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## RESEARCH ARTICLE

### SOLID WASTE MANAGEMENT IN CHANDIGARH

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#### ARTICLE INFO

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#### ABSTRACT

To solve global solid waste crisis keeping in mind the rapid urbanization, increasing industrialization, increase in population, change in life-style and social development, alternative steps have been suggested. Various types of data have been used as per the requirement of the objectives of the study. The primary data sources comprise the frequent travels through the study area. The primary data includes collection accomplished including the field observation, data collected on various types of bins and the field verification of garbage disposal sites. The secondary sources encompass town plans and other plan documents, topographical sheets, guide maps. The data and information on agents involved in recycling the waste material is acquired from Department of Environmental study.

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#### INTRODUCTION

Development is focus of all developed and developing; most urbanized and less urbanized as well as Northern hemisphere and southern hemisphere countries but its negative effect on environment particularly in the form of solid waste is a serious concern because health, cleanliness etc. are related to it. But solid waste, if not managed, collected and disposed of properly, will be one of the biggest obstacles in development. Various countries have now realized this fact and struggling to end this man made disaster. But in front of rapid running urbanization, planning for waste management seems handicapped. As the limits of urbanization are extending too far away areas in India, the problem of Solid waste management is causing a great concern to our environment. Industrial expansion lead to the increase in the job potential and trade prospects in large cities, which attracted the rural population to migrate to cities and this, further converted the cities into a major slum and concrete jungles. There is a positive correlation between city population size increase and waste generation. This suggests that increasing city size poses a greater problem to the solid waste management and making it a universal problem. Therefore, the increasing amount of solid waste generated in most of the cities is being recognized as a major health problem. During the past few decades, the changing production and consumption patterns have led to present new demands for natural resources and create new waste streams.

To fulfill these demands, capitalism has increased more and more production of goods as well as waste. Hence, a global solid waste crisis is emerging slowly and slowly. More production means more purchasing power of people, more generation of waste and more requirement of management which is possible by good will of Government, NGO's, M.C.'s and local people. It is apparent that there are two major problems due to poor solid waste management. One is the loss/under utilization of resourceful material and other is social cost due to health impact on rag pickers, community living in dump site surroundings and general public suffering from improper or no collection of waste from streets resulting in nuisance and spread of diseases. This inadequate disposal of waste also causes concentration of surface and ground water through leachate, soil contamination through direct waste contact or leachate, air pollution by burning of waste, spreading of diseases by different vectors like birds, insects and rodents, or uncontrolled release of methane by decomposition of waste.

Chandigarh is considered as the most planned and beautiful city of India. Its cleanness is India famous. What is new in this city to handle its sanitation conditions which attracts a lot of researchers to do study? What all other Indian cities can learn from this city? All these aspects are solid enough to conduct research on the solid waste management in this city. But nothing is perfect in this world, and the saying applies on Chandigarh also. Now city is transforming, like other Indian cities, hence requiring more research work on it. This is one step taken by us. In Chandigarh, growth of population, tourism and urbanization has resulted in generation of large volumes of solid waste. Most of the solid

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waste is presently disposed of on land and remains uncovered resulting in environmental pollution of surrounding area. According to the experts, apart from degrading aesthetic beauty, hazardous waste can contaminate surface and ground water sources and can cause even cancer, liver failure, mental retardation and a number of other diseases. Chronic exposures can lead to bio accumulation where these wastes, once ingested can't be excreted. While municipal and industrial solid waste has attracted the attention of the authorities, yet there is lack of concern for some special management of biomedical waste generated primarily from hospitals and other health care centers in the city. So there is an urgent need to do research in solid waste management to save the India's most planned and beautiful city from becoming into dumping site. The main aim of this study is to review the situation of solid waste generation, storage, transportation and disposal. We have evaluated management of solid waste in a planned city in general. Critical appraisal of public-private partnership in solid waste management has been provided. Further, we have outlined the road ahead by suggestions and recommendations towards attaining a cleaner environment in a city like Chandigarh.

## METHODS

Waste management is the collection, transportation, processing, recycling or disposal of waste materials, usually ones produced by human activity, in an effort to reduce their effect on human health or local aesthetics or amenity. A focus in recent decades has been to reduce waste materials' effect on the natural world and the environment and to recover resources from them. Waste management can involve solid, liquid, or gaseous substances with different methods and fields of expertise for each. Waste management practices differ for developed and developing nations, for urban and rural areas, and for residential, industrial, and commercial producers.

