

# Alternatives for the Better Management of the Wastes in India

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**ABSTRACT:** *Waste is a product of human activities that cannot be avoided. With economic growth, urbanization, the quantity and complexity of wastes produced had also expanded. City corporations in developing nations cannot handle increased quantities of waste, likely to result in waste generated in roadways as well as many other public areas. There is a need to work towards an environmentally, institutionally, financially, economically and socially sustainable waste management system and improved living standards in cities. Overpopulation as well as industrial revolution undermine urban as well as resource environment as well as undermine sustainable and equitable development. Insufficient waste disposal and management in most developing cities is a clear cause of environmental damage. The entire study examines diverse strategies to municipal solid waste management (MSWM) and even some estimates of waste volume in India. Community involvement and public strategic alliances in waste disposal are 2 choices reported in this paper. The least cost option is community involvement in waste management, and the strong case for a comprehensive involvement in waste management by the community. Thus, the current analysis of comparisons on different types of managements will assist researchers or the government in implementing this framework and making improvements as required, or in developing some other kind of hybrid model for further better solid waste management to meet the rising challenges in Solid Waste Management (SWM)*

**KEYWORDS:** *Biodegradable, Generation, Management, Local, Municipal, Organization, Urban, Waste.*

## 1. INTRODUCTION

The MSWM covers financial, organization, planning, engineering, legal aspects along with the management of MSW (sanitation, household waste, street sweeping, construction debris etc.) waste management, storage, collection, transportation [1]. The population explosion in urban areas is a social issue which is worldwide prevalent and which primarily changes the nature in developing nations of solid waste management. India is the second largest population country on the planet with a populace of more than one trillion and is one of the fastest urbanizing nations as well as being an area of physical, weather, geographical, ecological, economic, linguistic and cultural diversity. India's annual urban population growth rate is 3.09%. The proportion of urban population grew from 17.35% in 1951 to 26.15% in 1991. in urban areas [2]. Class I towns have increased from 212 to 300 from 1981 to 1991 with a population of more than 1,00,000 [3]. It should be noted that in these Class I cities there are up to 65.2% of the urban population. In the last 55 years of its independence, the multipurpose socio-economic advancement of India has been achieved. But despite the high cost of public administration in several urban areas, the current quality of service is really low, that public health as well as the quality of the environment in overall pose a potential hazard [4]. MSWM is also one of India's most overlooked facets of development in the urban areas. 23 metro cities of the India, approximately 30 000 tons of such wastes are produced daily, as well as around 50,000 tones are produced daily in Indian Class I cities. Waste stacks and all kinds of waste that flow on the streets are becoming a common figure throughout the people's lives of our town. Indian urban populations are rapidly getting larger as well as concentrations, posing major challenges for municipalities to provide sufficient support, including water, electricity, roads, training as well as public sanitation, including MSWM. Approximately 5-25% of municipal agencies invest in MSWM. The level of service currently available in many urban areas, despite such high expenditure, is so low that the on one side the quality of the environment and on the other side public health are particularly at risk. Various steps to improve the situation are being taken [5].

### 1.1 Waste Generation and characteristics

The municipalities may not weigh waste vehicles regularly in most Indian cities but calculate the amount depending on the number of voyages the accumulating automobile makes. The database for the manufacturing and collection of solid waste is seldom kept. As per records in comparatively smaller towns as well as in cities, waste material is estimated at around 0.1, 0.3 as well as 0.5 kg per day and 0.66 kg per capita in a single day. Studies conducted by NEERI show that per capita generation rates are increasing, as cities vary in size between 0.4 to 0.7 kg in a single day. Metro areas have documented values of up to 0.6 kg/capita in a single day. The per unit area quantities of waste are projected to increase annually at approximately 1.33%. Table 1, in accordance with the recent statistics, shows the concentrations of municipal solid waste generated in suburbs [2]. Such tables have been determined by the amount of travel as well as the amount of travel. This shows clearly how much solid waste is collected, than what might be actually produced.

Table 1: Shows the Cities SW Generation Status in the Indian Metro Cities ( as per data from CPCB, 1999) [2]

Sl. No.	Metro City	Municipal Population	MSW (tones per day)	Per capita generation (Kg per day)
1	AHMEDABAD	28 76 710	1683	0.585
2	BANGALORE	41 30 288	2000	0.484
3	BHOPAL	1062771	564	0.514
4	BOMBAY	12288519	5355	0.436
5	CALCUTTA	10643211	3692	0.347
6	COIMBATORE	816321	650	0.429
7	DELHI	8419084	4000	0.475
8	HYDERABAD	4098734	1566	0.382
9	INDORE	1091674	350	0.32
10	JAIPUR	1458483	580	0.398
11	KANPUR	1874409	1200	0.64
12	KOCHI	670009	347	0.518
13	LUCKNOW	1619115	1010	0.624
14	LUDHIANA	1042740	400	0.384
15	MADRAS	4752976	3124	0.657
16	MADURAI	940989	370	0.393
17	NAGPUR	1624752	443	0.273
18	PATNA	917243	330	0.36
19	PUNE	2244196	700	0.312
20	SURAT	1498817	900	0.6
21	VADODARA	1031346	400	0.388
22	VARANASI	1030863	412	0.4
23	VISAKHAPATNAM	752037	300	0.399
	Total/Average	66885287	30058	0.449

