

POLICY REPORT

Waste Management in Myanmar

Current Status, Key Challenges and Recommendations
for National and City Waste Management Strategies

2017

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Waste Management in Myanmar: Current Status, Key Challenges and Recommendations for National and City Waste Management Strategies

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Foreword

The Institute for Global Environmental Strategies (IGES) actively engages in the field of sustainable consumption and production, including waste management, with a demonstrated history of advancing strategic research on reduce, reuse, and recycle (3R) policies and strategies in the Asia and Pacific region. Correspondingly, the UN Environment International Environmental Technology Centre (UN Environment-IETC) was established with the explicit purpose of promoting the application of environmentally sound technologies and improving waste management in developing countries and countries in transition.

In this context, the IGES Centre Collaborating with UNEP on Environmental Technologies (CCET) was formally launched on the sidelines of the twentieth session of the Conference of the Parties to the United Nations' Framework Convention on Climate Change (UNFCCC-COP 20) held in Lima, Peru, in December 2014. CCET was founded with the direct aim of enhancing collaboration between the two organisations, working towards implementing the International Environmental Technology Centre's strategy and expanding its reach and delivery in international operations related to waste management. In so doing, CCET provides specialised technical knowledge and experience to support the development of national and city management strategies and action plans based on the principle of holistic, integrated waste management. CCET does this by engaging in a consultative dialogue with key stakeholders, documenting good practices and lessons learned, thereby building an effective knowledge base for domestic and international outreach to assist the Centre with its mission in Japan and abroad.

Recent statistics indicate that 3.5 billion people—roughly half of the world's present population—lack access to waste management services, with open dumping and burning representing the primary waste disposal methods in many low and middle income countries. Taking this into account, waste management is attracting increasing attention from the international development community, featuring prominently in discussions on the Sustainable Development Goals (SDGs) and the Paris Climate Change Agreement, among others. Accordingly, there is now wide recognition that shifting from waste disposal to integrated resource management, eco-efficiency and the 3Rs remains crucial for realising the economic, environmental and social objectives of sustainable development. Indeed, this approach shows enormous potential for generating jobs and promoting economic prosperity while at the same time tackling environmental issues such as climate change in a pro-poor and equitable manner.

Achieving these goals will involve strong political commitment and leadership, including by establishing a clear rationale for addressing waste management as a national and local priority. This starts with agreement on an organised, logical set of steps for directing actions through the design and implementation of national and city waste management strategies. Given that waste management touches on a range of important issues relevant to public policy, such strategies must be carefully coordinated with national and subnational authorities, as well as local communities, making efforts to ensure appropriate alignment with existing legislation, processes and plans.

Bearing this in mind, there is a wealth of valuable information and resources available, documenting many successful examples of waste management from around the world that can be used to inform policy and decision making.

In this respect, CCET has been providing technical assistance to the Government of Myanmar, Cambodia and the Maldives towards the development of national and city-level waste management strategies consistent with a holistic waste management approach, aimed at addressing solid, liquid and gaseous waste in an integrated and complementary manner, in accordance with national and local circumstances. This policy report discusses the major findings of a rapid assessment/quick study on Myanmar's existing waste management systems and practices as well as a series of multi stakeholder workshops organised between January and December 2016. The report provides the context, overview and examination of the country's present status of waste management, discusses key challenges and obstacles, and summarises a number of policy recommendations for consideration in the development of Myanmar's national and city waste management strategies and action plans. I hope that this report will inspire and encourage national and local government bodies in Myanmar, as well as other relevant stakeholders, to make waste management a policy priority so that it may further support sustainable development and climate change mitigation efforts in the country.

Kazunobu Onogawa
Director, CCET

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This study is based on field work conducted in Myanmar over the course of developing the country's National and City Waste Management Strategies with support of CCET and the financial assistance from the Ministry of the Environment, Japan (MOEJ).

Executive Summary

Myanmar has been facing considerable challenges with the management of waste in the recent past as a result of increasing income and consumption levels, urban growth, and lack of effective waste treatment and disposal methods. Waste management is also a cross-cutting issue that touches on many aspects of social and economic development, and as such is widely associated with a range of global challenges including public health, climate change, poverty reduction, food security, resource efficiency and sustainable production and consumption. In this regard, the IGES Centre Collaborating with UNEP on Environmental Technologies (CCET) has been providing technical assistance to the Ministry of Natural Resources and Environmental Conservation (MONREC) and other key stakeholders, including Mandalay City Development Committee (MCDC), towards the development of sustainable waste management strategies at the national and city levels based on a holistic waste management approach: addressing all waste streams (solid waste, liquid waste / wastewater, and gaseous emissions), primarily focusing on solid waste and its relationship with other types of waste since early 2016. This policy report therefore discusses the major findings of a quick study on Myanmar's existing waste management systems and practices as well as a series of multi stakeholder workshops organised between January through December 2016. It presents an overview of the present status of waste management in Myanmar, discusses key challenges and obstacles, and provides a number of policy recommendations for MONREC and other stakeholders to consider in the development of the country's National and City Waste Management Strategies and Action Plans supported by CCET.

Waste management in Myanmar has traditionally been the responsibility of township and city development committees designated within respective States and Regions. In Yangon, Mandalay and Nay Pyi Taw, three autonomous City Development Committees, their respective Pollution Control and Cleansing Departments (PCCDs) and their network of administrative branches and sub-units are tasked with solid waste management. At present, waste collected by respective townships and city development committees is transported to open dumping sites located within city boundaries, which face a number of challenges in terms of operations and management. Municipal waste collection systems in Myanmar cities can largely be characterised as labour intensive, relying on the use of both manual workers and non-specialised vehicles. Similarly, recycling activities are carried out in many cities in Myanmar mostly by the informal sector, which includes waste pickers, waste collectors, and waste dealers. All major cities (Yangon, Mandalay and Nay Pyi Taw) experience bottlenecks with regard to managing industrial waste, which is often transported to landfill sites without prior treatment. Mandalay and Yangon collect medical waste from large hospitals and special clinics on a daily basis while collection service is provided to smaller facilities once a week or on an on-call basis. Domestic waste water is usually released into storm water drainage systems and natural waterways; industrial wastewater is currently managed in a haphazard manner, although a number of private companies located in selected Special Economic Zones (SEZ) are progressively implementing wastewater treatment systems. The main sources of outdoor air

pollution include inefficient modes of waste transport, inefficient combustion of household fuels for cooking, lighting and heating, coal fired power plants, industrial agriculture and waste burning.

This study confirms that waste management in Myanmar is at a preliminary stage, with the country experiencing significant waste management challenges at both national and city levels due to a range of technical, social, economic and institutional constraints. In this regard, overall recommendation of this report is the importance of developing a national waste management strategy designed to serve as a principal framework for waste policies and practices across the country, supporting city-level waste management strategies focused on the piloting and execution of concrete actions led by township and city development committees. In order to ensure that these strategies are implemented in a coordinated, cost-effective and efficient manner, the following recommendations may be considered:

At the local level, township and city development committees should take leadership and responsibility for planning and implementing city waste management strategies and action plans in consultation with relevant stakeholders, including citizens and civil society groups, the informal sector, small- and medium recycling associations, academia as well as other key public departments. The strategies should first prioritise extending regular waste collection services across all areas of towns and cities, including informal communities and peri-urban zones, establish proper mechanisms to control the current illegal dumping and open burning of waste, and make efforts to improve final disposal sites from open dumping to control and sanitary landfills. As a next step, each township and city development committee should more concentrate on developing resource management strategies based on waste hierarchy including waste prevention, minimisation, reuse, recycling, and recovery prior to final waste disposal. This will involve promoting customary recovery, repair and reuse practices, working to divert the landfilling of food waste for other purposes, such as composting and bioenergy generation, and maximising the participation of communities, including engaging informal and small-scale entrepreneurial recyclers in the conventional waste management sector. Over the long-term, individual township and city development committees should aim toward introducing a more holistic approach for managing all residual waste, such as implementing pollution control measures for tackling emissions and effluents potentially hazardous to human and environmental health. As above, successful application of these strategies will necessitate building partnerships with relevant stakeholders, as well as encouraging citizen participation and awareness raising with a view to promote overall behaviour change: harnessing adequate financial and human resources for these actions thus remains crucial.

