



New Approach to Solid Waste Management in India: Use of Economic Instruments

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ABSTRACT

Urbanization and rapid economic growth in India has led to the problem of burgeoning solid waste in Indian cities. This problem of solid waste is very acute in metropolitan cities due to growing material wealth, high concentration of population, limited financial, technical and managerial resources for waste management and non-availability of land for waste disposal. Cities like Mumbai, Delhi and Bengaluru have landfills which have crossed their capacity and the urban local bodies are unable to start new landfills.

There are numerous stakeholders involved in solid waste management but the nodal responsibility lies with the urban local bodies. Urban local bodies due to inefficiency and technical, managerial and financial limitations have not been able to provide the service efficiently. In India, the instruments used for reducing waste are of command and control type and flat user charges, with no incentives for the household to reduce the waste. It is now the importance of innovative management approaches and instruments have been realized and more and more countries are adopting these approaches for a sustainable solid waste management. With the Swachh Bharat Mission, there is now an enhanced focus on cleanliness and managing solid waste has become a priority. In this paper, I will be looking at the importance of economic instruments for a sustainable solid waste management in Indian cities.

Keywords-- Cities, Collection Efficiency, Solid Waste Management, Economic Instruments

poor due to inefficiency and lack of cost recovery. This inefficiency of services results in the deterioration of the urban environment in the form of air, water and land pollution that poses risk to human health and well-being [12]. One such matter of concern is the burgeoning amount of solid waste generated in urban areas and their poor disposal. Least attention is paid for solid waste management in comparison to air and water pollution. This has resulted in poor health and declining living conditions in Indian cities and the most affected by this are the urban poor. In this context, this paper looks at the solid waste management situation in Indian cities and the management approach of the municipal authorities to improve the conditions. The study highlights on the cost recovery principles for the service provided and the importance of economic and regulatory instruments in improving the cost recovery, which leads to augmentation of municipal finances resulting in better management of urban solid waste. The primary emphasis of the paper lies in highlighting the importance of economic instruments in urban solid waste management.

Solid Waste Management

Definitions of waste invariably refer to lack of use or value. McDougall et al defines waste, as "Waste is a by-product of human activity. Physically, it contains the same materials as are found in useful products, it only differs from useful production by its lack of value" [11]. World Bank differs slightly in the waste definition and it defines waste as 'any unwanted material intentionally thrown away for disposal however, certain wastes can become resources valuable to others if removed from the normal waste stream' [19]. In this paper, I will be limiting my study to municipal solid waste. Planning Commission considers waste consisting of household and commercial waste, debris, sanitation residue, industrial and hospital wastes as municipal solid waste [13]. Industrial and other hazardous wastes are given special attention and are considered under industrial category about which I would not be dealing in this paper.

I. INTRODUCTION

Rapid urbanization accompanied by growth of slums and poor living conditions has become a matter of grave concern in India. Rapid urban growth intensifies the pressure on urban infrastructure and municipal administration. Poor management, lack of financial resources and technical expertise limit the capability of the municipal authorities in adequate provision of urban services. A large share of municipal finances goes into provision of urban services, but the service provision is

For many decades municipal solid waste management was treated as just a routine process of collection of day-to-day waste and did not receive any special attention [4]. Rising urbanization and growth in municipal waste generation coupled with aging disposal system led to poor municipal waste management. Due to its environmental impact, the awareness towards municipal solid waste management has increased in the recent decades and solid waste management has become a matter of high priority among policy makers and administrators. Chapter 21 of Agenda 21 on Solid waste management and sewage related issues offers an integrated strategy for waste management, which addresses both formal and informal sectors and includes the following areas, (i) minimization of waste, (ii) promotion of waste recycling and reuse, (iii) increasing coverage, (iv) ensuring environmentally sound disposal [17]. Also, the Sustainable Development Goal 6 on Clean Water and Sanitation focuses on increasing recycling and eliminating dumping of waste [18]

Sources and Types of Municipal Solid Waste

For an appropriate integrated waste management strategy it is very important to have the relevant knowledge about sources and types of waste. Solid waste can be classified under eight major categories, residential, industrial, commercial, institutional, construction and demolition, municipal services, processes and agricultural [19]. In developed nations, industrial, construction and demolition processes and agricultural wastes are not considered as municipal solid wastes. In India due to very poor waste segregation process, all the above stated wastes end up being a component of municipal solid waste.

