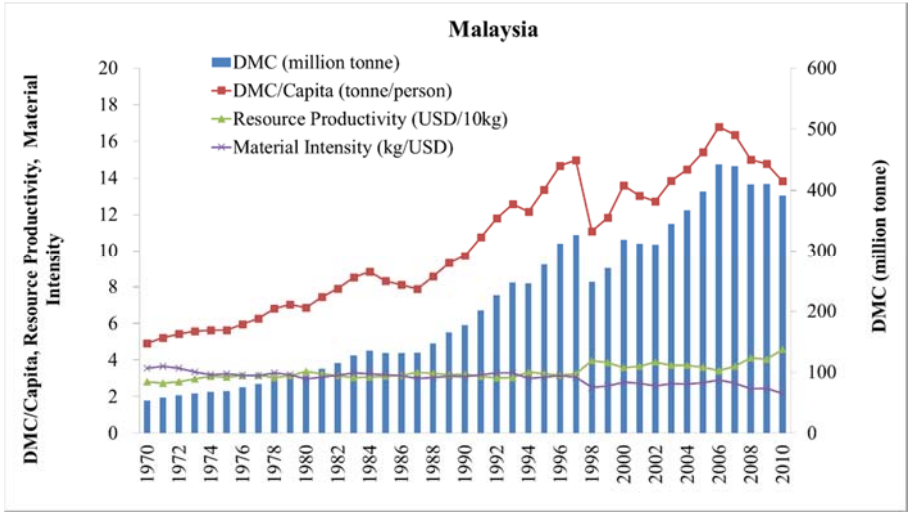


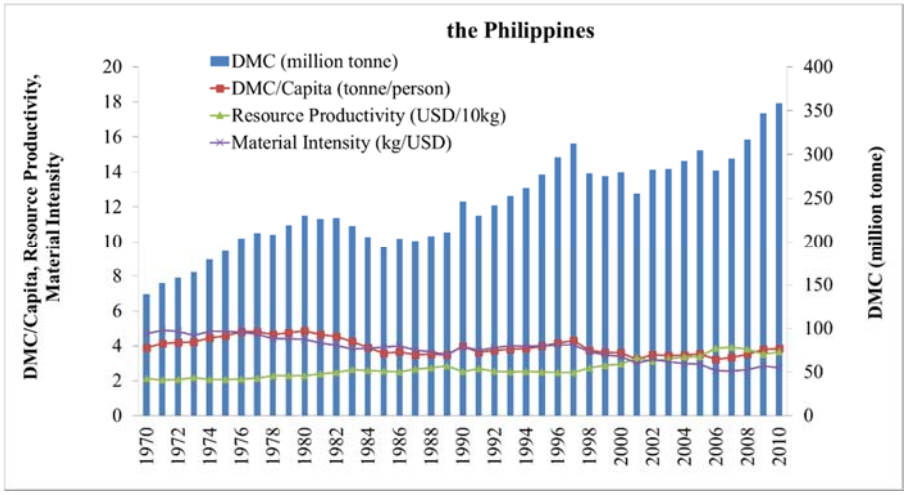
Indonesia



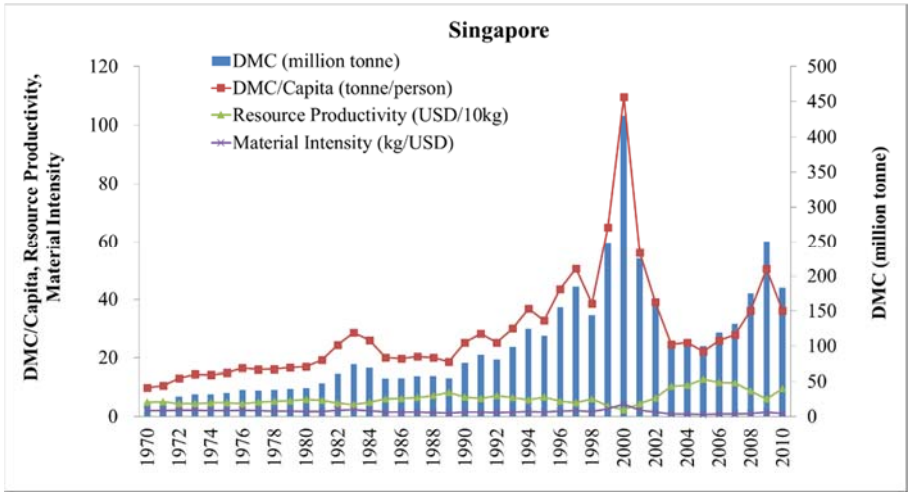
Japan



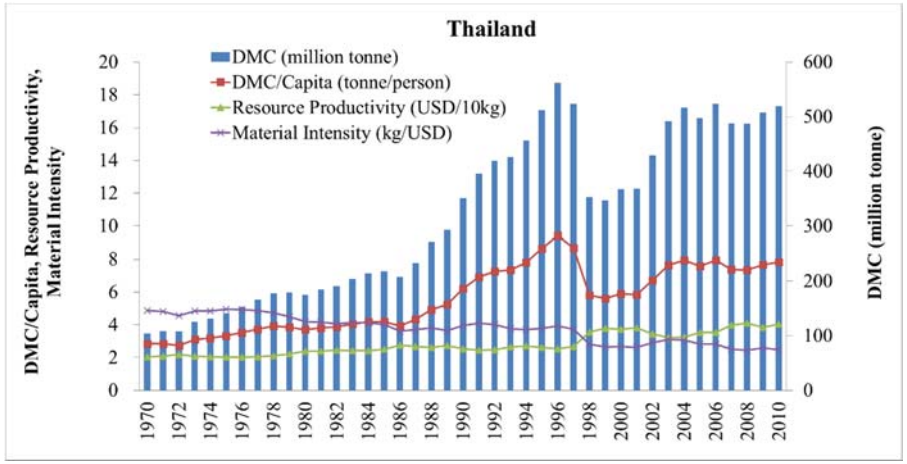
Malaysia



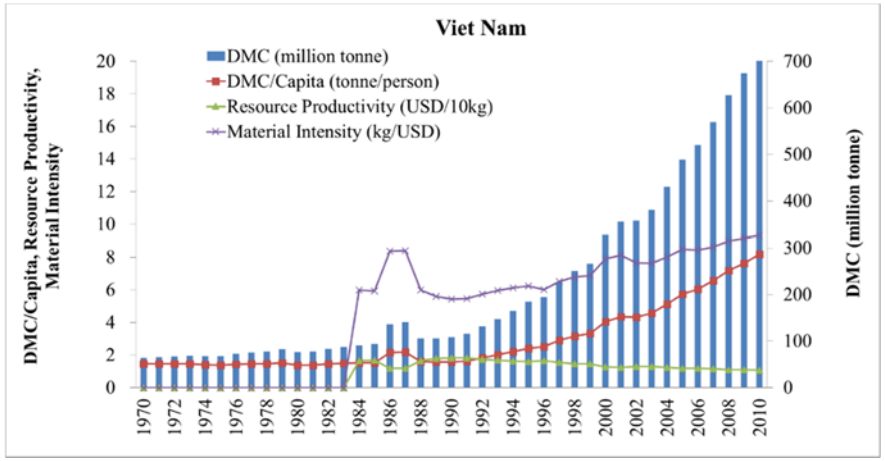
The Philippines



Singapore



Thailand



Viet Nam

Source: compiled by author based on UNEP-Live

Figure 3-8. *DMC, resource productivity and material intensity (1970-2010)*

3.2.2.3. General Assessment

The application of EW-MFA at the national policy arena has become a fast-growing field of research with increasing policy relevance (*Bringezu and Moriguchi, 2002*), but its application is still very limited in developing countries *(Aoki-Suzuki et al., 2012)*. In the developing countries surveyed by *Aoki-Suzuki et al. (2012)*, a large number of organizations, including government and academia, are collecting statistics relevant to MFA, but data collection is fragmented due to a lack of coordination between actors. Thus, it is difficult to get an overview of existing data among stakeholders. *Aoki-Suzuki et al. (2012)* recommended increasing international collaborative efforts that focus on the (i) establishment of national focal points for MFA data collection and compilation in a country, (ii) development of case studies illustrating how MFA has provided policy makers with an improved basis for policy assessment, (iii) training and capacity development to harmonize data definitions and documentation formats, building on the work already done by the OECD and the EU, and (iv) international collaborative research projects to further develop the capacity of academia and research institutes for MFA.

Resource efficiency and the 3Rs is a cross-cutting international agenda and have been highlighted particularly in Sustainable Development Goal (SDG) 12 (Sustainable Consumption and Production). Countries in Asia and the Pacific, where resource demand is increasing, would benefit from developing resource efficiency policies and a set of indicators based on macro-level material flows. The timing for developing such policies and indicators, as well as the diverse characteristics of different economies and economic structures should be carefully considered to foster effective actions in the context of each country.

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4. Experts' Assessment of Policy Readiness for Related Ha Noi 3R Goals and Progress at Regional Level

This assessment is based on information collected through Country Chapters prepared by experts for the State of the 3Rs in Asia and the Pacific Project.

4.1. List of Selected 3R Goals

The following 9 goals are related to this report.

Goal 1: Significant reduction in the quantity of municipal solid waste generated, by instituting policies, programmes and projects at national and local levels, encouraging both producers and consumers to reduce the waste through greening production, greening lifestyle and sustainable consumption.