The waste materials are produced by a percentage as described in Table 2 of the different elements. The document content was significantly from 1.0% to 6.0% and with population expansion it tends to increase [6]. In India, waste paper's volume got significantly reduced, as people are used to collect the amount thrown away for their use as a fuel, as well as for material / food packaging sold on the roads. The content of plastics, rubber and leather is less than that of paper, and not more than 1% except in metropolises. There is also a low metal content (less than 1 percent). The large scale recycling of these components is primarily responsible for these low levels. Paper is priority recycled, while plastics and glass are less recycled.

Table 2: Shows the MSW characteristics produced by the metro towns (as per the records mentioned in CPCB, 1999) [2]

<i>Characteristics (% by weight)</i>									
Sl No.	Metro City	paper	Textile	leather	Plastic	Metal	Glass	Ash, fine earth and others	Compostable matter
1	AHMEDABAD	6.0	1.0	NA	3.0	NA	NA	50.0	40.0
2	BANGALORE	8.0	5.0	NA	6.0	3.0	6.0	27.0	45.0
3	BHOPAL	10.0	5.0	2.0	2.0	NA	1.0	35.0	45.0
4	BOMBAY	10.0	3.6	0.2	2.0	NA	0.2	44.0	40.0
5	CALCUTTA	10.0	3.0	1.0	8.0	NA	3.0	35.0	40.0
6	COIMBATORE	5.0	9.0	NA	1.0	NA	NA	50.0	35.0
7	DELHI	6.6	4.0	0.6	1.5	2.5	1.2	51.5	31.8
8	HYDERABAD	7.0	1.7	NA	1.3	NA	NA	50.0	40.0
9	INDORE	5.0	2.0	NA	1.0	NA	NA	49.0	43.0
10	JAIPUR	6.0	2.0	NA	1.0	NA	2.0	47.0	42.0
11	KANPUR	5.0	1.0	5.0	1.5	NA	NA	52.5	40.0
12	KOCHI	4.9	NA	NA	1.1	NA	NA	36.0	58.0
13	LUCKNOW	4.0	2.0	NA	4.0	1.0	NA	49.0	40.0
14	LUDHIANA	3.0	5.0	NA	3.0	NA	NA	30.0	40.0

