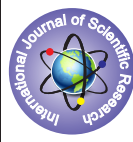


Some Alternative Solutions in Municipal Solid waste management in South Asian Countries: A Case study of Municipal Corporations of Punjab



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ABSTRACT

In Asian countries the rapid population, industrialization, urbanization and economic growth contribute to increasing solid waste (SW) generation. This paper reviews the existing management of Municipal Solid Waste and the current problem of collection, transportation and disposal processes in Municipal Corporations of Punjab (India) and implementation of Municipal Solid waste management in some south Asian countries. Punjab generates approximately 3017.25 tonne municipal solid waste per day. Out of this 1830 tonne per day (TPD) municipal solid waste is generated only by four municipal corporations i.e Ludhiana, Amritsar, Jalandhar and Patiala. Approximately 28 per cent of total solid waste is generated only in industrial city Ludhiana. The increasing amount of solid waste generated in most of the cities is being recognized as a major health problem. In most of the cases, the toxic and hazardous waste is mixed with domestic solid waste and is disposed off in unsafe dumps without treatment. This disposal method gives the environmental pollution, such as the pollution of soil, surface and groundwater caused by leachate. The main objective of this paper is to review the condition and current problems of solid waste management (SWM) in Ludhiana, Patiala, Jalandhar and Amritsar (Corporation cities of Punjab, India) and to find out alternative solutions to reduce the waste generation.

INTRODUCTION

Growth of urban population in Punjab is a major challenge of 21st century. Urban population in Punjab is growing rapidly. Punjab is in the midst of urban transition. At the dawn of the twentieth century, only 12.46 per cent of the total population of the then pre-partition united Punjab was urban. At the beginning of the twenty-first century, the urban population of Punjab has increased to 33.95 per cent, against 27.78 per cent for the country as a whole. As per census 2001, Punjab is the fifth major urbanized state of India after Tamil Nadu (43.86 per cent), Maharashtra (42.40 per cent), Gujarat (37.35 per cent) and Karnataka (33.98 per cent).

Whereas the 'THE MUNICIPAL SOLID Waste (MANAGEMENT AND HANDLING RULES, 2000)' were notified by Ministry of Environment & Forest in the year of 2000, but even after passing a decade progress of Municipal Corporations is very poor for the implementation of Act. Municipal Solid Waste (MSW) in Punjab is dumped without treating, which is affecting environment and health of the citizens.

METHODOLOGY

The study is based on the primary and secondary data collected from various government publications particularly Statistical Abstracts of Punjab for relevant years and Municipal Statistics of Punjab. The period of the study is from the year 2002-03 to 2009-10, for which data was available for four Municipal Corporations of Punjab, and this data was obtained from Municipal Corporation offices of Punjab. Since the data was obtained from different sources, therefore, there may be some minor differences in the analyzed figures. Four Municipal Corporations have been studied; i.e Ludhiana, Jalandhar, Amritsar and Patiala. The new Municipal Corporation Bathinda was not studied as its working started lately as compared to the above mentioned corporations. Simple percentages, growth rates and proportions have been worked out. Informal discussion was also held with public and political representatives and municipal councillors and commissioners. Secondary data was collected from municipal corporation's journals, official records, brochures, books, etc. Data relating to the generation and management of solid waste was collected at the secondary levels. Secondary data on solid waste management was collected from the offices of the Municipal Corporations and Punjab Pollution Control Board, whereas primary data was collected at household's level. It was also examined as to how the Corporation was dumping the solid waste. To work out the per capita figures, population figures for different years covered in the study were interpolated using the growth rates pertaining 1991-2001 for the concerned Corporations.

EXISTING MUNICIPAL SOLID WASTE MANAGEMENT

Punjab is generating annually 11,01,296.25 metric tonne and 3017 tonne per day (TPD) municipal solid waste, although

in some years it varied. Out of this 1830 tonne per day and 6,67,950 metric tonne annually is contributed by four municipal corporations in Punjab i.e Ludhiana, Amritsar, Jalandhar and Patiala.

