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# STUDY OF CURRENT SCENARIO & IMPROVEMENT SUGGESTION FOR THE MUNICIPAL SOLID WASTE MANAGEMENT PRACTICES IN PURNEA CITY

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**Abstract -** Rapid growth in urban population coupled with economic growth and rise in community living standards has resulted in the generation of huge quantities of municipal solid waste posing a serious problem to municipal corporations. Approximately 59.3 tons/day of waste is generated in Purnea city, out of which only 30% of waste is collected by Purnea Municipal Corporation directly, and the 70% of municipal solid waste is collected and transported through NGO Shivam. The current scenario and status of the Municipal Solid Waste (MSW) for Purnea city is studied. The results indicated that organic waste was highest among other components of the wastes. A considerable proportion of organic carbon was found which causes health problems to the dwellers of the city. To avoid this situation small community bins are placed in the nook and corner of the city, besides, the litter bins are provided as per requirement. Disposal vehicles, small auto-rickshaws, hand carts, and tricycles are provided to maximize the collection of waste. The current municipal waste treatment methods in Purnea are unsustainable and will burden future generations. The main goal of this paper is an ardent need for proper suggestions to improve municipal solid waste in Purnea City, especially technical solutions based on the conditions of Purnea municipal solid waste management. The municipal solid waste is changing its composition over the time; moreover due to several issues, there is no properly operating sanitary landfill. Some of the landfills are either closed or badly managed. So, much of municipal solid waste gets dumped in the open dumps, posing health risks to residents in their vicinity. This may cause a high risk of contamination of groundwater/surface water, soil, and air. Further to improve the MSWM in Purnea City, we analyzed the gaps, strengths and weaknesses; several recommendations were proposed in need to improve the existing system complying with the MSW (H & M) rules, 2016. The site should be planned as an integrated facility for compost plant and sanitary landfill. The solution must be carried out as soon as possible by Purnea Municipal Corporation to close the open dumping situation. Purnea Municipal Corporations should arrange an adequate area that is required for sanitary land-filling to reduce the MSW at the disposal site. Apart from this, it is suggested that the Purnea Municipal Corporation should create awareness on storage, segregation, antilittering with the help of NGOs and also organize the workshop for the awareness and involvement of citizens and NGOs.

***Key Words*: Contamination, Landfill, MSW (H & M) Rules 2016, Municipal Solid Waste, Municipal Solid Waste, Open Dump, Purnea Municipal Corporation**

## 1. INTRODUCTION

The municipal solid waste management is one of the essential duties of municipal bodies to arrange for daily street sweeping, cleaning, collection, transportation processing, and disposal of waste in a scientific way at the appropriate site. Improper handling and disposal practices of solid wastes continue to be a serious problem [1]. Municipal Solid Waste Management is (MSWM) is one of the environmental problems in Purnea city. Improper management of Municipal Solid Waste (MSW) IS causing hazards to the inhabitants. In studies, it was revealed that about 85%-90% of MSW is disposed of unscientifically in open land and landfills in Purnea, creating problems to public health and overall environment [2].

Urbanization and Industrialization have increased the quantity and diverse nature of wastes, which need proper handling and treatment. Purnea City has a mixed demographic profile with about 3, 61, 371 of the total population living in the municipal area [3]. Most of the municipal areas are highly unsatisfactory managed due to inadequate services, limited finances, and municipal authorities as well as people's apathetic behaviour towards MSWM [4].

## 2. STUDY AREA PURNEA CITY

The Municipal Solid Waste (MSW) consists of organic and inorganic waste materials generated by various societal activities. The improper disposal of MSW pollutes all the vital components of the living environment, i.e. air, land, and water. Purnea is located in the east of Bihar state. It is situated at $25^0$ 46' 15" N and $87^0$ 28' 55" E covers an area of 92 $Km^2$ at an average elevation of 36 meters [2]. Purnea city has earned the name "Mini Darjeeling", as it experiences favorable weather throughout

the year [5]. In summers, the maximum temperature rises to 44°C. In winter months the temperature varies between 9°C [6] and the annual rainfall is about 1427 mm [7].

