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Design and Development of Municipal Solid Waste Management System for Madhubani Town, Bihar

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ABSTRACT: The study was conducted to observe the present status of solid waste management system and development a new management system in Madhubani Town Bihar. For this persistent survey was conducted to study the existing strength and weakness of waste management system. In addition, questionnaire survey was carried out to understand the problems faced by the stakeholders. By the survey work it was recognized that few people (4%) were familiar with the waste management system. Majority of the people (96%) were blind about the waste management system. There was not a single person got the waste management training. For disposing of waste, about 13% people used bin, 24% people threw the waste in the drain and 63% people kept the waste in open area. For developing waste management system plastic bin were recommended instead of concrete and steel bins. For the assortment of cleaning time, cleaning interval, vehicle type, and collection route of waste at morning, 1 to 2 days per week, waste collection van through teacher's quarter route respectively were suggested. It was proposed to set up transfer station including disposal site and biogas plant near the new bus stand. For incineration, enclosed container was advised. Finally, to establish composting plant and sanitary landfill have been proposed near agriculture field.

KEYWORDS: Municipal solid waste, Solid Waste Management, Madhubani, Sanitary Landfill, MSW

I. INTRODUCTION

Solid wastes are all those wastes arising from human and animal activities that are normally solid and that are discarded as useless or unwanted (1985). Improper disposal of solid waste can create unsanitary conditions and these conditions can lead to pollution of the environment and to outbreaks of vector-borne disease. Increasing population levels, booming economy, rapid urbanization and the rise in community living standards have greatly accelerated the municipal solid waste generation rate in developing countries Some waste may have value to someone either in its present state or in a converted state. The word waste is most prominent in the modern era. When the wastes are properly managed then the total condition of the environment will be improved. Waste management is all those activities and actions required to manage waste from its initiation to its final disposal. This includes amongst other things such as collection, transportation, treatment and disposal of waste together with monitoring and regulation. It also encompasses the legal and regulatory framework that relates to waste management encompassing guidance on recycling. Environmental degradation due to unplanned waste disposal and improper waste management in urban areas were not the prime concern even a few decades ago in the developing state, 2003. But due to the increasing urban population, the environmentalists think about the scientific waste management with topmost priority in urban planning in the developing countries. It has only been in the veryrecent times, when certain NGOs started working and highlighting the pathetic state of municipal waste services provision in the stateof Bihar Distt of Madhubani is all about approximately 50 acres of land.The generation of Municipal Solid Waste in Bihar State is from different sources such as: institutional, industrial, commercial, residential, construction and demolition waste and waste generated from municipal services. For efficient Management of Solid Waste each Municipal authority will have to ensure 100% collection of waste from households. The effective and integrated solid waste management system includes:

a)segregation of waste at source (at household

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level).
b) 100% collection of segregated waste from each household.
c) transfer of reusable and recyclable waste to the depot for reuse.
d) transfer of biodegradable waste to the compost plant for composting.
e) transfer of animal waste and slaughter house waste to the compost plant for composting.
f) dentification of bulk generators and insist them to start composting in their own premises.
g) identification and integration of rag pickers in the solid waste management system.
h) encourage marketing and sale of enriched bio fertilizer to the bulk consumers i.e. farmers.
i) establish a scientific Sanitary Land Fill for each town within easy reach either at town regional j) disposal of rejects of compost plantand inert material from recyclable waste depot to the sanitary land fill in a scientific manner.

There is no such formal study has been conducted in the state to identify the qualityand quantity ofwaste generated in the state. However,on an average the per capita wastegeneration in the Municipal Corporation is taken as 0.3 kg/capita/day, Patna MunicipalCorporation 0.4 kg/capita/day, MunicipalCouncils 0.2 kg/capita/day and for Nagar Panchayats it is taken as 0.15 kg/capita/day. Considering the above per capita rate of generation of municipal solid waste,the total solid waste generation in the state is given in the belowtable:

Table-1 :Waste Generation in TPD& TPA

Sl. No	Type of ULBs	Total No. of Households	Waste generation in kg/capita/day	Waste Generation in TPD	Waste Generation in TPA
1	Municipal Corporation	537550	0.3 kg	806	294309
2	Patna Municipal Corporation	223088	0.4 kg	446	162854
3	Municipal Council	648111	0.2 kg	648	236561
4	Nagar Panchayat	495168	0.15 kg	371	135552
Total		**1903917**		**2272**	**829276**

II. OBJECTIVE

1. Design of municipal solid waste system for Madhubani town.
2. ComparativeAssessment of exiting solid waste management system to designed solid waste management system.
3. Qualification and characterization of Municipal solid waste of Madhubani town.