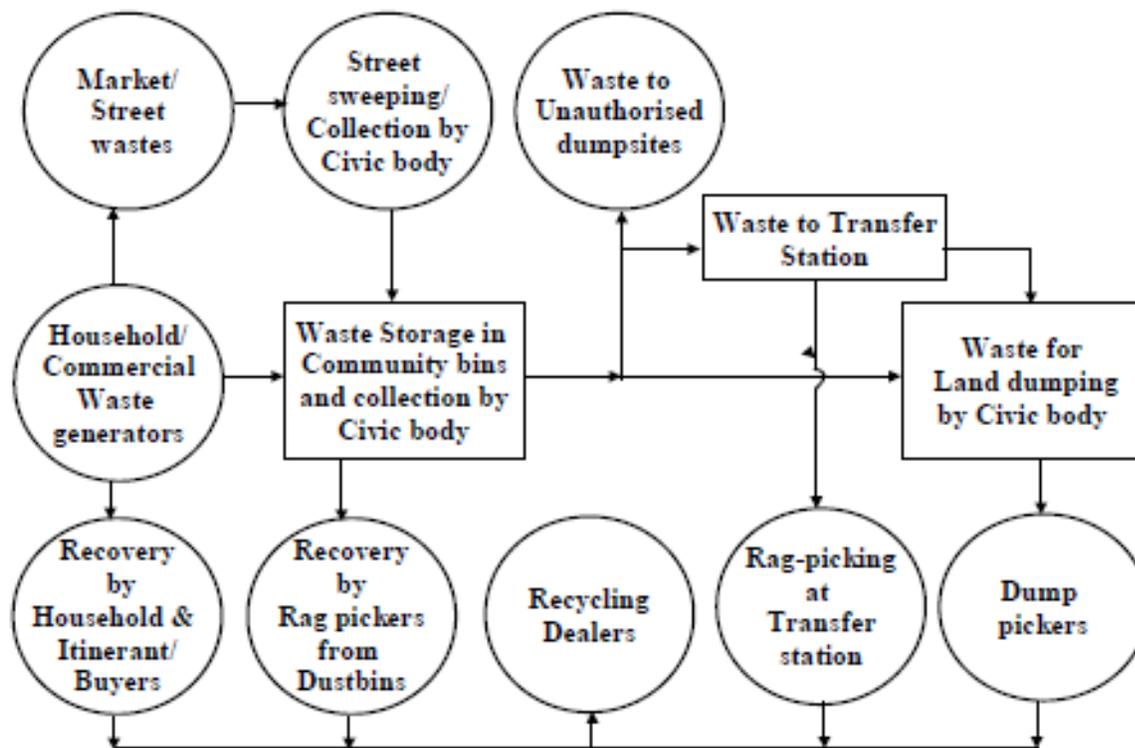


15	MADRAS	10.0	5.0	5.0	3.0	NA	NA	33.0	44.0
16	MADURAI	5.0	1.0	NA	3.0	NA	NA	46.0	45.0
17	NAGPUR	4.5	7.0	1.9	1.3	0.4	1.2	53.4	30.4
18	PATNA	4.0	5.0	2.0	6.0	1.0	2.0	35.0	45.0
19	PUNE	5.0	NA	NA	5.0	NA	10.0	15.0	55.0
20	SURAT	4.0	5.0	NA	3.0	NA	3.0	45.0	40.0
21	VADODARA	4.0	NA	NA	7.0	NA	NA	49.0	40.0
22	VARANASI	3.0	4.0	NA	10.0	NA	NA	35.0	48.0
23	VISAKHAPATNAM	3.0	2.0	NA	5.0	NA	5.0	50.0	35.0
	Average	5.7	3.5	0.8	3.9	2.1	2.1	40.3	41.8

In India MSW, the biodegradable proportion is quite large, The use of fresh veggies in particular. The elevated compostable fraction, together with the tropical climate, often guarantees that waste will be collected and disposed. Indian MSW has a high level of ash as well as fine earth because of the inclusion of road sweeping in the MSW; waste drainage as well as waste incineration. The proportion of ash as well as fine land decreases with increasing in population as a consequence of enhancements in road surfaces. The density is increased by the high ash and earth content between 330 and 560 kg/m<sup>3</sup>. On a dry weight basis, the organic content of the specimens varies 20 to 40 percent. The MSW varies between 0.5-0.7, 0.5-0.8 and 0.5 - 0.8 percent, respectively, of nitrogen, phosphorus and potassium. The range of heat is between 200 and 3000 BTU per lb. [7].

### 1.2 Present Management Practices

Figure 1 illustrates the current arrangement of MSWM in India. The containers used for the family storage are made of a variety of methods, and also have multiple perspectives as well as measures. This same container type reflects its customer's financial situation (i.e., the waste generator). Separation is not practiced from scrap at the source. In India the storage system of the groups of people is usually rehearsed. People store their losses in traffic canisters and explicitly at crossings. Such cans are generally of metallic, cemented ones or a composite of the duo materials. Local storage may reduce waste range expenditure but may limit concerns linked to the absence of specific space on place. Nevertheless, apart from strategically placing these local game storage plans, households generally throw their losses onto the side of the streets by road clearing groups, for freedom. In reality, even if action capability courses are oriented approach, the main reasons for squandering are indiscipline and slightly due to various rummaging losses by cloth pickers as well as homeless animals. In a country like India, as well as the moderate work available, the product range is a serious and cost-effective alternative to the automated range. Even though waste storage as well as discipline of the generators are insufficient, waste is continually discarded mostly on roads [6].



