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Comparative Study of Garbage Management of Two Indian Cities

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INTRODUCTION

URBANIZATION AND its allied processes have made a profound impact on the environment of the metropolitan cities of India. Due to uncontrolled urbanization, environmental degradation has been occurring very rapidly and causing shortages of housing, worsening water quality, excessive air pollution, noise, dust and heat and the problems of disposal of solid and hazardous wastes. If we have a cursory glance at the percentage of total population of India residing in million plus cities, we can see that it has increased drastically from less than one per cent in 1901 to three per cent in 1951 and further to eight per cent in 1991. The percentage of total urban population of India residing in million plus cities has also increased drastically from six per cent in 1901 to 19 per cent in 1951 and further to 33 per cent in 1991. The volume of domestic waste water generation is highest in the metropolitan city of Mumbai, which is 2228.1 ml/d followed by Kolkata (1383 ml/d) and Chennai (276 ml/d). Mumbai generated the largest amount of Municipal Solid Waste in 1996 which was 5355 tonnes/day. Chennai generated 3124 tonnes/day waste (Maiti, Sutepa, and Praween K. Agrawal, 2005). Per capita organic waste generation in Thiruvananthapuram city is 0.17 kg/day (www.swmindia.blogspot.in).

Improper handling and collection of solid waste have serious health consequences. They block drainage systems and contaminate ground water at landfill sites. In many cities, it is difficult to secure land for waste disposal facilities. Most cities in the region are also unable to manage the increasing amounts of hazardous wastes generated by rapid industrialization. Conversion of agricultural land and forests, as well as reclaiming of wetlands, for urban uses and infrastructure, put additional pressure on nearby areas that are ecologically sensitive.

Urbanization and its correlation with environmental degradation

The relationship between cities and nature has long been a point of contention for both environmentally minded social theorists and

socially minded environmental theorists. Urbanization has long been discussed as a process whereby one kind of environment, namely the "natural" environment, is traded in for, or rather taken over by, a much more crude and unsavoury "built" environment. The modern city represents a regressive encroachment of the synthetic on the natural, of the inorganic (concrete, metals, and glass) on the organic or crude, elemental stimuli on variegated wide-ranging ones". The city is posited as the antithesis of nature, the organic is pitted against the artificial and in the process, a normative ideal is inscribed in the moral order of nature (Heynen, Nik, and others, 2006). Great threat to health and safety in cities come from water and air pollution, especially at the households and community levels. Air pollution from cities has an impact on residents' health as well as on vegetation and soils at a considerable distance. Urban transport contributes to air pollution and the large concentration of cars and industries in cities causes the lion's share of urban global greenhouse gas emissions. Water borne diseases are found most commonly in low-income neighbourhoods as a result of inadequate sanitation, drainage and solid waste collection services. Health risks, especially to the poor are also posed by industrial effluents. In many cities, even in those in Pacific island countries; it is difficult to secure land for waste disposal facilities, especially onshore landfill sites. Ground water overdraft has led to land subsidence and a higher frequency of flooding, particularly in the lowest-lying and poorest areas (Ichimura, Masakazu, 2003). Worsening environmental conditions can have serious effects on human health and welfare particularly on the poor.

Sustainable Development

The rhetoric of "sustainability" has spread to the field of urban research and planning since 1990. The World Commission on Environment and Development defined sustainable development as "...development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Sustainable Development also needs to ensure a better quality of life for all, in a just and essential manner, whilst living within the limits of supporting ecosystems. A Sustainable Development framework has become extremely influential in planning, however, a strong critique has stemmed from social critical theorists, including urban political ecologists. Sustainable Development obscures the fact that the "nature" that entrepreneurial city officials, profit-seeking businesses, radical environmentalists and communities exposed to contaminations wish to preserve are not all the same. Thus the very