As shown in Table 1 Municipal Corporation Ludhiana (MCL) generated the highest per capita municipal solid waste (MSW) in year 2008 as compared to other municipal corporations. Although, Municipal Corporation Amritsar (MCA) and Municipal Corporation Jalandhar (MCJ) generated higher municipal solid waste than that of Patiala yet Municipal Corporation Patiala generated higher per capita MSW. MCL contributed 46.44 per cent MSW to total municipal solid wastes generated by above mentioned four corporations. As per census 2001 population of Ludhiana city was 13.95 lacs and as per our estimates in 2008-09 city population was near about 18.11 lacs Ludhiana generated 850 tonne per day solid waste and 3,10,250 tonne annually. Per capita solid waste was 171.31 kg, which was the highest in Punjab. There are two big dumping grounds to dump solid waste in 67 acre land. On Tajpur road MSW is dumped on 37 acre land and on Hambran Road MSW is dumped on 30 acre land. These dumps are open and there is not any type of solid waste treatment plant here. This solid wastes increasing toxics in environment.

(Table 1)
Per Capita Municipal Solid Waste in Selected Municipal Corporations in Punjab in 2008-09

Municipal Corporation	Estimated Population (lacs)	MSW in TPD	Per centage Share	MSW Annum MC.	Per capita in 2008 MSW (KG)
Ludhiana	18.11	850	46.44	3,10,250	171.31
Jalandhar	9.16	350	19.12	1,27,750	139.46
Amritsar	13.05	450	24.60	1,64,250	125.86
Patiala	3.90	180	9.84	65,700	168.46
Total	44.22	1830	100.00	6,67,950	1612

Source : Punjab pollution control board

Note : Population for different years has been worked out using the growth rates pertaining to selected Corporations between 1991 to 2001.

In case of Municipal Corporation Amritsar (MCA), city is one of the most ancient and fascinating cities of India. Rapid population and urbanization of city increased congestion of city. In population, Amritsar comes second after Ludhiana in Punjab. The city is expanding in north-western and eastern side. Thousands of pilgrims visit Amritsar every year. As a result MSW has become a big problem for the citizens. Population of Amritsar was 9.75 lacs as per census 2001 and as per estimate it

touched 13.05 lacs in 2008-09. The total area of the Municipal Corporation Amritsar is 139.58 sq. km. MCA is annually generating 1,64,250 MT and 450 Ton Per Day municipal solid waste. Although MCA is the second highest MSW generating city yet it generated the least per capita MSW as compared to other municipal corporations. MCA has contributed 125.86 kg. per capita MSW, which is 24.60 per cent of above mention corporations.

Coming to **Jalandhar**, this is famous for sports goods in Punjab. Municipal Corporation Jalandhar (MCJ) is also expanding day by day. MCJ area is spread over in 110 sq. Km. Population of MCJ was 7.01 lacs as per census 2001 and as per estimate it touched 9.16 lacs in 2008-09. Citizens are facing the problem of poor solid waste provision. MCJ is not able to handle this problem till date. Jalandhar generated 1,27,750 ton municipal solid waste annually with 350 TPD (ton per day), which contributed 19.12 per cent of the total MSW generated by above mentioned four corporations. Per capita MSW was 139.46 kg. MCJ disposes the waste on site near Wariyana village, which is 14 acres area. This site is not sufficient for the disposal of waste as the population is increasing and large quantity of solid waste is being generated. The waste is scattered over the area. There was one private manure producing plant from municipal solid waste, which is not working now.

Patiala is a heritage city. Patiala has very little industry. Municipal Corporation Patiala (MCP) is expanding rapidly on Chandigarh, Sirhind, Sangrur and Nabha Road. MCP is spreaded over near about 59 square km. Population of Patiala was 3.23 lacs as per census 2001 and as per estimate it was 3.9 lacs in 2008-09. MCP generated 65,700 M.T solid waste annually and 180 tonnes per day. It was 9.84 per cent of the total MSW generated with 168.46 kg per capita municipal solid wastes which was more than Amritsar and Jalandhar. Internal parts of city are narrow and congested. MCP had near about 12 acre of land on Sanour road to dump solid waste but some part land has been sold out. Although Patiala has very little industry as compared to Ludhiana, Jalandhar and Amritsar yet it generated very high per capita municipal solid waste and very close to Ludhiana.

