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Characterization of urban waste management practices in developing Asian countries: A new analytical framework based on waste characteristics and urban dimension

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ABSTRACT

This paper characterizes municipal solid waste (MSW) management practices in developing Asia, with a focus on low and middle-income countries. The analysis that is conducted supports a proposed framework that maps out the trends observed in the region in relation to two parameters, waste compositions and urban dimension, which was prepared based on a set of national and urban case studies. The management of MSW in developing Asian countries is driven, first and foremost, by a public health imperative: the collection and disposal of waste in order to avoid the spread of disease vectors from uncollected waste. This comes, however, at a high cost, with local government authorities in these countries spending up to 50% of their budgets in the provision of these services. Little or no value is derived from waste, which is typically seen as a liability and not as a resource that can be harnessed. On the other hand, in many cities in developing Asia there is an informal sector that ekes out a living from the recovery of recyclable materials found in waste. Members of this “informal waste sector” are especially active in areas that are not served by formal waste collection systems, such as slums or squatter areas. A distinctive element shared among many cities in developing Asian countries concerns the composition of the municipal solid waste. MSW in those countries tends to be richer in biodegradable organic matter, which usually accounts for more than 50% of the total waste composition, suggesting that biological methods are more appropriate for treating this organic fraction. Conversely, thermal combustion technologies, which are extensively applied in high-income countries, are technically and economically challenging to deploy in light of the lower calorific value of waste streams which are rich in organics and moisture. Specific approaches and methods are therefore required for designing adequate waste management systems in developing Asian countries. In addition, despite some common characteristics shared among cities in developing Asia, their specific circumstances can significantly vary, even within the same country, calling for the need for context-specific waste management approaches. Set against this background, this paper proposes a guiding framework in the form of a matrix that maps out approaches observed in the management of municipal solid waste in cities of developing Asian countries as a function of the city dimension, share of organics on waste streams, and wealth generated by the city. The cities of Surabaya (Indonesia), Bangalore (India), Quy Nhon (Viet Nam), and Matale (Sri Lanka) are showcased as good practices in the region in the management of solid waste, with their experiences used to illustrate the framework laid out in the matrix.

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1. Introduction

The Asian continent is a vast and diverse region, straddling from the Caucasus at its Western-most extreme, to the territories of Japan and Indonesia in the Pacific. It is a region of immense

geographical and ethnical diversity, encompassing 30% of the global mass land and a combined population of 3.9 billion people, or 56% of the humanity (World Bank, 2014a, 2014b).

Economic and demographic growth in the continent has been accompanied by increased urbanization rates. From 1990 to 2010 the proportion of Asian's urban population increased from 31.5% to 42.2%, and by 2010, 1.76 billion people lived in cities in Asia, which represents more than half of the world's urban population (UN-Habitat, 2011). High urbanization rates have been pushing

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the boundaries of cities, posing significant challenges to national and local governments alike. Amongst these, the increasing quantities of municipal solid waste (MSW) generated is arguably one of the most daunting challenges that city governments have been facing. As of 2011, cities around the world generated 1.3 billion tons of solid waste on an annual basis, a volume that is expected to reach 2.2 billion tons by 2025 (Hoorweg and Bhada-Tata, 2012). It is estimated that municipalities in developing countries currently spend 20–50% of their budgets in managing and disposing solid waste, with little or no value derived from it (World Bank, 2014c). On the other hand, the impacts of unmanaged municipal solid waste extend far beyond city boundaries. A study by Jambeck et al. (2015), for example, estimated that 4.8–12.7 million ton of plastic waste generated inland in 2010 entered ocean ecosystems.

