Solid Waste Management in Patna

Manoj Kumar Pandey,

B.A -Eco. (Hons) ,M.A(R.Eco. & Co-op),PGDFM (Financial Management)
Specialist: Urban Development & Urban Reforms
Member : Water Supply and Sanitation Collaborative Council (WSSCC) Geneva, Switzerland
Member(Ex.): International Solid Waste Association
Email: manojkp456@gmail.com
Mob. : +91 9608747680

Introduction:

Municipal solid waste management is a part of public health and sanitation, and is entrusted to the municipal government for execution. Municipal Solid waste management (SWM) has become acute problem in India due to rapid urbanization and uncontrolled growth rate of population

Municipal Solid Waste (MSW) is the trash or garbage that is discarded day to day in a human settlement. According to MSW Rules 2000, MSW includes commercial and residential wastes generated in a municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes. Waste generation encompasses activities in which materials are identified as no longer being of value (being in the present form) and are either thrown away or gathered together for disposal.

Municipal Solid Waste consists of the following kinds of waste: Treated Biomedical Waste, Horticultural Waste, Construction & Demolition Waste, Road Sweeping Waste, General House Hold Waste (including Kitchen Waste), Drain Silt/Waste, Market and Commercial Waste, Institutional Waste, Slaughter House Waste and Dead Animals, Sludge from STPs (sewage treatment plant)and ETPs (effluent treatment plant) ,besides other the other kinds of waste found in urban settlements are; Industrial or Hazardous Waste, Bio-Medical or Hospital Waste and E-Waste.

Municipal Solid Waste Management(MSWM) comprises of waste segregation and storage at source, primary collection, secondary storage, transportation, secondary segregation, resource recovery, processing, treatment, and final disposal. Therefore Municipal Solid Waste Management (MSWM) refers to a systematic process that of solid waste. Though Solid Waste Management (SWM) is an age old service provided by the urban local bodies (ULBs), efficient municipal solid waste management benefits in maintaining hygienic conditions leading to lesser health issues, better living environment,

improved economic prosperity in the area, aesthetically cleaner surroundings with cleaner drains for storm water flow, cleaner water sources and safer neighbourhoods. So the importance of solid waste management can not be undermined . The failure of SWM can result in serious health problems and environmental degradation,. Municipalities have overall responsibility for solid waste management (SWM) in their cities

Patna – profile of the city

Patna is one of the oldest surviving cities in the country which was known by the name of Patliputra. Historical evidence shows that the city was a flourishing center of culture, political and religious activities. It is the capital of the state of Bihar and in recent years represents a flourishing centre of administrative, commercial and educational activities. Located between the latitude 25°30'N to 26°45' N and longitude 85°0' E to 85°15' E, it is on the southern bank of river Ganga The western periphery of the Patna Urban Area is bounded by River Son. The urban areas of Hajipur and Sonepur are on the northern banks of River Ganges. Its location is in the eastern part of India between Delhi and Kolkata. Due to the presence of large perennial rivers on three sides, there is limited scope for geographical growth of the town. As a result of this constraint Patna has developed as a linear city, which has its bearings on municipal sanitation jobs.

. **Climate and Topography :**

Patna is located at an elevation of about 50m above mean sea level. Patna and its upland is sandwiched between the high Himalayan ranges in the far north and the high tracts of Chotanagpur in the south.

Patna has a humid subtropical climate with hot summers during March to June, the monsoon during June to September and mild winters during November to February.

Another noteworthy feature of Patna and the region is its high seismic vulnerability.

Existing Land Use:

Land use	Percentage(%)
Residential	47.55
Commercial	4.46
Mix Use	3.37
Industrial	1.05
Public and Semi-Public	10.18
Open Space / Recreational	3.07
Transport / Roads	5.90
Airport	1.05
Brick Kiln	.70
River / Flood Plain	3.35
Water Body	1.01
Vacant Land / Agriculture Land	17.66
Forest	0.64
Total PMC Area	100

Source: Draft Master plan 2031

Present Solid Waste Management System in Patna :

The Patna Municipal Corporation was established on the 15th August 1952 in accordance with The Patna Municipal Corporation Act, 1951, The Patna Municipal Corporation Act 1951 came into force on 15-08-1952 with the enforcement of Act, the former Patna City Municipality, the former Patna administrative committee and the former Patna Bankipur joint water works committee were replaced by The Patna Municipal Corporation on 15-08-1952. Thus came into being a New Civic Body with the merger of the 88 year Old Patna City Municipality and the 35 year old Patna Administration Committee with more powers and responsibilities and the PMC was established with effect from 15th August 1952.Solid waste management is an overall responsibility of the corporation as per Bihar Municipal act2007 and MSW(management & Handling) rules 2000.Patna Municipal Corporation (PMC) is one of the Mission Cities under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) of the Government of India (GoI) and is eligible for grants from central / state government under this scheme. Erstwhile Patna Regional Development Authority(primarily dealt with Urban Planning) also merged with PMC in the year 2007.

