Innovations

Status of Household Solid Waste Management in Mainpuri City of Uttar Pradesh, India

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Abstract
Generation of solid waste by human activities is mandatory but due to population growth, urbanization, industrialization, economic growth there is a dramatic change in nature and amount of solid waste generated. The amount of solid waste generation has been increasing in proportion to rising population and growth in the economic sector. This paper is an attempt to study the current status of solid waste (generation of household solid waste and disposal scenario according to income groups) and how the municipality of city handle the generation of solid waste. This study is based on both primary and secondary sources of data, primary data wascollected through the household survey in Mainpuri city in the 2022. Households of Mainpuri city belong to different income groups were selected and entire sample size consists of 1836 households. The result reveals that solid waste management has become a major problem in small size cities like Mainpuri. The city has a recycling plant for solid waste management but the capacity of the plant is not able to fulfil the current necessity that'swhy excessive amount of solid waste lies down near the Isan River, and around the recycling plant; If the city does not get any appropriate solid waste management plan in future condition becomes more worse. In present situation Mainpuri city needs a suitable plan for (SWM) solid waste management to overcome the approaching challenges.

Keywords: *Solid waste, Management, Recycling plant, Challenges*

1. Introduction

Waste has been generated since the beginning of human beings. The nature of waste generation has become more complex with the progress of civilization. The unprecedented change in our way of life along with industrial development has changed the basic nature of the environment. Usually, many items are consumed in urban and rural areas and then residues are obtained. Some residues are useless due to no proper disposal system situation of 'pollution'arises. In common man eyes, anything that is unwanted, not useful, or that has no economic value is 'garbage' or 'waste [1].Waste is ''Anything that does not create value'' [2]. The word ''Solid Waste'' refers to discarded or abandoned waste material from street sweeping, houses, industrial, commercial and agricultural activities that results from human activities in the form of solid is called solid waste. However, from a scientific perspective, there is no waste in the natural world. Almost every component of solid waste has some potential if it is treated or converted. Solid waste may be defined as organic or inorganic substances produced by commercial or domestic activities, that have lost their value from the viewpoint of the person who initially owned them but may be valuable to somebody else [3].The expanding economies, rapid urbanization, and raise the level of living standard in developing nations have significantly accelerated the quality, rate and amount of municipal solid waste generation [4]. In nature and society recycling and decomposition process always continue, hence one type of solid waste may prove useful to others [5]. Recycling the items like old iron, plastic, glass, paper, etc. comes in a new form in front of us and the bio-degradable substance in a fixed amount is decomposed by the micro-organisms [6]. Yet there is an excessive amount of waste currently being generated in this era. So, it is not possible to recycle or decompose and the excessive amount of solid waste becomes a serious problem for environment and human beings. Expanding population and rapid urbanizationare the primary forces of growth in the economy which leads to increase in human resources, economic activities and resource consumption [7].

As a result, waste is increasing rapidly due to expansion of population and economic development in the worldand the quantity of biodegradable solid waste

is decreases and the amount of non-biodegradable solid waste is increases day by day [8].In 2025, the population of the world will exceed about 8 (eight) billion, with almost 5 (Five) billion people living in urban areas [9]. Currently, 4 (Four) billion TPD (tons/day) solid waste (municipal, industrial, hazardous) is generated annually in the world. In which Municipal solid waste is1.6 to 2 billion tons/day [10].

Solid waste is taking a serious challenge in itself, not only for environmental experts but also for the general public. In 190112.26% (258.55 lakh) and according to 2011 census 31.2% (3771.06 lakh) population lived in urban areas. In the last few years, the population is continuously migrating from the rural, semi-urban areas to the cities. Due to which the population and number of towns are increasing. Total number of cities in 2001 was 5161, which increased to 7935 in 2011 [11], [12].This paper deal with the status of household solid waste management in Mainpuri City of Uttar Pradesh. Household waste is the primary source of municipal solid waste in city and the rest from commercial, medical, and other activities type and amount of solid waste varies with the time and season. The household solid waste is generally biodegradable in nature but the current state of waste is quite serious in the city because of the increasing amount, changing nature and type of solid waste.Perusal of the table no. 1 shows solid waste generation status of India according to CPCB report. It is clear from the table the amount of solid waste has decreased from the year 2013-14 to 2017-18.This decrease is not because the country reduced the solid waste generation but the reason behind it is delay or no-submission of annual report by the various responsible states. This shows the seriousness of concerned states and authorities for the SWM (Solid waste management), due to which it is difficult to correctly estimate solid waste generation in India.

