

Sustainable Waste Management; Case study of Nagpur INDIA

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Abstract

In India the amount of waste generated per capita is estimated to increase at a rate of 1%-1.33% annually. It is estimated that the total waste quantity generated in by the year 2047 would be approximately about 260 million tonnes per year. The enormous increase in waste generation will have impacts in terms of the land required for waste disposal. It is estimated that if the waste is not disposed off in a more systematic manner, more than 1400 sq. km of land would be required in the country by the year 2047 for its disposal.

At present the standard of solid waste management is far from being satisfactory. The environmental and health hazards caused by the unsanitary conditions in the cities were epitomized by the episode of Plague in Surat in 1994. That triggered public interest litigation in the Supreme Court of India. Based on the recommendations of the committee set up by the apex court in that Public Interest Litigation (PIL), the Government of India, has framed Municipal Solid Waste (Management and Handling) Rules 2000, under the Environmental Protection Act, 1986.

One of the major requisite of these rules is to establish door-to-door garbage collection system in the cities. Nagpur which is located in centre of India has taken initiative in implementing MSW Rules 2000 by introducing 100% door-to-door garbage collection. It has enabled:

1. Livelihood creation for 1600 people from most deprived segment of the society.
2. Clean environment as 75% of the total waste generated is being collected from doorstep.
3. Successful Public Private Peoples Partnership
4. Use of ergonomic tools for managing waste
5. Use of appropriate technology for waste management, also creating entrepreneurship opportunities.
6. Effective recycling of waste for useful purposes.
7. Partnership of Waste Producers

Partnership is going on successfully for last 3 years.

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I. BACKGROUND

There has been a significant increase in municipal solid waste (MSW) generation in India in the last few decades. This is largely because of rapid population growth and economic development in the country. The per capita of MSW generated daily in India ranges from about 100 gm in small towns to 500 gm in large towns. The increased MSW generation can be ascribed to our changing lifestyles, food habits and change in living standards. In India the amount of waste generated per capita is estimated to increase at a rate of 1%-1.33% annually. It is estimated that the total waste quantity generated in by the year 2047 would be approximately about 260 million tonnes per year, more than five times the present level of about 55 million tonnes. The enormous increase in solid waste generation will have significant impacts in terms of the land required for waste disposal. It is estimated that if the waste is not disposed off in a more systematic manner, more than 1400 sq. km of land which is equivalent to the size of city of Delhi would be required in the country by the year 2047 for its disposal.

In our country municipal corporations are primarily responsible for solid waste management. But with the growing population and urbanization municipal bodies are facing financial crunch and can no longer cope with the demands. The limited revenues earmarked for the municipalities make them ill equipped to provide for high cost involved in the collection, storage, treatment and proper disposal of waste. Municipalities are only able to provide secondary collection of waste, means they only collect waste from municipal bins or depots. A substantial part of the municipal solid waste generated remains unattended and grows in the heaps at poorly maintained collection centres. Open dumping of garbage facilitates breeding of disease vectors such as flies, mosquitoes, cockroaches, rats and other pests.

At present the standard of solid waste management is far from being satisfactory. The environmental and health hazards caused by the unsanitary conditions in the cities were epitomized by the episode of Plague in Surat in 1994. That triggered public interest litigation in the Supreme Court of India. Based on the recommendations of the committee set up by the apex court in that Public Interest Litigation (PIL), the Government of India has framed Municipal Solid Waste (Management and Handling) Rules 2000, under the Environmental Protection Act, 1986. The Municipal Solid Waste (Management and Handling) Rules 2000 are as follows:

1. Collection of municipal solid wastes- Organising doorstep collection of municipal solid waste from houses, hotels, restaurants, office complexes and commercial areas.
2. Segregation of municipal solid wastes- Municipal authority shall organise awareness programs for segregating the waste at source as dry and wet waste and promote recycling or reuse of segregated materials.
3. Storage of municipal solid waste- Municipal authorities shall establish and maintain storage facilities such that wastes stored are not exposed to open atmosphere and shall be aesthetically acceptable and user friendly and it should have easy to operate design for handling, transfer and transportation of waste.
4. Transportation of municipal solid wastes- Vehicles used for transportation of waste shall be covered and waste should not be visible to public, nor exposed to open

environment and shall be so designed that multiple handling of wastes prior to final disposal, is avoided.

5. Processing of municipal solid wastes- Municipal authorities shall adopt suitable technology or combination of such technologies to make use of wastes so as to minimize burden on landfill.