Administrative Structure :

a) The Corporation : Consists of a Mayor, a Deputy Mayor and 70 other Ward Councillors, The members of the House of People and The State Legislative Assembly representing constituencies which fall wholly or partially under the Corporation area and the members of the Council of the State and the members of the State Legislative Council registered as electors within the Municipal Corporation area are also members of this Corporation

(b) The Empowered Standing Committee: consists of 9 Ward Councillors including Mayor and Dy. Mayor

(c) The Municipal Commissioner is the Chief Executive Officer

Total No. of Wards : 72
Total No.Of Circles : 4
Grade of City : B

Salient Features of the City :

Population :

1971	1981	1991	2001	2011	Area Sq.K.M.	Total No. Of Registered Households at Present
475,300 (+30.4%)	813,963 (+71.3%)	955,418 (+17.5%)	1,376,950 (+44.0%)	1,683,200 (+22.2%)	109.4	2.06 lakh (approx.)

Source: BUIDCO

Daily Floating Population: 2-2.5 lakhs it is likely to be 4 lakhs by 2021
Transitory population : 3-4 lakhs P.A.

Projected Population in PMC area :

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2016	2021	2025	2031	2036
1.87 lakhs	21 lakhs	23.4 lakhs	27.08 lakhs	30.27 lakhs

Source: BUIDCO

Using figures for assumed average annual growth, Patna is the 21st fastest growing city in the world and 5th fastest growing city in India by the City Mayors' Foundation
Both the migration from the hinterland as well as the internal growth of population of Patna has contributed to this phenomenon.

Salient features of Existing Solid Waste Management in Patna

Patna Municipal Corporation (PMC) is providing municipal and allied civic services across its 72 wards. As of now solid waste management system is not systematic, scientific and sound in Patna municipal area, serious efforts are on to make the SWM system a systematic and scientific.

Waste Generation:

At present 1000-1200 TPD waste generated every day ,per capita generation is approx.450 gm to 600 gm per day. It was 1010 TPD in 2011 . It has been estimated that in coming years this generation quantity bound to increase.

Patna Including merged out growth area	2011	2016	2021	2026	2031	2036
	1010 TPD	1277 TPD	1514 TPD	1836 TPD	2299 TPD	2570 TPD

Source: BUIDCO

Sources of Waste :

Households domestic, hotels, commercial establishment, agricultural market , slaughter houses, medical/nursing clinic waste, building construction /demolition waste ,industrial waste

Composition of waste :

40% is domestic wastes and 60%, is industrial & commercial waste. The solid waste comprises of vegetable and putrescible fractions (49%); combustible fractions (12.5%) and non-combustible fraction (38.5%)

Characteristics of MSW:

MSW generated in Patna city can be characterized into following broad physically categories

Physical Characteristic	% by weight
Paper	4
Textile	5
leather	2
Plastics	6
Metals	1

Glass	2
Ash, fine earth, silt, etc	29
Compostable matter	51

Source: BUIDCO

There are many categories of MSW such as food waste, rubbish, commercial waste, Institutional waste, street sweeping waste, industrial waste, construction and demolition waste and sanitation waste-mew contains recyclable (paper, plastic; glass arrd metal etc), toxic substances (paints, pesticides, used batteries, medicines etc.) compostable organic matter (fruit and vegetable peels, food waste) soiled waste (blood stained cotton, sanitary napkins, disposable syringes).

In city of Patna it has also been found that extensive use of computers and other electronic equipments coupled with increasing discarding habits, rapid technological change, there is a significant increase in e-waste generation at the household level and public sectors which has to be addressed. Apart from Indira Gandhi Institute of Medical Sciences no other big or small hospitals or nursing homes have any system of disposal of medical waste generated by these institutions, though it has been envisioned that this treatment plant at IGIMS would also collect the medical waste from other hospitals in the city but it has been found that medical waste from other medical institutions are normally thrown with general waste suppose to be collected by PMC, These are in the form of disposable syringes, swabs, bandages, body fluids, human excreta, etc. This waste is highly infectious and can be a serious threat to human health if not managed in a scientific and discriminate manner..