Table 1. Status of solid waste generation and annual report (2013 – 2018)

Year	Solid waste generation status			Status of annual report received
	Solid waste generation (TPD)	Collected (TPD)	Treated (TPD)	
2013-14	142566	117645	33665	35
2014-15	141064	127531	34752	30
2015-16	135198.27	111027.55	25572.25	24
2016-17	119140.9	116685.9	24045.05	26
2017-18	43298.385	45082.15	15386.81	16

Source: CPCB reports from the year 2013 to 2018

According to the recent report of the CPCB, **43298.385 TPD (tonnes per day)** of MSW was generated in India from 2017 to 2018. Out of the total waste, approximately **45082.15 TPD** of Municipal solid waste was collected and only **15386.81 TPD** was treated or processed. This data is only received from 16 states out of 35.Table no. 1 also shows that states who submitted their report in 2017-18,

and states like Uttar Pradesh, Rajasthan, Maharashtra, Haryana, Himachal Pradesh, Punjab, Kerala, Delhi etc. doesn't submit their report for mentioned years positively. It is clear that in India management of solid waste is the most overlooked sector by central government and local authorities [13].

2. Objectives

- To study the current status of solid waste (household solid waste generation and disposal scenario according to income groups).
- To find out that how the municipality of city handle the issues related to solid waste management.

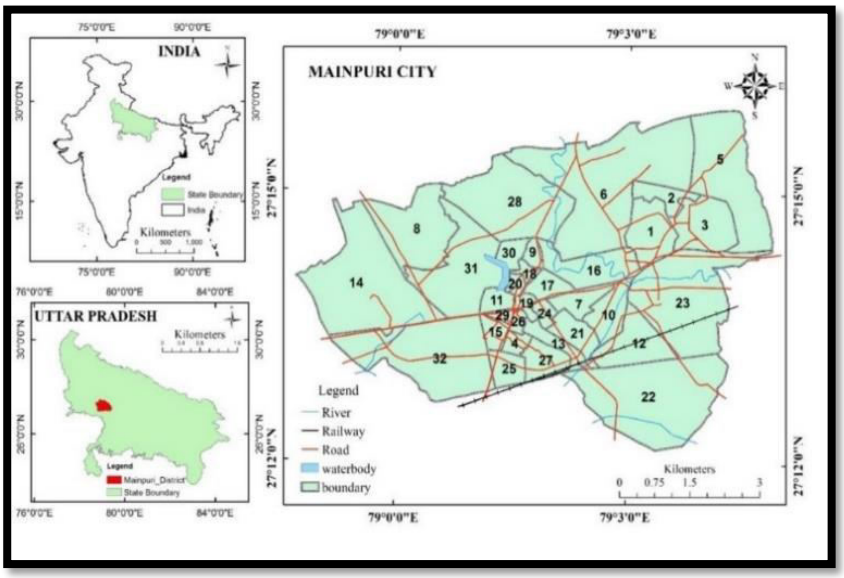
3. Materials and methods

The study is based on primary data acquired through the City Survey, households Survey, and samples collected from the respondents by questionnaire interview method. The Stratified random sampling technique has been used for sampling.
(i) In the first phase, 16 wards (about 50 % of wards) were selected from the 32 wards of Mainpuri city on the basis of population and their location in the city.
(ii) In the second phase, 10%of houses (1836) were selected from each selected ward on the based-on income groups.
High Income Group >₹ 35,000 / month (474 households)
Middle Income Group ₹ 10,000 - 35,000 / month (626 household)
Low Income Group <₹ 10,000 / month (736 households)
Distribution of income groups and questionnaire has been prepared with the help of data used in similar studies [14], [15], [16], [17], [18] and discussion with various authorities of the city like commissioner. Secondary data was collected from the Municipal council of Mainpuri (2022),District census handbook of Mainpuri city (2011), CPCB Report (2013-14 to 2017-18) etc.