6. Disposal of municipal solid waste- Land filling shall be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. Land filling of mixed waste shall be avoided unless the same is found unsuitable for waste processing.

II. SWACHATA DOOT APLYA DARI: A SCIENTIFIC AND INNOVATIVE APPROACH FOR MUNICIPAL SOLID WASTE MANAGEMENT

As can be seen from the above guidelines, collection and segregation of municipal solid waste is a primary requirement for implementation of MSW Rules 2000. Primary collection of garbage is important to prevent littering of waste on the streets. As per the MSW guidelines, waste has to be collected in segregated form so that it can be recycled to the extent possible by adoption of suitable technology. This recycling will minimise the burden on landfills.

Though doorstep collection of segregated waste is important for municipal solid waste management, it is not carried out by many of the municipal bodies in the country as they are lacking in financial resources or the expertise to comply with those rules and they often make little effort to revise outdated and deficient waste management systems. As the authorities were hardly able to provide cost-efficient service to citizens, one possibility was to outsource solid waste management by putting in charge professional private organizations like Centre for Development Communication (CDC). The key concept is a daily door-to-door collection of segregated domestic waste, but the model includes all aspects of solid waste management from waste generation to waste processing (e.g. recycling and vermi-composting) and the final disposal. The end consumer is both main contributor and main beneficiary, as he should segregate the waste instead of littering it and, in turn, profits from the cleanliness of the city and creation of a new awareness that CDC work is generating. Presently the Swachta Doot project is being successfully being implemented in several cities of India.

The Swachta Doot Project is a major solid waste management program that includes the following aspects:

- A. Daily door-to-door garbage collection
- B. Waste segregation
- C. Garbage lifting and Transportation
- D. Employment Generation
- E. Awareness building

A. Daily Door-to-door Garbage Collection

Daily door-to-door garbage collection is the core of the CDC model. It is most essential for complying with the norms prescribed by the Municipal Solid Wastes (Management

and Handling) Rules, 2000 as well as the Supreme Court Guidelines for solid waste management.

Swachta Doot

Rag pickers and private sweepers who were previously working in the same sector and spent their life at foul-smelling and most unhygienic places rummaging through debris with bare hands and getting an uncertain and irregular low payment for this dirty work are brought into organised sector by CDC, and now called as Swachta Doots

Training

Swachta Doots undergo a special training that equips them with the abilities necessary for their job:

- Handling the waste in a proper and hygienic manner
- Polite and helpful behaviour towards local residents
- Discipline, sincerity commitment to their work

The properly trained workers collect the waste from households and shops seven days a week and 365 days a year. This service is provided in the morning time (between 6.00 am to 1.00 pm). They wear colourful work clothes (uniforms) so that residents and shopkeepers can easily identify them. Training and neat public appearance helps the worker to be better accepted by the community.

The garbage is directly transported and unloaded to local containers (transfer stations) using specially designed vehicles. Those Containers are brought to landfill sites outside the city by municipal corporation workforce. There is a close cooperation between CDC and the municipal bodies so that waste is not stored longer than necessary in residential areas.

This way of domestic waste management is in compliance of MSW guidelines and guarantees that:

- Waste is handled only once
- It is exposed nowhere
- There is no need of burning the garbage or dumping it in streets, drains and open places

Equipment

CDC has developed a micro-plan to adopt waste collection to the special conditions that prevail in different areas. For example, in slum areas different type of waste is produced than in posh colonies and the size of the streets is varying. To implement this micro-plan, CDC uses different types of vehicles.

Swachta Doots collect the garbage with specially designed mechanical tricycle rickshaws and multi bucket wheelbarrows. They have several advantages:

- Workers can access even very narrow roads (for example in Slum areas)

- Segregated waste collection
- The waste can be directly unloaded in the container. It does not have to be touched. So, hygienic conditions for workers are improved.

CDC follows a dynamic model of selection of equipment and modifies the equipment according to the requirements of a particular locality, town or a city.

Evolution of Primary Collection Equipment

a) **Open Body Tricycle Rickshaws:** The open body tricycle rickshaw is the most basic primary collection equipment and its capacity is about 50 Kgs. Its benefits include low cost and since it collects the mixed waste, it takes less time for waste collection from individual households. This type of equipment is no more in use as it collects the waste in mixed form, which is in contravention of MSW Rules. Further the collected waste is often dumped onto the ground or road and attracts rag pickers to sort out the recyclable part of the waste, exposing them to serious health risks. Additionally, since the waste is transported open to atmosphere, it is non-aesthetic and it is also observed that waste keeps spilling from the sides of the rickshaw.

b) **6 Container Tricycle Rickshaws:** In order to overcome some of the problems faced in the above model, CDC evolved a 6-container tricycle rickshaw for primary collection of waste. The major advantages of this type of equipment is that it allows collection of waste in segregated form and prevents multiple handling as the waste can be directly unloaded to the secondary collection vehicle. Due to these reasons, this type of equipment complies with the MSW guidelines. Its cost is a little more than the open body tricycle rickshaw and can carry 75 kgs of waste in one trip. The only limitation with this type of equipment is that it led to frequent thefts of plastic containers requiring their replacement. This unnecessarily adds to the costs.