TABLE 1: SOURCES AND TYPES OF MUNICIPAL SOLID WASTE

Sources	Typical waste generations	Components of solid waste
Residential	Single and multifamily dwellings	Food wastes, paper, cardboard, plastics, textiles, glass, metals, ashes, special wastes (bulky items, consumer electronics, batteries, oil, tyres) and household hazardous waste
Commercial	Stores, hotels, restaurants, markets, office buildings	Paper, cardboard, plastics, wood, food wastes, glass metals and hazardous wastes
Institutional	Schools, government centre, hospitals, prisons	Paper, cardboard, plastics, wood, food wastes, glass metals and hazardous wastes
Municipal services	Street cleaning, landscaping, parks, beaches, recreational areas	Street sweepings, landscape and tree trimmings, general wastes from parks, beaches and other recreational areas.

SOURCE: Ranjith Kharvel Annepu, Sustainable Solid Waste Management in India, www.seas.columbia.edu, Accessed on 15th December, 2012.

political, contradictory and plural character of "nature" and "sustainability" is neglected in Sustainable Development theory and practices (Roy, Parama, 2011).

A Bird s Eye View of the Global Scenario

An alternative paradigm for solid waste management for low income countries was proposed in seminal form at the United Nations Conference on Environment and Development at Rio de Janeiro in June 1992 - 20 years after the first global conference on the human environment. More than 172 participating countries, the majority from middle and low income countries endorsed it. In Agenda 21, Sustainable Solid Waste Management is addressed to national governments that are advised to recognise the significance of the smallest administrative unit for the purposes of waste management. Local authorities construct, operate and maintain economic, social and environmental infrastructure, oversee planning processes, establish local environmental policies and regulations, and assist in implementing natural and subnatural environmental policies. As the level of governance closest to the people, they play a vital role in educating, mobilising and responding to the public to promote sustainable development (Para 28.1)

Agenda 21 stated that policy changes at the national and local levels should include "giving full recognition to and using the full range of low-cost options for waste management, including, where appropriate, their institutionalisation and incorporation within codes of practice and regulations" and "assigning high priority to the

extension of waste management services, as necessary and appropriate, to all settlements irrespective of their legal status, while giving due emphasis to meeting the waste disposal needs of the unserved, especially the unserved urban poor." (Para 21.45). Non-hazardous waste originating from homes and offices, has substantial amount of organic food waste and paper, plastic, metal and glass. The waste hierarchy's imperatives were that these should be source segregated and subjected to composting, recycling and waste recovery.

The Indian Context

India is one of the first countries worldwide to make provisions for environmental protection in its constitutional and legal framework. Article 48-A of the Indian Constitution stipulates that the government shall make attempts to protect and improve the environment. There are various National Acts for protection of environment such as the Environment (Protection) Act, 1986, the Water (Prevention and Control of Pollution) Act 1974, the Indian Forest Act 1927, the Wildlife Protection Act 1972 and the Biological Diversity Act 2002.

Municipal authorities are assigned the responsibility to develop infrastructure for collecting, separating, transporting, processing, and recycling municipal solid wastes. India framed its first Municipal Solid Waste (Management and Handling) Rules 2000, in September 2000. It advocates daily doorstep collection of "wet" (food) wastes for composting. Biodegradable wastes should be processed by composting, vermicomposting, etc., and landfilling shall be restricted to non-biodegradable inert waste and compost rejects. The municipalities should ensure community participation in waste segregation (by not mixing food wastes and plastics wastes) and promote recycling or reuse of segregated materials. Garbage and dry leaves should never be burnt. The Supreme Court has also banned the use of pesticides on garbage in its judgement on July 28,1997.

The Act prohibits littering and throwing of garbage on roads. Citizens should keep their wet (food) wastes and dry (recyclable) wastes within their premises until collected, and must ensure delivery of wastes as per the collection and segregation system of their city, preferably by house-to-house collection at fixed times or directly into trucks stopping at street corners at regular pre-informed timings. The cities should provide free waste collection for all slums and public areas, but charge the full cost of collection on "Polluter-Pays" Principle, from hotels, eateries, marriage halls, hospitals and clinics, wholesale markets, shops in commercial streets, office complexes, cattle - sheds,

slaughter - houses, fairs and exhibitions, inner-city cottage industry and petty trade.