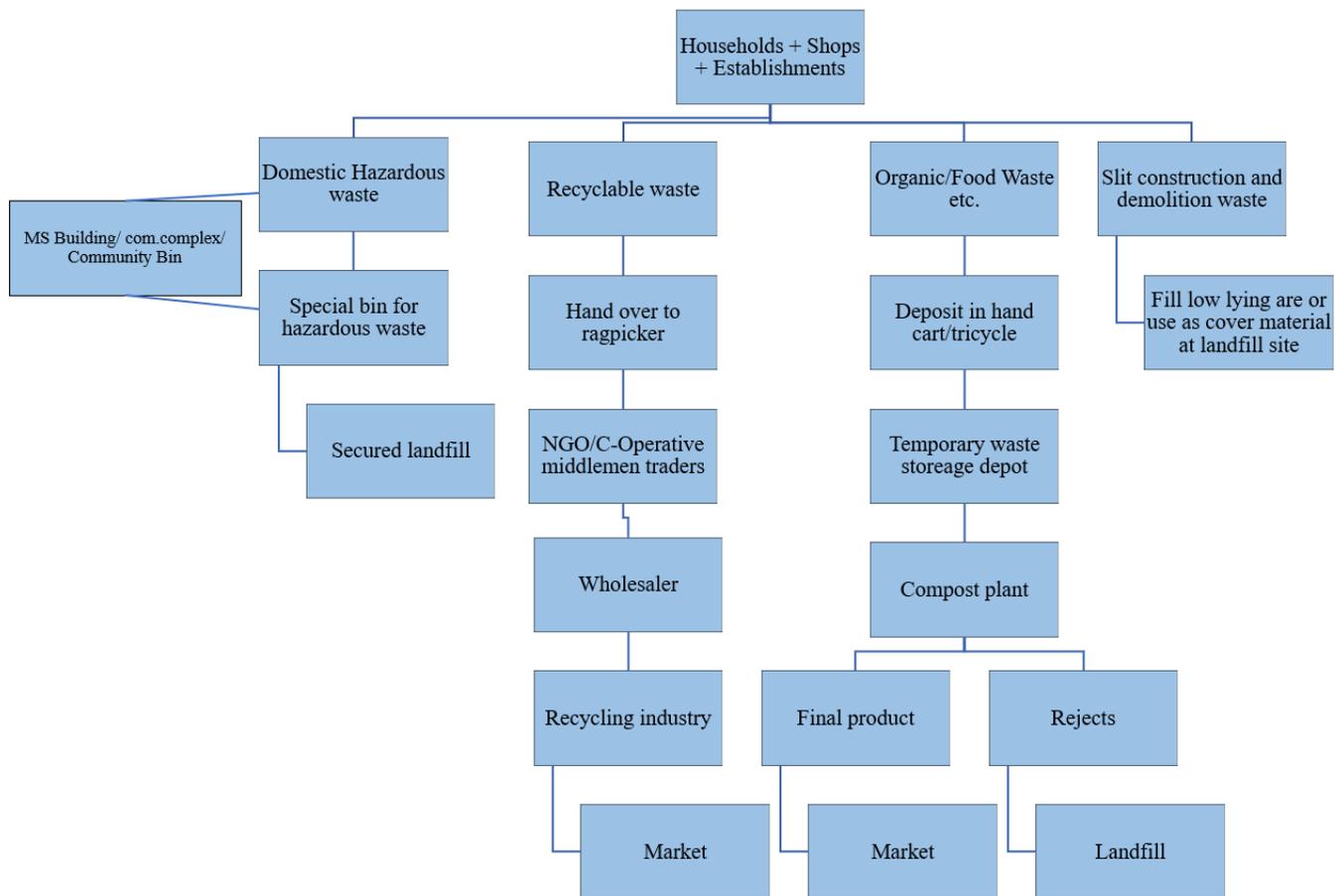
**Figure 1: Illustrates Schematic View of the SWM Practice in India**

Specialists believe that due to the lack of attention by the urban inhabitants is an important barrier to maintaining the streets safe in order to increase conservation activities. The problem in ghettos as well as low and center pay zones is generally very intense. If the occupants are not trying to store loss in cans as well as stop throwing trash onto the street, it would be almost incomprehensible for the municipal authority to give better environmental factors. A conservation worker must cover a particular region at a given time. The conservationist cannot protect the whole region assigned to him if the people spread litter around everywhere and may not cover certain areas on some days. In some countries NGOs have aligned with proposals for a wasteful range from families leading to change in neighboring road conditions, because of these powerless circumstances for squanderers' transitional ability [8].

Different types of cars are used to fritter away the transport from bullock vans to compactors. The widely useful 5 to 9 tone body trucks are nevertheless used in the same way. In smaller cities, despite being rude and inefficient, heavy transports are employed. Compactor vans are also used in a number of urban centres. Almost all of the waste is transported by city buses; however, private vehicles are also used to extend the armada scale in several major cities. The vehicles are supported by other city automobiles, where civil refugee automobiles are least required at the total metropolitan workshop. The overwhelming majority of the labs have small repairs offices. While preventive aid is necessary for maintaining a valid operating state of the Armada range, the usual situation is not preventive maintenance. Depots are only developed in a few urban metropolises. The industrial sector such as businesses, employment, inns and so on is also being collected in conjunction with family abandons in commercial buildings, which are liable to pay the municipal authorities an arranged cost to collect waste from their property. Their sludges are also collected. Therefore, the large number of stores do not open until 9 am until then, and is usually left in the area until the next day. Thus, no matter whether ordinary administrations are present, sludges are constantly seen in the region.

### *1.3 National Plan for MSWM*

The MSWM elements for India have been summed up in a flow chart as seen by the SC Committee of India, figure 2.



**Figure 2: Shows the Flow Chart proposed/recommended by the concerned committee constituted by the SC of India.**

A few endeavors are in progress to improve better administration of city strong squanders [9]. Pondering on authoritative, specialized, monetary and legitimate issues are being considered for the possible methods for the board. The Board was assessed for unusual participation in garbage and methods of co-operation with ready nations were explored. Any of the activity in this field involved a NWMC established by a Ministry of Urban Affairs and Jobs, a public strategy report on MSWM, the dissemination of the MSWM guide and the NEERI. [10] and execution by the GOI, the CPCB and SPCB of the MW (management along with handling) rules under the EPA, Coordinated efforts of Municipal Agencies as well as the MoEF [11]. The proposal of the Expert Board of the Honorable SC (India) concentrates on the areas so that country makes strides towards MSWM.