At the national level, MONREC in cooperation with other relevant government departments and ministries, should formalise the establishment of an effective legal framework, supported by enabling policies, financial mechanisms and an operational monitoring/enforcement system on waste management at the national level. This should

include developing waste management performance indicators and the requisite methodology to track progress of city waste management strategies against national targets, as well as maintaining a national waste database. MONREC and its partners should also work towards incentivising city actions aimed at improving waste management through national awards and certification programmes. In addition, national guidelines should be established regarding waste classification, as well as the development of definitions related to sustainable materials management with a view towards facilitating trade and investment in recycling, recovery and other related waste management solutions.

Although waste management in Myanmar is still lacking in many respects compared to other, more experienced countries, international co-operation can play a catalytic role in helping the country improve governance and build the local capacity and infrastructure necessary for effective waste management. For instance, enhancing access to capital financing will be essential for developing the critical infrastructure for addressing increasing levels of waste generation, as well as the collection, transport, treatment and introduction of more sustainable disposal options. At the same time, it is worth noting that international funding for waste management should also be economically affordable and appropriate to the local circumstances of Myanmar as opposed to being determined by countries which have modernised their waste systems over a longer time period. In this regard, a major priority for Myanmar will be to continue strengthening knowledge and performance of the public sector with a view towards establishing more inclusive approaches, such as the endorsement of proactive policies, regulations, and sound institutions that ensure that the country is equipped with the competencies and skills to deliver sustainable, locally supported waste management systems. Accordingly, promoting city-to-city cooperation between Myanmar cities and mentor cities with longstanding-experience in upgrading their waste management systems presents a useful strategy for encouraging the sharing of experiences such as best practices, as well as other technical assistance.

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Abbreviations and Acronyms

ADB	Asian Development Bank
BORDA	Bremen Overseas Development & Research Association
CBD	Central Business District
CCET	IGES Centre Collaborating with UNEP on Environmental Technologies
ECD	Environmental Conservation Department
EU	European Union
GDP	Gross Domestic Product
IGES	Institute for Global Environmental Strategies
JICA	Japan International Cooperation Agency
KOICA	Korean International Cooperation Agency
MCDC	Mandalay City Development Committee
MONREC	Ministry of Natural Resources and Environmental Conservation
NCDC	Nay Pyi Taw City Development Committee
NGO	Non-Governmental Organization
NSDS	National Sustainable Development Strategy
PCCD	Pollution Control and Cleansing Department
PRC	People's Republic of China
PPP	Public-Private Partnership
3R	Reduce, Reuse, Recycle
SEZ	Special Economic Zone
UNDP	United Nations Development Programme
UN Environment	United Nations Environment Programme (UNEP)
UN-Habitat	United Nations Human Settlements Programme
WHO	World Health Organization
WWF	World Wide Fund for Nature
YCDC	Yangon City Development Committee

1. Introduction

1.1. Background

Waste management is one of the most serious environmental and public health issues faced by developing countries, especially for populations residing in urban areas¹. Myanmar is no exception, where both the national and city-level governments are grappling with considerable challenges concerning the management of waste due to increasing income and consumption levels, expanding urbanisation, and a deficiency of effective waste treatment and disposal options, among others. Much like in other countries, a lack of proper waste regulations, together with poor monitoring and enforcement of existing laws, frequently result in waste generators opting for the least expensive, most available course of action for waste disposal. Consequently, both domestic and industrial waste in Myanmar is often dumped in the street, on vacant land, or into drains, streams or other watercourses; occasionally it is also burned to minimise the nuisance caused by accumulating piles of waste. This made adverse impacts for air soil, groundwater and the coastal and marine environment, and thus also on public health. In light of the Myanmar's accelerating economic growth, this also represents an increasing matter of concern.

In view of these challenges, Myanmar's Environmental Conservation Law was established in 2012 with the objective of enabling the implementation of the country's

National Environmental Policy of 1994. Environmental Conservation Rules have also been developed for the implementation of the Law. Accordingly, Myanmar's Environmental Conservation Law and its associated rules emphasise that the development of national and city waste management strategies are urgently required.

In response to a request for support from Myanmar's Ministry of Natural Resources and Environmental Conservation (MONREC), the UN Environment International Environmental Technology Centre (IETC) has been actively working with national and local governments and other institutions to build capacity for waste management and promote the development of effective policy frameworks and strategies. In this regard, the IGES – Centre Collaborating with UNEP on Environmental Technologies (CCET) was selected to provide technical assistance towards the development of waste management strategies at the national and city levels in Myanmar based on a holistic waste management approach: addressing all waste streams (solid waste, liquid waste / wastewater, and gaseous emissions), primarily focusing on solid waste and its relationship with other types of waste.

In line with the above, a quick study of Myanmar's existing waste management systems and practices was conducted to review the scope and effectiveness of

¹ UNEP and ISWA (2015); Premakumara, DGJ, Maeda, T (2015)

Myanmar's current waste management system, identify key challenges and areas for improvement to meet the country's desired level of performance, and analyse gaps in current waste management policy and practice. The subsequent findings were further used to provide appropriate data for organisation of a series of participatory workshops and consultations with key national and local stakeholders, aimed at drafting national and city level waste management strategies that address waste issues in a more holistic and integrated manner.

1.2. Objectives

This policy report aims to present the major findings of a rapid assessment/quick study and a series of multi-stakeholder workshops and consultations carried out during the period of January through December 2016. It provides an overview of Myanmar's current waste management status, discusses major

challenges and obstacles and suggests a number of policy recommendations for MONREC and other key policy makers to consider in the development of the country's National and City Waste Management Strategies and Action Plans. By reflecting the outcome of discussions on best practices as well as the expressed views of stakeholders throughout this process, this report seeks to offer guidance on how Myanmar can work towards promoting more efficient, inclusive and environmentally-sustainable waste management systems at the national and subnational levels.

1.3. Analytical Framework

Ensuring effective waste management represents one of the main challenges and responsibilities of city governments in both developed and developing countries. It is a cross-cutting issue that touches on many aspects of environmental, social and economic development. As such, waste



Figure 1: Holistic Waste Management, UN Environment-IETC. Source: Musthaq, 2016

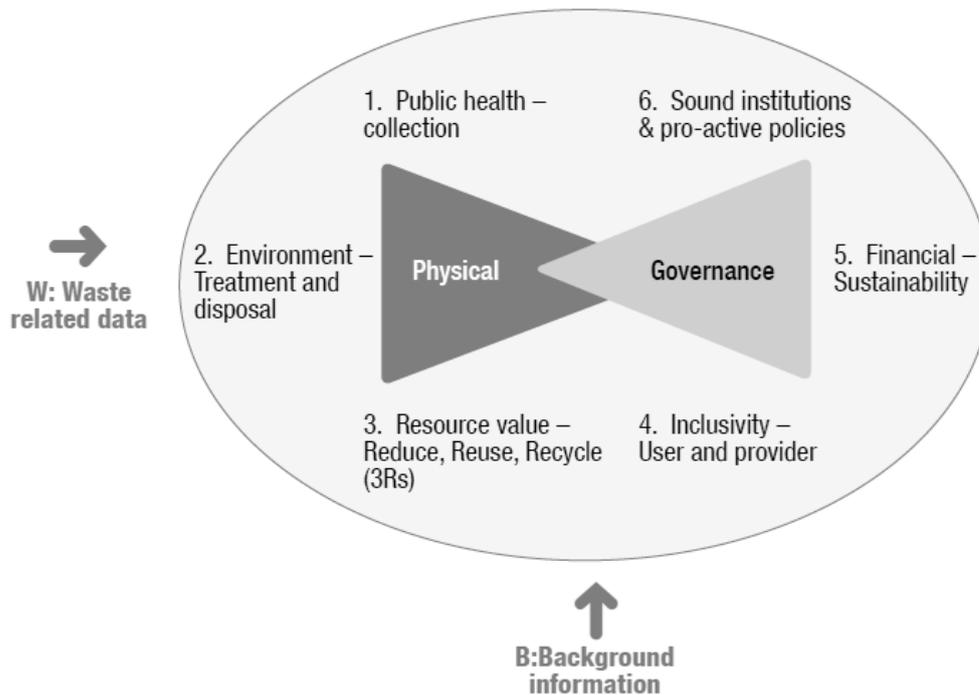


Figure 2: Integrated Waste Management. Source: UNEP/ISWA, 2015

management is widely associated with a range of global challenges including public health, climate change, poverty reduction, food security, resource efficiency and sustainable production and consumption. In this connection, generating the necessary political commitment for guiding innovative actions aimed at improving waste management can be strengthened by corroborating these efforts with global agreements such as the recently committed Sustainable Development Goals (2015) and the Paris Climate Agreement (2015).

