Strategy for Municipal Solid Waste Management: - A Case Study of Patna

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***Abstract*—**Rapid urbanisation has given rise to the production of waste in the cities. Most of the Municipal bodies are not capable to manage the Municipal Solid Waste (MSW) efficiently. The production of the waste and its management has been a matter of concern and threat to the environment. At some places the ill management of the waste has given rise to environmental problems.

The way in which, local bodies collect and dispose various types of waste is not scientific and eco-friendly. It needs concern and new approach. There is scarcity of land around the big cities. The landfill method which is used today needs large piece of land to dispose off the MSW.

Segregation at the source, reuse and recycling can be a very effective method to manage MSW. Zero waste technology can also play very important role. If segregation at the source is done then it is estimated than 80% of the waste can be reused and recycled. This will save the handling cost and costly land.

***Keywords*—** Municipal Solid waste (MSW), Zero waste Technology (ZWT), Patna Municipal Corporation (PMC).

I. Introduction

THE Patna Municipal Corporation was established on 15 August 1952 by the Government of Bihar. The city is divided into 72 administrative wards, which accommodates a population of 1.7 million as per 2011 Census. This civic administrative body administers an area of 110 km2.

The functions of the PMC include water supply, drainage and sewerage, sanitation, solid waste management, street lighting, and building regulation.

The Patna Municipal Corporation is managed through 4 Circles. Each circle is administered by an Executive officer who is deputed by the State Government. Each Circle has Assistant Health officer to view the sanitation work. The Circles are:

- New Capital Circle
- Kankarbagh Circle
- Bankipore Circle
- Patna City Circle.

II. The present system adapted by PMC

The Municipal Solid waste management (MSW) in Patna is done by Patna Municipal Corporation (PMC). As survey done by authors, about 800 tonnes of MSW is produced in the Patna municipal area per day (year 2000). At this time, there is no door to door collection system. Some years ago door to door collection system was run by an NGO called 'Nidan' but it could not last long. Some other NGOs are working in this way but on a very small scale; say on the "Muhalla" level.

On the road side there are some garbage points where people dump waste. These places are not identified by PMC but these are randomly selected by the people. At most of the places garbage bins are not present so, MSW can be found lying on the road side. Sometimes, it creates problem for the traffic. It creates bottle neck on the road where traffic slows down and creates traffic jam.

Vacant land is also used for throwing the MSW, which is left unattended by the PMC workers. The MSW thrown besides the road and apart from the garbage point is almost neglected by PMC workers. According to PMC sources, about 90% waste is attended. Rest of the MSW is left unattended lying beside the road, parks, playgrounds and vacant land.

Fig. 1 The road side MSW: - the waste lying on the roadside, which is never attended by the municipal workers. The sweepers only take care of the waste which is on the metalled portion of the road.

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Fig 2 Hospital waste: - Rag picker can be seen in the picture collecting items of his own interest for reuse and recycling. This garbage point in near Nursing Home.

The PMC staffs collect the MSW from the points with the help of shovels, cat machines and JCB machines. Latter it is collected in the tractors and trucks and is sent to the dumping site. During the transportation the trucks and tractors go on littering the waste on the road, making the road dirty and the travel on the road unhygienic.

The dumping ground is situated at "Ilahibagh, Bairiya" on the Patna - Jahanabad road, about four kilometres south of zero mile. The dumping place is surrounded by the habitation. The habitants are facing environmental problems, in summer PMC workers fire to the waste. The smoke produced by the fire pollutes the surrounding area. The smoke changes its direction according to the air flow and makes the habitation. The residents living near the dumping ground are facing permanent respiratory problems. As per the Master Plan 2031, this area is again suggested as a dumping ground. Despite the fact that, it is surrounded by the habitation.

Fig3 The dumping ground of Patna Municipal Corporation. it is the dumping ground of Patna Municipal Corporation (PMC). This area is surrounded by the habitation. In summer when PMC workers set fire to the waste, the surrounding area is covered with smoke which makes the living of the habitants difficult.