### 2.1 Dimension of Solid Waste Problem

Currently, Purnea city generates around 59.3 T/day of MSW at an average of 0.55 kg/day/per capita with a population of about 3, 61, 371 [2]. Purnea city is facing serious problems due to existing disposal practices of generated waste incurring high cost due to lack of proper infrastructural facilities, also the open dumping in the expanding zone of the city poses serious problems to the structures constructed on these old dumps in addition to the groundwater quality due to improper leachate management [3]. However, with an increasing population, the local authorities are struggling to provide the proper municipal solid waste management system to a satisfactory level. Recently, the authorities have taken initiatives and measures to organize the municipal solid waste management (MSWM) sector. Purnea city has several narrow streets and gulleys, high population density, and has pockets of the rural area which have been amalgamated with developed areas, posing serious problems for the collection and transport of municipal waste. The phenomenal growth of vehicles on roads makes the task even more difficult.

**Table -1: Future population and Future Solid Waste Generation – Projection**

| Year | Projected Population | Waste Generated (Tons/day) |
|---|---|---|
| 2011 | 2,82,248 | 46.8 |
| 2015 | 3,27,070 | 51.9 |
| 2020 | 3,61,371 | 59.3 |
| 2025 | 4,10,433 | 67.3 |
| 2030 | 4,64,918 | 76.6 |

In the year 2030, Purnea will generate 76.6 Tons/day of solid waste as per data provided by Purnea Municipal Corporation. Table 1 presents the projected solid waste to be generated in the projected years [2].

### 2.2 Characteristics of Municipal Solid Waste

The biodegradable matter in the waste collected from Purnea city is about 56% and can be converted into manure. Recyclable materials such as paper, cardboard, glass, metal, plastic, electronics are 15% and at present only 10% of the waste has been going recycling properly. 29% of inert materials have been used for landfilling purposes. The average composition of waste on a wet weight basis is shown in Figure 1. The testing was done in PHED Laboratory, Purnea. A total of seven samples were tested. Organic matter based on test results was found to be 56% while inorganic matter was 29%, and rest constitutes other matter [2].

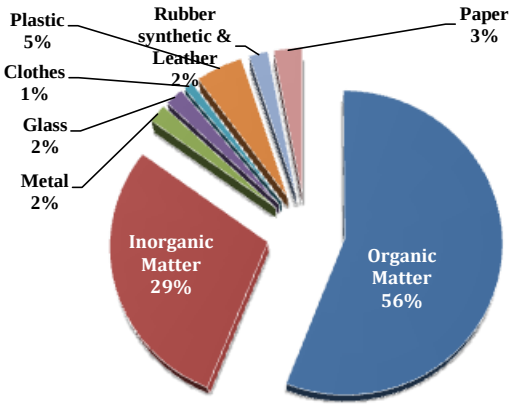


**Fig -1: Average physical characteristics**

These percentages differ from city to city depending upon food habits. Also, it has been noted that the characteristics of the waste are changing with time.

**Table -2: Chemical characteristics of waste**

| Parameter | Average |
|---|---|
| pH | 7.70 |
| Moisture | 39.1 |
| Organic carbon | 11.37 |
| Total Kjeldhal Nitrogen | 0.57 |
| C/N Ratio | 30.94 |
| Total Phosphorus | 17.20 |
| Total Potassium | 19.4 |
| Density | 550 kg/cum |
| Calorific value | 1000 kcal/kg |

The data provided by Purnea Municipal Corporation for the chemical characteristics of waste generated from various sources are tabulated above. Table 2 showed that the Organic carbon of the waste is 11.37, the C/N ratio of the waste is 30.94 and the average density based on test results was found to be 550 kg/m$^3$. The gross calorific value was been observed as 1000 kcal/kg [2].

