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A Glance at the World

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This column comprises notes and info not subjected to peer-review focusing on waste management issues in different corners of the world. Its aim is to open a window onto the solid waste management situation in any given country, major city or significant geographic area that may be of interest to the scientific and technical community.

Breaking the climate change-municipal solid waste dump nexus – A case study in Chennai, India

Landfills are one of the safest ways of organized waste disposal. There are no scientifically engineered landfills in India. The open dump creates various environmental issues such as open burnings and greenhouse gas emissions (CO_2, CH_4 and VOCs).

The Asian Regional Research Program on Environmental Technology (ARRPET) sponsored by Swedish International Development Cooperation Agency focusing on 'Sustainable Solid Waste Landfill Management in Asia', has helped us to understand various aspects of solid waste management and landfills. Significant contributions of the project are developing in order to enhance the rehabilitation of dumpsites in the developing countries, characterize the dumpsites and establish the feasibility of dumpsite by methane emission reduction using biocovers in the landfills.

This paper presents a review of the current conditions of the landfills in Asia based on reports and research papers. Moreover, it attempts to understand the aspects of solid waste management and its nexus with climate change issues in Asia related to open dumpsites, focusing on those in Chennai, India.

90% of the open dumpsites in Asia are without precautionary measures. The methane they produced contributes to the global emission in the range of 10–70 Tg/y. Approximately 500 t of methane and carbon dioxide are generated daily from the dumpsites in India (Hebbliker and Joshua, 2001). Most of the open dumpsites, being shallow and subjected to open burning, may generate less gas. Jha et al. (2008) report a substantial level of emission from Chennai dumpsites.

Open dumpsites in Chennai

The urban population in Chennai has increased by 1.23% during the year 1991–2001 (CMDA, 2008) and waste generation has increased by approximately 5% per annum. According to Professor Kumar of Madras School of Economics, Chennai, this city has the highest per capita solid waste generation rate in India at 0.7 kg/d . The estimated per day generation of waste in Chennai is 3036 t/d.

In Chennai, the waste is dumped in two locations: Kodungaiyur and Perungudi. These open dumpsites are susceptible to open burnings, groundwater pollution, scavengers and disease vectors. The amount of gases emitted differs spatially due to waste composition, age, quantity, moisture content and ratio of hydrogen/oxygen available at the time of decomposition. Wastes with high moisture content cause a high rate of methane emission. The emission flux is known to range from 1.0 to 23.5 mg CH_4 m^{-2} h^{-1}, 6 to 460 μg N_2O m^{-2} h^{-1} and 39 to 906 mg CO_2 m^2 h^{-1} at Kodungaiyur and 0.9–433 mg CH_4 m^{-2} h^{-1}, 2.7–1200 μg N_2O m^{-2} h^{-1} and 12.3–964.4 mg CO_2 m^{-2} h^{-1} at Perungudi (Jha et al., 2008). Burning of municipal solid wastes by rag pickers at these sites is a common sight. In such cases, CO_2 emission is prominent. The proximity of both sites to residential areas increases the manifestation of the adverse effects of the dumpsites.

Open dumps and vector-borne diseases

Along with the raised temperature, the open dumpsites provide disease vectors a perfect ground for breeding and proliferation. The proximity of the residential areas to the dumpsites facilitates the movement of the vectors from the dumpsites to residential areas, thereby increasing the potential of disease transmission.

Chennai, with an annual average relative humidity of 71.1%, is suitable for most of the vectors. There was a substantial rise in 'emerging infectious diseases' like dengue, chikungunya and leptospirosis vector borne diseases in 2009 from the year 2008 and more so in 2010 (Kannan, 2010). The malaria parasite and mosquito development show a very significant relationship to temperature and relative humidity. The optimum humidity for their growth is reported to be 60–70% and the temperature is 25–27 °C, with the maximum temperature of 40 °C for survival (Dhiman, 2010).

Management options

The climate change – disease nexus of open dumping has to be broken. Investments should be made on mitigation measures. The source of GHGs should be reduced or eliminated by managing the solid waste in a sustainable way starting with the 3R, moving to engineered landfills. The measures adopted should take into account the needs of the region based on local weather conditions, land availability and proximity of the treatment facility to the residential area. Chennai presents the land availability issue, making the landfill option less feasible. All the disposal methods have some environmental liability: the chosen technology should pose the least threat to the climate and also it should also be economically

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feasible. Financial obligations related to a technique should take into account the operational expense as well as the cost required for restoration after the treatment phase.