**Land use:** Chandigarh is the only city of Independent India which has every part of land used for specific purpose. Le-Corbusier forwarded following area for every type of land:

**Table 1. Chandigarh city: Land use plan of Le-Corbusier**

Land use type	Percentage of Area Allocated
1. Recreational and cultural	0.50
2. Public and Semi-public	2.60
3. Industrial	4.10
4. Commercial and officials	5.40
5. Educational	7.20
6. Reserved	9.60
7. Open spaces	18.00
8. Circulation	23.70
9. Residential	28.90
Total	100.00

Source: Chandigarh Informograph 1977, p.7

**National Norms for waste Management:** If we fit NEERI's criteria for waste generation, Chandigarh should have around 250 gm at its 900625 population (according to Census of India, 2001) but in actual it has 422 gm per day which shows that people of Chandigarh generate more garbage (see Table 2). With rapid increase of population and change in life style of people we can suppose that in future per capita garbage generation will increase. Hence genuine and alternative steps should be taken otherwise; 'the beautiful city' will become dumping site of waste.

## Sanitation Zones

The whole city has been divided into 4 zones as per details given below in Table 3.

**Table 2. Waste generation per capita in Indian cities**

Population Range (in Million)	Average per capita waste generation (gms per capita per day)
0.1 to 0.5	210
0.5 to 1.0	250
1.0 to 2.0	270
2.0 to 5.0	350
5.0 plus	500

Source: NEERI (1995)

**Table 3. Chandigarh: Zone-wise distribution of Sectors**

Zones	Areas
Zone-1	Sector 5,6,7,8,18,19,26,27,28, Industrial Area, Mani majra & Adjoining Slums.
Zone-2	Sector 2,3,4,9,10,11,12,14,15,16,17, Dhanas, Khudda and Adjoining Slums.
Zone-3	Sector 22, 23, 24, 25,35,36,37,38,39,43,42,41,40,52,53,54,55,56, Dumping Ground, Daddu Majra and Adjoining Slums.
Zone-4	Sector 21,20,30,29, Ram Darbar,31,32,33,34,44,45,46,47,48,49,50,51, Labour Colony no.5 and Adjoining Slums.

**Physical Composition of garbage:** The physical composition of city is found to be varying considerably. In India, authentic information regarding the physical composition of garbage is not generally available, as municipalities do not carry out regular analyses of the garbage. The garbage of Chandigarh city is managed by the Municipal Corporation from every 27th to 29th March. Table 4 and Figure 1 indicates that the physical component of the garbage highly vary in term of their weight to the total. The three physical component i.e. vegetable matter, dust, ashes and stone and wooden matter constitutes 95 percent of total physical waste, whereas the paper, metals glass, rags, cans and plastic leather, rubber contributes only five percent of physical composition of solid waste. Moreover, it indicates that the city produces sixty-percent bio-degradable waste, which may be used for vermi-composting. On the basis of the 2005 solid waste analyses, the physical characteristics of garbage of the city are described in the following ways: The above table describes chemical composition of solid waste indicates that moisture, organic matter and carbon constitute approximately 70 percent of total chemical waste. The high percent of this component denotes the potentiality of solid waste for energy generation by the technique of Bio-press etc.

**Collection of waste:** All areas including villages, slums and rehabilitation colonies falling in the Municipal limits of U.T. Chandigarh are covered for collection of wastes. Garbage is picked up from dustbins three times in a day. With a view to ensure segregation of garbage at the house hold level, the Corporation in collaboration with Chandigarh Animal Welfare and Eco Developed society is persuading the residents of the city to adopt door to door collection and to segregate the garbage at the house hold level. Total quantity of waste generated per day is 380 tonnes including horticulture. Hence per capita garbage generation is 0.422 kg per day. Out of 380 tonnes of waste generated, 350 tonnes per day is collected and all this amount i.e. 350 tonnes is disposed off in land fill site. 'Dust Bin Free Scheme' is the most important achievement of M.C.C.