Though no separate estimates are available forthese types of wastes. There is urgent need to institute a study to assess the quantities of the following categories of wastes to plan for their management.

Domestic and commercial waste – Compostable, recyclable

Industrial waste – non-hazardous and hazardous

Hospital/biomedical waste – non-hazardous and hazardous

E-waste – recyclable and non-recyclable

Construction debris – reusable as building material

CHEMICAL WASTE CHARACTERISTICS OF PATNA CITY:

Chemical Characteristic	Value
C/N Ratio	18.62
HCV (Kcal/kg)	819
Moisture	36%

Source: BUIDCO

Collectively the above data indicate that the available mixed MSW loads comprise a substantial portion of organic matter which is compostable and a fair fraction of inert. The combustible fraction at 17% is rather low. Accordingly from volume reduction point of view the mixed waste is found to be suitable for composting which involves least risk in terms of feedstock quality, etc

Characteristics of waste generation:

Food habits, standard of living, degree of commercial activities and seasons. Rapid urbanization along with improved standard of living is witnessing rapid increase in waste generation

Segregation at Source:

At present it is not in the practice

Storage at Source: Normally done in polythene bags, plastic buckets, papers, cartoons, carry packets. It is estimated that 75% of the households and 80% of shops and establishments continue to throw the waste on the streets, which shows the lack of civic awareness.

Primary Collection:

No Door to Door Collection by PMC, Normally wastes thrown into nearby container bins or in open spaces (which is found everywhere).

Street Sweeping :

Daily sweeping is done manually though **,** major roads normally covered , garbage collected through sweeping either left on the road side or carried to nearby secondary point by handcarts

Secondary Collection :

There are approximate 870 collection points across the city ,besides this there exists a large number of unauthorized collection point in the form of open space all across the city. Approx. 550 container bins (1.1 Cum) are placed at designated secondary points for the purpose of waste collection. The indiscriminately disposed waste is picked up manually by the street sweepers deployed by the PMC and brought to the designated point wherever possible by means of trolley handcart. The container bins are either inadequate, not maintained properly or have been damaged due to rough usage In absence of a robust system of collection and storage, waste is generally found to be disposed of indiscriminately on road sides, outside the bins at the secondary collection points , into the drains on the sides of the roads, in nallas and other depressions/ low lying areas, etc.These are characterized by overflowing waste, scattered waste around the Bins, Invasion of cattle. PMC is in need of more such containers to cope with the problem.

Transportation:

Largely manual loading(though mechanized loading done by large compactors ,which are very few in number)Tractors ,dumpers, Hyva, Tippers etc. used. transportation to a temporary intermediate point ,which is one each in each circle .From these intermediate points the waste transferred to dumping site which is 22 km away from the city.

PMC does not have required fleet strength for collection, lifting and transportation of waste. Generally mixed MSW including sweeping, drain silt and construction debris is transported by means of open trucks, tippers and tractor trolleys , sometimes it is covered .

Most of the fleet owned by PMC is over a decade old which is worn out and is in urgent need of complete replacement. On the whole, the available capacity for waste transport is estimated to be around 60%-75% of the present generation which is a major cause of concern from environment and public health point of views. Now PMC is in process of buying new vehicles to fill the gap . In view of these constraints and challenges, waste remains uncollected at the designated points or disposed of

at unauthorized points on the sides of roads, railway lines, highways, nalla, depressions, unoccupied plots, open public spaces, etc.

Frequency of Removal :
Every day from 6.00 am to 2.pm , on Sunday and holiday limited operation.

Efficiency of removal and transportation to Landfill site: 60 to 75%(Approx.)

Vehicle /tools/ equipments used in SWM:

Vehicle /tools/ equipments	PMC's	On Hire	Total
Tractors with trolley	45	101	146
Skid Steer Loader	4	-	4
Loader back hoe	3	9	12
tipper	14	6	20
Hyva	-	8	8
Compactor	7	1	8
Hydraulic excavator			
Hand cart	371	-	371
Mini loader 672	1		1
Besides these tools used manually are- Kudal,Belcha, Brooms.			

Source-PMC

That PMC has initiated the process of procurement of vehicle to fill the resource gap.