Goal 3: Achieve significant increase in recycling rate of recyclables (e.g., plastic, paper, metal, etc.), by introducing policies and measures, and by setting up financial mechanisms and institutional frameworks involving relevant stakeholders (e.g., producers, consumers, recycling industry, users of recycled materials, etc.) and development of modern recycling industry.

Goal 9: Develop proper classification and inventory of hazardous waste as a prerequisite towards sound management of hazardous waste.

Goal 11: Promote full scale use of agricultural biomass waste and livestock waste through reuse and/or recycle measures as appropriate, to achieve a number of co-benefits including GHG emission reduction, energy security, sustainable livelihoods in rural areas and poverty reduction, among others.

Goal 12: Strengthen regional, national and local efforts to address the issue of waste, in particular plastics in the marine and coastal environment.

Goal 13: Ensure environmentally sound management of e-waste at all stages, including collection, storage, transportation, recovery, recycling, treatment and disposal, with appropriate considerations on working conditions, including health and safety aspects of those involved.

Goal 15: Progressive implementation of "extended producer responsibility (EPR)" by encouraging producers, importers and retailers and other relevant stakeholders to fulfill their responsibilities for collecting, recycling and disposal of new and emerging waste streams, in particular e-waste.

Goal 17: Improve resource efficiency and resource productivity by greening jobs nation-wide in all economic and development sectors.

Goal 18: Maximize co-benefits from waste management technologies for local air, water, oceans, and soil pollution and global climate change.

4.2. Experts' Assessment of Progress in Policy Readiness for Related 3R Goals

Based on the collected information and data from each country report, the current status of Asia Pacific countries in terms of policy readiness in selected Ha Noi 3R Goals is summarized in *Table 4-1*.

Table 4-1. *Progress in policy readiness for related Ha Noi 3R goals*

Ha Noi Goals	Country											
	Bangladesh	Cambodia	China	India	Indonesia	Japan	Malaysia	The Philippines	Singapore	Thai land	Viet Nam	Palau
Goal 1 (MSW)	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓
Goal 3 (RR)	✓✓✓	–	✓✓✓	✓✓✓	–	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓	✓✓✓
Goal 9 (HW)	✓	✓	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓	✓
Goal 11 (Agri.)	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	–	–	✓✓✓	✓✓✓	–
Goal 12 (Marine)	–	–	✓✓	✓✓	–	✓✓✓	✓	–	✓✓✓	✓✓✓	✓	✓
Goal 13 (E-waste)	✓✓	✓✓✓	✓✓✓	✓✓✓	–	✓✓✓	✓✓✓	✓	✓	✓✓✓	✓	✓
Goal 15 (EPR)	✓✓	–	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓	✓	✓	✓	✓✓	✓✓✓
Goal 17 (MFA)	–	–	✓✓	✓✓✓	–	✓✓✓	✓	✓✓✓	✓	✓✓✓	✓	–
Goal 18 (GHGs)	✓	–	✓✓✓	✓✓✓	–	✓✓✓	✓✓✓	–	✓✓✓	✓✓✓	✓✓	–