Current situation in developing countries has become more acute because basic services such as water supply, sane infrastructure, transport facilities, and the collection of waste, are not adequately delivered [12]. Worldwide cities face high emissions levels. There has been an enormous rise in solid waste created by a wealthier lifestyle in the cities. Increased amounts of garbage are not being treated and stored on highways and other sites by local corporations in developed countries. There must be an environmental effort, institutional, financially, economically and socially sustainable waste management system. A global consensus is emerging for developing solutions at local level and for community participation to improve waste management [13]. The MSWM in Mumbai eventually began with the participation of private as well as NGOs such as Excel Industry Limited as well as Stree-Mukti-Sangathan. Several case studies on government and the private sector engagement in MSWM in developed nations have been promising [14]–[16]. An urban research in Tanzania called for a community-based solution to the WM [17]. In the Indian background, however, these studies are missing and this research would therefore be an important contribution to MSW managing literature. In the present report, alternate approaches to MSW management are examined and waste management costs projections in Mumbai. The following are the options taken

into account: Community interest in squander the executives of the CBOs, the CBOs, NGOs and the neighborhood council.

#### *1.4 Alternative approach I: Community based WM*

For the SWM, community engagement is important [18]. Effectiveness of community as well as the private sector involvement in WM has been recorded in case studies from various countries [19]. Strong urban governance has led to a community-based participation in WM in Mumbai as part of the collaborative initiative between the GOI & MCGM in unification with the UNCHS. This kind of decentralized WM scheme takes its name from Advanced Locality Management (ALM). Which is being a community-based solution to effective municipal government governance. The ALM was founded in 1997 and implemented in 1998. ALM focuses on the coordination concept and alliance between CBOs, NGOs as well as for management of the civic services at the local level. This project aims primarily to ensure waste gets separated into reusable & compostable materials, with both the local treatment of biodegradable waste and the sale of recyclable materials.

The ALM model works like this: Each group that joins the scheme forms a committee that is in charge of preparing, executing, & inspection of the different aspects of community development. It also acts as a liaison between the MC of Greater Mumbai (MCGM) as well as the local residents to ensure that public services run smoothly. MCGM runs a number of outreach projects to increase citizen awareness. Furthermore, MCGM places a high emphasis on resolving civic issues in neighborhoods that participate in WM initiatives. The MCGM allocates a ward officer to investigate citizen complaints and work with the local committee. The multiple WM processes under ALM are illustrated in Figure 3. Residents in the ALM programme must separate their waste into different categories like wet waste in the green color dustbin and the dry waste in the blue color dustbin leading to segregation on the basis of the biodegradable as well as the recyclable products. The waste collection, processing of biodegradable waste as well as selling recyclable materials, which is organized and educated by non-governmental organizations. MCGM supports and prioritizes these areas with other public facilities through the development of compost bodies in these areas.

In this system nongovernmental organizations, coordination of rag pickers and instruction in collecting as well as composting waste play a significant role. There are 360 ALM groups, with an average population of 0.2 million and a daily waste of 69 tones. Moreover, the service includes 283 composting centers. The waste management obligations between NGOs, MCGM, as well as CBOs the are presented in Table 3 as part of a group involvement strategy. The residents pay money to the salaries of rag pickers. The costs of MCGM under this scheme are driven by the population isolating their deficit in 2 groups – wet (green color dustbin) and dry (blue color dustbin) wastes. Natural waste is taken care of into treating the soil pits and prepared. These plans for the most part use vermicomposting or high-impact fertilizing the soil methods for treating the soil squander. There are a number of social and natural advantages related with this methodology, appeared in Figure 4. In this examination elusive advantage related with better expectation for everyday comforts for cloth pickers and spotless and solid environmental factors are not assessed. This paper centers around assessing unmistakable expenses and advantages related with this methodology