Table No 1: Sources and types of municipal solid waste

Source	Type of solid wastes
Residential	Food wastes, papers, plastics, cardboards, glass, metals, ash and other bulk household waste like used batteries, consumer goods etc.
Industrial (small and informal industrial units)	Scrap materials, plastic, cardboards, metal and glass
Commercial (offices, stores, restaurants, markets, etc)	Paper, cardboard, plastic, wood, glass, metals, food waste etc
Institutional (schools, government centres)	Paper, plastic, wood, cardboard, glass etc
Hospitals	Paper, plastic, cardboard, wood, glass and medical wastes
Construction and Demolition (Construction sites, road works, repairs,	Steel, wood, concrete, dirt etc.

demolition etc)	
Municipal services (street cleaning, recreational areas, municipal utility sites like treatment plants etc)	Dirt, tree and plant leaves, sludge etc

Source: [19]

Health Hazards of Poor Solid Waste Management

There is an association between poor solid waste management and human health effects. Improper solid waste management causes all types of pollution: air, soil and water. Non-collection of solid waste generated and allowing them to decay on roadside and vacant land can lead to break down of epidemics. Indian solid waste because of its high organic content and due to favourable conditions in terms of humidity and temperature decay very fast and become breeding grounds for flies, mosquitoes and insects. Human fecal matter is commonly found in municipal solid waste, which can become breeding ground and spread epidemics. Indiscriminate dumping of waste contaminates surface and ground water. Uncontrolled burning or improper incineration adds to urban air pollution. Leachates from dumps can contaminate ground water. Greenhouse gases are also generated from the decomposition of organic wastes in landfills [19]. Dumps provide very poor working conditions for scavengers and pose significant health risk.

II. SOLID WASTE MANAGEMENT SITUATION IN INDIA

India is a developing country with low per capita income and a low rate of urbanization (31 percent of the population resides in urban areas). Low per capita income and low rate of urbanization doesn't transform into low solid waste generation, because of the absolute numbers and the high concentration of urban population in very few metropolitan cities. Municipal solid waste management has become a matter of concern in these large metropolitan cities because of high concentration of population, poverty, poor living standards, large number of slums and inefficient urban service providers.

Solid waste management in India has received less attention from policy makers and administrators. Solid waste management comes under the purview of urban local bodies, who pay less attention to it in comparison to water supply and sanitation. But solid waste management is the most essential housekeeping service required by urban dwellers to maintain their quality of life. In India this service is very poor and far from satisfaction. Institutional weakness, shortage of human, financial and technical resources, inadequate coverage, improper collection, transportation, disposal and lack of user

response and awareness are the main reasons for the existing poor municipal solid waste management system in Indian cities [7].

In Urban India about 1,33,760 metric tonnes of waste is generated daily with a per-capita average generation of 450 gm/day. The total amount of waste handled is about 62 million tonne per year which is expected to increase further with the current rapid economic and urban growth. Planning Commission estimates that urban India would generate about 4,50,000 metric tonnes per day by 2031 and 11,95,000 metric tonnes per day by 2050 [14]. Of the total waste generated only about 68 percent of the waste is collected in Indian cities. Of the collected waste about 80 percent is disposed in open dumps sites without any treatment.

Waste generation rates in India vary in relation to the city size. It has been found that about 500 g per capita per day solid waste is generated in cities with a population above 5 lakh and about 210g per capita per day solid waste is generated in cities with a population between 1 lakh and 5 lakh [20]. Metropolitan cities Mumbai and Delhi are the largest generates of solid waste per capita. In India, the amount of waste generated per capita is estimated to increase at a rate of 1-1.33 percent annually [15]. This along with rapidly growing urban population calls for immediate attention of policy makers and municipal administrators.