## Dust Bin Free Scheme:

A garbage disposal project initiated in 2004 by the Central pollution control board (CPCB) with the cost of Rs. 9 Crore was the first of its kind in the country with aim of getting rid of dustbin sites i.e. Known as 'Garbage Bin-Free'. The corporation through the Resident Welfare Association/NGO's manages house to house

collection of waste in these sectors. Under this scheme, all garbage containers are to be removed and ‘Sehaj Safai Kendra’s set up. Garbage is collected for onward transmission to a dumping ground.

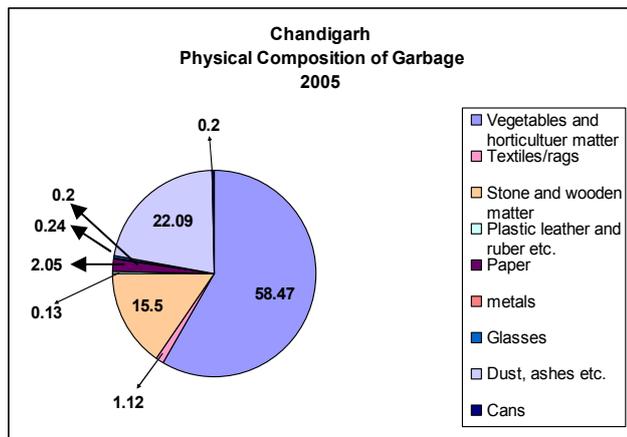


Figure 1 : Chandigarh: Physical composition of Garbage, 2005

Table 4: Chandigarh: Physical composition of Garbage, 2005

Content	Percentage to Total Garbage
1. Paper	2.05
2. Vegetables and horticulture matter	58.47
3. Dust, ashes etc.	22.09
4. Metals	0.20
5. Glasses	0.24
6. Textiles/rags	1.12
7. Plastic leather and rubber etc.	0.13
8. Stone and wooden matter	15.50
9. Cans	0.20
Total	100

Source: Municipal Corporation, Chandigarh

Table 5 : The chemical composition of the solid waste of the city

Component	Percentage of content by weight
1. Moisture	18.17
2. PH	7.89
3. Organic matter	34.43
4. Carbon	17.51
5. Nitrogen	0.63
6. C/N	27.80
Total	100

Source: Municipal Corporation of Chandigarh

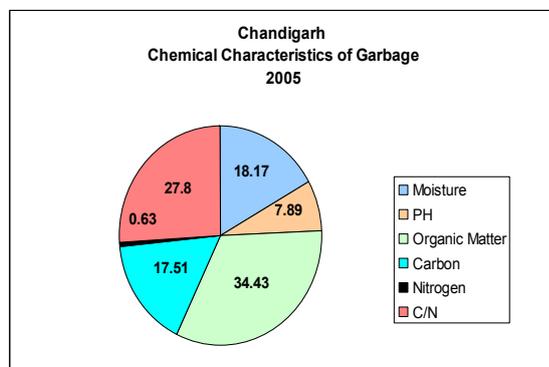


Figure 2 : Chemical characteristics of Garbage, 2005

**Storage Facilities:** Storage of waste at source is the first essential step of Solid Waste Management. In the absence of system of storage of waste at source, the waste is thrown on the streets, treating streets as receptacle of waste. Lifting of garbage from dustbins is mainly mechanical but manual is also done from open collection of dry leave and horticulture waste and for removal of

scattered garbage etc. Large dustbins are put on at every 10th street. It is very tragic that M.C. has many containers without cover resulting in bad smell and odor. These containers are unsuitable for storage of food waste for 24 hours and more. Though population of Chandigarh has been rising at very speed rate but M.C. has no will to increase Wheel Barrows, Hand Carts, and Garbage Collection Cycle carts (Large and Medium). Second, M.C. has no idea about how to collect waste from multi-storey building.

Table 6: Types of Bins

Type	Specifications (Shape & Size)	Existing Number	Proposed for Future
1. R.C.C	-	-	-
2. Little Bins (Portable)	Small	395	-
3. Trolleys	Open	12	-
4. Trailers	-	12	-
5. Containers (Capacity)	4.5 CuM	396	100
	6.5 CuM (with top)	04	-
	6.5 CuM (Without top) for collection of horticulture waste from SSK's and other places.	100	-
6. Dumper Places	-	31	10
7. Wheel Barrows and Hand Carts	-	200	-
8. Garbage Collection Cycle carts (Large)	-	120	-
(Medium)	-	155	-

Source: Municipal Corporation of Chandigarh, 2007.