Fig 4 Construction waste lying on the road side: - This can be used directly for building construction, landscaping and filling instead of throwing it in dumping ground

TABLE I
STAFF SETUP IN THE DIFFERENT ANCHALS OF PMC (IN 2000)

New Rajdhani Anchal (staff set up)		
Sl no	Item	
1.	Total staff	797
2.	.No of sweepers	N A
3.	No of tractors	25
4.	No of trippers	14
5.	No of loader	5
6.	No of suction machine	1
7.	No of Hand carts	175
New Capital Area (Staff Setup)		
1.	Total staff	615
2.	No sweepers	578
3.	No of tippers	N A
4.	No of tractors	N A
Bankipure Anchal (staff setup)		
1.	Total staff	NA
2.	No sweepers	N A
3.	No of tippers	N A
4.	No of tractors	N A
5.	No of loaders	3
6.	No of Handcarts	100

Source: Patna Municpial Corporation (2000)

TABLE II
EXISTING GARBAGE POINTS IN THE PATNA MUNICIPAL AREA, WHERE PEOPLE THROW THE GARBAGE. MOST OF THE POINTS ARE RANDOMLY SELECTED BY THE PEOPLE, WHICH IS NOT IDENTIFIED BY PMC

No	Sub-divisions (Anchals) of PMC	Number of Garbage points
1	Bankipure	158
2	Kankar bagh	109
3	New rajdhani	280
4	Patna city	298

Here it is worthy to mention that in 1975 when the population was only half million, area was 31.5 km^2. At that time, there were 3496 sweepers for the PMC area.

Now in 2014 when the population has increased to 1.8 million, area has increased to 109.21 km2, there are only 2600 sweepers (permanent-1400, daily waedge-1200) working in PMC area.

(Source- Daily News paper 'Hindustan (Hindi)', Patna edition, September, 2014.)

III. Waste Management Deficiencies

1. Segregation

Presently, the waste is not segregated at the household level. The residents dump the waste in the nearby vacant land.

2. Collection

At present there is an inefficient collection services in place. House-to-house collection of solid waste is not in practice. The solid waste is dumped by the individuals in the low lying areas which are then picked up by the local body who collects the garbage on trolley handcarts and dumps the waste in an unorganized manner into the roadside gaps without any treatment. The waste is kept open at the collection points, which leads to subsequent foul smell, water, air pollution and unhygienic conditions. There are no specific disposal sites maintained by the PMC. The local body does not have adequate and suitable vehicles for collection of waste or garbage.

3. Transportation

Transportation of the garbage is in open truck, dumper and tractor. The local body does not have suitable vehicles for the collection of waste or garbage in terms of timely lifting and transportation. At the same time garbage is handled manually which leads to health problems to the workers.

4. Treatment and disposal

At present the waste does not undergo treatment and a crude method of dumping solid waste in low-lying areas is in practice.

5. Waste Generated per capita

The sources of solid waste generation in Patna Urban Area are the household, hotels, markets, education institutions, offices etc. The quantity of waste generated ranges from 650MT-800MT, out of which 40% is domestic wastes and 60%, is industrial & commercial waste. The solid waste comprises of vegetable fractions (49%); combustible fractions (12.5%) and non combustible fraction (38.5%). The analysis reveals that at the aggregate level, the average per capita waste generated is 331 grams (year 2000).

6. Disposal Facility

The local bodies are dumping the waste without following any scientific method in low lying areas as well as the outskirts of the city besides the dumping ground.

IV. Solid Waste Management Issues

The state of solid waste collection method is unorganized and unscientific in Patna. The local bodies are only able to collect part of the total quantum of waste generated in the city. Unattended waste are left on streets lead to drain blockages, soil and ground water pollution and results in acute unhygienic conditions. Major issues of MSW sector includes:

1. Indiscriminate disposal of waste by the residents

The spacing between the dustbins is more than 1.5km, leading to litter of waste on the local and cluster level streets.