Table No 2: MSW generation and treatment facilities in Indian Cities

Solid Waste Characteristics in India	
Generation (MT per day)	1,33,760
Collection efficiency	68 %
Total Waste Collected (MT per day)	90,957
Waste lost/littered (MT per day)	42,803
Composition of MSW	
Organic waste (51 %)	68,218
Inert & non-organic (32%)	42,803
Recyclable (17%)	22,739
MSW Treatment facilities	
MSW treated/processed (MT per day)	25,884
Land filling	
Landfilled (MT per day)	65,489

MT: Metric Tonne

Source: [14]

Table No 3: Municipal Solid Waste generated in Indian Cities

Sr. No	Cities	Municipal Solid Waste (Tonnes per day)		
		1999-2000	2004-2005	2010-11
1	Ahmedabad	1,683	1,302	2,300
2	Bangalore	2,000	1,669	3,700

3	Chennai	3,124	3,036	4,500
4	Delhi	4,000	5,922	6,800
5	Hyderabad	1,566	2,187	4,200
6	Kolkata	3,692	2,653	3,670
7	Mumbai	5,355	5,320	6,500
8	Pune	700	1,175	1,300

Source: [6]

Characteristics of Municipal Solid Waste Management in India

About 51 percent of the waste is organic waste which can be composted, 32 percent is non-organic and 17 percent is recyclable. Municipal solid waste in India also has a high content of ash as coal is traditionally used as a household fuel source. The percentage of paper, metal, glass and plastic is low in India due to the low per capita income and consumption patterns. This composition is gradually changing and the content of paper, plastic and metals in the municipal solid waste is increasing.

Table No 4: Composition of solid waste in major India cities (percentage by weight)

City	Paper	Metals	Glass	Textiles	Plastic	Ash & Dust	Organic	Others
Mumbai	3.2	0.1	0.5	3.3	--	15.5	59.4	18.1
Kolkata	0.1	0.7	0.	0.3	1.5	33.6	46.6	17.0
Delhi	5.9	0.6	0.3	3.6	1.5	23.0	57.7	7.5
Chennai	5.9	0.7	--	7.1	--	16.4	56.2	13.7
Bengaluru	1.5	0.1	0.2	3.1	0.9	12.0	75.0	7.2
Ahmedabad	5.2	0.8	0.9	4.1	0.7	29.0	49.0	10.4

Source: National Solid Waste Association of India

Collection Efficiency of Waste

The collection efficiency of municipal solid waste is about 68 percent. The uncollected waste which is about 32 percent is generally allowed to lie in the vacant plots and roadsides leading to hygiene problems. The final destination of the waste collected is dumping grounds. Most urban solid waste in Indian cities and towns is land filled in normal conditions without any precautions. Dumping in sanitary landfills although advised is not practiced in India. This unscientific way of dumping the collected waste may lead to serious environmental and health implications.

Waste Growth Trends

Waste quantities are linked to economic activity and resource consumption. In India rapid economic growth

since liberalization and urbanization has resulted in rapid increase in municipal solid waste generation. An even more serious matter of concern in this regard is the growing material wealth in which Indians try to follow the consumption trends as seen in United States and Western Europe. This will result in increase in per capita waste generation.

Waste generation rates are affected by economic development, social conditions, consumption patterns, industrialization, urbanization and climate. The quantities and characteristics of solid waste produced vary from city to city. The factors influencing the quantity and composition include the level of income, population, climate, industrial activities, individual lifestyles and social behaviour. Although per capita solid waste generation is low, but because of India's high urban population, the sheer immensity of the problem along with financial and infrastructural constraints including non-availability of land has made safe disposal of solid waste a difficult task. There is a decline in the standard of services with respect of waste [13]. This decline in the standard of services is in spite of huge financial and human resources spent on solid waste management.

III. ISSUES IN MANAGING URBAN SOLID WASTE

In a developing country like India solid waste management is a complex process due to the fact that

- The kinds of waste generated in Indian cities vary widely, and different waste management approaches and technologies have to be used based upon the nature of the waste.
- Effective solid waste management has a direct impact on social, economic and environmental conditions.
- Large numbers of stakeholders are involved.
- Solid waste management in Indian cities are informal where rag pickers play a major role.
- (NIMBY) Not-In-My-Back Yard syndrome in which no individual or a stakeholder takes the responsibility of proper waste disposal.

Some of the major issues in disposal of municipal solid waste are elucidated below.

