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Sustainable SWM in developing countries focusing on faster growing economies, India and China

Sadhan Kumar Ghosh*

*Professor, Mechanical Engineering Department, Jadavpur University, Kolkata 700032, India
President, International Society of Waste Management, Air and Water (ISWMAW), India*

Abstract

The waste management is a major issue in most of the developing countries in the globe. India and China are two faster growing economies who also have similar problems to handle huge amount of municipal solid waste (MSW). Moreover, with the population growth and the increasing GDP, the MSW generation rate is increasing proportionately. Both the countries investing a loads of funds in landfill sites, MSW handling and treatment, but still the problem is not resolved. The main hurdle is the awareness of the citizen and poor institutional initiative all through the country, in general. There are a number of good initiatives, of course. This study aims to explore the present situation of the management of MSW and analyse the sustainability of the initiatives to protect the environment and resource utilisation leading to the least amount of landfill in India and China.

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1. Introduction

Rapid urbanization and population growth are big challenges to make an efficient management system of municipal solid waste (MSW). The per capita MSW generation in India ranges from 0.2 to 0.8 kg/ day and increasing at a rate of 1-1.33% annually [1][2]. The per capita MSW generation in China is 0.44-4.3 kg per person in 2012[3]. As per census 2011, India has population of over 1.21 billion where 31.2% constitutes the urban population. Urban India alone generates about 62 million ton of municipal solid waste (MSW) annually which is estimated to increase up to 250 million ton by year 2047 [4][5]. India introduced MSW Management and Handling

* Corresponding author.

E-mail address: sadhankghosh9@gmail.com

rules in the year 2000 for handling and further treatment of the waste which is under revision at present expecting the revised rules to release in 2015 end. However, many of the cities in India still do not or unable to comply with the applicable rules. The management of urban waste management in cities are of deep concern due to various reasons like poor land use and infrastructure, weak technical and financial capacity, lack of enforcement of regulations, poor coordination between authorities, deficient policies and absence of political priorities [6]. Table 1 shows the comparative data of China and India. Of course there are plenty of investment on account of management of SWM in India. The JnNuRM (Jawaharlal Nehru National Urban Renewal Mission) has spent more than INR 150,000 crore for the five year plan period (2007 - 2012). A huge portion of the amount was spent for the development of Sanitary Landfill site, Compost plant, Biogas plant, Waste to Energy plant, Recycling plant etc in 61 Indian cities. There are some improvement seen during these period. The present mission, SBM (Swachh Bharat Mission) has been announced in October 2014 for the period 2014-2019, which is a massive cleanliness drive in India, nearly 20% of the total amount will be spent in SWM. In urban areas of India, the land required for landfill is 1240 hectares per year and the majority of dumpsites are over their capacity. Furthermore, the world health organisation suggests that improved MSW management can prevent and control 22 different diseases.

Table 1. China and India - Comparative data

	China	India	Reference
Population	1.36 billion	1.25 billion	(4), (5)
Population Increase	0.61%	1.24%	(4), (5)
Population density	145 people/ km ²	386people/ km ²	(4), (5)
Geographical area	9.6 million km ²	3287240 km ²	(4), (5)
Rate of increase of MSW generation	3% - 10%	1% - 1.33%	(9), (1)
Per capita MSW generation	0.44 to 4.3% kg	0.2 to 1.0 kg	(3), (1)

MSW generation in China has increased rapidly in the past 20 years with the annual rate of increase as 3-10% [9]. In general, China still has a long way to go in the management of solid waste with respect to solid waste recycling, treatment technology and management strategy when compared with developed countries, e.g., Germany, Sweden, UK, Japan, and the United States [10]. According to the World Bank (2005), China produced 190 million metric tons of MSW in 2004 and became the world's largest MSW generator. It was estimated that cities and towns in China would dispose municipal waste 871,000 tons/day by the end of the 12th Five-Year Plan (2011-2015) with an increase of 580,000 tons/day compared to the 2010 level [7]. Facing this pressure, China has devoted considerable effort to managing its MSW. From 1990 to 2004, investment in MSW treatment equipment and infrastructure increased 21 times and over 30 times more MSW is now treated or disposed of safely [8].

This study aims to focus on the solid waste management in India and China with respect to its sustainability.

2. Literature review

Waste generation has close relationships with population, urbanization and affluence. Waste generation rate of a country or region can be linked to gross domestic product (GDP) per capita, energy consumption per capita, as well as private final consumption per capita [11][12]. MSW consists of daily items including recyclable materials like paper, plastics, textiles, metals, glass, yard wastes; organic materials like food; inorganic materials such as dirt, a small amount of construction wastes (mainly come from house decoration of community residents and the quantity is relatively small, the mixture of these construction wastes in MSW can be attributed to the poor sorting system and the voluntary awareness of some inhabitants); and miscellaneous other materials [13]. The MSW collection efficiency ranges between 70 and 90% in the major metro cities in India, whereas in several smaller cities it is below 50% [14]. It has been reported that Indian cities dispose of their waste in open dumps located in the outskirts of the city without any concern for environmental degradation or impact on human health. The economical and infrastructural constraints, including unavailability of land for safe waste disposal, and lack of awareness and fear at all levels restrain progress resulting in inefficient, unsafe urban solid waste management [15]. The management of

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