Waste handling is manual, particularly with loading and unloading garbage from bins. Consequently, the round trip time increases and the labour and vehicle productivity are reduced. Waste is handled several times. There is a potential health hazard for working as all types of wastes, including infestations, hospital waste, and human excrete etc. are disposed off in the bins. Moreover, the workers are not given any protective clothing and implements. There is not any stand by vehicles for deployment during periodic maintenance or break down of a vehicle in service. There is no separate arrangement for transportation of hazardous wastes from hospitals and nursing homes.

**Solid waste management by Public-Private Partnership**

“Public Private Partnership is an agreement between representatives of the public and private sectors as well as of civil society to jointly manage and implement commonly identified objectives and activities of solid waste.”Public-private partnerships (PPP) are considered as alternatives to full privatization in which government and private companies assume co-responsibility and co-ownership for the delivery of city services. Through these partnerships, the advantages of the private sector—dynamism, access to finance, knowledge of technologies, managerial efficiency, and entrepreneurial spirit—are combined with the social responsibility, environmental awareness, local knowledge and job generation concerns of the public sector. Under mutually favorable circumstances it is advantageous to have both the public and the private sectors playing active roles, thus capitalizing on the strengths of each sector.

**PPP in Solid Waste Management in Chandigarh**

Solid waste Management project has been set up by the Municipal Corporation and the Chandigarh Administration in cooperation with Jai Prakash Associates at Daddu Majra. A MOU was signed on 30 December 2005 to set up a solid waste processing unit on 10 acre of land on based of European technology and on 22

February 2006 with laying the foundation stone of Rs. 23-crore solid waste management plant by Governor S.F. Rodrigues, work started with hope of completing within one year. The project, which remained a dream for a long time, became a reality with constant year long efforts of the Administration for its clearance from the Union Government. A core group of experts and officials has been set up for constant validation of the project and to take corrective measures immediately by removing bottlenecks to ensure its speedy implementation. According to this project, On the one hand, M.C. will get economically benefits and on the other hand, people of Chandigarh will get clean and good environment. Whatever pellets the company will get from the solid waste, it will provide this pellets to its cement plant in Himachal Pradesh as energy source. Jaypee claimed that it will be cost effective and environment friendly project. Company will also open a Health centre to provide free medical care. Presently Chandigarh generates 380 meters tones garbage and 350 meters tones are collected daily but this project has 700 metric tones of garbage processing capacity daily. It is the responsibility of M.C. to provide garbage to the unit and in return M.C. will get 15% profit of it. To convert garbage into the pellets, company will use it into its hydro-power project and 15% of its benefits will be served to M.C. Total area of the project is 10 acre (4840 yards<sup>2</sup> or 435600 feet<sup>2</sup>). Out of all garbage, 40% will be unused material which will be dumped into dumping site. Jaypee group has 23% breakeven point in this garbage processing. It means out of total revenue earned by firm must be 23% for the company to sustain the plant otherwise company will be in loss. Though plant was to be get ready till September 2007 but due to rule and regulations and time to time Govt. obstacles, it has delayed and hope will ready till March end, according to M.C. sources. The company will provide employment to 100 persons. 35 officers and 65 Labors is the ratio of employment. Though project is under construction but is supposed that it would promote ecological sustainability.

### Process of Solid Waste Management

It is the duty of M.C. to provide all garbage collected from the city to the company. Company will put all this garbage in its Weigh Bridge. Leachate of the waste will be separated in this storage area and send to further treatment. The rest portion of garbage after separating leachate will be uplifted and put in the Hopper by the Loader. Hopper will uplift garbage for processing in Primary shredder. Before entering into the shredder, two garbage pickers will pick up the big objects like Stones, dead animal, inert, etc for dumping and tyres and textile boxes for recycling. Woody and big mass are sent into Hot Air Generator. Primary shredder crushes all garbage. All rest portions after processing in the Primary shredder is treated under Magnetic Separator which picks all metals. Rotary Trammel is the next stage where garbage again treated. Now garbage is put into the Rotary Dryer where all garbage is dried. It is very interested fact that in India usually garbage is wet, hence less scope for energy generation but Jaypee Group is the only company in India which is using Rotary dryer to make garbage dry. Dried garbage again brought under Magnetic Separator to pick up ferrous material like nails, steel part, etc for safe disposal. Now garbage is treated in Ballistic Separator. Ballistic Separator has been imported from Germany. Ballistic Separator will release three type of garbage, garbage as fuel, garbage as an unused will be dumped into dumping site and fluff will be sent to cement plant. After processing in Ballistic Separator garbage will be brought under Secondary shredder which will result garbage into RDF (Refuse Drive Fuel). Fluff will be stored in the Storage area where from it will be uploading into trucks for cement plant.