Separation and Treatment of Waste

Waste segregation is the most important component of an effective solid waste management. If organic and combustible wastes are separated they can be used economically. In India organic waste, which constitute about 50 percent of the total waste if segregated can be used economically as manure by composting. Segregation of organic waste can be done at the households prior to collection, at the landfill prior to final disposal or a combination of both. Segregation of waste at the source is the important process, as segregation at landfill is a tedious process and requires the organization of labours and scavengers to segregate the waste.

Recycling

Recycling of the municipal solid waste provides substantial social and economic benefits to the society. Recycling helps in avoiding the externalities of landfill and of primary material production and also helps to extend the life of stocks of exhaustible resources [3]. In India it is difficult to establish the quantum of waste recovery. Some studies show that only about 7 to 15 percent of the waste is recycled [7]. Reuse and recycling are very important component of solid waste management, but in Indian cities they are carried in very hazardous manner and in poor environmental conditions. Resource recovery and recycling in India is labour intensive and carried out by the informal sector. In the past the role of the informal sector in waste management has hardly been recognized by municipal authorities. Often the authorities even actively hindered such recovery and recycling activities. Now more and more, the importance of recycling activities in reducing waste volume, the role of informal sector in recovering resources and its economic benefits is being acknowledged [20].

Land Requirement

Incineration is an ideal way of disposing the municipal solid waste. But incineration is an expensive process (costs around Rs 3000/tonne as compared to Rs 300/tonne for sanitary land fill). At the moment in Indian cities complete incineration of solid waste seems to be impossible and land filling is the only economic option currently available. Even simpler sanitary landfills are non-existent in India. Most of the solid waste disposal is by simple land filling. This along with enormous increase in solid waste generation has significant impact in terms of land required for disposal of waste. This task of acquiring land for disposal seems to be more daunting because the cities with highest generation of solid waste, happens to be the cities with serious scarcity of vacant land. Bengaluru has faced severe opposition from farmers for starting new landfills near their agricultural fields. In Mumbai and Delhi people residing near landfills have protested very often due to environmental concerns.

Financial Constraints of Urban Local Bodies

Urban local bodies due to their limited financial capabilities are unable to cope up with the growing problem of increasing solid waste generation. ULBs spend about 20 to 30 percent of their total budgetary resources on solid waste management. Many municipal authorities even have difficulties when trying to define their actual solid waste management costs. About 70 percent of the resources go into collection of the waste and about 25 percent for transportation of the waste. Hence very little amount is spent on disposal thus leading to very poor conditions of solid waste disposal in India. As disposal receives less attention as much as 90 percent of the solid waste ends in open dumps [12]. Despite large amount of money spend on collection the efficiency of waste collection in Indian cities is very low.

Regulatory Instruments

In India since the adoption of the Municipal solid wastes (Management and Handling) Rules 2000[1] , standards apply to all aspects of solid waste management including waste storage, collection, transfer and final disposal. They include ambient standards both technical and operations. Technical and operational standards relating to solid waste collection and disposal specify compliance criteria in collection, segregation, storage, transportation, processing and disposal of municipal solid wastes [16]. Most of the standards are ambiguous in nature and are poorly complied with. Implementation and monitoring rests with different authorities which makes them even more difficult to implement. The command and control mechanism to improve waste management in India through standards and regulations has been far from satisfactory.

User Charges

In India there does not exist the concept of polluter pays principle in solid waste management. In most cities charges for solid waste are linked to property taxes. Now with the passing of the new legislation solid waste user charges are been collected separately. A system of flat rate user charge per household is followed.

It is now very important to move away from a flat rate user charges towards a user charge based upon the quantity of waste generated or based upon the number of persons in a household. Due to the operational problem in weighing the solid waste daily, user charges based on number of households seems to be a viable option in the case of Indian cities, but again this user charge method might not be a true reflection of waste generated.

Flat Fee System: A flat fee system is one, which charge households and commercial establishments a fixed fee for a period independent of the quantity of waste generated. Flat fee systems are unsound from both economic and environmental perspective. Economically such a pricing does not consider marginal cost and hence disallows an efficient solution [4]. From the waste generator point of view the marginal price of extra waste generated is zero, which discourages waste generator from producing less waste even though the community and service providing agency incurs a non-zero incremental cost.

Unit Pricing Method: A unit pricing method is one which charge households and commercial establishments a price based upon the quantity of waste generated. But this method of charging for waste is hardly practiced in Indian cities.