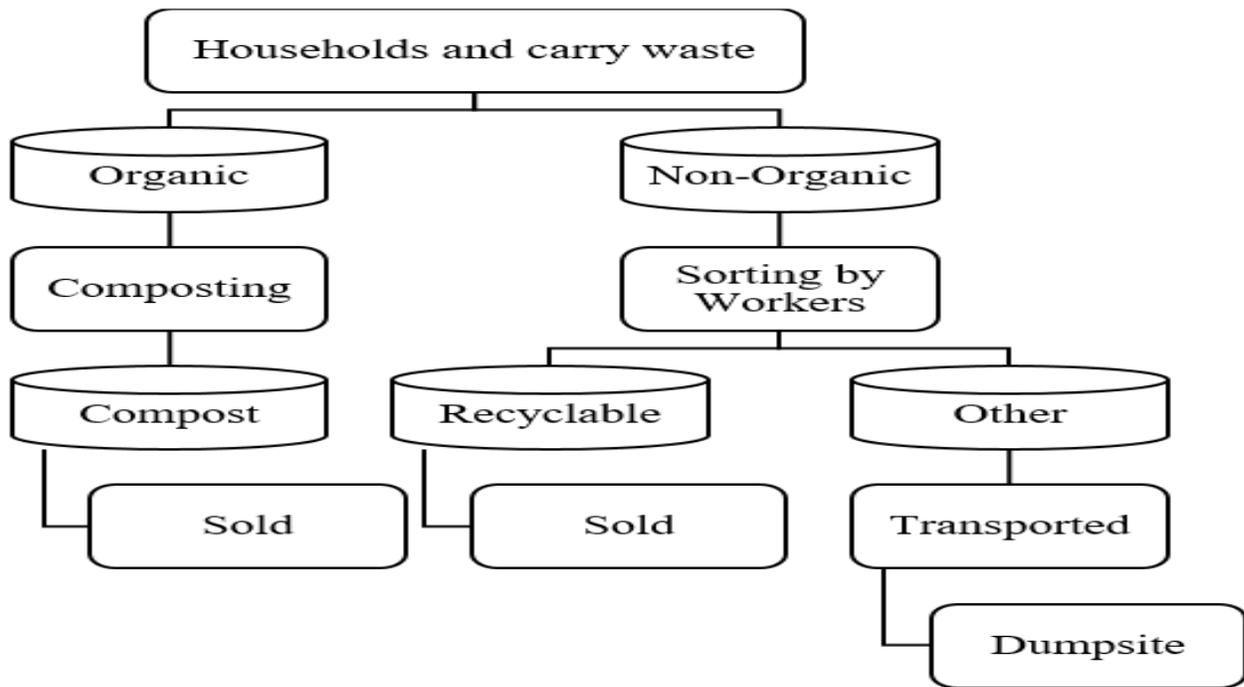
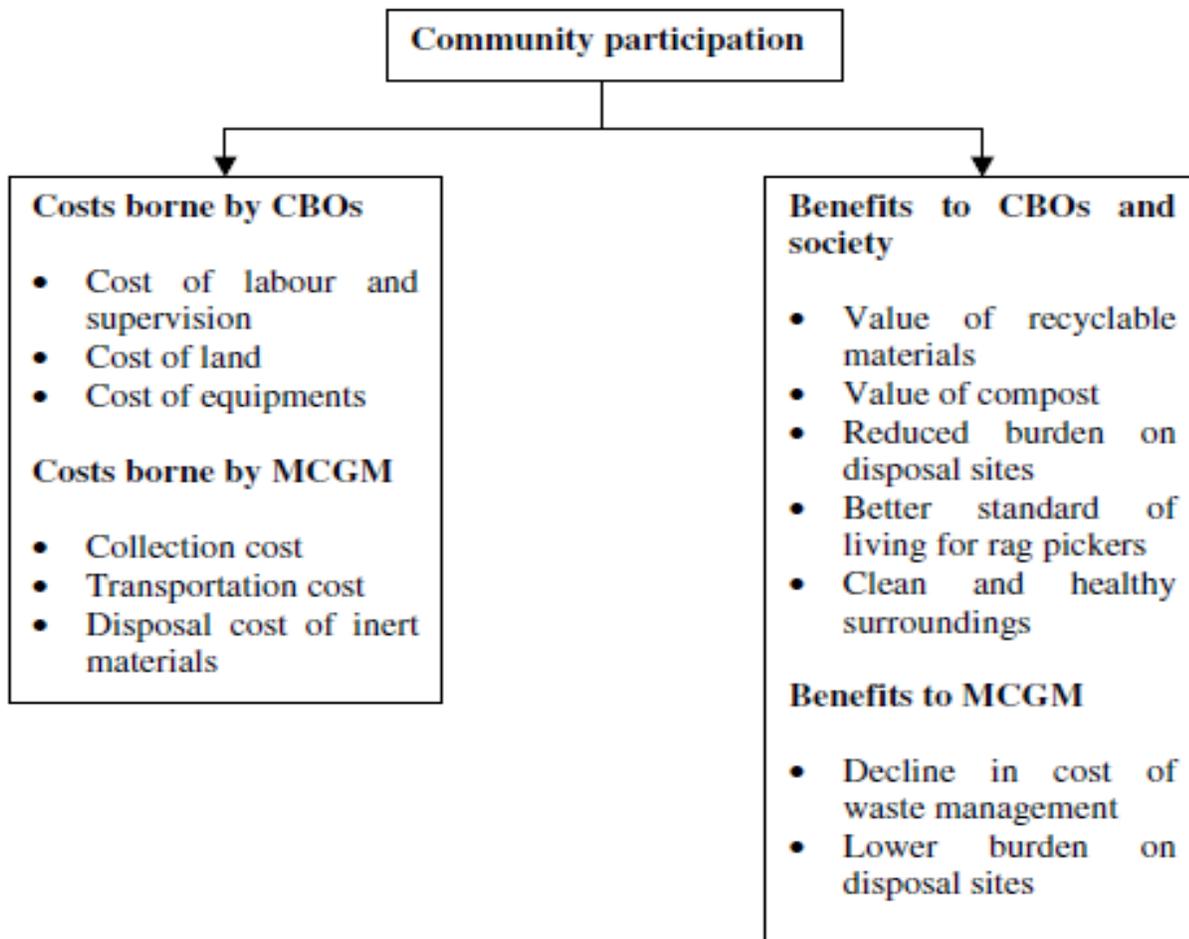