TABLE 2: THE FOUR STEPS OF SCHEDULE I OF THE 2000 RULES

Step	*Completion date*
Set up waste processing and disposal facilities	December 2003 or earlier
Monitor the performance of processing and disposal facilities	Once every 6 months
Improve existing landfill sites as per provisions of the rules	December 2002 or earlier
Identify landfill sites for future use and make sites ready for operation.	December 2002 or earlier

SOURCE: Ministry of Environment and Forests (2000), Government of India.

The rules apply equally to every municipal authority regardless of its size. The management of MSW is covered under Schedule II of the Rules. The rules require that all cities and towns establish suitable treatment and disposal facilities. The rules authorize Central Pollution Control Board (CPCB) at the top of its chain as the agency to monitor the implementation of the rules. At the bottom of the chain lie the municipal authorities who are responsible for implementing the rules. The responsibility for granting authorization of setting up of waste processing facilities is with the State Pollution Control Board (SPCB). A "Committee" is constituted to help SPCB in taking appropriate decisions while granting authorization for setting up of waste processing facilities. The municipal authority or a private operator is required to apply to the SPCB for approval of waste processing and disposal facilities (Singh, Gurdeep, et al., 2007). Decentralised ward - wise composting of well - segregated wet waste in local parks is recommended, for recycling of organic waste and also for huge savings in garbage transport costs to scarce disposal sites. The waste-management infrastructure should be a strictly-enforced pre-condition in new development areas. Temporary toilets at all construction sites (located on the eventual sewage-disposal line) and restriction of cattle movement on streets are advocated. Livestock should be stall-fed or relocated outside large cities.

Solid Waste Management in Thiruvananthapuram City

The urban sector of Kerala comprises of five Municipal Corporations and 53 Municipalities. Almost 26 per cent of the

population lives in urban areas. The Census of India 2001 recorded an urban population of 82,67,135 in the state out of the total population of 3,18,38,619 and is spread over 159 Census towns in the state. The district Thiruvananthapuram of Kerala, has a gross area of 2192 sq km (5.64 % of the area of the state) accommodating 32,34,356 persons (2001) which is 10.16 per cent of the state's population. Out of this, 10.92 lakh live in urban areas, namely Thiruvananthapuram city, Neyyattinkara, Nedumangad, Attingal and Varkala towns.

Sewage Waste Management functioning in Kerala is below the average. This has resulted in problems of health, sanitation and environmental degradation. The total quality of solid waste generated in Kerala is not estimated accurately. More than 50 per cent of the solid waste generated in Thiruvananthapuram city comes from residential buildings. On an average the city produces 300 tonnes of solid waste every day. The city collects about Rs. 30 to 35 crore every year as Own Source Income (through tax and non tax revenue) and about Rs. 12 crore is spent every year on Public Health and Sanitation. A substantial percentage of this expenditure is used for solid waste management. Despite spending this money, the corporation is unable to provide satisfactory SWM services. For the collection mechanism, the city corporation has provided workers to collect the waste from residential and commercial units.

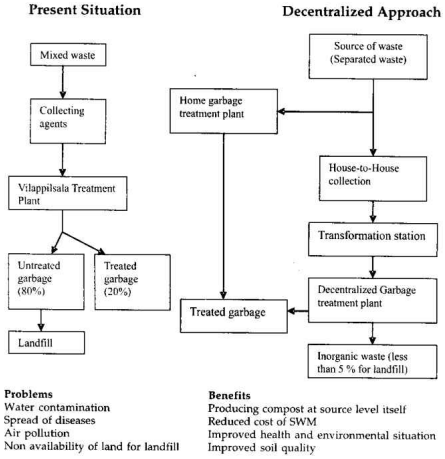
The study of transportation stage was carried out by field visits to the busiest market places located at Chalai and Peroorkada. In all the places it was found that the wastes are not properly collected by the corporation. During earlier times the containers of the city corporation were found collecting waste from the city in the morning. The trucks used to be parked at certain points in the city during day time and carried to Vilappilsala waste management plant after 9 pm. But now they are accumulated at the nearby places and burnt there itself.