COLLECTION AND TRANSPORTATION OF MSW

To maintain solid waste disposal in Ludhiana city 315 mohalla sudhar committees (sanitation and cleaning on PPP model) were supervising some part of the city. There were 4533 sweepers/sanitary workers providing services. Out of these 3000 sweepers were working on contract/daily wages and 1533 sweeper and sanitary worker providing their services on regular basis. In some outer parts of the city private sweepers are providing the services of collection of solid waste system from houses as shown in table 2

(Table 2)
Transportation for Collection of Solid Wastes in Selected Municipal Corporation in Punjab

Transportation	Ludhiana	Amritsar	Jalandhar	Patiala
Minni Trucks	-	7	-	-
Tractors+ Trolleys	8	56	12	16
Dumper Placer/big/twin	25	-	14	-
JCB/Loaders	8	3	12	1
Tippers/minni tipp.	25	-	20	-
Front End Loader	-	7	-	1
Three wheelers	-	-	33	-
Refuse Collector	-	-	1	-
Road Cleaner	-	-	1	-
Carrier	-	-	-	2
Total Vehicles	66	73	93	20

In Ludhiana per 1000 population 2.50 sweeper/sanitary workers were providing their services on the basis of 2008-09 population (18.11 lacs). Although MCL generated the highest municipal solid waste in Punjab yet transportation of garbage is not satisfactory. The reason is that here is a shortage of vehicles in the corporation and mostly vehicles used for garbage collection are very old. MCL had total 66 vehicles. Against per thousand kg solid waste availability of vehicles was only 0.07.

Municipal Corporation Amritsar was the second biggest municipal solid waste generating corporation. As shown in Table 2 MCA had 280 mohalla sudhar committees and total 2410 sweepers and sanitary workers were providing their services on the basis of 2008-09 population (13.05 lacs). Out of these 1443 sweepers were working on regular basis and 967 were working on contract or daily basis. In Amritsar against per 1000 population 1.84 sweepers/sanitary workers were providing their services on the basis of 2008-09 population, which indicated the poor system for sweeping and garbage collection in city. Transportation of garbage is also not very good. MCA had total 73 vehicles. Availability of these vehicles against per thousand kg solid waste was only 0.16 which was little better than Ludhiana.

Coming to Municipal Corporation Jalandhar, solid waste collection and disposal infrastructure was better than Ludhiana and Amritsar. As shown in Table 2 to maintain solid waste disposal in city 2264 sweepers/sanitary workers were providing services and all were working on regular basis. In Jalandhar against per 1000 population 2.47 sweepers/sanitary workers were providing their services on the basis of 2008-09 population, which indicated better human resource service as compared to Municipal Corporation Amritsar, and very close to Municipal Corporation Ludhiana. Transportation and collection of garbage of MCJ was better than other studied corporations. MCJ had total 93 vehicles. Availability of these vehicles against per thousand kg solid waste was 0.26, which was better than Ludhiana, Amritsar and Patiala.

In Municipal Corporation Patiala (MCP) as shown in Table 2 to maintain solid waste disposal in city 90 mohalla sudhar committees were supervising some part of the city. There were 747 sweepers and sanitary workers providing services. Out of this 526 were working on regular basis and 221 on daily wages and or on contract. In Patiala against per 1000 population 1.91 sweeper/sanitary worker were providing their services on the basis of 2008-09 population, which indicated Patiala was better than Amritsar. Transportation of garbage is also not very good in Patiala. MCP had total 20 vehicles. Availability of these vehicles against per thousand kg solid waste was only 0.11, which is the worst than all studied corporations.