Figure 3: Shows the various phases of waste management under ALM

Table 3: Assignment of responsibilities among MCGM, CBOs and the MGOs

CBOs	MGOs	MCGM
Marketability of compost	Training rag pickers	Collection and transportation of non-biodegradable and non-recyclable materials
Composting of organic waste	Coordinating between CBOs and MCGM	Disposal of non-biodegradable and non-recyclable materials
Payment of salary of rag pickers		Looking after the complaints of communities participating in waste management programme



**Figure 4: Shows the various types of costs and advantages associated with the community compost plant.**

#### *1.5 PPP for Waste Treatment is an Alternative Solution II.*

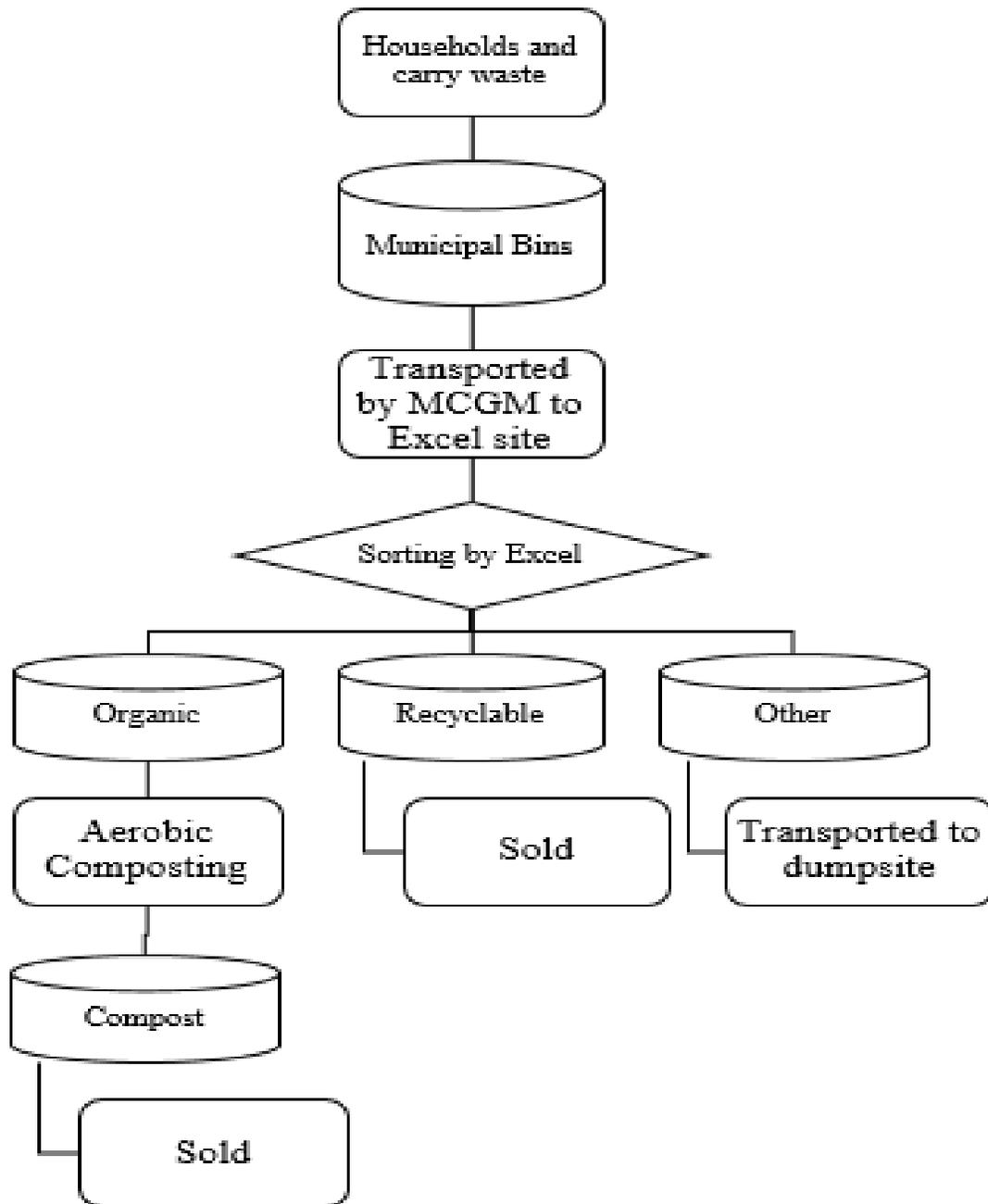
The provision of essential environmental services like waste control as well as waste water management is increasingly being tracked in public-private partnerships in most of the cities of the Asia. A number of private waste management companies have illustrated this feature successfully; Excel Industry Limited of Financial capital of India, Mumbai is one such an example. This analysis illustrates the benefits of P-P WM collaborations, through the Excel Industry and MCGM relationship, as seen in Table 4.