The Waste Processing Plant

Thiruvananthapuram Corporation has established a centralized SWM plant for managing the garbage generated in the city. The plant is situated in Vilappilsala, 16 Km away from the city centre. It was installed by Poabsons Private Limited (Private Company) in 2000 and later handed over to Thiruvananthapuram Corporation in 2007. The plant is using mechanical composting for garbage treatment. The corporation acquired the land in 1993 in Chowalloor ward in Vilappilsala. The waste collected from the various wards is transported to the processing centre at Vilappilsala for treatment. Around 50 garbage trucks are used for transportation of waste.

From the visit to the Vilappilsala plant, the researcher identified many issues related to its proper functioning. Daily the city corporation collects an average of 200 to 300 tonnes of solid waste. But the plant has the capacity to treat only 50 tonnes waste a day. The plant is facilitated for organic waste management only. But nonsegregated waste has created severe problems in the proper working of the plant. In fact, 80 per cent of the waste collected becomes inorganic due to improper segregation. Only 50 tonnes of waste is converted to organic manure. The rest considered as inorganic (150 to 250 tonnes) is piled up as an open dump in the plant locale itself. Landfill is not the sustainable way of solid waste disposal. The land available in Vilappil plant has got whacked by solid waste land filling. Also open dumps have encouraged the breeding of flies, rats and mosquitoes. They are spreading epidemics like dengue fever, rat fever, yellow fever, skin diseases and other viral infections which are widely reported in the locality. Flammable waste materials dumped together at open dumps were also found to be a great threat to the villagers living near this plant. A diagrammatic representation of the Solid Waste Management in Thiruvanathapuram city (present situation vis-à-vis decentralised approach) is as follows:

The people of Vilappilsala organized and formed Janakeeya Samiti to protest against garbage disposal in their village. The City Corporation on the other hand alleged that the Panchayat President along with agitators had organised protests and blocked the movement of garbage trucks to the plant. A Division Bench of the Kerala High Court issued notice to the Vilappil Panchayat President Smt. Sobhana Kumari and the Vilappilsala Janakeeya Samiti leaders Burhanudeen and Beneckson on a petition filed by the Thiruvananthapuram Corporation seeking to initiate contempt of court proceedings against them for violating court orders on the solid waste treatment plant at Vilappilsala. The notice was issued by a Bench comprising of Acting Chief Justice Manjula Chellur and Justice P.R. Ramachandra Menon. The Court had ordered police protection for resuming the operation of the garbage treatment plant and directed opening of the locks of the gates of the plant with the assistance of police. On 18th February, 2012 the Panchayat representatives under the leadership of Vilappil President Smt. Shobana Kumari locked the plant. It was the culmination of a long struggle by the Janakeeya Samiti for the closure of the plant. The City Corporation and State government are engaged in a tug of war over waste disposal and pipe compost project for solid waste management. This is a delicate situation, but the common citizens are helpless. To put the situation in a nutshell, the people living in this city are at the receiving end of the garbage crisis.



Solid Waste Management in Chennai

Chennai (formerly Madras), is located at the northern end of the Tamil Nadu coast. Originally a coastal village, it was selected by the British as a base for trading activities on the east coast of India. Chennai currently has a population of 4.34 million. The Chennai Metropolitan Area comprises the city of Chennai, 16 Muncipalities, 20 Town Panchayats and 214 Village Panchayats. The quality of urban services in the suburban towns, such as water supply, sanitation, garbage collection etc., is very low. Nearly one-third of the population of Chennai live in slums, most of which have no access to services such as sanitation and solid-waste management. In Chennai city, there are three distinctly different players in the arena of SWM, all operating under the overarching framework of the MSW Rules.