Chennai should opt for a combination of different techniques such as composting of the organic content. The area is not so suitable for landfills and the new composting systems can reduce the further need for land. The compost can be used for growing non-edible crops to prevent the absorption and retention of toxic compounds in the waste. Incineration is commonly employed in the case of a number of burnable wastes and space restrictions. It produces energy in the form of heat, steam or electricity. Briquettes formed from the plastic content of the waste mixed with starch and wood chips have been reported as having acceptable refuse derived fuel quality for incineration (Chiemchaisri et al., 2006).

Research opportunities exist in designing cleaner incineration technology. The current Indian policy which discourages incineration due to the prevailing waste characteristics requires an objective review. Cleaner technologies should be promoted and operational expenses reduced. The financial requirement in this regard should be viewed as an investment. If incineration cannot be opted for, then the open cell method, which has shown great results in reducing the environmental threats related to open dumpsites to a large extent (Visvananthan et al., 2005), may be applied.

The existing open dumpsites require improvement and conversion into sustainable landfills by a sequential process.

Cracking the climate change-dumpsite nexus

A regional, followed by on-site execution plan, needs to be developed in order to understand and sever the climate change-dumpsite nexus. A possible approach is depicted in Fig. 1. The efforts to reduce the gas emissions should address a multitude of cause-effect factors controlled and driven by policy instruments. Logistics available for managing the issue is further linked to the availability and to the nature of the receiving environmental component; in this context it maybe the availability of land and current and projected pressures on land resource. To offset the problems, newer research findings may lend support. It is essential to ensure a two-way interaction between the economic and research sectors to shortlist management options and also between technology and public participation. Taking health sector into consideration, the manifestation of the effects of emissions from dumpsites can be interpreted on the basis of the prevalence distribution and the economic implications of vector borne diseases. Public involvement is important to develop and make changes in policies dealing with societal concerns. The approach may be modified according to the onsite requirements.

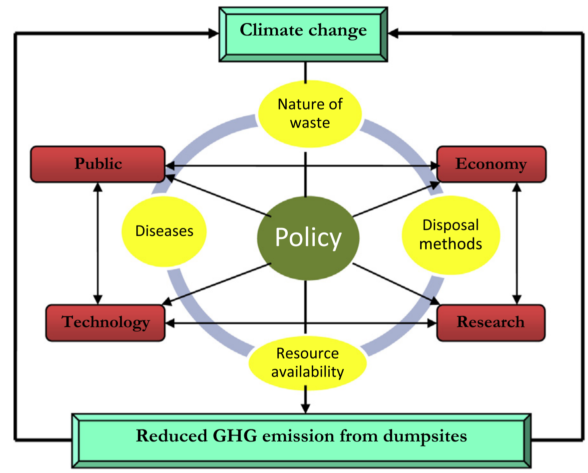

Fig. 1. Complexity in breaking the climate change and solid waste nexus.

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Conflicts and risk management of the Laogang Landfill in a developing world city, Shanghai

Shanghai, as one of the largest municipalities in China, is undergoing fast economic growth. Ever-increasing population growth and accelerated urbanization has caused a rise in the generation of MSW (Municipal Solid Waste).

In 2011, the quantity of MSW entering the municipal recycling system reached 7.042 million tonnes, corresponding to 19210 t/d (Fig. 1). Currently, there are five landfill sites, two waste-to-energy incineration plants and four composting plants in Shanghai. The total designed capacity of landfills is 6550 t/d, with Laogang Landfill Phase IV 4900 t/d, Songjiang Landfill 400 t/d, Chongming Landfill 300 t/d, Changxing Landfill 150 t/d, Liming Landfill 800 t/d. The designed capacity of Jiangqiao and Yuqiao waste-to-energy incineration plant is 2500 t/d (1500 t/d and 1000 t/d respectively). The four composting plants are responsible for absorbing 3000 t/d waste. The Meishang composting plant, which opened in 2003, is responsible for absorbing 1000 t/d. In addition, Jiading, Qingpu and Songjiang composting plants are responsible for absorbing 500 t/d, 500 t/d and 1000 t/d, respectively. Waste disposal facilities would eventually reach their capacity by receiving the wastes after source separation, which underlines the need for new facilities.

While Shanghai is launching the source separation program, new waste treatment infrastructures are under construction. With a growing public awareness of environmental issues, the lack of public involvement is resulting in NIMBY (Not-In-My-Back-Yard) syndrome or other locally unwanted land uses (LULUs), which often delays construction or even prevents the identification of a new waste disposal facility (Edelstein, 1988).