EXISTING SOLID WASTE MANAGEMENT

MSW generation and composition:- Municipal Solid Waste Management (MSWM) is one of the prime responsibilities of Urban Local Bodies. In case of Punjab in urban area, the household, shopping center, offices, etc. street waste is generally dumped outside houses or at some collection site, and is left for municipal authorities for taking it to a common dumping ground. It is common to find solid waste dumps near towns and cities. These dumps are mostly in depression or in open grounds. Widespread land, air and water pollution is caused from these dumps. The dumping sites are not properly managed nor have been planted with suitable plant species to help in quick degradation of solid waste by way of creating conducive for the growth of micro- organism besides providing greenery. Appropriate post dumping practices are also seldom performed causing perpetual problem of air and water pollution. Punjab generated approximately 3017.25 tonne municipal solid waste per day. Out of this 1830 tonne per day (TPD) municipal solid waste was generated only by four municipal corporations i.e Ludhiana, Amritsar, Jalandhar and Patiala. Approximately 28 per cent of total solid waste is generated only in industrial city Ludhiana.

SOLID WASTE COLLECTED AND TREATED IN PUNJAB

In Punjab the position of hazardous and bio medical waste

treatment is little satisfactory but the position of provision for municipal solid waste is very poor as per data collected by Punjab Pollution Control Board in 2007-08 as shown in Table 3 Municipal corporations and municipalities' progress remained zero for the provision of municipal solid waste treatment.

(Table 3) Solid Waste Collected and Treated in Punjab

District	Municipal Wastes			Hazardous Wastes			Bio-Medical Wastes		
	Collected (M.T.)	Treated (M.T.)	Per cent	Collected (M.T.)	Treated (M.T.)	Per cent	Collected (M.T.)	Treated (M.T.)	Per cent
Ludhiana	339,906.00	0.00	0.00	10,395.20	8,416.10	80.96	495.60	495.60	100.00
Amritsar	171,823.30	0.00	0.00	334.80	334.80	100.00	139.70	139.70	100.00
Jalandhar	141,963.00	0.00	0.00	4,804.20	872.00	18.15	487.80	487.80	100.00
Patiala	100,375.00	0.00	0.00	524.10	225.10	42.95	80.30	80.30	100.00

Source: PPCB as cited in the Statistical Abstract of Punjab, 2008

* M.T. stands for metric tonne

treated. The position of bio-medical was quite better. Total collection of bio-medical waste was 495.6 MT, which was totally treated.

In **Amritsar** district 1,71,823.3 metric tonne (MT) municipal solid waste (MSW) was collected. But there was no MSW treated. In this district 334.8 metric tonne hazardous waste was collected. Total hazardous waste collection was treated. Collection of bio-medical waste was 139.7 MT, which was totally treated. In **Jalandhar** district 1,41,963 metric tonne (MT) municipal solid waste (MSW) was collected. But there was no MSW treated. In district 4804.2 metric tonne hazardous waste was collected. Out of this collection only 872 MT (18.15 per cent) was treated. The position of bio-medical was better. Total collection of bio-medical waste was 487.8 MT which was totally treated.

The picture of Municipal Corporation Patiala was not different from others. Here 1,00,375 metric tonne (MT) municipal solid waste was collected. But there was no MSW treated. In district 524.1 MT hazardous waste was collected. Out of this collection only 225.1 MT (42.95 per cent) was treated. Total collection of bio-medical waste was 80.3 MT and all collected bio medical waste was treated.

ALTERNATIVE SOLUTIONS IN SWM

Management and disposal of Municipal Solid Waste

Due to current lavishing lifestyle trade, continuous waste generation is an obvious phenomenon. For better management of solid waste, periodic review of each steps involved in waste management like Generation, Collection, Disposal etc should be conducted & accordingly implementation of "Best Practices" is necessary. Best practices for waste management can be achieved by well known '3 Rs' principle. '3 Rs' principle (Reduce, Reuse, Recycle) can be described as follows: '3 Rs' classify waste management strategies according to their desirability in terms of waste minimization. These "3 Rs" are the foundation of most waste minimization strategies. The aim of this is to extract the maximum practical benefits from products and to generate the minimum amount of waste.

CHANGING OF THE PUBLIC BEHAVIOR

The improvement in living standards has changed life style and MSW composition. In high-income residential areas in some developing Asian countries recyclable material (i.e. plastics, metal, glass and others) tend to increase, because of the consumption of more packaged products. This trend was also found in Corporation cities of Punjab too.