As seen in Figure 1, waste is a broad concept that can be understood as by-products of economic activities which comprise gases, liquids and solids². Accordingly, this study is based on and guided by the concept of

holistic waste management, a principle that aims to address the sum total of all waste streams (solid, liquid, and gaseous) in a complementary and coherent manner. In addition, previous work conducted in this area³ has determined that in order for waste management systems to achieve sustainability over the long-term, due consideration should be given to both physical (technical) features of waste management flow, including waste collection, transport, recycling, treatment, and final disposal, as well as to the role of governance, such as policies, regulations, institutions, stakeholder participation, and finance, among others (Figure 2). In this regard, the term Integrated Waste Management refers to a vision of waste management that accounts for these

² See Musthaq (2016)

³ Premakumara, DGJ, Maeda, T (2015); Premakumara, DGJ, Simon Gilby and Yatsuka Kataoka (2016); Premakumara DGJ (2016)

multiple elements⁴. In line with this analytical framework, efforts were made to identify gaps across the waste management chain with regard to *policies, institutions, technologies, infrastructure, key stakeholders and financing*, which were subsequently used to determine and select appropriate targets for addressing waste issues in Myanmar at the national and city levels.

1.4. Methodology

Information for this report was compiled using both primary and secondary data collection methods. A quick study was carried out in early 2016 (January-April) aimed at undertaking a rapid assessment of the country's existing waste management system, as well as identifying major gaps, challenges, and good practices at national and sub-national levels. In addition to a literature review, technical discussions and personal interviews were conducted with relevant staff of MONREC's Environmental Conservation Department (ECD), Mandalay City Development Committee (MCDC), Yangon City Development Committee (YCDC), and Nay Pyi Taw City Development Committee (NCDC), together with site visits to respective waste management facilities.

The study reviewed waste management trends, including the quantification and characterization of various waste streams at the national and city levels, future waste generation projections, as well as evaluated waste management practices and associated infrastructure such as collection, disposal,



Figure 3: Consultation with the key stakeholders.
Source: authors, 2016

and recycling systems, local and national policy frameworks, financing mechanisms, institutional arrangements, and stakeholders' roles and responsibilities.

The preliminary findings served as the basis for organising a series of national and city-level workshops and consultations aimed at raising awareness on the waste baseline documented in the quick study as well as identifying and proposing necessary policy interventions at both national and local governments. First, a national-level workshop was conducted on 13-15 June 2016 in the capital city of Nay Pyi Taw to solicit inputs and views of key stakeholders. MONREC, Ministry of Health, Ministry of Industry, representatives from Mandalay, Yangon, and Nay Pyi Taw City Development Committees—as well as members of the private sector, academia and civil society—participated in the workshop, which featured dynamic discussions on the process of identifying key goals, targets, objectives and actions aimed at moving the country towards a resource-efficient and zero waste society.

⁴Integrated Solid Waste Management was mentioned in the UNEP's Governing Council Decision GC 24/5 (2007) and again in GC 25/8 (2009). Past usages of the terms 'integrated waste management' and 'integrated solid waste management' are

classified in Table 1 of Wilson et al. (2013). See <http://www.icevirtualibrary.com/content/article/10.1680/warm.12.00005>.

Subsequently, a two-day multi-stakeholder consultation workshop was held on 16-17 June 2016 in Mandalay City aimed at stocktaking major issues, challenges and opportunities in the waste sector and supporting the municipality to identify specific targets, indicators and actions to be taken up for consideration in the city's waste management strategy. MCDC, together with a cross-section of public, private and civil society stakeholders took part in the city level workshop, which offered practical guidance on all steps of the strategic planning process for waste management.

This first series of workshops provided the basis for identifying some initial ideas for Myanmar's national and city-level waste management strategies. These ideas were thereafter reviewed by several focus group discussions conducted in September 2016 with relevant government agencies from the national, regional and township levels, as well as actors from the private sector, industries, academia and civil society groups, who provided comments and feedback. Discussions focused on improving policy and regulatory alignment with existing MONREC and MCDC rules, regulations and standards, planning and budget cycles, national coordination mechanisms, monitoring and evaluation, as well as a clear emphasis on institutional roles and responsibilities to ensure effective implementation of the strategies. Complementarities between the waste management strategies and other policy development processes currently underway in Myanmar were also discussed, including the country's National Environmental Policy, National Climate Change Strategy, and Green Economy Policy

Framework under preparation with support from the United Nations Development Programme (UNDP), the United Nations Human Settlement Programme (UN-Habitat), and the World Wide Fund for Nature (WWF), respectively.

Following another series of stakeholder consultations, a second round of national and city workshops were organized in Yangon (5-6 December 2016) and Mandalay (8 December 2016) with the participation of both political and administrative staff including the Secretary of YCDC's Chief Minister's Office, the Director General of MONREC's Environmental Conservation Department and accompanying officials, the Union Attorney General's Office, Ministry of Planning & Finance, Ministry of Construction, Ministry of Home Affairs, YCDC, MCDC, and NCDC, as well as international development partners (UNDP, JICA, ADB). In addition, in order to ensure close alignment between the national and city-level strategies, regional MONREC representatives from Myanmar's 7 States (Kayin, Mon, Chin, Kachin, Rakhine, Shan, Kayah) and 7 Regions (Yangon, Mandalay, Magwe, Ayeyarwady, Thanintharyi, Bago, Sagaing) also took part in the workshop. In Mandalay, MCDC participants engaged in respective discussions on how to implement the city-level strategy, action plan, as well as the identification of a subsequent pilot project.

1.5. Contents

Following this brief introduction, Section 2 provides an overview of current waste management in Myanmar, reviewing both physical and governance elements important

to the promotion of a sustainable waste management system based on the aforementioned analytical framework. The current status of Myanmar's waste management system is described, supported by relevant data on waste generation and composition, transportation, treatment, disposal and reduce, reuse, and recycling (3R) activities of all waste streams including municipal, industrial, medical/hazardous, liquid and gaseous waste. Broader governance aspects including an examination of the country's existing policy, legal, institutional, and financial framework, as well as the involvement of key stakeholders are thereafter discussed. The key challenges and gaps to be addressed are then highlighted in Section 3. Section 4 concludes the report with a discussion on how to ensure the strategies can effectively address the waste management challenges facing Myanmar together with specific policy recommendations towards this end.

2. Overview of the Current Waste Management System in Myanmar

2.1. Current Status of Waste Management – Physical Component

Myanmar, the largest country in mainland Southeast Asia, recorded a population of 51 million as of 2014 census data⁵. Of this total, 30% is comprised by urban populations; the other 70% is made up of Myanmar's rural population, most of whom are largely dependent on subsistence farming. Recent policy reforms promoting economic liberalisation have opened the country to foreign direct investment which in turn has contributed to Myanmar's rapid industrialisation and urbanisation. This economic growth, together with gradual shifts in consumption and production patterns have led to escalating waste generation as well as the proliferation of emerging waste streams such as industrial, medical, and hazardous waste, ultimately creating immense challenges for national, state/regional and township governments with regard to waste management.

Municipal Solid Waste (MSW)

According to 2012 estimations by the World Bank, MSW generation in Myanmar comprised 5,616 tonnes/day with per capita waste generation totalling 0.44 kg/capita/day, projected to reach about 21,012 tonnes/day with 0.85 kg/capita/day

⁵ 2014 Population and Housing Census of Myanmar – Data Sheet http://myanmar.unfpa.org/sites/asiapacific/files/pub-pdf/Census%20Data%20Sheet%20-%20ENGLISH_0.pdf

⁶For more information: <http://siteresources.worldbank.org/INTURBANDEVELOPMENT/>

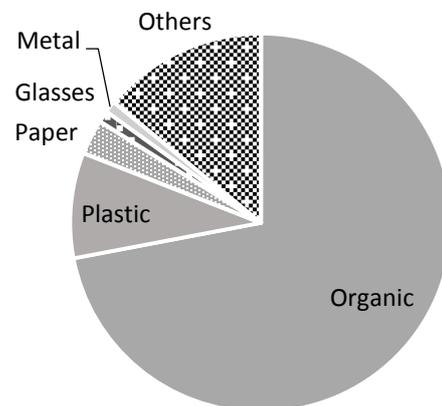


Figure 4: Waste Composition in Yangon. Source: YCDC, 2016

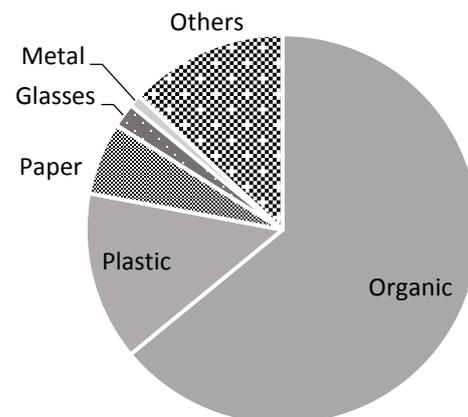


Figure 5: Waste Composition in Mandalay, 2016 Source: MCDC, 2016

by 2025⁶. Approximately 55% of the country's total waste is generated by three major cities including Yangon (1,981 tons/day), Mandalay (955 tons/day), and Nay Pyi Taw (160 tons/day)⁷. As referenced in Figures 4 and 5 with data from Mandalay and Yangon in respectively, Myanmar's MSW

Resources/336387-1334852610766/What_a_Waste2012_Final.pdf

⁷ Data collected from the respective cities, 2016

largely originates from households (60%), markets (15%), commercial producers (10%), hotels (2%), gardens (5%) and others (8%), and is composed mainly of organic materials, (77%) while the remainder comprises plastic (13%), paper (7%), and others (3%).