## 3. PRESENT PRACTICE OF SOLID WASTE MANAGEMENT

Presently, the Shivam NGO and Purnea municipal corporation, the agency vested with the responsibility of collection and disposal of solid waste, is engaged in a series of approaches such as involvement of citizen, investment in infrastructure and technology, as well as monitoring the various systems that are involved in managing the present mix of actions and techniques. The Municipal Corporation has divided into 46 wards. As per the present practice, collection carriage and disposal of solid waste is done by engaging 282 sweepers, under the supervision of 02 sanitary inspectors. The tractor, trolleys, Handcarts, and tricycles are engaged on alternate day for the carriage of municipal solid waste from community bins to disposal site. The household waste is collected in the community bins daily through handcart vehicles and is disposed of off to the site twice a week. The tricycles and trolleys are being used in collecting household waste from the roadside to the community bins. The dumped garbage is allowed to decompose and shrink at the spot, spreading and levelling are often done by dozer/excavators as and when required [3].

### 3.1 Collection

Source segregation is still a concern in Purnea City. Purnea Municipal Corporation manages about 30% of MSW and the Rest 70% of MSW manages through NGOs from primary collection to disposal sites [2]. The collection of municipal solid waste is carried out in two phases. The first stage is a primary collection, in which the municipal solid waste is collected on auto tipper & pushcarts. An Auto tipper has been provided for every 1000 households and a pushcart for every 200 households. About 282 Sweepers are being utilized (both Purnea Municipal Corporation and contractors) in the door-to-door collection, street sweeping, and transportation of MSW [3]. The waste collected from the households is brought and transferred to landfill sites through tipper trucks & trolley tractor.

The Purnea Municipal Corporation has assigned the primary collection and transportation activity to Self Help Groups (SHG's) which are basically below poverty women's groups and landfill sites are operated by the private sector based on public-private partnership (PPP). Annually about 1 crore is spent on municipal solid waste management salaries for both 100 Sweepers by Purnea Municipal Corporation directly and for 182 Sweepers, through a contractor who performs the door-to-door collection, Tipping fees, etc. [3]. The system and practice continued to be outdated and inefficient. There are no clear plans to enhance their efficiency or improve working conditions through the provision of modern equipment and protective gear. There is a lack of knowledge of the characteristics of MSW aid in the preparation of a long-term plan for an MSWM system. Hence, it was deemed necessary by the Purnea Municipal Corporation to assess the existing status of the MSWM system in Purnea city.

### 3.2 Transportation

Transportation of solid waste from collection centers to the final disposal site/landfill is another important step in municipal solid waste management. Currently, transportation of municipal solid waste is using small auto-rickshaws, hand carts, tricycles, and auto, etc. Which brings the municipal solid waste to primary collection centers. From there trolley tractor collects the municipal solid waste and transport it to waste disposal sites/landfills [3].

Major issues in transporting waste are:

1. Due to open beds in tractors and trucks, the waste spills from the truck, during transport, thereby causing a nuisance.
2. Loading of waste by manual without the use of protective gear is dangerous to the health of workers.
3. The secondary storage system is not synchronized with the transport system. Problems arise when a transport fleet is modernized because waste at the secondary storage system is still dumped on the ground.
4. Due to an inadequate number of vehicles, the area cannot be serviced properly.
5. Due to inadequate workshop facilities and maintenance procedures, the vehicles are poorly maintained. This problem leads to a breakdown of trucks and becomes out of service for a long time.

**Table -3: Waste collection**

| Category | Quantity of waste (tons/day) |
|---|---|
| Waste collected by Vehicles | 36 |
| Uncollected waste | 13.3 |
| Waste collected by rag pickers | 10 (including paper) |
| Total Waste Generated | 59.3 |

As per data provided by Purnea Municipal Corporation (see table 3), The total quantity of waste generated in the Purnea city is found to be 59.3 ton/day, Out of which the vehicles collect only 36 ton/day, 13.3 ton/day is not collected and 10 ton/day picked by the rag pickers.