Notes: ✓✓✓ National law/regulation incorporating 3R principles has been enforced;
✓✓ National law/regulation has been enacted but not yet (fully) implemented;
✓ Department-level regulation and/or project-based implementation and/or informal sector activity exists/National level policy yet to be prepared;
– Actions yet to be initiated or insufficient data and information

Source: prepared by IGES based on the data and information of Country Chapters, State of the 3Rs in Asia and the Pacific

Bangladesh

Bangladesh's adoption of 3R strategy in 2010 before having a formal or comprehensive waste management policy reflects the advantage that a late starter in the development process potentially has. As a labor abundant and material scarce economy, with a large number of urban poor engaged in waste related livelihoods, waste recovery rate in the country is high. But, waste recycling rate stands at 12% in 2015. With the new initiative of establishing organic compost plant in each secondary city and in view of the fact that organic compost in Bangladesh still accounts for about 75%, the recycling rate is bound to increase in the years ahead. Bangladesh's recycling rate target, 15% by 2020, is thus well backed-up by necessary policy and action programs. The next course of action that can be expected involve entrusting one single authority for (i) compiling all 3R-related policies spread over in different government sectoral policy documents, (ii) enforcing those policies, (iii) setting physical targets of recycling, and (iv) evaluating the performance.

Cambodia

Cambodia developed a national strategy on 3R for waste management in 2008 as a response to the objectives of the 3R Initiative of the "Ministerial Conference on the 3R Initiative" in Tokyo, held in April 2005, which aims to reduce, reuse and recycle waste and products to the extent economically feasible. This strategy focuses on waste management by households, industries and health sector with particular consideration for waste collection for proper disposal at landfills, waste separation for recycling purpose, waste composting, and developing and operating landfills properly. The strategy further specified targets for 3R implementation: (i) by 2015, solid waste separation for recycling should be between 10 to 20% for household, 30 to 40% for business areas and 50% for industrial wastes, while organic waste composting is about 20% for household organic wastes (including business centers), and (ii) by 2020, solid waste separation for recycling purpose should be increased to 50% for households waste, 70% for business areas and 80% for industrial wastes, while waste composting should be doubled to 40% for household organic wastes and 50% for organic wastes from business centers. While indicators and targets have been identified, there is difficulty in assessing progress because of the absence of a formal survey on 3R practices in the country. But, based on actual practice and observation, waste separation at sources is higher than the target indicators. The main purpose of the practice of waste separation is to sell the value recyclable materials to Viet Nam and Thailand. As for 3R recycling activity in country, it still seems limited.

China

Faced with a rapid increase in waste generation along with a shortage of environmentally sound disposal facilities, the establishment of laws and policies on waste management and 3Rs has made considerable progress since 2000. The enactment of the *Law of the People's Republic of China on the Promotion of Clean Production* in 2002 laid the legal foundation for fully enhancing the implementation of "3R" activities in enterprises. The newly revised *Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Wastes* in 2004 identified "3R" as the basic principle in the management of solid wastes. It also introduced the new system of extending producers' responsibility in the management of major solid wastes, and clearly defined the responsibility and policies of the central government in fostering and vigorously developing the resource recycling industry. In addition, major policies and laws have been issued one by one since 2004 to support resource efficiency, and resource and energy savings, including the *Renewable Energy Law of the People's Republic of China* in 2005, the *Circular Economy Promotion Law of the People's Republic of China* in 2008, the *Regulations on Management to Recovery and Treatment of Waste Electrical and Electronic Equipment in 2008*, and the *Regulations on the Recycling of Waste and Old Resources*. As a

result, the MSW generation per capita in urban areas show a decreasing trend, and the recycling rate of ISW and the waste disposal rate of MSW, IW and HW are rising.

According to the 13th Five Year Plan, the construction and expanding of eco-industrial parks, implementation of EPR, waste separation at source, 3Rs of food waste and construction and demolition waste, as well as expanding the scope of services from urban to rural areas will be strengthened in the following five years.

Solid waste management involves many government departments, and different ministries are responsible for different kinds of wastes in China. In practice, managing a particular kind of waste tend to involve other departments. For example, MSW management and 3R system covers the MSW collection, transportation and treatment system is the responsibility of the Ministry of Housing and Urban-rural Development (MOHURD), whereas and recyclable waste recycling system is under the Ministry of Agriculture (MOA) and the National Development and Reform Commission (NDRC). Meanwhile, Local Authorities are in charge of the collection of MSW, building and operating of MSW facilities, treatment and disposal of MSW, and recycling and reuse of recyclable waste. How to efficiently link the waste management and resource management to realize the integrated waste/resource management by strengthening cooperation of the relative government sectors, as well as the participation of relative stakeholders are key challenges.

India

India has a tradition of protecting the environment since the ancient time and in the modern society establishing the Factory Act 1948 encouraged factories to do so by incorporating several actions for controlling the use of materials, chemicals and water, and the recycling of such. After the UN Conference on Human Environment in 1972 and the amendment in the constitution, India started its second stage of journey towards environmental protection and resource conservation by introducing a series of recycling-related legislation from Water Act 1974 to MSW rules 2000. As India experienced a steady increase in the amount of waste generation, there came several challenges in the implementation of the MSW rules 2000, such as keeping the per capita waste generation steadily at lower level with an increase in recycling rates and final treatment of MSW. Although its recycling rate is not as high as some of advanced countries such as Japan, Germany and many others, it is steadily improving, reaching 27% in 2016. With several schemes like, JNNURM, SBM and AMRUT, India is progressing well towards a material recirculation-based society.