### Benefits of Public-private partnership

1. Cost-effective use of resources
2. Improved service delivery

3. Employment creation and income generation
4. Respect of labor standards and regulations (corporate social responsibility)
5. Protection of environment (corporate social responsibility)

### Application of Solid waste Technologies and limitations

The main technological options available for processing /treatment and disposal of Municipal Solid Waste are composting, vermi-composting, anaerobic digestion / biomethanation, Incineration, gasification and refuse derived Fuel (RDF), and also known as pelletization and sanitary landfilling/landfill gas recovery. Not all technology is equally good. Each one of them has advantages and limitations.

#### Composting

Composting is the process of decomposition of organic matter by micro-organism in warm, moist, aerobic and anaerobic environment. The compost made out of urban heterogeneous waste is founds to be of higher nutrient value. Composting of Municipal Solid Waste is the most simple and cost effective technology for treatment the organic fraction of Municipal Solid Waste. It doesn't require large capital investment, composed to other waste treatment plant and this technology is scale neutral. Composting maintains soil health.

#### Vermi-composting

Vermi-composting is the natural organic manure produced from the excreta of earth-worms fed on scientifically semi-compost organic waste. It requires less mechanization and it is easy to operate. It is, however, to be ensured that toxic material doesn't enter the chain which if present could kill the earth –worms. Urea which is excessively used in surrounding areas of Chandigarh can be replaced by Solid waste.

#### Waste to Energy (WTE)

The factors which determine WTE projects are quantum of investment scale of operation, availability of quantity waste, sanitary requirements and project risks. For WTE Project, nearby 500-5000 tonnes per day waste are required but Chandigarh has only 380 tonnes per day. Hence it is not economically beneficial for Chandigarh to set-up a WTE projects.

#### Anaerobic Digestion and Bio-Methanation

Bio-methanation is a comparatively well established technology for disinfections, deodorization and stabilization of sewage sludge, farmyard manures, animal slurries and industrial sludge. The method is suitable for kitchen wastes and other putrescible wastes, which may be too wet and lacking in structure for aerobic composting. Though a modular construction of plant and closed treatment needs less land areas and can be treated within every sector but Chandigarh has not gone for it till now.

#### Production of Refuse Derived Fuel (RDF) or Pelletization

It is basically a processing method for mixed Municipal Solid Waste, which can be very effective in preparing as enriched fuel feed for thermal processes like incineration or industrial furnaces. The RDF pellets can be conveniently stored and transported long distances and can be used as a coal substitute at a lower price. As pelletization involves significant Municipal Solid Waste sorting operations, it provides a greater opportunity to remove environmentally harmful materials from the incoming waste prior

to combustion. The process is energy intensive and not suitable for wet Municipal Solid Waste during rainy season.

### **Incineration**

This method, commonly used in developed countries is most suitable for high calorific value waste with a large component of paper, plastic, packaging material, pathological wastes, etc. It can reduce waste volumes by over 90 percent and convert waste to innocuous material, with energy recovery. The method is relatively hygienic, noiseless and odorless and land requirements are minimal. The plant can be located within city limits, reducing the cost of waste transportation.

### **Pyrolysis/Gasification, Plasma Pyrolysis Vitrification (PPV)/ Plasma Arc Process**

Pyrolysis gasification processes are established for homogeneous organic matter like wood, pulp, etc., which plasma Pyrolysis Vitrification is a relatively new technology for disposal of particularly hazardous waste, radioactive waste, etc. In all these processes, besides net energy recovery, proper destruction of the waste is also ensured. These processes, therefore, have an edge over incineration. This process produces fuel gas /fuel oil, which replace fossil fuels and compared to incineration, atmospheric pollution can be controlled at the plant level. It is a capital and energy intensive process.