Waste collection and disposal in Myanmar have traditionally been the responsibility of the respective townships and city development committees. In Yangon, Mandalay and Nay Pyi Taw, autonomous City Development Committees and their Pollution Control and Cleansing Departments (PCCDs) with their network of administrative branches and sub-units are tasked with solid waste management in municipal areas.

MSW collection system in Myanmar cities can largely be characterised as labour intensive, relying on the use of both manual workers and non-specialised vehicles. Current waste collection systems in Myanmar include both primary and

secondary collection. Primary collection takes place in different forms such as door-to-door (bell collection), block, and container collection methods. The primary waste collection system is carried out either or in combination of push carts and tri-bicycles while secondary collection is performed mainly with tipper trucks (dumpers). Due to the escalating state of waste generation as shown by Figure 5, both Mandalay and Yangon City Development Committees have prioritised solid waste management as issues of immediate concern, both in terms of the environment and public health.

Waste separation at source and 3R (activities are not widely prevalent in Myanmar, although some cities conduct public awareness-raising campaigns and environmental education programmes for local residents in order to promote 3R activities. For example, MCDC has prohibited the production, trading and use of thin plastic bags in its administrative area and of the promotion of alternative bags such as

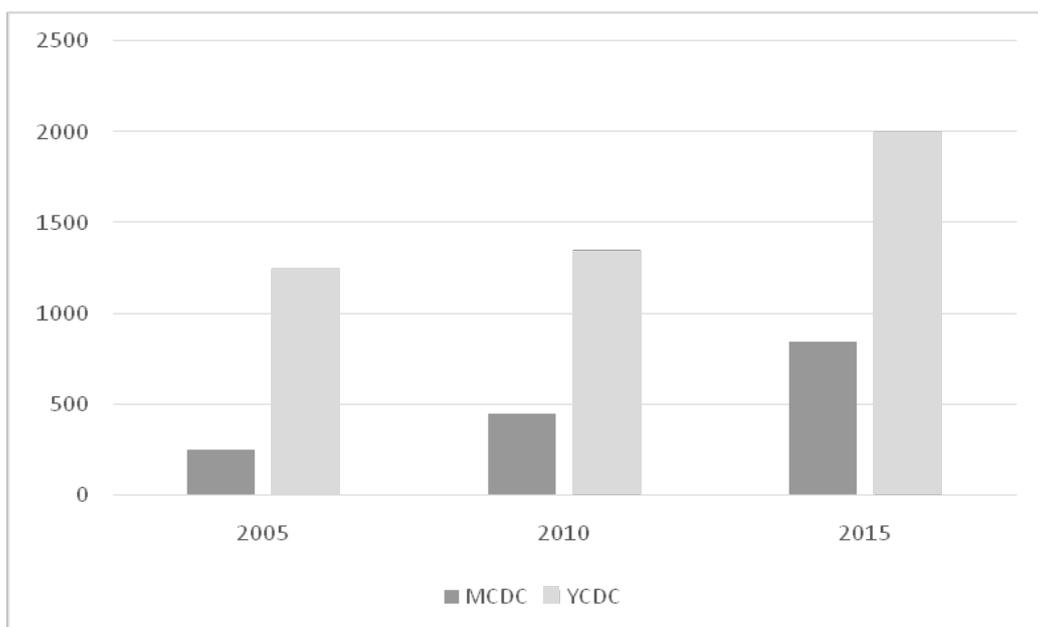


Figure 6: Waste generation in 2 largest cities in Myanmar. Source: MCDC and YCDC, 2016

string bags, leaves boxes and baskets has been ongoing since 2009. Similarly, public awareness programmes have also been implemented by MCDC with a view to promote more sustainable lifestyles and mobilise citizens' support for 3R initiatives.

The recycling of waste is carried out in many cities in Myanmar mostly by the informal sector, which includes waste pickers, waste collectors, and waste dealers. These waste pickers and waste collectors gather recyclable materials such as newspapers, metal, plastic bottles, tin and glass from households, communal depots, streets, commercial areas and final disposal sites and in turn sell these items to waste dealers who subsequently clean, sort, store and sell

them in bulk to the recycling industry both locally and for export. Currently there is a lack of accurate and reliable data on recycling volumes, ratios and the number of recycling factories present in Myanmar cities. However, a sample survey carried out in Yangon City identified that 86 tonnes of recyclable materials from the landfills are directed to the waste dealers per day. Out of this total 57% was glass; cardboard and paper accounted for 15% and 13%, respectively. Plastic (7%), tin cans (7%) and other materials such as metal, iron and steel, (1%) were also observed to be collected.

At present, waste collected by the respective townships and city development committees is transported to the final disposal sites,



Figure 7: Landfill operation in Mandalay. Source: Authors, 2016

Table 1: Major landfill sites in Yangon and Mandalay Cities

Location	Capacity (t/d)	Condition	Remarks
<i>Yangon City Development Committee (YCDC)</i>			
Hteinpin	1,080	Open dumping	Operating
Dawai Chang	843	Open dumping	Operating
Shwepyithar	61	Open dumping	Operating
Mingalardon	43	Open dumping	Operating
Dala	33	Open dumping	Operating
SeikiyKhanaungato	4	Open dumping	Operating
<i>Mandalay City Development Committee (MCDC)</i>			
Kyar Ni Kan (North)	450	Open dumping	Operating
Thaung Inn Myount Inn (South)	300	Open dumping	Operating
New Braway factory	142	Open dumping	Closed in 2009
New Kandawgyi lake	80	Open dumping	Closed in 2009
New Zanngkalow pond	28	Open dumping	Closed in 2007
Corner of N/E Mandalay	450	Open dumping	Closed in 2013

Source: MCDC and YCDC, 2016

mostly open dumping sites located within city boundaries (See Figure 7). Table 1 summarises the basic operation of the landfill sites in Yangon and Mandalay cities. These are often located about 10 to 25 km away from the city's CBD (Central Business District) area and are found to comprise approximately 1 hectare or so. The typical period of time dumping can be conducted in line with onsite capacity was observed to be one or two years to a maximum of five years. Most dump sites experience a range of challenges in terms of operations and management. Transported waste is then unloaded on the ground or onto existing waste. Waste is subsequently sorted by waste pickers by hand and manual tools, such as rakes. Following manual sorting, unsorted waste is moved further inside the dumpsite by using mechanical equipment, such as bulldozers. Sorted waste is thereafter packed, stored and transported back to the

city for resale. Landfill fires are common and these generate dense smoke and noxious fumes. In addition to offensive odours, uncontrolled dumps pose a number of health hazards including from pathogenic organisms, insects, rodents as well as air pollution from dust, accidental burning, and ground and surface water pollution from issues of unaddressed leachate.

Industrial Waste

All major cities (Yangon, Mandalay and Nay Pyi Taw) are facing tremendous challenges with regard to managing the increased volume and different types of industrial waste. Accordingly, all cities are responsible for collecting industrial waste from respective factories but only on an on-call basis. Consequently, collected waste is often transported to landfill sites without prior

treatment. There is currently no reliable data on the generation and collection of industrial waste by the cities. According to YCDC, approximately 150 tons of industrial waste are daily collected by the city. In Yangon, Dowa Eco-System Co., Ltd., a subsidiary of Dowa Holdings Co., Ltd. of Japan has established and begun operating Myanmar's first industrial waste treatment and controlled landfill facility at the Thilawa Special Economic Zone (Figure 8).