Established in 1941, Excel Industry Limited is a leading agro-chemical company in India. The organic part of MSW is transformed into manure by means of mechanical aerobic composting. It handles 30-40 tons per day of waste, and it is sent to the Excel Industries Ltd free of charge by MCGM. Whole procedure calls for 2 hectares of soil. Rs. 0.50 lakh (US\$1142) was rented from the property and electricity costs are 1.6 lakh (US\$3646, respectively) a year [2]. MCGM collects then transports garbage, but Excel Industry handles food waste with aerobic composting. The company ships non-biodegradable as well as non-recyclable products to waste areas. Figure 5 shows the flow diagram of the operations performed in this context. Table 4 demonstrates how waste management responsibilities under the PPP are shared by MCGM as well as the private sector.

**Table 4: Shows the demarcation between the MCGM and the Private sector under PPP for the management of the waste**

<b>MCGM</b>	<b>Private Sector</b>
Collection of waste from community bins	Capital investment for processing of organic waste
Transportation of waste to private sector compound	Conversion of organic waste in to compost
Disposal of non-biodegradable and non-recyclable materials	Marketability of compost





**Figure 5: Shows the Waste management by the Participation of the Private sector**

## 2. DISCUSSION

While community involvement is the least expensive option, it is associated with certain bottlenecks. Some of the bottlenecks highlighted while collecting the data and surveying the fields in the alternative community participation are as follows: The problem of some people in the community not being involved was faced by CBOs and NGOs. Problems related to compost revenue recovery. CBOs are often faced with a lack of community cooperation. The general perception that this is a problem arises because MCGM is obliged to collect waste. Therefore, work is needed to change people's perceptions. The public must be mindful of the need for cleaning the public as well as the dilemma with the scarce capital of local corporations, which contributes to the increased interest of the population in WM. Furthermore, MCGM makes the ALM systems very much competitive by offering benefits to reduce local taxes. Often controversial is the selling of waste-produced manure. The city's residents can take advantage of a small proportion of compost, and a large proportion must be sold to farmers. Farmers had no concern for MSW

manure, though. In Dhaka the retrieval of compost by a proper marketing network and the quality monitoring of compost have been demonstrated to be unproblematic. Certain case studies demonstrate that if correctly engineered, PPP can become a very successful methodology in future which not only will be cost effective but also be very. On the other side inefficient way of implementation of this methodology can lead to be expensive also as in case of Mumbai. Current scheme focuses only on waste disposal in the private sector, whereas MCGM is responsible for waste control as well as transport. As a consequence, the storage and transport of waste is not changed because waste disposal costs are also increased. In order to minimize PPP costs, shortfalls in waste generation as well as transport must also be reduced. The private sector's position in waste treatment as well as shipping needs to be examined.

### 3. CONCLUSION

The present chapter compares and contrasts two MSW new strategies. The first is community participation, as well as the other is private industry participation. The information in this report comes from a variety of NGOs and the private industry. Numerical strategies have been introduced to assess costs per tonne of waste administration. The waste management costs per tonne have been identified for Rs 1518, with a group involvement of 35,000 dollars, Rs 1797, with PPP (41 dollars), as well as Rs 1908, with 45 dollars, while the waste management is the responsibility of MCGM alone. Consequently, participation of the community in WM is the least expensive choice. Waste isolation at source leads to a major decrease in the expense of managing waste through neighborhood involvement, reducing demand for Community bins including the transportation of waste at the source. Even so, the PPP scheme concentrates on the disposal of waste without enhancing recycling as well as transportation practices, resulting in higher waste treatment costs per tonne. Community participation in the management of waste is high. However, metropolitan municipal authorities and NGOs have to work together to create an educated society as well as address waste management bottlenecks to include the community. Furthermore, it is necessary to study the function of PPP in waste management. With the growing world population, solid waste management is becoming a global societal challenge from a low priority, localized issue. There are unbearable dangers associated with solid waste to public health and the environment of big cities. Throughout this article are illustrated the key characteristics of the present MSWM scenario in India and future way to improve the scenario. Today, India faces an urban solid waste challenge which is an obligation of all people in society. Cultural consciousness as well as perception are minimal. For conventional, inorganic as well as recyclable waste, there is no domestic separation scheme. There seems to be an adequate regulatory structure in the country to comply with MSWM. The implementation is lacking. Despite stringent laws, the most common form of waste disposal is open dumping. There may be explanations for a poor execution of a mixture of social, economic, structural as well as financial problems. Public awareness, policy will because public engagement are crucial as a critical element for the effective implementation of legislation and a comprehensive approach to sustainable management of sound urban waste in the region.

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