In the next section, I will be looking into the importance of integrated and innovative approaches towards solid waste management in Indian cities. It is important for the policy makers and municipal administrators to move from the traditional waste management approach towards new and innovative approaches of managing the municipal waste.

IV. INTEGRATED SOLID WASTE MANAGEMENT

Integrated solid waste management is defined as the selection and application of appropriate techniques, technologies and management programs to achieve specific waste management objectives and goals [19]. The general waste hierarchy accepted by industrialized countries is comprised of the following order; reduce, reuse, recycle, waste transformation (through composting, incineration) and land filling [19]. Land filling is of the last order. However, in India we skip the hierarchy and directly dispose our waste in the landfills.

Solid Waste Management in developing countries has received less attention from policy makers and academicians than that paid to other environmental problems such as air pollution and water pollution [12]. But in recent years there is increasing public awareness of the need for collection and proper disposal of municipal solid waste. In Indian cities appropriate and safe solid waste management are of utmost importance to provide healthy living conditions for the population. In India almost one third of the solid waste generated is not collected. It is mainly the urban poor who suffer the most from poor solid waste management. While solid waste management is becoming more and more an important function of the municipalities, but they are constrained by the lack of funds to perform this function effectively.

The state must take initiatives to reduce the externalities of waste by considering measures such as full cost accounting, package deposits, manufacturer's responsibility and extended product care [19]. Along with the initiatives of the state and industry the general community also has to change its behaviour by reducing waste and showing discipline in separating waste and exercising environmentally friendly purchase habits [19].

V. NEW APPROACHES TO SOLID WASTE MANAGEMENT

In this section, I will look into new waste management approaches based on polluter-pays principle, emphasizing mainly on the use of economic instruments for waste management.

Importance of Economic Instruments

In order to improve the existing waste management situation it is required to reorganize the present system and introduce new innovative instruments which can be regulatory, financial, market based, economic, planning and public information based. Here in this paper, I will be limiting my study to the role and importance of economic instruments. In theory economic instruments have the capacity to regulate pollution according to market mechanisms and thus facilitate deregulation and a reduction in government involvement

[1]. Experiences across the world show that economic instruments alone have not been able to achieve the objectives of environmental preservation. Generally economic instruments complement regulations.

The new economic instruments should be based on the following concepts; (i) user charge system based on polluter pays, (ii) new economic instruments should be consistent, reliable, adoptable and coherent with the existing market systems, (iii) new instruments should not put additional load on implementation and monitoring agencies, (iv) new instruments should not be context specific but should be easily adaptable.

Table No 5: Different instruments for solid waste management

Regulatory Instruments	Technology Standards, Bans/Prohibitions and Quotas
Economic Instruments	Input Charges, Product Charges, User Charges/Fees
Market Instruments	Market for Waste, Recycling
Financial Mechanisms	Deposit-refund Systems (can also be considered as economic instruments)
Public Information Instruments	Education and Training, Voluntary Agreements
Urban Planning Instruments	Physical Planning, Waste Collection Systems

VI. ECONOMIC INSTRUMENTS FOR SOLID WASTE MANAGEMENT

Economic Instruments refer to the use of market-based instruments to encourage the adoption and development of environmentally-sound technologies and environment-friendly products to further complement the existing legislative framework for environment protection. The basic rationale of economic instruments is to change the behaviour of consumers and the general public to one that recognizes the value of the environment. Furthermore, economic instruments provide resource users with incentives for sustainable utilization and simultaneously enable the capture of a larger share of resource rents as government revenue.

Various types of economic instruments like charges, subsidies, deposit refund systems can be conceived in integrated solid waste management.

Charges

Within charges generally three types of charges apply to the collection and disposal of solid wastes (i) user charges, (ii) disposal charges, (iii) product charges [1].

User Charges: User charges are commonly applied to the collection of municipal solid waste. In India they are considered normal payments for municipal solid

waste services and rarely act as incentives to reduce waste. In many cities of India the charges are attached to the property taxes and does not reflect the marginal social costs of environmental effects. Recently many municipal corporations have delinked user charges from property taxes and now they charge a flat amount per household. These charges again do not reflect the marginal costs of solid waste generation. Ideally charges should be based on the amount of waste generated [1]. User charge must be set to cover the marginal service cost.