III. METHODOLOGY

This chapter includes the methodology adopted in conducting the Laboratory tests to find out the physical, Chemical and geotechnical properties of MSW and Refuse. The following geotechnical tests were conducted on refuse samples to determine their geotechnical engineering characteristics. Laboratory tests were performed according to the Indian Standards (IS-2720) methods of testing soil for engineering purposes. The geotechnical laboratory tests were conducted at Jaypee University, Waknaghat, Solan. Figure 3.1 shows the flow diagram of research methodology adopted in this report in order to accomplish the project.
The methodology of the study was performed by the following flow diagram-

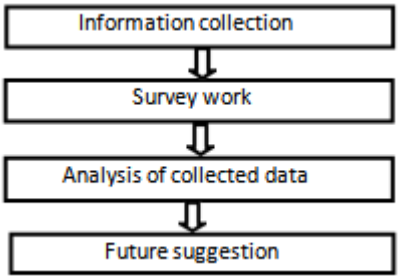

Fig.3.1

Information Collection

Information and data were collected from initial observation and also from internet, previous research, survey report, literature review and available secondary sources like books, journals, government documents and research works.

Survey work

The entire operation was conducted by different types of survey work namely reconnaissance and questionnaire survey.

Reconnaissance survey

Reconnaissance survey was done before starting the main work in order to know how the works could be executed in the best possible ways. In this study reconnaissance survey was performed for gathering initial information regarding the present status of waste management system. By this survey work it was recognized the surface shape of ground, position of natural and man-made features and their structural relationship of total area of Madhubani Town.

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Physical Characterization of MSW:

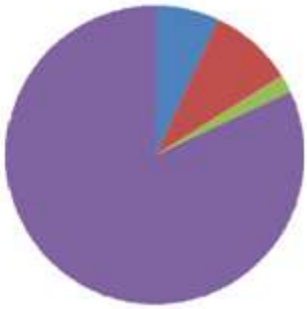
Sample collection was done in accordance with ASTM D5231-92 (ASTM 2008) in the very first week of January, 2017. Sampling has been done for 7 consecutive working days from dumping site, each day 150 kg sample collected while trucks used to unload. Each day samples were collected from at least 7 no. of wards in order to cover all the wards of the city, since city is divided into total 41 wards. By the end of 6th day total 1050 kg sample has been segregated. This sampling method involves sampling of MSW from vehicles deployed for collection and transportation of MSW. According to this method, collection crew coming from the desired zone reaching to the dump site; each day randomly samples were collected in order to make the waste stream representative. MWS was further classified based on the income class i.e. Low-Income Group (LIG), High Income Group (HIG), Medium Income Group (MIG) of different areas. The conventional and fundamental method of gravimetric profiling was adopted by emptying out the entire MWS on a plastic sheet to prohibit the mixing of waste/soil. The 100 kg of fresh waste samples has been collected for 7 times during first months of the year 2017 from the Madhubani dumping site by using the previously mentioned methodology. The waste samples have been segregated manually onsite with the help of rag pickers present the dump site of Madhubani. Thereafter, Segregation of MSW samples has been done into various physical components, such as food waste (fruit, vegetables etc.), paper, plastic, rubber, metals, inerts, construction and demolition material etc. After segregation, all components have been weighed separately. The mean waste composition was calculated by using the results of the composition of each of the sorting samples. Each time, approximately 5 kg of waste sample has been collected in a polythene bag and send to the laboratory for chemical characterization. Moisture content has been analysed immediately, and rest of the samples has been refrigerated and used for chemical analysis. The gradation of MSW samples also has been performed using the sieves of diameter 200, 150, 100, 50, and 20 mm.

Chemical Characterization of MSW

"In order to perform characterization of the Chemical characterization of waste has been done to understand its potential for various waste processing techniques, like vermicomposting, composting, refused derived fuel (RDF) and incineration. Proximate analysis involves the determination of, Volatile content (%), % ash content, and the calculation of % fixed carbon. The proximate analysis will be conducted according to ASTM standards E790 (ASTM 2004a), E830 (ASTM 2004b), and E897 (ASTM 2004c). Bomb Calorimeter will be used in order to determine the calorific values

Geotechnical Characterization of MSW:

The geotechnical properties are also the one most important properties in order to determine the design and maintenance of the landfills. The specific gravity of the samples was determined in accordance with ASTM D854 (ASTM 2006a). Average specific gravity and Average moisture content were used to calculate unit weight, degree of saturation, void ration and unit weight, (Venkatramaiah 1993). Constant head permeability will be used in order to calculate the coefficient of permeability of MSW samples [ASTM D 2434-68 (ASTM 2006b)]. It will be reported in cm at 27°C. Field capacity is defined as water holding capacity of the waste against the action of the gravity; is one of the most important geotechnical property of the MSW; determination—undisturbed samples (7.0 kg) of 17 cm in diameter and 40 cm in height in a cylinder were first saturated with water and then left to drain until the drainage ceased.