This area is jointly developed by Myanmar and Japan, with the development of Phase 1 Area (211ha) completed in June 2015. It is planned this site will receive industrial waste not only from the Thilawa Special Economic Zone but from across the country as well. In addition to tackling different discharge sources, and managing the controlled landfill, the new company will provide comprehensive waste management services to cover the collection, transportation, intermediate treatment and recycling of waste according to their different characteristics. In so doing, the company will work to address the waste management needs of different industries whilst helping to contribute towards the sustainable industrial development in Myanmar.

Medical Waste

Overall, health-care waste management practices in Myanmar are substandard although there is basic awareness at all levels about the importance of protecting health workers, as well as visitors to health care facilities and communities living within the vicinity of health-care waste. Respective townships and city development committees



Figure 8: Dowa industrial waste treatment facility in Yangon. Source: authors, 2016

are responsible for collecting medical waste. Both YCDC and MCDC collect medical waste from large hospitals and special clinics on a daily basis while collection service is provided to smaller facilities once a week or on an on-call basis. Three different colour bags are used for separating the waste: (i) blue or green (YCDC)/ black (MCDC) for non-hazardous health care waste or domestic waste uncontaminated with infectious or pathogenic agents (food residues, paper, cardboard and plastic wrapping); (ii) yellow for pathological waste, infectious waste as well as items that have

been used for medical care; and (iii) red for sharps, and mainly, but not exclusively, auto-disable or disposal syringes with needles and pharmaceutical waste that consists of outdated drugs or expired unfinished medical solvents. Infectious waste is incinerated or burned in cemeteries while sharp wastes are buried underground in landfills. Other waste is treated as domestic waste. Though there is incomplete information on the current levels of medical waste generation in the country, YCDC and MCDC estimate that on average the medical waste that is collected comprises 280 and 779 tons per year, respectively. A significant portion of this (over 70%) is infectious waste.

In Mandalay, for instance, there are an estimated 1,000 general medical clinics and 50 special clinics. Although MCDC collects

medical waste from a number of the larger special clinics and government hospitals, many smaller clinics without access to such services self-manage their waste through dumping and pit burning. As shown in Figure 9, this is common practice in Myanmar and underlines the critical importance of developing proper collection and treatment systems for medical wastes.

Wastewater

Waste water is classified as either domestic or industrial waste in Myanmar's cities. Inadequate waste water and sanitation services, combined with underinvestment in



Figure 9: Medical waste disposed at the landfill in Nay Pyi Taw. Source: Authors, 2016



Figure 10: Central waste treatment facility in Nay Pyi Taw. Source: Authors, 2016

preventative health care, have resulted in significant environmental and human health challenges. Research on waste water management identified that large resettlement areas in Yangon, Mandalay and Nay Pyi Taw have urban sanitation services that are well below acceptable levels, with the situation worse in the other lower income regions and areas of the country. With the exception of their respective CBDs, there are no conventional central waste water and sewerage collection and treatment systems operating in Myanmar's three major cities.

Domestic waste water is usually released into storm water drainage systems and natural waterways. In Yangon, only six areas of the city (7% of total population) were observed to have wastewater and sewage wastes managed in connection to treatment

plant drainage facilities whereby activated sludge is used as fertiliser and treated water is disposed to Yangon River. For other parts of the city, septic tank wastes are transported by vacuum trucks to designated treatment ponds. In Mandalay, septic tank sewage wastes are collected with a vacuum truck and disposed to oxidation ponds on the grounds of Ayeyatneyein cemetery, Kyar Ni Kan village, Patheingyi township (former site) and Patheingyi township (newly designated site). The remaining sludge after evaporation is utilized as fertiliser. Further, all industries generating wastewater have constructed individual temporary treatment systems to connect and dispose liquid waste via a 10-inch drainage pipe line which is subsequently connected to the DohteHtaWaddy River without any prior treatment.

In Nay Pyi Taw, there is a centralised waste water and sewage treatment facility which is connected the premises in Wannatheikdeed Quarter comprising 110 units and a population of 10,000. The treatment plant makes use of an anaerobic microorganism system and chlorination processing before discharging treated water to the local Bukwe Creek.

Myanmar hosts a number of industrial zones across the country, located in close proximity to larger cities and villages. Accordingly, there are three categories of industrial zones-- government industry zones, special economic zones (SEZs) and private industrial zones-- and all of which face wastewater management issues. For example, out of 18 designated government

industrial zones in Yangon, most do not maintain wastewater treatment plants. The private industrial zones, located in the southern and northern part of the city, are mainly occupied by garment factories, steel fabrication factories, and chemical industries such as emulsion and food production manufacturing. As these zones are often situated close to major rivers, there is a high risk of pollution to ground water, surface water and waterways.

The Government of Myanmar has authorized the establishment of three SEZs in Yangon, Kyaukpyu, and Dawei that are currently under development. The Thilawa SEZ, located near Yangon, has constructed a wastewater treatment plant. On the other hand, there are three government industry

Table 2: Air Pollution Status in the Sample Locations of Yangon Landfill Sites

Location	Results
Mingalardon dumping site (Mingalardon): Monitoring location is 0.89 km away from the dumping site. 24hrs continuous monitoring	Rainy (AM): Particulates (PM ₁₀ – 192 µg/m ³ , TSPM – 212 µg/m ³), Gases (SO ₂ – 2 ppb, NO ₂ – 27 ppb) Dry (PM): Particulates (PM ₁₀ – 145 µg/m ³ , TSPM – 180 µg/m ³), Gases (SO ₂ – 3 ppb, NO ₂ – 39 ppb)
KyuChaung dumping site (ShwePyi Thar): Monitoring location is 3.33 km away from the dumping site. 24hrs continuous monitoring	Dry (AM/PM): Particulates (PM ₁₀ – 311.65 µg/m ³ , TSPM – 379.28 µg/m ³), Gases (CO ₂ – 0.42 ppm, SO ₂ – 2.64 ppb, NO ₂ – 34.91 ppb)
Htin Pin dumping site (Hlaing Thar Yar): Monitoring location is 2.85 km away from the dumping site. 24hrs continuous monitoring	Dry (AM/PM): Particulates (PM ₁₀ – 134 µg/m ³ , TSPM – 190 µg/m ³), Gases (CO ₂ – 0.1 ppm, SO ₂ – 1.05 ppb, NO ₂ – 39 ppb)
Dala dumping site (Dala): Monitoring location is 4.87 km away from the dumping site. 24hrs continuous monitoring	Dry (AM/PM): Particulates (PM ₁₀ – 160 µg/m ³ , TSPM – 215 µg/m ³), Gases (CO ₂ – 1.8ppm, SO ₂ – 30 ppb, NO ₂ – 52 ppb, VOC – 1 ppm)

Source: Sample survey conducted by the Authors, 2016

zones in Mandalay comprising 1,500 small and medium size industries. Of these, approximately 100 factories were observed to generate wastewater amounting to 1,500 – 2,000 m³/day. However, a majority of these factories have not installed proper wastewater treatment facilities. According to MDCD, local authorities have been engaging with international donor partners such as JICA, ADB as well as the Chinese Government to discuss potential collaboration on improving wastewater treatment systems in both domestic and industrial areas.

Gaseous Waste (air pollution)

According to national reports, air pollution in Myanmar not only poses risks to public health, but stands among the worst in the world⁸. Based on WHO's 2015 global assessment on air pollution, the most detailed data set ever compiled on outdoor air quality, Myanmar's urban and rural areas together registered annual median concentration of particulate matter of an aerodynamic diameter of 2.5 mm or less (PM_{2.5})/μg/m³ of 51 and an estimated range of 32 to 80. In urban areas, the recorded figure was 57 (median) in urban areas with a range of 35-90⁹. Further, WHO data shows that upwards of 22,000 deaths per year in Myanmar can be attributed to ambient air pollution. This is third highest per capita mortality rate WHO documented in the

Southeast Asian region, with India identified as number one. According to the staff of WHO Myanmar office, the main sources of outdoor air pollution in Myanmar include inefficient modes of waste transport, inefficient combustion of household fuels for cooking, lighting and heating, coal fired power plants, industrial agriculture and waste burning¹⁰. With the assistance of local counterparts, this study also conducted field analysis in and around Yangon's landfill sites with a view to assess the level of air pollution (gas and particulates) found in the area. Results of this analysis are shown in Table 2. Correspondingly, in a 2011 assessment conducted by WRI, aggregate annual greenhouse gas emissions (GHGs) in Myanmar were estimated at 265 million tCO₂e/year¹¹. Significant GHG emissions were attributed to Myanmar's agriculture sector (69%), presumably due to the burning of agricultural waste; similarly, 8% of emissions were found to be generated by the waste sector in 2005¹².