2. Absence of Modern Waste Collection Technique and instruments

The Waste collection and transportation is handled using the age-old technique of broom and wheel borrowers due to narrow streets and lack of suitable infrastructure. It is worth mentioning that piecemeal approach on modernization of waste management techniques collapses with change in administrative set up.

3. Non-Segregation and Recycling/Reuse of Solid Waste

The intermixing of waste during collection and transportation lead to the increase in quantum of waste to be disposed.

4. Patna Master Plan 203

In the master paln report it is estimated that, the current rate of waste generation is about 450 to 600 gms / person/day. Which amounts to about 1000 tonns of MSW per day.

For 2031 it is projected that, the waste will be produced at the rate of 600 to 800 gms /capita. At this rate the waste generated will be about 3092 tonns per day.

On the basis of this data, the problem of waste management will need more concern.

In availability of landfill site for waste disposal has lead to the dumping of waste along the major roads and low-lying drainage channels in south of the city.

V. Types of waste

There are four broad categories of waste according to their nature:

a. Organic waste: kitchen waste, vegetables, flowers, leaves, fruits.

b. Toxic waste: old medicines, paints, chemicals, bulbs, spray cans, fertilizers and pesticide containers, batteries, shoe polish.

c. Recyclable: paper, glass, metals, plastics.

d. Soiled: hospital waste such as cloth soiled with blood and other body fluids.

The classification of waste from the point of segregation, recycle and reuse, it can be as following:

1. Biodegradable and
2. Non biodegradable

Biodegradable wastes include organic waste, e g kitchen waste, vegetable waste, vegetables, fruits, flowers, leaves of the garden and paper.

Non-biodegradable can be further segregated into:

a. Recyclable waste-plastic, paper, glass, metal, etc.

b. Toxic waste-old medicines, paints, chemicals, bulb, spray cans, and pesticide containers, batteries and shoe polish.

c. Soiled- hospital waste such as cloth soiled with blood and other body fluids. Toxic and soiled waste must be disposed off with utmost care.

d. Recyclable waste- demolition waste, crap metals, iron sheets, wooden furniture, wooden fixtures.

Fig. 5 Composition of waste: - We can see the composition of the waste such as Coconut shell, plastic glass, wrappers and plastic pouches, egg shells, paper, plastic packing, metal wire, jute, thermocole plate and other waste.

VI. The Generation Of Waste

TABLE III
TYPES OF WASTE ARE GENERATED FROM THE DIFFERENT PLACES AND USERS

Sl no	Source of waste	Type of waste generated
1.	**Household**	Carry bags, Bottles, Containers, trash bags, vegetable waste, food waste, old clothes, old furniture, ash,
2.	**Health and medicine**	Disposable syringes, glucose bottles, Blood and uro bags, intravenous tubes, Cathetors, surgical gloves, cartoons ,
3.	**Hotel and catering**	Packaging items, Mineral water bottles, Plastic plates, glasses, spoons
4.	**Air/Rail and travel**	Mineral water bottles, plastic plates, glasses, spoons, plastic bags
5.	**Building construction**	Old bricks, broken tiles, wooden fixtures, old trusses, plaster waste, cuttings of tiles and stones,
6.	**Small scale industry**	Industrial waste like plastics and pouches, leather and rexin cuttings, cardboards, plastic bottles, clothes cuttings, plastic cuttings
7.	**Offices and institutes**	Paper waste, used cartridges, old computers, old furniture, e- waste
8.	**Meat Shops**	Cartoons, meat waste,
9.	**Vegetable markets**	Vegetable waste, cartoons

TABLE IV
PHYSICAL COMPOSITION OF MSW IN PATNA

Sl. No.	Ingredients	Percentage
1	Total compostable	51.96
2	Paper etc	4.78
3	Plastic	4.14
4	Glass	2.0
5	Metal	1.66
6	Inert	25.47
7	Rubber and leather	1.17
8	Rags	4.17
9	Wooden matter	1.43
10	Coconut	2.34
11	Bones	0.01
12	Total	100

Source: CPCB (2000)

VII. Solution

The landfill method requires costly land. This method is not sustainable neither environment friendly. The ground where MSW is dumped becomes useless for a long time. The surrounding area becomes polluted and creates health hazards for the nearby habitants. The ground water becomes polluted. Though in Patna there is no monitoring system or any agency to look after the environmental pollution created by waste management system.