**Table -4: Waste collected by the vehicles[3]**

| Type of vehicle | No of vehicle | Waste Capacity (tons) | Trips/ day | Carrying capacity | Vehicle running | Waste carried | Actual waste collected |
|---|---|---|---|---|---|---|---|
| Tata Dumper | 1 | 7 | 4 | 28 | 4 | 4 | 9 |
| JCB | 2 | 9 | 3 | 54 | 0 | 5 | 0 |
| Tractor trolley | 11 | 3 | 3 | 99 | 10 | 2 | 15 |
| Tempo | 30 | 5 | 3 | 450 | 3 | 3 | 12 |
| | | | | | | **Total** | **36** |

### 3.3 Current Disposal Practices in Purnea City

Presently, Purnea does not have any scientific treatment method facilities for municipal solid waste generated by municipal and industries around Purnea. This has led to the development of several illegal and unauthorized dumpsites in Purnea [2]. The waste produced by the bulk generators such as hotels, restaurants, markets, etc., is being directly collected and transported to the treatment/disposal sites.

#### 3.3.1 Sanitary Landfill Site

At present, Purnea is handling the municipal solid waste of about 59.3 tons/day only [2]. There is no waste treatment facility existing at Purnea. The government has not sanctioned new facilities.

### 3.3.2 Illegal Dump Sites

There are more than 10 dump sites and it consists of both municipal and industrial waste existing in and around Purnea city area [2]. While the Purnea Municipal Corporation and the Bihar State Pollution Control Board (BSPCB) close these sites, the new ones emerge elsewhere posing health risks to residents in their vicinity. The Purnea Municipal Corporation is merely collecting waste instead of disposal after collection.

## 3.4 Strength and Weakness Analysis of MSW Management

**Table -5: Strengths and Weaknesses of MSW management of Purnea City[8]**

| Strengths | Weaknesses |
|---|---|
| • Private sectors have a strong capacity to manage MSW, including collection, transport, treatment, and dispose of while applying environmentally sound technologies.<br>• Availability of strong human resources (including manual labor) to meet the demand for MSW management.<br>• Informal sectors play an important role in the recycling of MSW. | • Weak legal and institutional framework for solid waste management (SWM), especially implementation, monitoring, and evaluation (M&E).<br>• Policy and standards do not meet the ability of stakeholders (e.g. private sectors).<br>• Lack of experts and staff who have technical knowledge and skills in SWM.<br>• Lack of financial support from the government.<br>• Lack of technologies for SWM.<br>• Poor infrastructure (e.g. landfill design and operation is not efficient.<br>• Weak environmental protection in landfills<br>• It does not take advantage of the private sector role in SWM.<br>• Lack of waste separation at source due to lack of environmental awareness of local people |

Table 5 illustrated the SW (Strength and Weakness) analysis for MSW management in Purnea City. The SW (Strengths and Weaknesses) analysis is a tool to identify the positive and negative points of the performance of any process, organization, project, and company. SW analysis was done on the MSW management of Purnea City to rectify the current issues on the MSW practices; while enhancing the positive points and minimizing the negative ones for future city strategies.

## 4. DISCUSSION AND SUGGESTIONS

In this work, a detailed study of the collection, storage, transport, and disposal practices were conducted for Purnea city. An improvement to the existing system has been proposed to meet the MSW (H & M) rules 2016. It was found that the disposal site has been planned as an integrated facility for compost plant and sanitary landfill. Private sectors, NGOs, and rag pickers are to be brought in to the institutional framework for effective management of MSW.

The following key points are suggested to practice for minimization of waste:

- ❖ Prohibit the littering: The notification should be issued which is not done yet. Also, it is required to increase the number of litter bins. Litterbins should be provided at strategic locations for the citizens to dispose the waste. This will reduce the waste coming on the street as well as the requirement for sweeping and thus reduces the cost of MSW management. Legal notification to this effect to the citizens will enable the corporation to enforce antilittering.