1. A public body (the Corporation of Chennai)
2. A private body (CES Onyx, a subsidiary of M/s CGEA Asia Holdings, Singapore followed by Neel Metal Fanalca and finally Ramky Enviro Engineers) and
3. A non – profit organization (Exnora)

In 1996, the Government of Tamil Nadu, directed the Corporation of Chennai to introduce private participation in the collection of solid waste to enhance efficiency and quality of services and bringing in the extra resources required for the same. In order to facilitate privatization of SWM, the state government passed an order exempting the Corporation from the provisions of the Contract Labour (Regulation and Abolition) Act 1970. Despite strong protests by worker unions, the final contract with Onyx was finalized for privatization of SWM (sweeping collecting, storing and transporting waste) in three out of 10 zones for seven years (2000-2007). The Corporation continued to handle SWM in the other seven zones. Both the Corporation and Onyx did not offer SWM services in notified slums. These continued to be under the purview of the Tamil Nadu Slum Clearance Board.

Neel Metal Fanalca was the next entrant in the field followed by Ramky Enviro Engineers. The technology was all imported from abroad. The private operator committed to deploy more than 1800 employees, 31 compactor trucks, 30-35 hook lift trucks, 180 auto rickshaws, 800 modified bicycles, mechanical sweepers and 5300 mobile garbage bins. All garbage collected was stored in an intermediate depot where tonnage was checked at computerized weighbridges. From this point, garbage was transported to the landfill site. All workers of the private firm were provided with appropriate uniforms, gloves, caps, shoes and safety gear.

The Corporation of Chennai generates a large quantum of solid waste (estimated to be roughly 3000 tonnes per day) It has a network of transfer stations and two land fill sites at Kodungaiyur and Perungudi. The per capita contribution of garbage is thus quite low; less than one kilo on average. The garbage generated in Chennai has a high organic content (23.3% carbon) and a high moisture content (18.5%) but a low calorific value (2069 k cal kg^{-1}) and is therefore, not suitable for energy recovery through combustion. Chennai is a classic case in point as to why resource recovery plants in India have failed due to the high moisture and ash content, and low calorific value of the garbage. The estimated daily generation of waste in the city is as

follows:

TABLE 3: ESTIMATE OF DAILY GENERATION OF WASTE (IN TONNES)

Area	*Residential and Commercial*	*Hospital*	*Total*	*e-waste*	*Construction debris*
Chennai city	2620	80	2700	5	500
Municipalities	1073	11	1084	2	50
Town Panchayats	207	1	208	1	NA
Panchayat Union	255	1	256	2	-
Total	4155	93	4248	10	550

SOURCE: www.cmdachennai.gov.in, Accessed on 15th May 2012.

NA Not Available

The solid waste is collected by various kinds of vehicles, taken to transfer stations and ultimately dumped in low-lying areas as landfill material. However, sanitary land-filling practices are not followed, with the result that the area becomes insanitary, is ingested with vectors, flies, pigs, etc. and sometimes contaminates the nearby groundwater. The Pallikarnai marsh, for instance, has lost over 150 hectares of wetland to untreated garbage that is just dumped there. A similar situation prevails in Kodungaiyur which was once an open field for grazing livestock. In fact, the situation is worse in Manali, Madhavaram, Ambattur and Sholinganallur where untreated waste is dumped in city outskirts. The city's total consumption of carbon works out to 780 tonnes per day. A substantial portion of income for most of the households is spent on food. These organic materials end up as unconsumed household/municipal garbage. In unsewered areas of the city, night soil is returned to the land or water. Around 260 million litre per day of sewage is collected by the municipal system. The organic loading is around 95 tonnes per day, of which the carbon equivalent is around 51 tonnes. The carbon content of the carbon-di-oxide exhaled by the entire population is estimated to be 530 tonnes/day. The rest is accumulated in the ecology as human/animal and plant growth.