### **Sanitary Landfill and Landfill Gas recovery**

Sanitary landfills are the ultimate means of disposal of all types of residual, residential, commercial and institutional waste as well as unutilized Municipal Solid Waste from waste processing facilities and other types of inorganic waste and inert that can't be reused or recycled in the foreseeable future. Its main advantages is that it is the least cost option for waste disposal and has the potential for the recovery of landfill gas as a source of energy, with net environmental gains if organic wastes are landfilled. The gas after necessary cleaning can be utilized for power generation or as domestic fuel for direct thermal applications.

### **Recycling and resource recovery**

An extensive network of agents is involved in recycling activities of a wide variety of materials. The materials recycled are paper, plastics materials, glass, food waste and other items. Main contributors in the recycling process are ragpickers. They pick waste from bins, markets, open spaces and sell it to Kabariwalas. Kabari wala sell this waste to small dealers and they further sale to larger dealers or to a recycling Industry.

### **Mushroom cultivation**

It should be done on dumping site. Waste has a lot of energy which can be converted into the nutrition. But problem in it is this that Mushroom cultivation needs some fixed temperature conditions. Second, toxic elements should not be in waste. The simple solution to manage waste is not technology but our culture as well.

### **Problems in Management of solid waste**

The methods and techniques of MSW are unscientific, outdated and inefficient and area/population coverage is low.

### **Apathy of Municipal Corporation**

Though Municipal authority has held the responsibility of managing solid waste but elected representatives as well as health

and sanitation department relegate the responsibility of managing solid waste (MSW) to junior officials such as sanitary inspectors. In the same fashion, a large portion of the municipal budget is allocated for solid waste management, but most of it is spent on the wages of sanitation workers whose productivity is very low. On the one hand, sanitation workers are most unskilled and don't know how to use modern equipment but on the other hand M.C. is eager to modernize all equipment. Hence, a mismatch has come in equipment and equipment users.

### **Absence of community participation**

Though Residential Welfare Associations are active for Solid Waste Management but residents are not satisfied with their work hence now are less cooperative for these RWS's. There is no workshop for sweeper and Jamadars who are the real managers of Solid Waste has been organized. Secondly, only one workshop is not sufficient for mass awareness and community participation.

### **Problem in Collection**

Though Chandigarh M.C. practices door to door collection (DTDC) but Municipal sanitation workers are not regular. Hence, people discharged garbage here and there due to absence of dustbins. With introduction of 'Bin Free Scheme', all bins have been removed and now people are supposed to dispose off their garbage in 'Sehaj Safai Kendras' (SSK). Sometimes they are very far away hence simple solution for residents is whether keep solid waste in their home or avoid it far away from their houses.

### **No storage of waste at Source**

There is no practice of storing the waste at source in a scientifically segregated way. No separate dustbins for wet and dry waste at the residential areas.

### **Irregular street sweeping**

As like of other Indian cities, Irregular street sweeping is common in Chandigarh also. The tools used for street sweeping are generally inefficient and out-dated. Traditional handcarts /tricycles are used for collection. In many colonies, waste is deposited on the ground necessitating multiple handling. The city allocates work to sanitation workers on ad hoc basis. Hence, some sanitation workers are found under worked while some over burdened. Even street sweeping is not carried out on a day to day basis.

### **Transportation of waste**

Most of the transport vehicles are old and open. They are usually loaded manually.

### **Processing of waste**

Though 20-25 tonnes per day approximately are brought for vermin-culture in institutions i.e. Punjab Engineering College Sector 11, Police Line Sector 26, and General Hospital Sector 16, Leisure valley Sector 10, Municipal Park Sector 36 and Khad Banao Kendra's Sector 41 etc. but no composition is done and Pellets facilities available. Now M.C. with collaboration of Jaypee Group is going to be set up a garbage processing plant.

### **Disposal of Waste**

For the whole city, there is only one single dumping site which already 30 acres has been filled, leveled and reclaimed. There is no future proposal for landfill site. Landfill site releases landfill

gas with 50 to 60 percent methane by volume. Though M.C. now is going to have steps for using this gas but till now it has been going to degrade the environment and exaggerated global warming.