Disposal Charges: Many countries apply charges (disposal charges) on waste disposal. A charge is levied on dumping of municipal and industrial waste. The rate depends upon the type of waste and the method of treatment before dumping. In Denmark, a charge is levied on solid waste from household and industrial firms. In United States there are disposal charges for wastes like used tires and oil [1]. In India apart from disposal charges on industrial wastes there does not exist any disposal charges on municipal wastes.

Product Charges: In Western Europe and America most product charges on waste have applied to nonreturnable containers, lubricant oils, plastic bags, fertilizers, pesticides, tires and fuels. Product charges are kept high for plastic containers or glass bottles to encourage the deposit-refund system, in which the users can deposit the containers and get back the charges paid. Product charges are mainly to encourage recycling of the waste. In India there does not exist product charges system, but there exists informal recycling process through rag pickers and kabadiwallas. Kabadiwallas are itinerant buyers who purchase items such as cans, bottles and paper etc that will be reused or recycled.

Subsidies: Subsidies are provided by the State to local waste management authorities and the private sector for various aspects of solid waste management. In India subsidies and incentives in terms of tax holidays, soft loans, tax free bonds are provided for private sector enterprises involved in solid waste collection and disposal process. Incentives are also available for private enterprisers for constructing treatment, compost and incineration plants.

Deposit Refund Systems: Deposit refund systems that impose special taxes, charges or fees on consumers are designed to encourage recycling and prevent pollution. They are applied most often to beverage bottles in which a consumer has to deposit an amount on drink containers, which will be paid back when he returns the containers. In addition to beverage bottles, deposit-refund systems are applied and proven effective in the recycling of automobiles and automobiles batteries in the United States [1].

Drawbacks of Flat Fee Pricing (User Charges) for Municipal Solid Waste Services

In most Indian cities suppliers of MSW services charge a fixed fee per household. The waste generator is charged nothing for any additional solid waste generated

beyond the first one, which means that the price does not reflect rising marginal private cost. Waste generators effectively pay a marginal price of zero and hence have no incentive to reduce wastes [5]. In cities where municipal solid waste services are publicly provided, the price mechanism is further dampened because the fee is not explicitly communicated but rather collected through property taxes [4]. The use of fixed fee distorts the pricing mechanism thus removing the incentive to reduce waste generation. All these factors contribute to an over allocation of resources to waste management services without improving the efficiency of services and an overproduction of municipal waste.

This inefficiency can be corrected through introducing market based pricing policies which charge based on the marginal cost of waste generation. Many charging systems like variable rate charges, retail disposal charges, deposit system etc. can rectify the inefficiency in waste charges collection.

Advantages of Economic Instruments

- The most important advantage of economic instruments is that it raises public revenues either through user charges or other economic instruments.
- It can bring in cost effectiveness through the optimal use of resources.
- It is in line with the polluter pays principle and can increase awareness among the waste generators
- Economic instruments bring in efficiency in waste management and improve waste management technologies [9] [10].

Disadvantages of Economic Instruments

Despite its strengths economic instruments has some inherent disadvantages

- Environmental quality cannot be predicted in economic instruments as waste generators may choose their own solutions.
- In the case of charges, waste generators may continue to generate waste if charges are not set at an appropriate level.
- Sophisticated implementation and monitoring institutions are required to implement economic instruments [9] [10].

VII. CHARACTERISTICS OF SOLID WASTE MANAGEMENT IN INDIAN CITIES

Indian urban local bodies (ULB) s has a relative scarcity of capital and an abundance of unskilled and inexpensive labour. In response to the abundant availability of inexpensive labour, waste management systems should be more labour intensive and less capital intensive. Indian cities have extensive areas with substandard conditions, slums, narrow streets and unpaved streets. This makes it difficult for large collection trucks to

enter all areas. Slums and poor settlements which are the poorly served regions can have small scale community based waste management systems. Waste generated in developing countries contains a large percent of organic materials, usually three times higher than cities in the industrialized world [12]. Indian cities also have a large organic content in their waste, hence composting is the best approach. Dynamic informal sector exists in many Indian cities, which earn their income through, refuse collection and recycling of waste. Most of them are migrants, children and women, unemployed, handicapped and elderly individuals. The World Bank has estimated that up to 2 percent of the population in third world countries survive by recovering materials from the waste. In Santa Cruz, Bolivia, informal refuse collectors serve about 37 percent of the population [12].