Management of Solid Waste

The present practice of solid waste management in Chennai is open dumping. This is ecologically unsustainable and will not extend for a long period due to lack of land. The **Chennai Corporation** is working on a proposal for compulsory source segregation of waste material at large **residential apartments** in the city. If the **residential**

complexes do not initiate these projects, they will be fined. The civic body is planning to strictly enforce source segregation, especially in hotels and wedding halls, as they generate huge quantities of waste. However, coordination between the **residential associations** and the corporation is required for successful implementation of the project. One of the issues explored by the researcher in household interactions was how citizens viewed the performance of various services. On the whole, services for taking waste from the houses were perceived to be very poor. None of the households opined an excellent service for waste picking from the houses. Waste disposal habits of the households were determined by housing condition, existing levels of service, effectiveness of regulations and other factors. Most of the households opined that waste collection services are not working properly.

From December 2004, mixed refuse is not accepted by the corporation and an administrative charge is imposed on people who do not hand over their garbage to the waste collector, but these measures are not deterrent enough to prevent people from dumping wastes on the roadside. Households were asked about wastes like paper, glass and cloth. The reply was that these are usually sold for recycling. From the interaction with households, the researcher also found that most of the households were unaware of how and where all the garbage collected in their city is disposed off. At present, nine out of the ten zones in the corporation area have a transfer station. Most of them felt that there was little cooperation from the households.

Exnora International is a non-governmental environmental service organization started in 1989 in Chennai. The success of the new system caught on and within the first few years of its founding, Exnora had around 1000 Civic Exnora, functioning successfully. Civic Exnora were also interviewed by the researcher to know more about solid waste management in the city. On an average, each Civic Exnora was found serving 150-200 households. Continuity in providing waste collection service is critical for them. But the interaction with them brought to light the grim reality that the system is not without its share of problems. The improved primary collection system is found to be increasing the pressure on secondary collection, which the local body is failing to handle. This results in garbage accumulation. Another problem identified is disposing wastes in dumping grounds. The two dumping grounds for the city—Perungudi and Kodungaiyur—which are erstwhile prime wetlands have got slowly covered by the city's garbage. This has resulted in the leacheate polluting the soil and the ground water. Air pollution also threatens the human and animal life in its surrounding areas. Thus, collection and disposal of garbage in

Chennai is a mere relocation and not a management of waste. There is a felt need for shifting focus from mechanical collection and disposal to innovative new methods of waste recovery such as composting of organic waste at household level.

The Chennai case study also points out that the handing over of SWM operations to the private agency in select zones seems to have brought about some positive changes, at least in terms of effectiveness of SWM operations and cleanliness level of neighbourhoods. However, there is a feeling among residents that the performance of the private player has slipped over the years. To conclude, the Chennai model shows that public sector, on its own, has not been able to respond effectively to the challenges posed by SWM. On the other hand, private and civil society participation pose challenges which are not confined to issues of equity and accountability alone. The efficacy of civil society responses is also influenced by a host of local variables.

CONCLUSION

The study has examined issues of waste management in Chennai using field visits and interview methods. A well functioning secondary collection system was found to be a major issue in Chennai. The present system of collection, transfer and dumping does not make any distinction between types of waste other than domestic and commercial waste and to some extent construction debris. An integrated solid waste management system was also found lacking in Thiruvananthapuram as well. Processing with application of suitable technologies was found to be non-existent. Various available options for household burial, vermi-composting, bio-gas production, etc. remain at best premises on paper. The field reality is that the optimal solution lies in reducing and reusing the plastic and other non-degradable wastes. In the field of SWM, evidence seems to indicate that service efficiency and coverage is often enhanced by private sector participation. But this need not always be the case. In fact, in most efforts at privatization of urban services, the state does not move away from its role completely—roles only change, with the state taking on different responsibilities.

Major Suggestions

Agents should collect only segregated waste from the houses;

Collected waste should reach the treatment plant without any delay to avoid air pollution;

Plastic and recyclable materials should be properly separated;

Vermicomposting and biogas plant should be developed by Residents Welfare Associations;

Environmental Impact Assessment (EIA) of the landfill site should be done;

There should be complaint cells at ward level for solving waste management issues.

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