With the experience of implementing various rules pertaining to waste management, India has come to emphasize more the concept of 5Rs - Reduce, Reuse, Recover, Recycle and Remanufacture, which includes the 3Rs and the promotion of the Circular Economy. Thus, all existing rules have been revised and new rules on waste management have been formulated in 2016. India has taken several initiatives in utilizing renewable energy sources such as biomass, solar energy, hydro power and wind power. In India, initiatives have been undertaken for the construction and expending of eco-industrial parks, implementation of EPR, waste separation at source, several treatment including composting, energy recovery with least amount to landfill, 3Rs of construction and demolition waste, hazardous waste, plastics wastes, utilization of bio resources, as well as expanding the scope of India in strengthening the 3R initiatives in near future. Most of the initiatives support the Ha Noi 3R goals.

Indonesia

It is difficult to assess progress made on the 3R goals without reference to comprehensive data.

Indonesia has made efforts to address 9 selected Ha Noi 3R-related goals in the following manner:

Goal 1: Specific policies, programs and projects related to MSW at the national and local levels have been introduced, with an emphasis on community participation.

Goal 3: Recycling rate for materials such as plastic, paper, metal, etc. in Indonesia is relatively high particularly among the informal sector. The introduction of waste banks and transfer stations will enhance recycling activities in relation to this goal. However, the integration of this activity, particularly in establishing financial mechanisms and institutional frameworks with the involvement of relevant stakeholders (e.g., producers, recycling industry, users of recycled materials, etc.) and development of modern recycling industry is still lacking.

Goal 9: Classification and inventory of hazardous wastes is clearly mandated in GR 101/2014, but is not in effect for small and household industries.

Goal 11: Large agricultural industries including palm oil related industries are working towards recovery and utilization of biomass waste.

Goal 12: Indonesia is taking initial steps to address marine litter and coastal plastic waste by initiating projects and programs, particularly in tourist areas.

Goal 13, 15, 17, 18: No significant progress has been observed on these goals.

Japan

With the introduction of series of recycling-related legislation from mid-1990s to 2000s along with the Basic Act of Sound Material Cycle Society in 2000 and Fundamental Plan in 2003, Japan is experiencing steady decrease in the amount of waste generation and final treatment of MSW. Although its recycling rate itself is not high as some of advanced EU countries such as Germany, recycling rate is also steadily improving. Based on this steady progress and in the 3rd Fundamental Plan of Sound Material Cycle Society, Japan has emphasized more on first 2Rs of the 3Rs; namely "Reduce and Reuse". In addition, Japan advocated for the 3Rs and resource efficiency in the 2000s and 2010s. After Japan experienced the Great East Japan Earthquake, Japan achieved over 80% recycling rate of disaster waste generated by the disaster.

In 2016, Japan hosted G7 Environmental Ministers Meeting, where the Toyama Framework on Material Cycles was adopted. Echoing the adoption of the SDGs and Paris Agreement, this framework calls for several ambitious global actions such as "Our common goal is to realize a society which uses resources including stock resources efficiently and sustainably across the whole life cycle, by reducing the consumption of natural resources and promoting recycled materials and renewable resources so as to remain within the boundaries of the planet". Based on such vision and experience of sound material cycle society, it is time for Japan to next be a role model of socio-technical transition to sustainability within planetary boundaries.

Malaysia

MSW management in Malaysia is at a crossroads following several changes that are being implemented or planned for improvement in the overall services rendered to the public. Waste collection is at par with developed nations and almost all urban MSW is being collected for disposal. However, illegal dumping still occurs sporadically and it can account for 10% of the total MSW generated.

Several recommendations are given to further enhance the quality of waste management, particularly to increase 3R activities:

- Implementation of an Integrated Waste Management policy especially a 3R inclusive one, at an early stage is urgently required.

- Waste separation among the states should be enforced. It is only partially imposed at present and not for all types of households. 3R goals have been only achieved partially.
- A clear transparent strategy on incineration or WtE should be established. This will ensure public support if relevant education is given in advance.
- Biomass utilization should be enhanced. There is tremendous potential in biomass utilization for bioenergy, bio-chemicals, etc.
- Policy on plastic bag usage should be reviewed. A total ban on plastic bags should be considered and bags should gradually be replaced with those made from biodegradable starch-based plastics.
- Role of informal recyclers should be coordinated and formalized. Their contributions should be recognized and data included in the 3R Reports.
- Climate change or global warming could be reduced significantly if these recommendations are applied.
- Hazardous waste management is at a par with developed nations and it should be further improved with more 3R activities within Malaysia to also reduce transboundary movement of hazardous waste. Clear policies on e-waste will reduce the wastage of these resources and increase 3R output.

The Philippines

The increasing trend in waste generation due to modernization, growing population and urbanization in the Philippines, and the threats it poses both to the environment and human health calls for an urgent need for strict implementation of SWM policies particularly 3R.

As cited in the Philippines' RA 9003, although the local government units (LGUs) are primarily responsible for the implementation of the Act, the participation of the private sector and the community is also encouraged (Section 5q). The Act also mandates that the Solid Waste Management Board in every province, city or municipality should have a representative from the NGO sector, recycling industry, and manufacturing or packaging industries (Sections 11, 12). Sections 29 and 30 of the Act prohibit the use of non-environmentally acceptable products and packaging within a year of the Act coming into force, except for those used in hospitals, nursing homes or medical facilities, or those for which there is no commercially available alternatives as identified by the NSWMC. Section 52 allows anyone to file a civil, criminal or administrative action against any individual, institution or agency, or against government officials who violate or fail to comply with the law.

Pursuant to the relevant provisions of R.A. No. 7160, otherwise known as the Local Government Code, the LGUs shall be primarily responsible for the implementation and enforcement of the provisions of RA 9003 within their respective jurisdictions. It mandates the segregation of solid waste at source (Section 21) and the creation of material recovery facility (MRF) in every barangay or cluster of barangays (Section 32). The barangay is responsible for the collection of the segregated biodegradable and recyclable waste while the city or municipality is responsible for the collection of non-recyclable and special waste (RA 9003, Section 10) (Country Chapter, The Philippines).