2.2. Current Status of Waste Management - Governance Component

Policy, Legal and Regulatory Framework

According to Myanmar's 2008 Constitution, the country is a unitary parliamentary

⁸ Nick Baker (2016) <http://www.mmtimes.com/index.php/national-news/22840-myanmar-s-air-pollution-among-the-worst-in-the-world-who.html>

⁹ WHO. 2016. Ambient air pollution: A global assessment of exposure and burden of disease. World Health Organisation, Geneva

¹⁰ Nick Baker "Myanmar's air pollution among the worst in the world: WHO". Sunday, October 16,

2016 <http://www.mmtimes.com/index.php/national-news/22840-myanmar-s-air-pollution-among-the-worst-in-the-world-who.html>

¹¹ Climate Analysis Indicators Tool (CAIT) Version 9.0. (Washington, DC: World Resources Institute, 2011) World Resources Institute.

¹² For more information: Emissions Summary for Myanmar https://unfccc.int/files/ghg_data/ghg_data_unfccc/ghg_profiles/application/pdf/mmr_ghg_profile.pdf

republic organised into the following levels of administration: the lowest administrative unit is the village, with several grouped together into village tracts; next are urban wards; then towns, with several towns grouped together into townships (where the lowest levels of government offices are generally located); townships are in turn organised into districts, with several districts ultimately comprising a region or state.

Myanmar maintains seven States and seven Regions (formerly known as Divisions) and one Union territory containing the capital Nay Pyi Taw and surrounding townships. Although all Regions and States in the country are constitutionally equivalent, the ethnic majority of the country are the Burman/Bamar people who reside mostly in the Myanmar's seven Regions occupying the middle of the country¹³. Similarly, in large measure the country's ethnic minorities located primarily in the seven States that are positioned along the border of the country. The President appoints a Chief Minister for each State and Region who in turn is responsible for engaging with the State/Region's unicameral legislative assembly (Hluttaw). However, laws that passed by the Union Legislative Assembly (Pyidaungsu Hluttaw) supersede those adopted at the Regional/State level¹⁴.

The importance of environmental protection in Myanmar is recognised in both national (Union) and local (States/Regions/Townships) policies, which are in part due to the country being a signatory of various multilateral

environmental treaties and agreements. Myanmar's National Environmental Policy of 1994 instituted environmental regulations on the utilisation, conservation, and prevention of environmental degradation including water, land, forest, mineral, marine resources, and other natural resources. Following the development of this national policy, the country drafted its Agenda 21 commitment (1997) to implement integrated management of natural resources, providing a blueprint for achieving specific targets on environmentally sustainable development-- including improving solid waste management and the promotion of environmentally sound management of toxic chemical and hazardous wastes. In 2009, the country's National Sustainable Development Strategy (NSDS) was prepared, marking an important step for Myanmar, as this guiding document aims to ensure development remains in harmony with the three main pillars of sustainability: environment, economy and society. The National Environmental Conservation Law and the Environmental Conservation Department (ECD) was established in 2012 as a mechanism to enforce environmental conservation and protection.

¹³ For a discussion of local governance, see MDRI and the Asia Foundation (2013): State and Region Governments in Myanmar

¹⁴ Bingham Centre for the Rule of Law (2013): Constitutional Awareness Myanmar

Table 3: Related Environmental Laws and Enforcement Systems in Selected Cities

	Mandalay City Development Committee (MCDC)	Yangon City Development Committee (YCDC)	Nay Pyi Taw City Development Committee (NCDC)
Related Laws/ Acts	<ul style="list-style-type: none"> - MCDC Law 2015, Jan 12 - MCDC Environmental Conservation and Cleansing bylaws 2015, May 14 - The City of Mandalay Development Law (2002) 	<ul style="list-style-type: none"> - The Yangon Water - work Act (1885) - The City of Yangon Municipal Act (1922) - The Water Power Act (1927) - The Underground Water Act (1930) - The City of Yangon Development Law (1990) - The Yangon Civil Development Law 2013 	<ul style="list-style-type: none"> - NDC Pollution Control and Cleansing Department bylaws - NDC Water and Sanitation Department Bylaws - The Nay Pyi Taw Development Law (2009)
Enforcement methods	<ul style="list-style-type: none"> - Public awareness and training - Health impact training for waste handling workers - Public awareness training at school by different level - Informing the factories once every three months to dispose waste water only in the defined time (between 6pm and 5am) and to regulate the temperature of waste water to ensure it doesn't exceed 30.C - Inspecting disposal sites and main pipe line once a week - Conducting regular meetings with factory owners and instructing on the following appropriate regulations 	<ul style="list-style-type: none"> - Public awareness raising has been conducted by distributing pamphlets on a small scale - Dissemination of instructions on the separation of different waste types and carrying out regular monitoring to ensure enforcement 	<ul style="list-style-type: none"> - Issuing warnings after first violation

Source: Compiled by the Authors, 2016

The Government of Myanmar has also made efforts to encourage the industrial sector to minimise its impacts on the environment. For instance, Myanmar's Ministry of Industry is responsible for managing state-owned industries, 18 industrial zones, 3 special economic zones as well as coordinating with private industries to promote engagement with the industrial sector. In order to avoid unnecessary pollution and damage on the natural environment caused by industrial

waste, the Water and Air Pollution Control Plan (Standing Order No.3) was issued in 1995. According to this order, actions to control, reduce and eliminate wastes must be progressively developed and carried out. In addition, the Procedures for Environmental Impact Assessment and the Environmental Quality (Emission) Guidelines were developed in 2015 with the assistance of ADB to prevent potentially adverse environmental and social impacts resulting

from development projects by way of measuring and minimising levels of air, noise, water and solid waste pollution.

As shown in Table 3, a number of City and Township Development Committees have promulgated local policies and bylaws aimed at establishing a legal basis for action related to environmental conservation. For instance, MCDC has established its own laws, regulations and rules for waste management and environmental conservation, such as the Solid Waste Management bylaw of MCDC and Environmental Conservation and Cleansing bylaws dated 14 May 2015. In practice, however, actual implementation and proper enforcement of these environmental regulations has lagged behind general policy proclamations.

Institutional and Financing Mechanisms for Waste Management Services

National institutions do not take into account city level waste management issues; instead solid waste management is a principal function of the respective townships and city development committees. For example, at the city level, MCDC is the city government body responsible for financing, planning and delivering urban services including waste management in all six townships of Mandalay City. The governing body of MCDC is headed by the Mayor who also serves as the Minister for Development Affairs in Mandalay Regional Government. The Mayor is assisted by the Secretary, Joint-Secretary and five committee members for

the daily operation of the MCDC. Currently, MCDC is divided into 14 departments made up of over 6,000 staff. Among all these departments, three departments are focused on environmental conservation: the Cleansing Department for waste management, Water and Sanitation Department for water supply and waste water management, and Playground and Garden Department for the carrying out of greening and landscaping work. In addition, it was observed that MCDC works closely with different stakeholders for improving waste collection in the city, such as District and Township Development Committees and Organizations, Regional Health Departments, Wards Committees, the Environmental Conservation Department, Regional Irrigation and Public Works Departments, non-governmental organisations (NGOs), various political parties and the greater public.

It was noted that the largest proportion of budget expenditures related to waste management are associated with labour and waste handling. A total of 4,220 workers were employed by YCDC for waste collection and disposal in 2015. In contrast, 1,700 workers were employed for these tasks in the year 1983. This is very similar to the situation in MCDC where 2,000 workers were responsible for conducting waste management activities in 2016 compared to 900 workers in 2005 (See Figure 21). There has also been a general increase in the allocation of capital expenditure for waste collection over time, including for purchasing new waste collection trucks and developing appropriate waste treatment infrastructure such as the establishment of

final disposal sites. This reflects the commitment and determination of Myanmar's cities to enhance waste management systems and processes. However, collection and disposal are currently the main priorities of the municipalities and intermediate waste treatment (i.e., recycling) plays a minimal role at present.