Reuse and recycle can be a good solution to the problem. In the present waste management system different type of waste are mixed up at the collection point. So, reuse and recycle is not possible. The mixed waste can't be decomposed neither can be combusted.

A. *Recycle and reuse*

The solution to this problem is reuse and recycling. Reuse and recycling is possible only when different type of waste does not get mixed up at the collection point.

It is estimated that 80% of the waste can be reused and recycled (1). Thus the reduction in the total amount of waste will result in reducing the handling cost. This will further reduce the total amount of staff engaged in the Solid Waste Management (SWM) system. By the selling of waste and recycling, local bodies can generate the revenue.

This will also reduce the requirement of costly land required for dumping the waste.

B. *Role of rag pickers*

Rag pickers can play very important role in the recycling of waste. Though they are collecting and recycling the waste, but in a very insignificant manner. They are working for their lively hood and playing role in the recycling of the waste but they are not recognized.

If they are recognised and supported by the residents and other concerned authorities they can play a very important role in recycling the waste and thus reducing the work of PMC. They should be recognised by the PMC and they should be organised to take services from them.

C. *Zero waste technology (ZWT)*

Zero waste technology (ZWT) should be introduced in all the small medium and large scale industries. In this technology the production is done in such way that, least amount of waste is produced in the process of production. The process of production is done in such a way that waste is also reused during the production.

VIII. Proposals

1) Reuse and recycling and should be mandatory for all the residents and different waste generators of the city.
2) The local bodies should educate the people about reuse and recycling.
3) Zero waste technology (ZWT) should be introduced in all the small, medium and large scale industries.
4) Local bodies should give tax incentives to those who recycle the waste.

5) At the garbage points there should be four different type of bins. In these bins different type of waste can be stored. Such as the Organic waste, recyclable and toxic waste should be disposed off in different bins. Hospital waste should be kept in separate bins.
6) Bins should be kept according to the suitability and requirement of particular places, for example vegetable markets should be provided larger bins to accommodate large quantity of vegetable waste. It can be given directly to the animal owners to feed to cattle.
7) Industrial waste should be recycled as far as possible.
8) Garbage bins should be placed at regular interval of 100 metres of minimum 1 tonne capacity.
9) Hotels, restaurants and other similar type of waste producers should segregate their waste at the source so that the waste of similar type can be stored and disposed at large scale.
10) Large institutions and offices should donate their old and useless items publicly to the needy.
11) Demolition and construction waste should be sold or donated directly to the people.
12) The hazardous hospital waste should be treated in the incinerators.
13) The use and production of polythene carry bags should be banned.
14) The use of disposable plastic glass and plates should be reduced.
15) Use of paper carry bags and packets should be encouraged.
16) The traditional (vernacular) technology of making earthen pots, cups, plates and of leaves should be encouraged.
17) In packing and packages use of plastic and polythenes should be reduced and paper should be encouraged.
18) Individuals and NGOs should be encouraged to recycle and reuse the MSW.
19) Organic waste should be send directly for the composting from the source of production to the composting ground.
20) Rag pickers should be recognized and encouraged. So that, they help in reuse and recycle the waste. In this way, they may also get proper employment.

IX. Conclusion

Prevention is better than cure. We can't prevent generation of MSW but we can reduce the total amount of waste by reuse and recycling. By the reduction of waste we can further reduce the handling cost and the requirement of costly land for the disposal. The local bodies can also generate revenue by selling MSW. Various guidelines as mentioned above have been developed for solving the problem of management of MSW for Patna. Such type of guide lines can be incorporated at different cities of India.

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