Types of Containers	
<i>Metal Containers</i>	<i>Plastic Containers</i>
Heavy, Corrosive and Expensive	Light Weight & Durable and Non-Corrosive

c) **Closed Body Container with 2 compartments:** In some of the areas, a new type of tricycle rickshaw has also been utilised viz. Closed Body Container with 2 Compartments, which aids in segregated collection of waste, and since it's a closed body type the waste is not exposed to the atmosphere and therefore has aesthetic appearance. This type of equipment can carry 150 Kgs of waste and costs about Rs. 8000/-, which is a little more than 6 container type tricycle rickshaw. The only limitation with this equipment is that since the waste cannot be unloaded to the secondary collection vehicle, it leads to multiple handling, which is in contravention to MSW guidelines. This type of equipment is highly suitable for smaller cities where the waste can be directly transferred after collection to the landfill site.

d) **Closed Tipping Bodies with 2 containers:** To overcome the problem of multiple waste handling, a further improvement in the design of rickshaw has been incorporated, that includes hydraulic lifting of the rear side of the rickshaw unto the height of secondary collection vehicle so that the waste can be directly disposed off. This

type of equipment is most expensive and requires more maintenance as compared to the earlier ones.

e) **Mechanised Auto Rickshaws with closed container body with compartments:** In some cases CDC has deployed mechanised equipment in the form of Auto rickshaws for primary waste collection. The benefits of this type of equipment include high coverage area and can handle more waste. Further, since it has a closed container body, it is aesthetic in appearance and can directly unload the waste to final disposal point. This type of equipment is most optimum for smaller cities and towns as the overall economics is favourable as compared to manually driven rickshaws. The only demerit with this equipment as compared to the earlier models is that the initial capital cost is higher.

f) **Mechanised operations with Medium Utility Vehicles:** In line with the above-mentioned mechanised operations, CDC has also introduced medium utility vehicles for primary waste collection in some of its projects. The advantage of this type of system is that it can handle more waste than auto rickshaws and is most ideal for bin-free cities. It fully complies with the MSW guidelines and is aesthetic in appearance, as waste is not exposed in the open atmosphere. The demerit is that it is more expensive.

Door-to-Door Garbage Collection - The Monitoring System

Supervisors and Zonal In-charges inspect the field everyday. They regularly get in touch with households and shops to check for feedback, complaints and suggestions so that a satisfying service can be maintained. The CDC customer care service, telephone number is available from 6.00 am till 8.00 pm. In most cases complaints are redressed within 30 - 60 minutes during working hours, or the next morning if problems arise outside working hours.

B. Waste Segregation

Waste is not all the same. It has different characteristics according to which it can be divided accordingly:

- Recyclable e.g. glass, paper, plastic
- Organic e.g. food leftovers, garden waste
- Toxic e.g. tin, batteries
- Reusable e.g. plastic bottles, polythene bags

While recyclable waste is dry in nature, the organic kind is wet and 100% biodegradable. Hence, bacterial action is faster in the latter. If waste is segregated, it is easier to handle, does not cause much pollution and can be reused, recycled or decomposed.

The CDC model of waste management is based on the principle of segregating waste and treating it according to its characteristics. Waste should be segregated at the place or source of origin. In order to realize this concept CDC, implements the following approach:

- Educating the community about waste characteristics and the consequences of inappropriate waste dumping
- Collecting the waste in a segregated manner every day

- Using specially designed multi-chambered rickshaws for garbage collection

C. Garbage Lifting and Transportation

Since June 2004, CDC is also lifting the local containers and transporting them to landfill sites in few cities. This enables CDC to co-ordinate the different processes of primary waste collection and transportation. Containers are lifted before they overflow and waste is not stored longer than necessary in residential areas. Furthermore, superfluous containers can be removed for better public convenience.