In terms of policies, as shown in the Philippines' Country Chapter, the country has successfully created "very good or ideal" policies, but the problem or challenge is on effective implementation. Thus, it is important to identify what the issues and challenges are that delay or hinder the implementation of these policies. It is illogical to design a so-called "perfect technical system or set of policies if they cannot be implemented." By careful consideration of the available resources and the constraints, we can avoid the common mistake of "determining

what should be, and instead concentrate on what is possible" (UNEP-IETC 1996: 16 as cited in Atienza, 2013).

The problem on waste is often treated as a technical one, and thus technical solutions are offered. However, it is more of a behavioral problem, needing strong information, education and communication (IEC) campaigns to promote awareness to the community and make citizens empowered and accountable in managing their waste. In 2009, the NSWMC and the Solid Waste Management Association of the Philippines (SWAPP) in collaboration with other international organizations, formulated the "National Framework Plan for the Informal Sector in Solid Waste Management" It envisages the informal waste sector as an empowered and recognized partner in the implementation of 3R and it hopes to integrate this sector in the solid waste management system by "providing them with a favorable policy environment, skills development and access to a secured livelihood, employment and social services (NSWMC 2009: 34)"(Country Chapter, The Philippines).

In addition, through the conduct of multi-sector dialogues, massive IEC campaigns, seminars and workshops, promotion of the non-use/ reduction of use of plastics, Styrofoam and disposables particularly in commercial establishments, the different sectors of the society have become aware of the responsibility and accountability of managing their own waste. This entails dealing with the political, economic, environmental and social factors for effective 3R policy implementation.

The common problems for weak implementation of 3R policies are lack of technical, human and financial resources. However, by looking on the composition and sources of waste in the Philippines, it clearly shows that if only households and commercial establishments would practice waste segregation and manage the biodegradables and recyclables, only very small percentage of residual waste will be left for final disposal. Therefore, expensive and advance technologies may not always be necessary in the Philippines and other developing countries. Instead, the promotion of 3R and the use of simple, local and low-cost technologies should be strengthened. This will reduce pressure on the nation's finite natural resources and can address not only environmental, but also economic and social problems by turning waste into a resource (Atienza, 2013).

In terms of 3R accomplishment, the country is way behind its goals for achieving at least 25% waste diversion in 2006; the rate is steadily increasing from 22.22% in 2006 to 33.92% in 2010 in Metro Manila (MMDA, 2011). Some initiatives to promote waste management and recycling in the country included the following:

a) The DENR's National Search for the Model Cities and Barangays in eco-waste management. Cash and presidential trophies are given to recipients of the awards;
b) Implementation of other programs such as the Incentive Rebates program, waste-for-goods exchange programs, recycling collection events (RCEs), waste markets, among others; and
c) Organizing the informal waste sector to improve the efficiency of recovering recyclable wastes. (Country Chapter, The Philippines)

In terms of data, there is a lack of or limited credible and available data. Thus, there is a need to improve or strengthen the evaluation and monitoring system among LGUs. Based on EMB Environmental Quality Division- Hazardous Waste Management Section of the Department of Environment and Natural Resources (DENR), one of their current initiatives is to put the Self-Monitoring Report (SMR) online for effective monitoring among LGUs and TSDs.

In addition, the Country Chapter author further recommends the need to review the current 3R policies and programs especially in identifying the mechanisms and approaches towards effective implementation, and the institutionalization of effective 3R programs and best practices so that these would be sustainable despite the change of leadership both in the national and local government units.

Singapore

With limited land resources available for waste disposal, the National Environment Agency (NEA) has adopted the following strategies to manage the growth in solid waste generation:

- Minimize and segregate waste at source,
- Develop cost-effective collection, recycling and disposal systems,
- Build a resource-efficient society, and
- Maximize energy and resource recovery as well as landfill lifespan.

Today, Singapore has in place an integrated solid waste management system. Waste that is not reused or segregated at source for recycling, is collected and sent to disposal facilities. All incinerable waste is disposed of safely at WtE plants, while non-incinerable waste and ash residues from the incineration process are disposed of at the offshore Semakau Landfill.

Under the Sustainable Singapore Blueprint, Singapore aims to become a zero waste nation and there is an overall waste recycling rate target of 70% by 2030. Singapore's overall recycling rate has increased from 40% in 2000 to 60% in 2014. Singapore has achieved this through a combination of initiatives, including voluntary partnerships, continued education and outreach on the 3Rs, funding schemes and industry development. Singapore has also started introducing legislation on waste reduction and recycling, such as mandatory provision of recycling receptacles in condominiums/private apartments in 2008 and the mandatory reporting of waste data and reduction plans by large commercial premises (i.e. large hotels and shopping malls) in 2014.

Singapore is conducting trials on food waste recycling and embarked on studies for e-waste and packaging waste. The aim is to better manage and reduce the amount of these targeted waste streams, so as to achieve the overall waste recycling rate target of 70% by 2030. With more waste minimization and recycling, less resources need to be set aside to build disposal facilities, including extending the lifespan of Semakau Landfill which is estimated to last till 2035 and freeing up land which can be used for other purposes.

Thailand

His Majesty the King Bhumibol Adulyadej of Thailand graciously conferred the philosophy of sufficiency economy based on Buddhist principles of self-reliance, self-satisfaction and the middle path on the entire nation in 1997. The philosophy is trusted to lead the nation to balanced development in a more secure way, leading to a more resilient and sustainable economy. The characteristics of sufficiency included moderation, reasonableness and effective self-immunity as risk management related to 3R conditions for decisions and activities based on knowledge and virtue (awareness, honesty, heart). The middle path is the best consideration for action - moderation linking with reduce plus reuse and choosing the right resources to reduce waste; reasonableness linking with reduce plus recycle besides the rational consideration of factors involved and careful anticipation of the outcomes or consequences; and effective self-immunity as risk management linking with preparedness to cope with impact and change.

The National Economic and Social Development Plan has followed the path of sufficiency economy. The national policy and plan regarding the waste has put in motion an environmental-friendly waste disposal system. The Environmental Management Plan 2012-2016 is a specific plan for management of natural resources and environment focused on strategies that (i) minimize waste generations by applying the 3Rs (Reduce Reuse Recycle) principle (ii) integrated waste management technologies for promoting waste utilization and reducing landfill spaces, (iii) cluster solid waste management among municipalities, (iv) encourage Public Private Partnership for solid waste management, (v) introduce economic instrument, and (vi) incentivize measures employing pollution prevention principle such as cleaner technology and production (CT/CP), zero waste technology and green product.