Set in this context, the aim of this paper is, firstly, to identify and characterize trends in municipal solid management systems in developing Asian countries. Secondly, based on these trends, a guiding framework is proposed in the form of a matrix that maps out the practices observed in urban systems of these countries as a function of the urban population, share of organics on waste streams, and wealth generated by the city. Here municipal systems refer to urban systems understood at the scale of metropolitan areas as defined in the context of each country analyzed. While “developing Asia” is the geographical scope of this paper, its main focus is on low-income and lower-middle income countries of the region, where the challenges of managing MSW have been more severe and therefore, where these issues are considered as a priority to both national and local government authorities (UN-Habitat, 2010; UNEP, 2015). The main contribution of the paper is the new guiding framework proposed, which is the first in the literature to depict MSW management trends in developing Asia along a three-dimensional continuum of waste and city characteristics.

The paper is organized as follows: Section 2 lays out the normative and conceptual context of the paper; Section 3 identifies key issues and priority aspects to consider for a more sustainable MSW management sector in developing Asian countries; Section 4 describes the guiding framework proposed, and illustrates its

application with good practices identified in cities of lower-middle income countries of the region; Section 5 provides the main conclusions.

2. Normative and conceptual framework

Solid waste can be defined as any solid or semi-solid material that no longer carries value or use to the individual or entity that is responsible for its production, transformation or consumption (OECD, 2001). According to the Intergovernmental Panel on Climate Change (IPCC, 2006), municipal solid waste (MSW) refers to waste streams that are generated in urban areas and which are collected and treated by, or for, municipalities or other local authorities. The IPCC definition includes the following waste streams as part of MSW: food waste, garden and park waste, paper and cardboard, wood, textiles, nappies (disposable diapers), rubber and leather, plastics, metal, glass (including pottery and china), and others (e.g. ash, dirt, dust, soil, electronic waste). Waste from construction and demolition activities is usually excluded from MSW definitions, as well as industrial and liquid wastes from municipal sewage networks.

As an important caveat prior to comparing or benchmarking any waste related data is that there is not a consensual or uniform delimitation of MSW among countries. As shown in Table 1, some countries consider as part of “municipal solid waste” streams which typically are not included on commonly accepted definitions, such as medical waste or construction waste.

The existence of different definitions of MSW may pose challenges in comparing data across regions and countries, and should serve as caveat for any analysis of the topic. Other possible challenges in comparing cities or countries may derive from the adoption of different surveying methods, gaps in time series, and the extent to which informal sector activities are captured in national statistics (OECD, 2013).

This paper assigns special attention to “developing” countries in Asia. These are defined as the countries which rank either as low-income, lower-middle income or upper-middle income, based on

Table 1
Definitions of municipal solid waste in selected countries. Source: AIT/UNEP (2010), Damanhuri et al. (2014), EPA (2012), Magalang (2014), MOEF (2000), OECD (2013), Tanaka (2014) and Thai (2014).

Country	Coverage and scope	Waste types included in the municipal solid waste definition					
		Domestic/ residential	Commercial	Industrial	Construction and demolition	Medical and hazardous	Others
India	Municipal areas	Included	Included	Not included	Included	Not included	• N/A
Indonesia	Municipal areas, including commercial zones and industrial estates	Included	Included	Included	Included	Not included	• Domestic waste excludes human fecal matter
Japan	Solid waste in Japan is classified either as “municipal” or “industrial”	Included	Included	Not included	Included	Included	• N/A
Myanmar	Waste generated in municipalities, by industries and agricultural facilities	Included	Included	Included	Included	Included	• Virtually any solid material that is discarded is included in the definition
OECD	Waste that is treated by/for municipalities	Included	Included	Not included	Not included	Not included	• Waste from sewage networks is excluded
Philippines	Discarded solid waste from households, institutions, industries and agriculture	Included	Included	Included (non- hazardous)	Included	Not included	• Hazardous waste is not included, as well as waste from mining activities
Singapore	Waste from offices, shops, hotels, schools, institutions, markets, hawker centers	Included	Included	Not included	Not included	Not included	• Included waste from street cleaning
United States of America	Waste types that historically have been handled in the municipal solid waste streams	Included	Included	Not included	Not included	Not included	• E-waste is included as part of MSW
Viet Nam	Waste that is generated in the daily-life activities of individuals, households or at public areas	Included	Included	Not included	Included	Not included	• N/A

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