Accordingly, direct revenues are generated through the collection of user charges for waste management services. Waste collection charges for household or domestic waste are based on the volume of waste disposed (MCDC) or the location (YCDC) and the fee ranges from 300-900 kyats/month. Other wastes are charged based on the waste volume with the rate for one vehicle (3 tons' capacity) comprising roughly 35,000 kyats per trip. Similarly, commercial waste generators are required to pay special collection fees ranging from 20,000 to 150,000 kyats per month based on the volume of waste produced. This cost recovery policy helps to reduce waste disposal subsidies provided by the city and thus encourages more sound fiscal planning. In addition, it was observed that the cities have entered into partnerships with both local and international partners aimed at improving waste collection in their respective areas. Local NGOs also support community awareness activities and implement initiatives to promote the 3Rs. Similarly, the private sector (both formal and informal) is involved in waste collection and recycling activities (See Figure 11). Further, all three major cities (Yangon, Mandalay and Nay Pyi Taw) have received technical and financial support from international agencies

(JICA, KOICA, ADB, EU, BORDA) and engaged with foreign partners' cities to establish new waste collection, recycling, treatment and final disposal facilities.



Figure 11: Waste recycling in Mandalay. Source: Authors, 2016

3. Review of Major Gaps and Challenges

Both findings of the quick study and discussions with key stakeholders during workshops and consultations identified that Myanmar is facing significant waste management challenges at the national and city levels resulting from a range of

technical, social, economic and institutional constraints, which together are contributing to soil and water contamination, air pollution, climate change and impacts on biodiversity and ecological health.



Figure 12: List of key challenges identified at the consultation workshops.
Source: Compiled by Authors, 2016

Addressing these bottlenecks is a crucial first step towards achieving environmentally-sustainable waste management practices across the country. Some of the key challenges associated with waste management in the country are briefly described below.

3.1. Increasing amount of waste generation and hazardous waste

A fundamental challenge facing Myanmar is the rapid increase in waste generation in all major towns and cities across the country. The data of MCDC shows that the waste generation and collection has increased from 259 tonnes/day in 2005 to 896 in 2015. This is due to the gradual expansion of administrative boundaries of the city and the integration of adjacent neighbouring areas. In 1993, Mandalay City comprised only 4 townships with 54 wards. However, this number had increased up to 6 townships and 96 wards in 2015. This suggests that the rapid expansion of city populations in Myanmar is being accompanied by major increase in the volume of waste generated for collection. In addition, economic development and changes in lifestyles have resulted in growing variety of waste types, requiring separate collection and treatment due to certain hazardous components, including for example e-waste, industrial and medical waste. However, due to the lack of an effective management system, hazardous components are currently being collected together with household wastes and disposed of in landfill sites. Mounting waste generation results in a need for larger numbers of waste collection staff and equipment which ultimately leads to an

increase in the cost of waste management services.

3.2. Challenges with Implementing Existing Policies, Regulations and Institutional Arrangements

As highlighted above, there are currently a range of national and local policies, laws and rules on environmental conservation and pollution control in Myanmar. However, there are no direct regulations and policies for addressing waste management issues in a more holistic and integrated manner. Similarly, weak enforcement of existing laws and regulations was identified as one of the main barriers in the way of implementing sound waste management practices. In addition, a lack of knowledge and capacity at the national and local levels, absence of coordination between different administrative units and stakeholders, and lack of adequate data on collection rates to guide the development of an effective monitoring system were also identified as major impediments to the implementation proper waste management policies. For instance, all major cities are facing challenges in terms of locating suitable land within their designated zones for establishing new landfill sites, aimed at addressing increasing waste disposal demands; this is both due to restriction of open land for landfilling, as well as legal/institutional barriers, such as the mandate that all new land acquisition must first receive authorisation from Myanmar's central government.

3.3. Challenges with Mobilising Public Participation

All major cities have identified the importance of public participation and cooperation and introduced a number of programmes with local NGOs and volunteer groups to increase public awareness and participation for the promotion of 3R activities. For instance, civil society groups, local non-governmental organisations (NGOs), youth volunteer groups and health and social service associations have been involved in public awareness and environmental cleaning campaigns. In addition, some cities including MCDC have organised regular meetings with ward leaders and community members to educate the public on sustainable waste management activities. Both YCDC and MCDC have implemented environmental education programmes in local schools aimed at raising awareness of students about waste separation and recycling.

However, due to the lack of an existing waste management strategy, road map and infrastructure for proper waste separation, collection and 3R activities, public support for these activities has been limited, proving a challenge for mobilisation efforts. This has stymied effective engagement at the community level, which is fundamental for ensuring waste management services are inclusive and responsive to local needs.

3.4. Lack of Financial Sustainability

Public revenue for waste management is generated through the general taxes and collection of user charges for waste

management services. However, revenue captured from the collection of waste remains very low, and as such cannot maintain a balance with total waste management expenditures, especially for the capital costs required for new waste management infrastructure. It was also identified that there is a lack of financial support from the national government for local level waste management activities as service provision is considered the responsibility of municipalities.

Correspondingly, there is no useful examples of best practices (with the exception of Dowa Eco-System Co., Ltd. operating in Yangon) of private sector involvement in waste management due to lack of policy measures and capacity for establishing Public-Private Partnerships (PPP). The informal sector is involved in managing roughly 5% of waste collection and recycling in the city affording job opportunities for a significant number of urban poor. Efforts to integrate these waste collectors into the city's formal waste management system has been a challenge for township and city development committees. In the absence of adequate financing, waste services cannot be effectively managed or sustained over the long term.

3.5. Challenges with introducing sound waste management technologies

The current waste management system in majority of Myanmar's cities involve collection and disposal activities. However, waste collection services in Myanmar vary widely between major and smaller cities as

well as within urban and peri-urban or rural neighbourhoods. Collected waste is disposed in open dumpsites which pose a high risk to environmental and public health. Further, the country lacks a proper system in place to collect and treat industrial waste. Township Development Committees are responsible for collecting industrial waste along with the domestic waste although these wastes are often disposed in city dumpsites in a mixed fashion. In this regard, cities need to upgrade existing infrastructure for improving waste management system based on the established waste hierarchy model, with a view to reduce, reuse, recycle, treat and dispose of waste in a more environmentally friendly manner. This

requires affordable technologies for waste collection, transport, biological treatment (composting/biogas), recycling, treatment (waste-to-energy, waste water treatment facility) and the establishment of sanitary landfills. However, limited capacity and expertise for identifying and adapting suitable technologies to local conditions, inadequate resources, such as finance and technical capabilities for procuring new equipment, and limited research and practical application of selected technologies comprise some critical barriers obstructing progress (See Figure 13).



Figure 13: Waste collection trucks are waiting to enter to the landfill site in Mandalay.

Source: Authors, 2016

4. Conclusions and Recommendations

This study identified that waste management is at a very early stage of its development and remains one of the major concerns both at the national and subnational levels in Myanmar. The country's existing waste management system is impeded by a number of challenges, including: (i) increase in the volume and quantity of waste generation; (ii) growth and emergence of new types of waste; (iii) barriers to integrating informal urban waste workers into existing waste management systems; (iv) low waste collection coverage; (v) lack of suitable areas for landfilling; (vi) poor data and information on existing waste practices; (vii) absence of long-term planning and effective policy formulation; (viii) inadequate government attention to waste management challenges; (ix) absence of suitable financing and lack of skilled personnel; (x) poor public awareness and participation; (xi) ineffectual legislation; (xii) insufficient institutional coordination; and (xiii) poor monitoring and enforcement.

These challenges are contributing to an intensification of air, water, and soil pollution, posing public health issues as well driving a continued rise in the country's GHG emissions. In this regard, this report identified the importance of developing national and city level waste management strategies to serve as a principal framework for waste management across the country, supporting the piloting and execution of concrete actions led by township and city development committees. In order to ensure these strategies are implemented in a more coordinated, cost-effective and efficient

manner, a number of recommendations may be considered:

At the Local Level (Township and City Development Committees)

As an initial step, Township and City Development Committees should prioritise extending regular waste collection services across all areas of towns and cities, including informal communities and peri-urban zones, where such collection is unavailable. Waste that accumulates in open areas due to a deficiency or ineffective operation of the current waste collection system poses a number of environmental and public health risks. For this reason, township and city development committees should work towards identifying ways for improving the affordability and frequency of waste collection based on consultation with local residents. Strengthening primary waste collection service and encouraging the involvement of informal sector/ community groups is of critical importance when considering options for mobilising informal groups in the provision of waste management.

In addition, secondary waste collection and transportation to final disposal sites can be independently managed and operated by township and city development committees or with involvement of private waste collection companies. Establishing a proper waste collection fee system proportionate to the costs of waste collection is also recommended to ensure effective services.