Several policies have been implemented in the last decade that support the implementation of 3R and the management of other wastes. E-waste policy as a part of National Integrated WEEE Management Strategy was approved by the cabinet on 24 July 2007. Draft act on the management of WEEE and other end of life products was approved by the cabinet on 19 May 2015. Roadmap on waste and hazardous waste management was approved by the National Council for Peace and Order on 26 August 2014. The action plan "Thailand Zero Waste 2016" as national agenda include unlocking, promoting and supporting waste utilization based on 3Rs. Waste segregation at sources under Maintenance of Public Sanitary and Order Act (no.2) B.E. 2560 (2017) is fundamental for the country in waste management that can lead to practical achievement.

The implementation of waste management takes on the principle of "One stop service" decentralizing the role of waste management operator to local organizations under the Ministry of Interior; while the Pollution Control Department (PCD), Office of Natural Resources and Environmental Policy and Planning (ONEP) and Department of Environmental Quality Promotion (DEQP) under Ministry of Natural Resources and Environment are involved in waste management as regulator and technical advisor. Capacity building is a prerequisite for choosing technology to be employed in Thai society. In addition, simple activities like donation of goods to temples as an act of loving, kindness and compassion (Buddhism) or exchanged with other goods at Zero Baht Shop (realization that goods can be "purchased" without money) can promote the reuse or recycling of materials collected and segregated from home or public places. This activity promotes sustainable consumption, community waste management and "at-source segregation"

Viet Nam

In Viet Nam, waste management has been regulated by the Law on Environmental Protection 1993 (revised in 2005 and 2014), Law on Environmental Tax (2010), Law on Marine Resources and Environment (2015) and other by-law documents, while directions have also been provided by national strategies. Despite these laws and strategies, waste management still appears to be a challenge. MSW generation is fast increasing at about 10-16% annually. Waste prevention/reduction is still very weak; the separation-at-source is just at a pilot scale; collection rate is about 84-85% in urban areas and 40-55% in rural areas; recycling is implemented mainly by the informal sector; composting is in place, but not widely applied. Most of the MSW are still landfilled in unhygienic dumping sites while some incinerators at bigger scale are being developed.

Upon reviewing the nine goals, it can be noted that there has been limited progress in achieving the 3R goals of Ha Noi Declaration in Viet Nam. Only Goal 11 "biomass waste utilization" has

achieved some progress, while the others are still far from the desired targets. The reduction of MSW has not been achieved although there have been certain polices such as promoting cleaner production. Recycling activities have been promoted, but improvement has not been clearly observed. Regulation on hazardous waste management has been enforced and a manifest system has been developed, but data for hazardous waste remained unpublished. Although there are policies on marine pollution control and on tax on plastics bags, attention on marine litter issue is still limited and just starting. The EPR policy, which also covers e-waste, has been enacted since 2015; however, implementation is still facing many difficulties. The DMC is growing fast while material intensity and resource productivity are not improving. The GHG emissions from waste sector is increasing due to increasing waste volume as well as inefficient application of 3Rs practices.

There are many reasons for the current state of waste management in Viet Nam, but the main reason is the lack of adequate resources for waste management. Besides that, insufficient legislations, inefficient collaboration between relevant ministries and the lack of a monitoring and reporting system hindering the availability of reliable data explain such condition.

Pacific Island Countries

The limitations and challenges faced by countries in the Pacific Region in all respects make it difficult to implement ideal waste management systems which have worked well in Asia or any other more developed regions in the world. As in most countries, economic, social, cultural, political and environmental issues come into play. Although beset with the issue of economy of scale, the 3R initiatives, if well planned, implemented and driven by public-private partnerships can lead to more sustainable management of waste in the Pacific.

The driver to implement 3R in the Pacific Region is very obvious yet logistical considerations seem to be not working in favor of these environmentally sound systems. The significant amount of organic wastes (44%) generated offer huge opportunities to process most wastes within the countries with no requirement to ship out. With 43% potentially recyclable wastes, the Pacific Region is espousing the same desire to minimize wastes amidst the challenges of land constraints, geographical isolation, among others. However, non-profitable recycling business environment oftentimes prevents international or local ventures.

A number of countries in the Pacific Region have endorsed solid and hazardous waste policies or strategies and plans either as part of an integrated policy/strategy or as a stand-alone document. These include Cook Islands, Federated States of Micronesia, Guam, New Caledonia, Palau, Solomon Islands, Tokelau, Vanuatu and Wallis and Futuna. The rest of the countries would have either prepared documents not endorsed or no longer current (SPREP, 2016). Recently, Tuvalu had their integrated waste policy endorsed. Vanuatu had their one updated. Solomon Islands and Fiji had their ones revised to align with the regional strategy but still awaiting endorsement. Almost all of these policies have resource recovery components.

Palau can be cited as a showcase of policy readiness in the Pacific with their Beverage Recycling Law (container deposit legislation). The law enforces charging of additional 10c for imported beverage containers in the form of Recycling Fund for the management of empty containers through redemption and processing/export. The National Redemption Centre operated by the Koror State Government redeems empty beverage containers from the community with a payback of 5c per container. The redemption fee encourages stakeholders to collect and bring the containers to the processing center instead of including these in the general

waste stream for landfill disposal.

The rest of the Recycling Fund is shared between the Koror State for the operation of the Redemption Centre and other recycling activities and the national government for the operation of the landfill and awareness campaigns. Over the years, this sustainable financing mechanism provided complete funding for recycling operation, landfill operation and awareness campaigns with more than 90% of imported beverage containers redeemed.

The Cleaner Pacific 2025 sets strategic actions such as regular data collection/ management and policy development/enforcement, among other things, in the hope of strengthening the institutional capacity of countries to make more informed decisions and enforce the policies to progress on waste management initiatives.