- Segregation of Waste: At present, there is no segregation of waste at source. Segregation of waste at the point of generation i.e. homes, offices, shops must be done into two categories:
  - Wet waste comprising of biodegradable waste such as food waste etc.
  - Dry waste comprising of plastics, tins, etc. The Purnea Municipal Corporation must enforce this by notifying the citizens to do so.
- Generation of waste: The waste generation in the city is 300 to 550 gm/Capita/Day. Since the weight of the waste is only an estimate, Therefore It is suggested that the Purnea Municipal Corporation will collect information on the exact quantity of waste generation. It is also suggested that the physical examination of the waste to be carried out into four categories:
  - Biodegradable Waste
  - Recyclable Waste
  - Non-Biodegradable Waste
  - Green waste

  This will enable the Purnea Municipal Corporation to plan the recycling and processing of the waste.
- Employ sufficient no. of staff: In Purnea Municipal Corporation 46 wards are covering an area of 92 $km^2$. The Corporation has employed only 100 sweepers for street cleansing which are insufficient for the work. Hence it is suggested that the Purnea Municipal Corporation should employ a sufficient number of sweepers so that the daily cleaning should be done.
- Waste Collection: Purnea Municipal Corporation has not implemented the appropriate method of collection and it is suggested that the Purnea Municipal Corporation should provide house to house collection.
- Transportation of Waste: The Purnea Municipal Corporation has only 11 Tractors with trolleys which are inadequate. Though the generation of waste is 59.3 T/Day, only 36 T/Day is collected by Vehicles. Hence it is suggested that the Purnea Municipal Corporation should increase the number of vehicles and laborers to fulfill the requirement.
- Waste Processing: Currently the Purnea municipal corporation has no arrangement for processing hence it is suggested that the Purnea municipal corporation should make an adequate number of incinerators to reduce the MSW at the disposal site.
- Waste Disposal: Presently, Purnea Municipal Corporation does not have any scientific treatment method facilities for municipal solid waste generated by municipal and industries around Purnea. Hence it is suggested that the Purnea Municipal Corporation should make an adequate area is required for sanitary land-filling to reduce the MSW at the disposal site.
- Awareness and Involvement Programs: There is no awareness and involvement of citizens and NGOs. Hence it is suggested that the Purnea Municipal Corporation should create awareness on storage, segregation, and antilittering with the help of NGOs. Also, it is suggested to organize the workshop for the awareness and involvement of citizens and NGOs.
- Feasibility of Disposal Site: The porosity and permeability of the soil at the disposal site is very high. Hence, the possibility of groundwater pollution. Therefore the present site is not suitable for disposal of solid waste.
- Composting Plant: The C/N ratio of the waste generated at Purnea city is found to be 30.94, (Shown in Table 2) which is ideal for composting. Hence it is advisable to make a composting plant.

## 5. CONCLUSION

In this work, a detailed study of the collection, storage, transport, and disposal practices were conducted for Purnea city. The total quantity of MSW generated in Purnea City 59.3 T/Day and the rate of generation of MSW is 300 to 550 gm/Capita/Day. Current practices of municipal solid waste management in Purnea City are open dumping. About 90% of municipal solid waste is open dumping at trenching grounds in Ward 37 and the rest 10% is recycled. Paper, plastic, and metals are among the major

recyclable waste. The Gaps analysis revealed that there are several gaps in the regulation and economic policies, institutions framework and arrangements, technologies and infrastructure, capacity building, participation of stakeholders, and financing mechanism. One of the most important gaps is that there is a lack of clear responsibility and accountability of several institutions for the MSW management in Purnea City due to the involvement of multi agencies. The Gap and SW (Strength and Weakness) analysis pointed out that the private sector could play a pivotal role, as strength of the city, in MSW management, if the regulatory and policy-related weaknesses are resolved. Based on gaps and SW (Strengths and Weaknesses) analysis, several recommendations were proposed, such as, in an existing system is need to follow the MSW (H & M) rules 2016. The disposal site need to the planned as an integrated facility for compost plant and sanitary landfill. Organizing public awareness programs, which could start from the schools; increasing efforts for recycling, resource recovery, building transport stations for efficient transport of waste, renewing transport vehicles; capacity building programs for staff including abroad training and courses on waste management; and encouraging public-private partnerships in SWM are the practices recommended in present study.

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