Required Vehicle /tools/ equipments	**Quantity**
Small range municipal application vehicle (without compactor) with hydraulic tipping	151
Large range municipal application compactor vehicle with hydraulic tipping/ejection system	14
Very large range municipal application compactor vehicle with hydraulic tipping/ ejection system	7
Loader Back hoe	10
Skid Steer Loader	12
Jetting cum suction Machine	4
Hydraulic Excavator 200	3
Hydraulic Excavator 70	2
Large Size Tipper	15
Medium large size Tipper	29
Garbage container bins (Steel)	1950
Containerized Tricycle Rickshaw with plastic containers 8 bins	505
Hand Cart	820

Source PMC

Disposal :

As of now PMC does not have a facility / infrastructure for treatment and safe disposal of the collected waste. Waste collected from across the 72 wards,as well as part of the waste collected from the three ULBs of Danapur, Phulwari and Khagaul is presently reaching the designated dump site at village Bairia on the Gaya road where it is disposed of openly. The said site at Bairia has an area of 80 acres approx. which is in the possession of PMC and has been in use for open dumping for last 2-4 years. A partially built weigh bridge is found to be out of operation. For land filling purpose Hyva and hydraulic excavator on hire is being used at the site. Presently most of the city wastes are dumped without any treatment. This practice may lead to air and water pollution, releases foul smell and this situation may cause major threat to public health.The site is also characterized by lack of necessary infrastructure .

Now Bihar Urban infrastructure development Corporation Ltd.(BUIDCO) has initiated the process of a Integrated Solid waste Management process plant at the disposal site, that is "Development of Regional Municipal Solid waste to energy(electricity) & Scientific land filling facility in Patna on PPP " there is a plan to generate 8 MW electricity.

Manpower: Presently following personnel involved in day to day SWM job

Position	Total number	Operational level
Municipal Commissioner	1	Chief Executive
Additional Municipal Commissioner, Sanitation	1	Head quarter-over all in- charge of SWM operations
Deputy Municipal Commissioner, Sanitation	1	Assist A.M.C., Sanitation
Executive Officers	4	As head at Circle level
City Managers	4	Assist Executive officers at Circle level
Assistant Health officers	3	At Circle level
Sanitary Inspectors	5 (Total sanctioned strength is 21)	At Circle/ward level
Sanitary supervisors	95(Total sanctioned strength is 221)	At ward level
Sanitation workers	1064(PMC employees)1941(daily wagers) Total sanctioned strength is 3500	At primary level in wards

Source-PMC

Table -A

Sanitary personnel	Sanitation personnel – population wise			Sanitation personnel-per Sq. K.M.		
	1951	1975	2012	1951	1975	2012
One Sanitation worker	104	195	517	123	111	29
One Sanitary supervisor	2096	3262	17718	6	4.60	1
Sanitary Inspector	13476	22523	336640	1	0.67	0.05

Source-PMC

O&M Cost:
Salary/wages of employees ,Vehicle operating and hired cost ,equipments, tools etc. consumed a big amount per months. It has been estimated that it accounts for approx. 70 percent of total expenditure

Cost Recovery:
No user charges at present, though earlier it was proposed but later dropped.

Community /NGO Partnership:
No community partnership in SWM, it has been learnt that a few years back NGOs were given job of collection of garbage in some wards , but that too now non-existent.

Private Partnership :
in Transportation Private contractors supply vehicles for collection and transportation on hire .At Disposal site private contractor supply vehicle /equipments for land filling purpose on hire.

Public Private Partnership (PPP):
At Present None , some attempts were made in past. In the year 2009 Bihar Urban Development Authority (UD&HD,GoB) had selected A2Z infrastructure Limited ,New Delhi through an open tender for the job under SWM on PPP mode. Contract between PMC and the company was done and work begun from Jan.2010 . As per contract agreement the Company had to perform daily door to door primary collection of waste , Mechanical street sweeping , Storm water Drain cleaning in the nine wards (1-9) and Nine main roads of PMC, transportation of waste to landfill site as per MSW(M&H)rule 2000.
For all these jobs the the company was to be paid INR 728 per M.T. Other components of the agreement were : to maintain workshop ,O&M of vehicles, maintaining weigh bridge at landfill site, to install compost plant to convert bio degradable waste in to manures, refuse derived fuel plant, A 10 MW power plant at Bairia Rama chak ,the landfill site.It was also mentioned that that the partnership company would be allotted jobs in all 29 wards of NCC circle of the PMC ,but it was given jobs only for 9 wards.

A2Z had begun work from the month of Jan.2010 and continued till mid of July 2011 and had voluntarily stopped the work on the pretext of non payment of its services by PMC, which had by then reached to INR 7.62 crore(approx). On the other hand PMC had severe objections to the bills raised by the company for the payment from PMC ,ultimately the matter brought to Patna High Court by company and court directed PMC to pay the dues , PMC moved to double bench of Patna High Court against this decision given by single bench of high court. The matter is still sub-judiced. The company also alleged that as per agreement it was not given expansion to three remaining circles (kankarbagh, Patna city, Bankipore) of PMC , 20 more wards of New Capital Circles also not given to them .