Solid Waste is an inevitable product of development process. Solid waste should be dealt with utmost priority. In dealing with the solid waste there are two fundamental requirements (i) less waste and (ii) an effective system for managing the waste still produced [11]. In the present day it is important to integrate all the actors, technology and economic benefits for a sustainable solid waste management. 'Integrated Waste Management systems combine waste streams, waste collection, treatment and disposal methods, with the objective of achieving environmental benefits, economic optimization and societal acceptability. This will lead to a practical waste management system for any specific region' [11].

Table No 6: Guidelines for management of municipal solid wastes

Collection of Municipal solid wastes	Organizing house-to-house collection. Separate collection of waste from slaughterhouses, vegetable markets and hospitals.
Segregation of waste	Segregation of waste at the source and before dumping.
Storage and Transportation	Properly designed waste collection bins and transport vehicles
Processing of waste	Bio-medical wastes to be incinerated and biodegradable waste to be composted.
Disposal of Waste	Land filling should be restricted to non-biodegradable and inert waste. Land filling has to be in sanitary landfill sites.

Source: [16]

Waste Prevention

Waste prevention is given the highest priority in integrated waste management. This is a preventive action that seeks to reduce the amount of waste that individuals, business and other organizations generate.

Incentives for Reducing Waste

This is the most important area in an effective solid waste management. Waste has to be reduced at source. In developed countries there are many incentives and instruments to reduce waste at source. Special levies are levied on the manufacturers to internalize the costs of waste disposal. These levies have made the manufacturers to go for effective manufacturing and packaging processes. In the case of household waste generation in many European nations waste collection charges are on a scale according to the volume or weight of the waste generated. In India many ULBs doesn't even charge for the household waste generated, if they charge the charge is a flat fee with no incentive for the household to reduce waste.

The external cost of solid waste generation has to be internalized by the household and the public authority. The internalization of external costs may raise the costs of solid waste management [2]. At present in India none of the available instruments provide any incentive to households to reduce the volume of waste entering the municipal solid waste stream as charges levied on households are not in relation to the volume of waste. In the objective towards reducing waste it cannot be the usage of economic instruments and command and control instruments in isolation. A range of both economic instruments and command and control instruments imposed on the waste generators can reduce municipal waste.

There are many institutional deficiencies faced by municipal corporations in managing their waste. The most important one is the poor utilisation of human resources. There is high rate of absenteeism in municipal workers. In the municipal corporation of Delhi and Mumbai about 25 percent of the workers are absent on any given day.

No one single method of waste disposal can deal with all materials in waste in an environmentally sustainable way. Most ideally a range of management options are required and the use of different options such as incineration, composting or plain dumping depends upon the quantity and composition of the waste. Indian city refuse is not generally suited for incineration because of high moisture content, low calorific value and high-quantity of non-combustibles [8]. Composting of solid waste is a better option and practiced in many cities but the quality of compost is poor due to presence of high quantity of non-organic materials, dust and debris.

VIII. CONCLUSION

It is now widely accepted and acknowledged that the external cost of solid waste generation has to be internalized. Generators of waste, i.e. the households in the case of municipal waste management has to be charged based upon the quantity of waste generated. Command and control approaches like standards and legislations doesn't respond to market forces and they alone cannot bring in an

equitable and effective allocation of external costs among the waste generators. Economic instruments on the other hand respond to the market forces and are been experimented in many countries for internalizing the external cost of solid waste generation. It is quite clear from the experiences that economic instruments are capable of an effective allocation of external costs and also provide incentives for the waste generator to reduce waste. Economic instruments are found to be more effective along with command and control mechanisms. Now it is high time for the Indian urban local bodies to adopt the new innovative instruments to bring in about a reduction and efficient management of waste.

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 Domestic, trade and institutional waste to be collected on daily basis, Hazardous and toxic wastes are to be deposited by the waste producers at specified places
Segregation of recyclable/non-biodegradable waste
 These two categories of waste are to be kept in a separate bin or bag at the source of waste generation and collection itself
Storage of Waste at source
 No wastes should be thrown on the streets, footpaths, open spaces but should be stored at sources at waste
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