3.1 Study area

The city of Mainpuri serves as the administrative headquarter of Mainpuri district. This city is the part of the Agra administrative division. Latitudinal and longitudinal extent of the city is 27° 12' 8" N to 27° 15' 53.98" N and 78° 58' 42" E to 79°04' 52.11" E. The district has the appearance of a flat plain area, disrupted by small sand ridges in the western boundary, somerolling sand hills and meanders of the Isan and Kali Rivers, and the ravines alongside of the Yamuna River. National Highway no. 91 passes through the Mainpuri district via Kannauj and Etah as well as Kurawali, Sultanganj, Nabiganj and Bewar and two state highways run through the Mainpuri city UP SH 83 Mainpuri – Etawah and UP SH 84 Shikohabad - Firozabad- Mainpuri. Both state highways link the city to NH 91. Railway station of Mainpuri at Lane no. 12 was started in 1905. Cotton ginning, Oilseed milling, lamp &glass manufacturing are the major industries of the city.

Fig. 1: Location of Mainpuri City



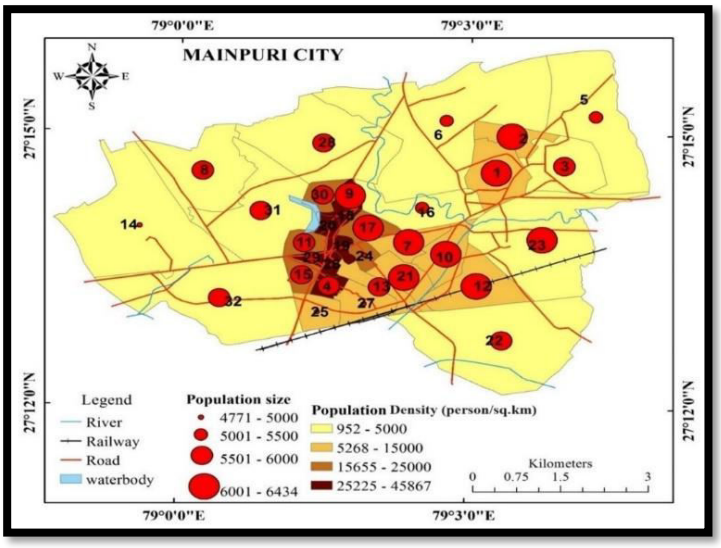
Source: Base map, Mainpuri City Council

4. Results and Discussion

4.1 Status of household solid waste in Mainpuri City

The Municipal Council of Mainpuri district is responsible for solid waste management services in Mainpuri city. As per the data of 2011 Census, the total population of Mainpuri city was 1, 20,400 (Census, 2011). According to the municipal council, (2022) population of the city is 1, 79,288. Perusal of the fig.2 reveals that 9 wards listed under the category of very high population (>6001), 11 wards under the category of high population (5501 - 6000) and 4 wards listed under the category of the moderate population (5001-5500), while 8 wards came under the category of the low population (<5000). This classification shows that the city's 35.06% population comes under the category of high population (5501 - 6000).It is observed that about 7 wards comes under the category of very high density of population (>25225 persons per sq. km), 5 wardsunder the category of high density (15655-25000 persons per sq. km) and 9 wardsunder the category of moderate density (5268-15,000 persons per sq. km), while 11 wards in the category of low population density (<5,000 persons per sq. km.). The classification clarifies that most of the high-density wards lie in the core of the city. According to the data of Municipal Council, Mainpuri city generates 40 tonnes of solid waste per day but survey conducted in the city revealed that approximately 80 to 100 tonnes solid waste per day was generated in the city, and capacity of the waste recycling plant is to treat only 40 tonnes of bio-degradable waste per day. This data shows that 50 % solid waste of the city is dumped on the vacant spots located near the Isan River, Shamsan Ghat Road, and Jail Road. Every day 10 to 12 trucks of Solid waste are being dumped on the banks of River Isan.

Fig. 2. Ward wise Population size and Density of Mainpuri city



Source: Census of India, 2011

4.2 Amount of solid waste generation by households

Quantity and Quality of waste vary according to residential, commercial, and industrial areas, as well as economic, occupational, educational, and population status. It was observed from table no.2 that approximately 42 % of the total sampled households generated less than 1 kg solid waste per day. Income wise data distribution shows that 53 percent households of high-income group generated 2-3 kgs of solid waste per day, 46 percent of the medium income group households generated 1-2 kg solid waste per day and 78 percent of the lower-income group households generated less than 1 kg solid waste per day. The higher-income group households of Mainpuri city are generating more solid waste than the lower and medium income households and most of their waste is consist of non-biodegradable items which are very harmful for the city people and the surrounding environment.