Following are some alternative solutions which have been successfully implemented in Surabaya and Medan, Indonesia. In these cities public awareness was improved after receiving guidance concerning environmental issues. The trainers were from local leaders and facilitators with the assistance of Non-Government Organizations (NGOs). This program was per-

As shown *Table 3* in the year 2007-08, **Ludhiana** district collected 3,39,906 metric tonne (MT) municipal solid waste (MSW). But there was no MSW treated. In the district 10395.2 metric tonne hazardous waste was collected. Out of this waste collection 8416.10 MT (80.96 per cent) was

formed as community based SWM . The program successfully applied 3R (reduce, reuse, recycling), which included waste separation at the source and composting. A Refuse Bank, which received domestic recyclable waste from the community, had also been initiated and operated in these cities. The gender role was dominant in 3R implementation. Most of the 3R cadres were women. In Yala, Thailand, the poor communities in reducing SW was triggered by exchanging the trash for nutrition food. They empower themselves in environmental awareness.

Reducing biodegradable MSW at source

Composting is one of the preferred methods for reducing biodegradable organic material. Composting can reduce more than 50% of biodegradable organic components of MSW on-site. Composting decreased the residential MSW between 38 and 55% in Dar es Salaam City, (Tanzania). Composting can also extend the life-time of landfills. Even this process can cut landfill space exhaustion rate of more than 50%.

Composting in most developing Asian countries occurs at household level rather than that at the municipal level. For example, in Dhaka, Bangladesh, composting was more successful in small-scale plants than in large-scale. The main reasons were effectiveness in operation and maintenance cost, well separation of SW, and effectiveness in marketing. Zurbrugg et al. found that composting in decentralized system could recover costs and yield a profit. Narayana also stated that the people contribution in composting increase themselves awareness and reduced the operating cost.

Waste to Energy (WTE)

Some developing countries in Asia are trying to change SW into energy. Philippines and Thailand have converted waste to energy. A pilot plant of 150 ton/day capacity of municipal SW produced 14,000 m³ of biogas, with 55-65% methane product, which was equivalent to 1.2 MW. In the Philippines the Clean Development Mechanism (CDM) was implemented with a WTE project in Payatas. This plant generated electricity of 60 kW to 70 kW, which was supplied to 20 residents. Almost similar in Thailand, the anaerobic digestion tanks have been operated in three areas. The anaerobic digestion tanks have capacity from 10 tons/day to 300 tons/day MSW which generate electricity from 625 kW to 2.5 MW.

Landfill as final disposal site has the potential to emit greenhouse gases (GHGs). GHG emissions, which contribute to climate change, are another environment issue which has to be coped with. Asuwei landfill site, located in Beijing City was the earliest and the biggest landfill site to capture GHGs. It had a capacity of 2000 tons/day. The landfill gas has captured after 2001. It is currently used to generate electricity.

Partnership in SWM

In all activities of SWM especially in municipalities, partner-

ship involves residents, institutions or local government and the private sector, such as micro companies. In Yala, Thailand, a program of recycling and garbage reducing was established through a relationship between poor communities and the municipal administration. Similarly to in India, the government had the cooperation with private sector and citizen in recycling SW. On the other hand, initiatives of the private sector (citizen and enterprises) such as public-private-community partnership also help to increase the efficiency of waste management system. Cooperation is built between governments, research institute, NGOs, stakeholder, and people participation to solve the problem in SWM.

CONCLUSION

Most of Asian developing countries face MSW generation problems. The main constraints are weak organization and limited budget allocation for SWM. Therefore, in most Asian develop-

ing countries SW reduction is conducted from the source up to the landfill sites. The activities involve community development and the informal sector. Alternative solutions of SWM in Asian developing countries use social and technical approaches. Social approaches are changing the public behavior by improving community through training, and encouraging partnerships with decentralized SWM. The technical approaches are reducing biodegradable SW at source, converting waste to energy, and using simple technology. These approaches are expected to improve the sustainability of SWM in Asian developing countries.

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