Secondly, Township and City Development Committees should implement measures to eliminate illegal disposal and the open burning of waste as well as improve the operation of existing disposal sites. Illegal dumping of waste in residential areas can be controlled by providing effective and affordable waste collection services, conducting educational and awareness programmes on the negative impacts of the illegal waste disposal and gathering, and issuing regulations supported by proper monitoring and enforcement mechanisms.

The introduction of final disposal technology should be decided upon with consideration of the technical and financial capacities of respective Committees. Based on the current situation, all Township and City Development Committees should take immediate measures to convert open dumpsites into controlled or engineered operations with proper access roads and fences as a first step. In addition, sanitary landfill sites should be equipped with impermeable liners to prevent liquid discharges from polluting ground and surface water, gas management systems to reduce risks of fire or explosion, sufficient soil cover to minimise odour, as well other environmental protection features. In the long-term, other technical options such as Waste-to-Energy Technology (incinerator and landfill gasification) can be also be considered with requisite operational and financial recovery plans.

Further, sustainable waste management does not imply an exclusive focus on waste collection and end-of-pipe treatment and disposal. Instead, waste should be managed as a resource by preventing materials from

becoming waste in the first place. Thus, it is necessary to integrate upstream pollution prevention actions based on the waste hierarchy, including waste prevention, minimisation, reuse, recycling, and recovery including energy recovery, prior to the final disposal. This will involve setting waste targets and formulating appropriate strategies for encouraging waste segregation at source, promoting traditional repair and reuse practices, preventing the landfilling of food and maximising the involvement of informal and small-scale entrepreneurial recycling within the conventional waste management sector.

For the successful implementation of waste separation and recycling activities at the neighbourhood levels, a comprehensive public awareness and education campaign on waste separation should be launched prior to implementation. In addition, township and city development committees can work with other stakeholders to integrate waste separation and 3R practices into the education system to encourage behaviour change with regard to the new waste management system.

Considering that organic waste comprises a large volume (about 60%-70% of total generated waste) as well as its resulting economic and environmental impacts, actions should be taken to reduce levels of organic waste (food waste) from households, markets, shopping malls and other enterprises. This requires implementing a separated organic waste collection and treatment system in communities, public markets and shopping malls. Township and City Development Committees can evaluate the technical feasibility of composting and bio-digester

methods at decentralised and centralised levels, conduct awareness raising campaigns on source separation of organic waste, encourage use of compost products for urban farming and city greening, and introduce local regulations, policies, rules and incentives in order to ban the landfilling of food waste and establish proper organic waste management system recycling.

In addition, each Township and City Development Committee should make efforts over the long term to separate hazardous waste at source, in particular infectious healthcare waste and hazardous industrial waste and ensure these are treated by environmentally sound facilities in order to protect human health and prevent environmental pollution. Township and City Development Committees may also consider appropriate technologies for waste water treatment (biological treatment, chemical treatment and physical treatment); in addition, an effective tariff and enforcement system and proper monitoring mechanism should be established.

Promoting partnership-building and awareness raising to encourage behaviour change is crucial to moving from the waste disposal practices to more resource circular approaches. This requires implementing innovative and well-designed environmental education and training programmes, with a view to both generate awareness and knowledge on new waste management practices, as well as motivate commitments and actions for sustainable lifestyles. Doing so entails ensuring that training approaches are both inclusive and in line with local circumstances, including (i) building the capacity of local authorities and their

administrative staff to ensure that selected waste management interventions are implementable, scalable and sustainable; (ii) guiding citizens on appropriate actions required to achieve waste management goals, such as ensuring specific information and instructions are widely disseminated on required facilities/services for waste separation and recycling; (iii) engaging citizens through public awareness and participatory, community-oriented approaches, such as organizing self-help groups and developing customized education courses on environmentally-friendly waste practices for interested youth; (iv) encouraging citizens by way of economic incentives that reward compliance, and penalise non-compliance; and (v) demonstrating success of implementation by sharing information on effective pilot projects, highlighting how proactive behaviours can be encouraged as well as the resulting benefits for citizens and government institutions involved in waste management.

At the National Level (MONREC and other relevant ministries)

Establishing an enabling environment including effective policies, legal systems, institutional framework, financing mechanisms and an enforcement/monitoring system for enforcing the successful implementation of waste management at the local level is a major responsibility of national level authorities. In this regard, MONREC should develop national waste management policies and strategies with ambitious, yet realistic and attainable waste management targets in consultation with concerned

stakeholders and encourage the development of action plans with a view towards reaching agreed-upon targets set by respective waste generating sectors (i.e., municipal waste, industrial waste, health and hazardous waste, liquid waste and gaseous waste). This will be required to ensure alignment with other on-going national-level policy efforts led by key development partners such as the National Environmental Policy (UNDP), the Green Growth Strategy (WWF) and the Climate Change Strategy (UN-Habitat), as well as to effectively achieve the Sustainable Development Goals (SDGs) and the Paris Agreement on Climate Change.

National authorities should develop waste classification and performance indicators as well the requisite methodology to track progress against national and city waste management strategies and targets, such as a national waste database. This should also include efforts aimed at incentivising city-actions to improve waste management through national awards and certification programmes. In addition, national guidelines should also be developed that contain definitions related to sustainable materials management and facilitate trade and investment in recycling, recovery and other related waste management solutions. This involves concentrating the majority of waste management responsibilities within a single government body or establishing an appropriate committee, independent department or agency and clearly defining the waste roles and responsibilities of other concerned institutions.

Actions should be taken to increase financial support as well as encouraging additional stakeholders, including the domestic and

international financial community and/or other private sector actors to invest in the improvement of local waste management based on local strategies and action plans. Moreover, where appropriate, national authorities can work towards enabling the establishment of innovative and transparent funding approaches, including independent, blended or pooled funding entities, as well as pay for performance delivery mechanisms. Myanmar's Corporate Social Responsibility (CSR) regulation targeting private enterprises may also be considered for this purpose.

In addition, establishing end-of-life incentive policies aimed at stimulating market demand for recycling, increasing product recyclability and creating the appropriate conditions for encouraging investments in collection, sorting and environmentally-friendly waste treatment should be implemented. This includes offering financial incentives and rewards to industries aimed at nurturing resource-efficiency initiatives, including the promotion of cleaner production practices and technologies. Other actions include supporting the informal and small and medium recycling sectors to enter new service agreements for carrying out collection, recycling, composting and waste treatment in partnership with townships and civil society organisations, which can assist in improving health and safety practices while at the same time supporting economic livelihoods.

National authorities should also work towards setting strong environmental standards, with reliable and transparent monitoring systems, to ensure regulations are clear and consequences for violations are well communicated. This is particularly the case

for industries and developers: laws and regulations should prioritise measuring the magnitude of environmental impact, outline terms of violations, and provide guidance on how community engagement strategies can help to enhance transparency and accountability. Capacity building programmes should emphasise areas for strengthening partnerships with national and international agencies promoting inclusive approaches to waste management with an emphasis on reinforcing sound institutions and proactive policies and technologies that are acceptable, affordable scalable, and appropriate to local circumstances.

International Cooperation

While waste management in Myanmar is at a preliminary stage of development, international cooperation has enormous potential for improving governance and building local capacity and infrastructure necessary for effective waste management. Improving access to capital finance is essential for assisting the development of Myanmar's critical infrastructure aimed at managing increasing levels of waste generation, as well as ensuring proper collection, transport, treatment and disposal. Doing so will include improving access to loan funding at affordable interest rates from international development institutions (World Bank, ADB and JICA) as well as leveraging investments from private investors, philanthropic sources and other bodies supporting climate finance (UN Environment, GEF and concerned donor countries). However, international investments to improve waste management in Myanmar should be appropriate and in line with local circumstances as opposed to being

determined by countries that have modernised their waste management systems over a longer time period.

A major priority for Myanmar will be to continue strengthening knowledge and performance of the public sector with a view towards establishing more inclusive approaches, such as the endorsement of appropriate policies, regulations, and institutions that ensure that the country is equipped with the competencies and skills to deliver sustainable, locally-supported waste management systems. Previous pilot projects implemented in Yangon and Mandalay in collaboration with Japanese partners from Tokyo, Kawasaki, Fukuoka and Kitakyushu Cities illustrates the potential of intercity cooperation for mainstreaming and disseminating environmentally sound waste management systems with Myanmar's Township and City Development committees. Promoting city-to-city cooperation between Myanmar cities and other mentor cities--not only from cities in industrialised countries but also from developing cities, which possess longstanding-experience in terms of upgrading their waste management systems, thus offers a useful strategy for encouraging the sharing of experiences including best practices, and other technical assistance.

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