4.3. Summary of Progress of 3R Goals at Regional Level

Although resource productivity has been steadily improving in many countries (Goal 17), total waste generation and material consumption show an increasing trend across the region (Goal 1 and 17). When it comes to actual implementation of legislation and policies on MSW and hazardous waste, progress varies across countries (Goal 1, 3, 9). Steady progress has been made with regard to 3R implementation for MSW management in the region, both in terms of legislation and policy development, as well as actions taken specifically within large cities (Goals 1 and 3). Most countries are enacting policies and guidelines to address hazardous waste management as a national waste management priority, yet important gaps remain, such as development of proper inventories (Goal 9).

With regard to emerging waste issues, e-waste management has been prioritized and a number of countries have started to apply EPR-based policies for e-waste management (Goal 13 and 15). Whilst marine/coastal plastic waste has been given increasing regional attention, concrete actions taken by national governments are limited in most countries (Goal 12 and 15). Several countries are advancing GHG mitigation efforts through landfill diversion and the use of intermediate waste treatment approaches (Japan, China, Singapore); however, more innovative interventions are needed to ensure co-benefits from the 3Rs are more effectively realized in the region (Goal 19).

5. Main Recommendations

Following an assessment of priority needs for the 3Rs as well as progress in 3R policy implementation in the region, this report highlights nine observations from the data and information presented in the two preceding sections, and provided corresponding recommendations aimed at further enhancing multilateral collaboration for 3R promotion and resource efficiency under the Regional 3R Forum in Asia and the Pacific:

a) The Regional 3R Forum's contributions to the participation countries for facilitating 3R policy dialogues and consolidating 3R policies and strategies need to be sustained

Since the launch of 3R Initiative in 2005 and Regional 3R Forum in Asia and the Pacific in 2009, there has been increasing awareness and prioritization of the 3Rs and resource efficiency agenda in the region. There has also been steady progress both with regard to legislation and policy development as well as the implementation of the 3Rs based on different priorities of countries including waste segregation, disaster waste management, the introduction of WtE technologies, packaging recycling and medical waste management, among others. Promoting knowledge sharing and exchange of technical experiences between countries both on good waste management practices and lessons learned from past failures through the Regional 3R Forum in Asia and the Pacific as well as J-PRISM will be useful for continued mainstreaming of 3R-related policies.

b) Continued focus on resource productivity and waste reduction measures are highly recommended

Total direct material consumption and waste generation volumes show an increasing trend across the region whilst resource productivity has been steadily improving in a number of countries. Therefore, continued efforts are necessary to prioritize resource productivity and waste minimization in all countries.

c) New and emerging waste streams need to be addressed in the region

E-waste, marine litter and coastal plastic waste, micro plastics and food waste and loss issues require increasing attention both by policy makers and experts in the region due to their high environmental and social impacts. Interventions should emphasize proper data collection and involvement of relevant stakeholders in line with recommendations listed below.

d) Closing gaps between institutional and investment needs and opportunities are strongly suggested

There are a number of ongoing plans led by countries in the region to invest in waste management infrastructure. However, significant gaps are observed with regard to the pace of government authorities in expanding the supporting infrastructure for waste treatment. Against this backdrop, there has been a growing international trend with regard to the circular use of materials and material reduction aimed at promoting new business models and opportunities. For instance, since the launch of EU's Action Plan on Circular Economy in December 2015 and continued advocacy of the concept by Ellen MacArthur Foundation, there has been rising global interest over circular economy as a leading policy driver for sustainable materials management. Policy makers in OECD countries have begun to understand the necessity of facilitating

investment in private-sector led activities contributing to circular economy including sharing, re-use, product-service systems, and advanced use of ICT (information and communication technologies) to achieve long-term de-carbonization and decoupling of materials use from economic growth. For these reasons, increasing engagement in the region on issues related to circular economy, sharing economy and long-term realization of 3Rs in line with the SDGs will be necessary as has been emphasized at the 7th Regional 3R Forum in Asia and the Pacific (Australia, 2016).

e) Stakeholder engagement and consensus-building-based policy making need to be emphasized

Policy making and implementation of Circular Economy and the 3Rs requires stakeholder engagement and collaboration. Governments in the region need to be aware of the importance of consensus-building-based policy making. Although many developing economies still place efforts on environmental regulations and enforcement of standards, it is also necessary to incorporate long-term strategies and policy visions via multi-stakeholder collaboration. Ensuring timely follow-up of interventions is also key for advancing 3R policy goals. For instance, various 3R-related activities, such as waste segregation, introduction and operation of appropriate technologies, and collection of waste management fees, cannot be carried out without proper understanding of the public and specifically, partnership with local communities. In this regard, it is essential to ensure that the awareness and capacity of local authorities is enhanced to guide effective 3R policy implementation in line with national legislative frameworks. The establishment of policy frameworks for the 3Rs through stakeholder engagement will also help countries to more effectively respond to new and emerging waste streams.

f) Special attention is required to address specific challenges faced by small island countries and remote rural areas in the region

Small island countries and remote rural areas such as mountainous geographies in the region face specific challenges in terms of costs associated with logistics, relatively low volume and dispersed generation of wastes, availability of technologies and facilities for sound waste management, market access for recyclables, and human and financial capacity constraints, among others. Increasing agricultural waste and municipal solid waste present significant threats to sanitation and the health of the residents of rural and remote areas often through surface water contamination or illegal and uncontrolled dumping of waste. The selection of appropriate, simple and affordable technologies together with the promotion of decentralized approaches is therefore recommended.

g) 3Rs need to be highlighted the as a part of the global sustainability agenda

Given that waste management and resource efficiency are well embedded within Paris Agreement on climate change as well as the SDGs, particularly SDG 12 (Sustainable Consumption and Production), it is expected that the 3Rs will continue to be featured strongly in international sustainable development discussions. In this context, the indicators introduced in this report should be further developed and elaborated upon to ensure they are well aligned with concepts of de-carbonization and planetary boundaries.

h) The Regional 3R Forum in Asia and the Pacific should be continued to lead global policy debate on resource efficiency, circular economy, waste management and the 3Rs