Table 2. Income-wise distribution of sampled households (in percentages) from Mainpuri City according to the Amount of solid waste generation

Income Group	Amount of solid waste generated by households			
	<1 kg/day	1- 2 kg/day	2-3kg/day	>3 kg/day
High	3.16	18.57	53.59	24.68
Medium	28.43	46.01	16.29	9.27
Low	77.85	18.62	3.53	-
Total	41.72	27.94	20.81	9.53

Source: Field survey, 2022

4.3 Solid waste disposal at the household level

According to government rules, every urban local authority has to provide or offer door to door waste collection service but due to lack of labour and financial crises, authorities are not able to give their services properly. Household solid waste disposal habits are very important to clean their neighbouring environment. It was observed from Table no. 2 that approximately 66 percent of the total sample households throw their solid waste on unauthorized sites (into the drain (7.46%), open plots, land/field (28.95%), waste dumps (29.29%)) and rest approximately 32 percent of total sample households throw their waste on authorized sites. Apart from this some households (2.37%) decompose their waste. This is a good practice of reducing and reusing of solid waste at source. On the basis of income-wise distribution approximately 60 % of the high-income group, 23 % of the medium income group, and 14 % of the low-income group dump their waste on authorized sites (Municipal waste bins). It is seen that unauthorized disposal of waste is highly prevalent in most of the lower-income group households because the dustbins are not placed near their houses but at a great distance in other localities.

Table 3. Income-wise distribution of sampled households (in percentages) from Mainpuri City according to Place of disposal

Income group	**Unauthorized sites**				**Authorized site**
	Into drain	Open spaces	Waste dumps	In hole of house	Municipal waste bins/ collection van
High	1.48	10.13	22.57	6.32	59.5
Medium	5.27	38.82	32.43	0.79	22.69
Low	15.64	43.88	32.88	-	13.6
Total	7.46	28.95	29.29	2.37	31.93

Source: Field survey, 2022

4.4 Collection of solid waste by Municipality

Collection of solid waste from the city is the responsibility of Mainpuri municipal council. Approximately 46 percent of total sampled households reported that solid waste was not collected from their locality more than 15 days. This type of attitude of the municipality is harmful to both natural environment and human health. It is clear from the income-wise distribution that the frequency of waste collection service is upright in the higher income groups as compared to the low-income groups. Approximately 55 percent of high-income group solid waste is collected daily, approximately 30 percent of medium-income group waste is collected weekly and nearly 56 percent of low-income group waste collect monthly. Data reveals that low-income people are highly affected by municipality services and lives in an unhygienic and messy environment which is very dangerous situation for their health.The condition of waste management in their

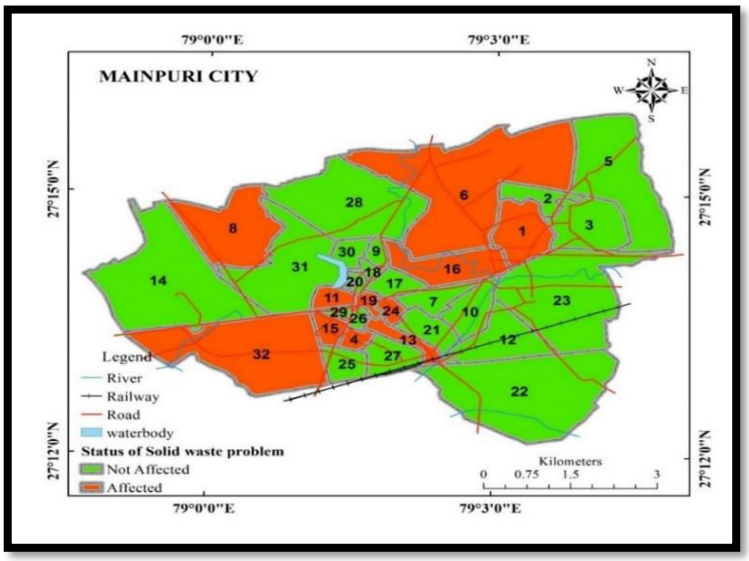
wards are worst because these wards are located in the low-lying areas of the Mainpuri city, near the pond (Raaja ka Taal) and Isan River. Due to the garbage lying at these unauthorized sites the people of the city are facing many problems like garbage blocking route, the drains and cause water logging problems giving breeding grounds to many germs, flies and insects. They may become the cause of many diseases like malaria, cholera etc. Foul smell surrounding environment and the uncollected waste attracts many animals like cows, dogs, pigs etc., causes many accidents and also creating the traffic problems.