Though it was first serious attempt on PPP model to keep the city clean ,and it was unfortunate that such serious move ended in the court. After this fiasco the Urban department directed the Bihar Urban Infrastructure Development Corporation Ltd.(BUIDCO) to hire other agency on PPP model for SWM in the city of Patna, in the year 2012 BUIDCO selected a Consortium **Jindal ITF Urban Infrastructure Limited** to do the job of SWM on PPP basis, but the said consortium moved out of job before signing the agreement . Then Urban Department floated an idea of a Special Purpose vehicle under BUIDCO to do the SWM job in Patna , which too could not be implemented . Finally it was decided that PMC would itself float Tender for selection of agency on PPP mode.

In The Year 2013 PMC made a serious move to select a agency on PPP mode for the job of Door to Door collection of Garbage and Transportation to land fill site. But due to cold response from Private agencies the matter dropped , again in 2014 a new move is on to hire a private agency on PPP mode to collect the garbage from house and transport them to nearby secondary garbage collection point. Salient feature of this new move is that there would be no user charges.

Management :

Day to Day operation is decentralized ,being managed at circle level by Executive officers. Sanitation and Accounts section directly involved . At policy level Municipal Commissioner , Empowered Standing Committee and Corporation Board involved .

Planning & Management:

No annual ,middle term and long term planning as such

Though every year , over all cleaning of drainage is being done in summer. MIS is also not available.

Regulatory Aspect :

Compliance to Municipal Solid waste (Management & Handling) Rules 2000 is at its minimal due to non following of its main directives in spirit.:

1-Prohibit littering on the streets by ensuring storage of waste at source in two bins; one for biodegradable waste and another for recyclable material

2-Primary collection of biodegradable and non-biodegradable waste from the doorstep, (including slums and squatter areas) at pre-informed timings on a day-to-day basis using containerized tricycle/handcarts/pick up vans

3- Street sweeping covering all the residential and commercial areas on all the days of the year irrespective of Sundays and public holidays

4- Abolition of open waste storage depots and provision of covered containers or closed body waste storage depots

5- Transportation of waste in covered vehicles on a day to day basis.

6. Treatment of biodegradable waste using composting or waste to energy technologies meeting the standards laid down.

7. Minimize the waste going to the land fill and dispose of only rejects from the treatment plants and inert material at the landfills as per the standards laid down in the rules.

PMC needs proper support and co-operation from Government in proper compliance .

Constraints & Challenges in Solid Waste Management in Patna:

- Population has increased rapidly ,so the waste generation, but staffs involved in sanitation has not increased since 1975 ,most of the employees retired, no new recruitment has been done since long, this has put a lot of pressure on existing personnel. Corporation also requires a team of specialist for this job
- Existing number of vehicles / equipments are not sufficient to handle the increased load of waste , major part of transportation is done through hired vehicles
- Since internal financial resource is not enough to sustain a consistent effort in Solid Waste Management, so there is need to make effort to augment the internal financial resource to meet the basic job of Corporation without any dependence on external assistance. Financial Management needs to be implemented, which is almost absent in ULB
- Rapidly growing population and increasing temporary population posing a major challenge besides waste dumping by a vast number of daily commuters; which is also big concern for PMC.
- Increasing quantity of e -waste is a continuous problem, which needs to be attended properly
- There is a need to put extra emphasis on awareness amongst the people of city as to importance of sanitation, health and hygiene .Mass campaign through print and electronic medium should be launched to create awareness, NGOs should also be involved ,Ward committees should be active and use their good offices for public involvement to make their ward clean.
- Use of technology is almost absent.
- City developing in an unplanned and haphazard way ,which putting extraordinary pressure on the PMC.
- Piles of solid wastes are found, left decayed at public, residential channel & low residential, channel & lowland areas in some places in city
- Solid waste collected from various sources are not separated, then disposed of at the open dump site, absence of waste recycling and proper treatment of waste .
- Enforcement of existing laws/regulations;
- Environmental issues also posing a big threat to solid waste management job in the city
- lack of proper plans for solid waste management
- The lack of research leads to the non selection of appropriate technology in terms of the local climatic and physical conditions, financial and human resource capabilities, and social or cultural acceptability.
- Absence of PPP mode in effective implementation of SWM job in the city
- Absence of external support

Therefore to achieve the objectives under Municipal Solid waste (Management & Handling) Rules 2000, PMC needs to prepare a macro and micro plan which would identify the problems in better management of solid waste and accordingly prepare a broad strategy .

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