IV. RESULT AND DISCUSSION

Present condition

From reconnaissance and questionnaire survey the following information and statistical data were found. This survey revealed that peoples were not aware about handling and disposal of wastes. By conducting the survey work it was found that approximately 7% people used plastic bin, 9% people used concrete bin and 2% people did not use any type of bin for disposal of waste. Most of the people about 82% threw the waste in an open area. The following figure showed the present scenario of solid waste managementsystem

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Plastic Bin 7%
Concrete Bin 9 %
Others 2%
No Management 82 %

Source of Solid Waste

Waste generation was varied from area to area. The main sources of solid wastes were dormitory, residential,commercial, institutional, building and construction site. The following scenarios were found from different sources by the survey work.

fig.(1a)

fig.(1b)

fig.(1c)

fig.(1d)

fig.(1e)

fig.(1f)

It was observed from that about 4% people were familiar with the waste management system. Majority of the people around 96% were not well-known with the waste management system. It was very alarming that there was not a single person got the waste management training. For disposing of waste, about 13% people were used bin, 24% people lobbed the waste in the drain and 63% people kept the waste in an open area.

Household waste generation in the Madhubani

The first and one of the largest challenges in trying to understand any waste system is to find out how much waste is produced. A survey was conducted (70 households; 132.3 kg waste collected) and the waste generation rate is found to be 0.315 kilograms per person per day. Using the rate, an average family of 6 people would produce around 1.89 kg of waste per day. At the municipal level with 64,000 households, this translate to 123.5 metric tons of household waste generated daily. On a daily basis A2Z collects around 120 MT of waste, which include the household and business waste too.

Waste Collection

Door to door collection is proposed for collection of solid wastes of general households and commercial establishments. In this system, the households deliver the wastes separately for organic and inorganicparts of the wastes (two bins system) to the vehicle atthe time of collection.Collector sounds horn or rings bell and waits at door step for residents to bring wastes to thecollection vehicle.

Following primary collection vehicles are proposed:

4- Containers carrierPushcart

8 -Containers carrier Tricycle/Tricycle with

compartments for dry and wetwaste.
auto Tipper/Smaller Tipper- 1 MTCapacity
All residents shall be encouraged through information and education campaign to;
keep the food waste, kitchen waste and other bio-degradable waste.
when generated, in the domestic waste container as prescribed and made available by the ULBs for the purposeand keeprecyclable and non-biodegradable waste in the waste container prescribed and supplied by theULBsfor the saidpurpose.
Households bins of Green and Blue colour of capacity10-12 ltr for a familyof five members is supplied by the ULB sfree of cost at thefirstinstanceonly.Thelifecycleofbinsisconsideredas3 years.

The collection method is **Door-to-Door**. Around 70-80% of household is covered under door to door collection. This was the first Door-to-Door Collection system implemented in the city. The new MSW management system in Madhubani wasdesigned to offer household two means for disposal.
1. Either daily Door-to-Door Collection.
2.Disposal through Convenient dumpsters placed throughout the town.

Waste collected from the households is expected to separate by the household itself in organic, inorganic and recyclables. Moreover, households are expected to separate dry and wet waste at household level only. But there no such practice done by the households of the city. Waste is collected 6 days in a week.

Moreover, every ward has its own dumping point and it is observed that in a every ward almost all households belong to same socioeconomic group, every day or once in two days when dumper used to come to collect the waste from each ward, it is weighted for 7 day for each of the socioeconomic group randomly from different wards in order to make a representative sample. From the data collected for seven days per house hold (6 members/ house hold assumed) and per capita generation was calculated which is shown in table no. 1. It can be clearly understood from the table that LIG has the lowest waste generation whereas HIG has the highest generation rate. If mean of all of the generation rates for socioeconomic groups is calculated, comes 0.316 kg/person/day.

V. CONCLUSION

The study was carried out to design and development waste management system in Madhubani Town. Based upon the survey work, the following conclusions were drawn:

It was helpful to know the present status of waste management system of Madhubani Town. Thepresent status of waste management system in Madhubani Town were identified by conducting reconnaissance and questionnaire survey.

Total quantities of waste generated Madhubani Town were estimated by mathematical calculation. Finally, according to survey data and scientific measurement a future management technique and a collection route were designed for proper management of waste.

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