Table 4. Solid waste collection frequency by municipality (in percentages)

Income group	Daily	Alternative days	Twice a week	Weekly	Fortnightly	Monthly
High	55.49	17.09	16.03	7.17	1.27	2.95
Medium	8.47	10.7	8.95	30.51	25.08	16.29
Low	3.53	2.04	3.8	13.59	21.07	55.97
Total	18.63	8.88	8.71	17.7	17.32	28.76

Source: field survey, 2022

Fig. 3 Map of Mainpuri city affected with solid waste management services



Source: field survey, 2022

4.5 Issues related to Municipal solid waste management

On the basis of assessment associated with the solid waste management practices in Mainpuri City, it is derived that the management of solid waste is in very poor condition and it is worsening day by day due to lack of awareness, financial lack, insufficient infrastructure and lethargic behaviour of agencies. From Table no. 1 we are able to understand the current state of solid waste management in India. From the help of table no. 2, 3, and 4 this study shows that the condition of solid waste management in low-income group households is very pathetic and municipal council does not give proper service in these areas. About 78% of low-

income group houses generated less than 1 kg of solid waste per day this amount of solid waste is negligible as compared to the high and medium income group. On the other hand, they don't have public bin in their areas this is one reason why about 86% of low-income group household dump their household waste on unauthorized site. Apart from this, the frequency of collection of waste by the municipality is very low all over the city; only 19% of sampled households get the municipality service daily. And out of these high-income group about 55%, medium income group about 8% and 3% of low income get municipal service daily; Rather than this about 56% of the low-income group get the municipal service monthly. Condition of solid waste varies according to location, living standard and climatic conditions. In rainy season, some wards faces worse condition e.g. (ward no. 4) Agravaal,(ward no. 5) Sansarpur,(ward no.6) Sheetala Dhaam,(ward no. 8) Dhaarau, (ward no. 11) Dariba-Mahmud nagar,(ward no. 23) Nagla Niranjan,(ward no. 28) Nagariya, (ward no. 31) Ram Lila Maidaan,(ward no. 32) Nagla Rate (figure no.2) during rainy season, leachate from these open dumped sites is causing substantial pollution to water bodies in Mainpuri city. With the interaction of various departments of the city and respondents, we are able to identify some major problems which are–

- No proper door-to-door collection service.
- Inadequate number of bins in wards and public areas.
- Segregation of solid waste was not implemented at the source place and the public doesn't know about this.
- Open burning of solid waste by local people and disposal of solid waste in illegal open dumps, drains, and low-lying areas.
- Solid wastes have littered the streets, footpaths, open spaces/plot lands, drains, or water bodies indiscriminately.
- Financial issues of the municipality.
- Solid waste management rules are not implemented on the ground level.
- The household's awareness level, regarding solid waste management, is observed to be very low in all income groups.

4.6 Suggestions

- The municipality should adopt an organized SWM plan for the city so the collection system of solid waste from public bins and households should be quick and regular.
- The municipality has to place at least bins at the main disposal sites of the city and promote Segregation process to recycling and reuse of solid waste.
- There should be a landfill site for the disposal of solid waste.
- The Indian government has to arrange additional funds for solid waste management and should promote awareness campaigns to reach more people through print and electronic media.

- Municipality can involve the private sector in the collection, transportation, and treatment of MSW.

4. Conclusion

We can't stop solid waste generation, due to changes in demography and economic growth the quantity and characteristics of MSW have changed manifolds. If we do not plan for solid waste management now, then the condition gets worst day by day because improper waste management affects our environment and health. The uncontrolled and unscientific processes of the disposal of municipal solid waste has resulted increasing number of instances involving human health as well as contamination of both surface and groundwater which poses major risk for human health and surrounding environment. Surprisingly, indiscriminate disposal of municipal solid waste without considering its impact on the environment in low-lying areas and near water bodies is a common practice in many cities of developing countries like India [19], [20], [21], [22].

In Indian cities, the municipal solid waste management system is unscientific, outdated, and inefficient. Government must encourage other processing and treatment methods (recovery/recycling, compost, incineration, and landfill Facilities) for reducing amount of solid waste.

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7. Conflict of Interest

The author(s) declares no conflict of interest.

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