D. Employment Generation

As CDC is not a profit-oriented organization, it is committed to improve quality of life, especially for the deprived section of the society. For this reason, most grassroots workers have been recruited from slum areas. CDC started its work initially with few workers. This number increased every day and now CDC could create livelihood for about 6000 persons in the Swachta Doot Project. The services have grown in various cities and presently CDC is catering to a population of nearly 6 million.

The following table highlights some of the current projects of CDC in various cities including employment generated approximate quantity of waste collected, utilized and finally transported as inert material to landfill sites.

City	House-holds covered	Road sweeping (length in km)	Employment generation	Waste collected (T/day)	Organic matter (T/day)	Recyclable content (1) (T/day)	Inert & Inorganic (T/day)
Jaipur	50000	150	300	100	60	10	30
Nagpur	450000	200	2500	900	540	90	270
Ahmedabad	30000	35	125	60	36	6	18
Gandhinagar	60000	0	100	120	72	12	36
Surat	100000	0	100	200	120	20	60
Nanded	10000	0	150	20	12	2	6
Delhi	200000	450	629	126	0	0	0
Bilaspur	10000	0	30	10	0	0	0
Udaipur	3000	40	30	0	0	0	0
Bharatpur	10000	60	94	15	0	0	0
Hanumangarh	17000	60	90	0	0	0	0
Beawar	10000	85	100	16	0	0	0
Jaisalmer	3000	30	32	0	0	0	0
Total	953000	1110	4280	1551	840	140	420
Average 5 members per Household				0 indicates non availability of data			

Note: 1) Recyclable contents include paper, glass, plastic and metal

2) All weight values are approximate values.

Introduction of door-to-door collection service has improved the financial condition of Swachta Doots who now receive regular payment as compared to the earlier situation when they could earn low (12-15/-per day) and irregular incomes. They are now enjoying dignified working conditions at CDC, as their profession is viewed with greater respect

amongst society members compared to their earlier work. As both genders are treated equally the number of women is almost as high as the number of male grassroots workers. Women are given the chance to make an own contribution to the living standard of their families. Additionally unemployed or underemployed educated youth profit from these job opportunities as they are recruited as Managers and Supervisors.

E. Awareness Building

It is CDC's conviction that the cleanliness of city is a collective good. It can only be achieved with the participation of all concerned. Therefore, CDC encourages and motivates people to keep their surroundings clean. They are provided education regarding sanitation and garbage disposal through various means of communication such as:

- Posters, folders, booklets, leaflets
- Exhibitions
- Wall paintings
- Living society meetings
- Debates and painting competitions in schools
- Regular talks with citizens

III. BENEFITS OF SWACHTA DOOT PROJECT

Social

- Improving social standard of Swachta Doots by providing training and financial stability
- The community is made aware of the consequences of unscientific waste throwing and can participate actively
- As the citizens are also involved in the project they develop a sense of belongingness
- People appreciate the service and consider it as necessary and essential. This makes the project self-sustainable

Economic

- City's image as a "green and clean" city can boost local economy especially in tourism branch
- Creates new avenues of employment
- Composting of organic matter and recycling of paper, glass, plastics and metals yield productive outcomes and reduces burden on landfill site

Public Health and Life Quality

- Waste is handled in a hygienic and scientific manner, so no pollution is caused at any stage

- Garbage on the roads is tremendously reduced
- Drains are no longer clogged with garbage – no smell, no breeding site for malaria spreading mosquitoes, no meeting place for pigs and other stray animals
- Quality of life improves as the whole city looks clean and aesthetic

This shows that the model is not only a convincing theoretical concept but also a successful intervention in the field of Municipal Solid Waste Management.

Methodology

- The idea of door-to-door (D2D) collection of garbage was not new for Nagpur Municipal Corporation (NMC). This work was started in 1996 in some wards of the city covering about 30% of the total population. But after the Supreme Court directive regarding 100% D2D garbage collection, it was implemented throughout the city.
- Requirements for implementing the directive included equipments like cycle rickshaws, ghanta gadi and manpower.
- In the city of Nagpur there are different types of residential areas like skyscrapers, slums, independent houses, bungalows, government colonies, etc. These categories have been grouped and suitable volunteers have been deployed for garbage collection.
- The volunteers were trained and oriented about waste disposal.
- Every volunteer i.e. 'Swachata Doot', cover about 200 – 300 households everyday depending upon the category.
- All the volunteers have been provided with uniforms and safety kit, which includes hand gloves, face mask, cap, etc.
- To oversee project implementation, one supervisor and coordinator has been appointed for every zone.