Although the Regional 3R Forum in Asia and the Pacific has been instrumental in supporting countries with policy development and implementation of the 3Rs, actors in the region are not yet prepared to lead international debate and discussion on emerging waste issues, including those related to waste, resource efficiency and the SDGs, climate nexus issues, waste containing nano-materials, including micro plastics, marine litter and food waste loss, among others. These issues should feature more prominently in regional discussions.

i) Capacities for data management and evidence-based policy making need to be enhanced for continued progress on the 3Rs

Considering the increasing emphasis placed on long-term policy goal setting and development of corresponding indicators, including among the SDGs and Ha Noi 3R Goals, the State of the 3Rs in Asia Pacific Project will continue to work towards harmonizing measurement processes for 3R policy formulation in the region. In this regard, efforts will also be required to confirm that data is both comparable and credible across countries, as this remains an important challenge for 3R policy and implementation in Asia and the Pacific. For this reason, institutional capacity should be strengthened on improving data management for evidence-based policy making across all countries; continued technical support from regional experts will be crucial to carry forward the work initiated under State of the 3Rs in Asia Pacific project.

Postscript

Dr. Anthony Shun Fung Chiu

Development over the last decades in the Asia Pacific region has brought about changes in the metabolism of society. The growing demand for resources and generation of wastes need the increasing attention of policy makers and planners to properly address not only the downstream aspect of waste management, but also the upstream challenge of sustainable consumption and production and waste prevention.

The Regional 3R Forum in Asia and the Pacific, along with the support of Japan, MOEJ, IGES and UNCRD, continue to be relevant in bringing together countries to support 3R implementation in the region, as well as the reporting of progress in 3R initiatives. This Report has highlighted the importance of having clear goals and indicators and monitoring progress in delivering results in the region, thereby providing evidence to continue the initial practice of preparing country reports.

Baseline data and information are crucial components into which appropriate actions can be formed. The information gathered in this summary report can provide a benchmark for further action planning among countries. The adoption of goals and indicators for 3R and also of those in the Sustainable Development Goals signify that national and regional actions and efforts are needed. Benchmarking on the performance of each country in terms of policies, programs and technologies (Best Available Technology) can aid in the preparation of concerted action towards the same goal of a sound material cycle society through the 3R principle. Countries can assess individual performance and progress against other countries in the region, and determine how effective its policies and programs are in attaining its objectives.

This Report also showed the increasing challenge brought about by emerging waste streams such as e-waste, demolition and construction waste and continuing challenges on managing plastic and food waste, as well as developing small-scale treatment technologies and recovery systems. These topics can use more focused discussions in the next forum to define the national and regional priorities, formulate strategies and collaborative efforts to manage such waste streams.

Alongside the learnings, the Report is also limited by the scope of the Regional 3R Forum in Asia and the Pacific, and identified goals and indicators. Discussions focus on data available from country reports, that is, municipal solid waste. Other specific industrial, medical, and specialized wastes streams like military wastes were not part of the ongoing discussions in the forum although 3R principles can and may be used to manage waste beyond those regularly generated by civil society.

Continuing on with the aim of implementing 3R in the region and with the reporting that this Report has begun, future endeavors may benefit from a standardized format of reporting results and progress on indicators as well as a thematic approach to the forum. Annual reports may become a norm for the forum to be prepared towards the end of the year, summarizing accomplishments (in terms of the indicators), challenges and future plans. While definitions of solid waste vary among countries, reporting of waste generation and recycling rates can be aided by specifying the waste it includes. In addition to the progress and results reporting, a theme may be chosen as a topic for discussion such as marine litter, demolition waste and e-waste to name a few. Having themes can allow sharing of national-level challenges and responses, especially with those countries that have yet to formulate policies for emerging waste streams.

About State of the 3Rs in Asia and the Pacific

Overview of State of the 3Rs in Asia and the Pacific

State of the 3Rs in Asia and the Pacific" is a synthesis and status report to assess current status of 3R policy implementation in the region based on country reports submitted to the Regional 3R Forum in Asia and the Pacific, which is convened by UNCRD with the support of Ministry of the Environment, Government of Japan and other partners.

Objectives of State of the 3Rs in Asia and the Pacific

The overall objective of State of the 3Rs in Asia and the Pacific Programme is to assist the member countries of the Regional 3R Forum in Asia and the Pacific for improved decision making towards effective implementation of 3Rs and environmentally sound waste management at local and national level, including promotion of 3Rs as an economic industry, by improving data, information, and indicators availability in all waste sectors (municipal, industrial, hazardous, WEEE, agricultural and biological, etc.) for achieving a low carbon and resource efficient region. It also aims to contribute to Sustainable Development Goals (SDGs) process in post-2015 development agenda by providing progress of 3R policy indicators in the region.
The specific objectives are: 1) to develop a synthesis and assessment report on the current status of 3R policy implementation in the region based on Country Chapters with national level data and information prepared by the experts; 2) to compile data-relevant information aimed at monitoring the progress of 3R policy implementation in the region in relation to the Ha Noi 3R Declaration (2013-2023); and 3) to contribute to the Regional 3R Forum in Asia and the Pacific by providing science-based advice on existing and future challenges and opportunities, including those on business, socioeconomic and sociocultural aspects of the 3Rs, for effective 3R implementation in the region.

Expected outputs of State of the 3Rs in Asia and the Pacific

Expected outputs of State of the 3Rs in Asia and the Pacific are 1) Regular submission of synthesis and status report of 3R policy implementation in the region to Regional 3R Forum in Asia and the Pacific; 2) Regular update of selected 3R policy indicators in relation to the Hanoi 3R Declaration (2013-2023) for member countries of Regional 3R Forum in Asia and the Pacific; 3) Establishment of a knowledge platform on progress on reporting of 3R policy implementation at local and national level (including regular update of country chapter); 4) Establishment of thematic experts' working groups on 3R policy in the region to develop common understanding/guideline/policy discussion papers to facilitate multi-stakeholders dialogues for effective promotion and implementation of 3R and resource efficiency related policies, tools and technologies; and 5) State of the 3Rs in Asia and the Pacific, prepared by top-regional and country experts on the 3R and waste management policy.