### Discussions and suggestions

The simple solution to manage waste is not technology but our culture as well. Hence culture should be targeted while managing waste. A large portion of the municipal budget is allocated for solid waste management, but most of it is spent on the wages of sanitation workers whose productivity is very low. Though Chandigarh M.C. practices door to door collection (DTDC) but Municipal sanitation workers are not regular. No separate dustbins for wet and dry waste at the residential areas. No sweeping is done on Sundays and public holidays. Most of the transport vehicles are old and open. They are usually loaded manually. Waste containers are usually without cover causing bad smelling and odor. M.C. must now take step to provide containers with top and old should be removed. In case of Multi Storied buildings where it may be difficult for the waste collector to collect recyclable waste from the doorstep, the association of such buildings may optionally keep one more community bin for storage of recyclable material. In slums, where because of lack of access or due to narrow lanes, it is not found convenient to introduce house-to-house collection system, community bins of suitable sizes ranging from 40 to 100 litres (0.04 to 0.1 cu.mtr.) capacity may be placed at suitable locations by the local body to facilitate the storage of waste generated by them. They may be directed to put their waste into community bins before the hour of clearance each day as shown. Segregation of garbage should be done at household level itself. Biodegradable waste may be processed and utilized as compost. Non- Biodegradable and recyclable waste should be channeled through incineration process. Public should not be allowed to organize functions like marriages on roads and in parks owned by the government as it results in insanitary conditions due to careless disposal of leftover/waste food. Burning of garbage should be prohibited. Public should be made aware about solid waste's bad consequences. They should not buy items with excess packaging. They must bring their own bags when shop. Solid Waste can be management by using GIS technologies like point can show Dustbins, line Transportation route and area Dumping site.

The main technological options available for processing /treatment and disposal of Municipal Solid Waste are composting, vermi-composting, anaerobic digestion / biomethanation, Incineration, gasification and refuse derived Fuel (RDF), and also known as pelletization and sanitary landfilling/landfill gas recovery. Some town planners suggest that waste of Mohali and Panchkula which are satellite town of Chandigarh should be treated at a common WTE facility, however in such cases the costs of waste transportation versus projects benefits must be carefully evaluated. Though a modular construction of Bio-methanation plant and closed treatment needs less land areas and can be treated within every sector but Chandigarh has not gone for it till now. Chandigarh has adopted pelletization technology process and projects after examining its viability and sustainability. In South India, M/S Selco International Limited in Hyderabad and M/S Sriram Energy Systems Ltd. In Vijayawada have set up pellets plant but in North India, M/S Jaypee Group is the only Limited which has done so in Chandigarh. Concentration of toxic/hazardous mater in gasified ash needs care in handling and disposal.

### Conclusion

The 'Solid Waste Management' has attracted the attention in India very recently and so far only limited research has been carried out

especially in the small cities. In the planned city, the consideration on garbage managing has been emphasised since its generation. But with the increase in population also garbage multiplied. Spreads of diseases during monsoon generally attract the attention of the people towards the garbage management. A geographic study on garbage unfolds the spatial components of its spread and the difficulties in management. It helps in identifying the existing problems and helps in not only finding solutions but also acts as a guide for future. Regular conduct of such studies after a period of maximum five years will assist the planner and administrator and provide a clean and better-managed city. This work therefore is just one step in this direction. In this paper, various types of data were used as per the requirement of the objectives of the study. The sources of data collected can be put under the following two categories. The primary data sources comprise the frequent travels through the study area. The secondary sources encompass town plans and other plan documents, topographical sheets, guide maps of Chandigarh. Information on types, composition, quantity of garbage and various types of bin used to collect the garbage was acquired from Health Department, Municipal Corporation, Chandigarh. The data and information on agents involved in recycling the waste material acquired from department of environment study. Solid waste Management project has been set up by the Municipal Corporation and the Chandigarh Administration in cooperation with Jai Prakash Associates at Daddu Majra. Jaypee claims that it will be cost effective and environment friendly project. This project has 700 metric tones of garbage processing capacity daily. Company has also given insurance of treatment of leachate. It is very interesting fact that in India usually garbage is wet, hence less scope for energy generation but Jaypee Group is the only company in India which is using Rotary dryer to make garbage dry. A large number of people (rag pickers) depend on solid waste for their livelihood. It is inevitable that PPP would affect their lives in some way.

This paper puts forward a future agenda. Chandigarh requires an efficient system of management of garbage using all stakeholders. The sector level information on various types of bins, volume of garbage produced and changes in the volume and composition of garbage at some interval of time regularly will help the managers to manage the city properly.

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