Key Highlights

- First project in India involving D2D collection of garbage from 100% households on all 365 days.
- The only project on solid waste management in India to recruit physically challenged persons. At present there are 37 such persons working on this project and thereby earning livelihood for themselves and their families.
- No dependence on external funding.
- Community involvement on a large scale.
- Well-defined roles for NMC, NGO and the community under the scheme.

Strategy followed

All concerned stakeholders were consulted before finalizing the implementation plan.
Implementation plan

- The work of D2D collection of waste by 'Volunteer' begins at 6.00 a.m. daily.
- Every household in the given group is attended daily.
- The doot goes around the demarcated households & announces his arrival by blowing a whistle.

- When the cycle rickshaw is completely filled with waste, it is unloaded in the nearby community dustbins. After unloading, the volunteer covers the remaining households.
- During every unloading, the recyclable waste is separated by the volunteer.
- At no point of time, he does manual handling of the waste collected.
- Monitoring indicators have been set in consultation with the NGO, which have further ensured prompt implementation of the project, e.g. households covered, timely complainant redressal, regular and surprise filed visits, community feedback, etc. are monitored regularly.

IV. RESULTS

- Benefits to NMC
 1. Successfully implemented the Supreme Court guidelines.
 2. Savings worth Rs. 5 crores in terms of lower costs for providing D2D garbage collection service to the citizens.
- Benefits to CDC (NGO)
 1. Other municipal corporations in India are adopting Swachata Doot model. CDC has assisted in preparation of policy in Rajasthan.
 2. CDC's budget for the financial year 2003-04 was Rs. 53 lakhs. After being appointed as implementer for this project, its financial credibility has escalated to Rs.15 crores. Moreover, we have been appointed to implement similar project in other cities of India.
 3. Financial institutions like Kotak Mahindra, ICICI, Tata Finance, etc. have come forward to sponsor equipments required for D2D collection. To date credit worth Rs.1 crore has been availed from these institutions.
 4. NMC has further reposed its confidence in CDC activities and has handed over the responsibility of secondary transportation of Municipal Solid Waste also to a joint venture involving CDC.
 5. Improvement in sanitation.
- Benefits to Citizens
 1. Regular D2D collection of garbage and active participation in the zero garbage drive.
 2. Better and prompt service at minimum costs.

Stakeholders / Partners:

'Swachata Doot Aplya Dari' is a joint initiative undertaken by various stakeholders / partners to maintain good hygiene and jointly create a cleaner city. In the following section we would like to highlight those who have made a significant contribution towards the initiative. These include:

a) Nagpur Municipal Corporation (NMC): Keeping the city clean has taken on a whole new meaning in the orange city i.e. Nagpur, the second capital of Maharashtra. Being innovative, clean and green has had a significant bearing on the city's future competitiveness and attractiveness as a business and traveling hub. Firm determination and hard administrative measures have contributed towards the success of the efforts of NMC. The innovative steps taken by NMC in MSW handling and disposal have led to visible changes in the city. Nagpur is recognized as one of the cleanest cities in the country.

b) Civic Cops (Nuisance Detectors): The civic cops supervise the work of Swachata doots i.e. the volunteers and addresses the grievances of the citizens. Furthermore, they collect the previous day's regarding information and report it to the higher authorities at the zonal office in writing, which was collected at the main office. Supervision by higher officials at the zonal office and appreciation of their efforts keeps these civic cops motivated & on their toes.

c) Non – Governmental Organizations (NGOs) Center for Development Communication (CDC): CDC had the most Herculean task i.e. implementation, wherein it had to involve people in implementing the programme, apart from recruiting volunteers, training and orientation, convincing the masses, etc. 'Show and tell' observation of a functioning D2D primary collection system was used to train the volunteers.

As it is rightly said 'public support comes when people see tangible results and benefit from such change'. The residents not only co-operated but also applauded the joint efforts undertaken by CDC, who have been responsible for making Nagpur a 'Green and Clean' city.

d) Swachata Doot (Volunteer): The volunteers or the Swachata Doots were the vital links and key contributors for making Nagpur a 'Green and Clean' city. These volunteers some of who were earlier know as '*Rag Pickers*' would previously collect and sort the recyclable dry waste like paper, plastics, metals, rags, etc for their daily living. Commencement of 'Swachata Doo Aaplya Dari' scheme has had positive impacts on the lives of these rag pickers and substitute sanitation workers resulting in livelihood creation for the members of the most downtrodden segment of society giving them dignity of work as 'Swachata Doots' having uniform and protective.

e) Citizens: The citizens have contributed to the scheme by whole-heartedly adopting the idea of waste disposal to volunteers only and making voluntary token monetary contribution towards the welfare of the volunteers.