e-ISSN No.: 2582-4228

Journal of Indian Association for Environmental Management

Journal homepage: www.http://op.niscair.res.in/index/php/JIAEM/index

Approach in Scientific Management of Municipal Solid Waste in Kadapa Town

Patan Hussen Basha and S. Sumithra*

Department of Environmental Science, Yogi Vemana University, Kadapa, A. P, India.
Corresponding Author: Email Id. ssumithra1@yahoo.co.in

Submitted:29 October 2024 Revised:05 December 2024 Accepted: 09 December 2024

***Abstract*:With an increase in population, lifestyle changes and migration, the quantity of waste have increased every year which may cause the challenge for the municipal authorities to manage it properly. Studies have been investigated to know the generation of solid waste such as residential and commercial. Quantification of waste at disposal site was carried out, as the biodegradable waste was treated by vermicomposting method, the paper and plastic waste found to be 34 - 22 % and 17- 9% at Ukkayapalli, Putlampalli and Mardimadugu dumping site. Moreover, for non-biodegradable waste generation in the Kadapa town we can solve the problem by 3 R technologies such as Reduce, Reuse and Recycle the materials.**

***Keywords*:Reduce, Recycle, Population, Lifestyle, Ukkayapalli**

I. INTRODUCTION

Municipal solid waste is commonly consists of garbage and rubbish which are used every day and disposed off such as food waste, papers, plastics, packaging, clippings of grass, batteries, rubber, cloth etc. This waste poses a significant threat to both the ecosystems and global economy (Darda et al. 2019). The calculated 7 to 10 billion tons of waste are generated world wide, among them municipal solid waste accounting for a 3.2 billion tons (Wilson et al. 2015). The municipal solid waste is said to be non hazardous waste that are generated by residential, commercial and institutional activities (Alonso and Themelis, 2011).

Increasing population, industrialization, upgraded lifestyle, urbanization and economic development are factors behind increasing solid waste generation. Many factors not only affect a particular area or a country but also have made solid waste generation a world wide problem (Mathur 2012; Sridhar 2016). Higher growth in the urban has massive and crowded cities that directly increase the municipal solid waste generation (Shahab and Anjum 2022). Dutta et al. (2014) proposed that the global population will reach 9 billion by 2050, raising serious concerns about the colossal volume of the future municipal solid waste and the intensified resource utilization, which further pose severe threats to our planets habitat (Rathore and Sarmah, 2020). The income levels and the education of the people in the various areas will vary the type and the generation of the waste due to their lifestyle and awareness.

Implementing a systems propose in municipal solid waste management will consider not only the individual components but also their interaction and their effect on the environment. Further, it has been observed that the immoderate drawing out of available resources and the prevalent disposal of municipal solid waste in landfills and incineration plants exert detrimental effects on both the socio – economic and environment components (Garibay –Rodriguez et al. 2018). Huge quantity of urban waste must be properly managed in an environmentally sound manner so that it cannot adversely impact the environment, inhabitant health and the daily life in Indian cities. Waste segregation should be done from house hold level itself. Private sector partnerships can contribute to capacity building by providing training programs, workshops, incentives and educational resources that equip individuals with the skills and knowledge.

The present scenario of solid waste management has emerged in the forms of problem, opportunity and big challenge not only due to the impact on environment, aesthetic concerns and health but also due to the massive amount of waste

generated everyday (Mani and Singh, 2016). Municipal solid waste Management and Handling Rules assign the citizens duty to segregate waste at their household and also gives strict adherence to avoiding littering streets and delivering bodies (MoEF, 2016). Awareness generation and recycling practices, improving the levels of cleanliness through SWM activities in statutory towns.

Proper waste management and various aspects have to be considered, such as a reduction in resources, and on-site storage, collection, transfer, Recycling and disposal.

The main objectives of the present day are

1. To study the existing population of the Kadapa town and projection of the future population.
2. To examine the existing scenario of municipal solid waste generation and quantification.
3. Identification and quantification of disposal site in the Kadapa town.
4. Municipal waste transportation from collection point to the dumping site with proper solid waste management.

Study Area

Kadapa district is located at 78º- 50 E Longitudes and 14º - 29' N Latitude. Kadapa town has been spread in 164.08 Sq. Km. This town has 50 wards and they has been divided in 4 zones. As per the Census 2022 the population of the Kadapa town as 3,86,280. The city of Kadapa is managed by the Kadapa Municipal Corporation (KMC).

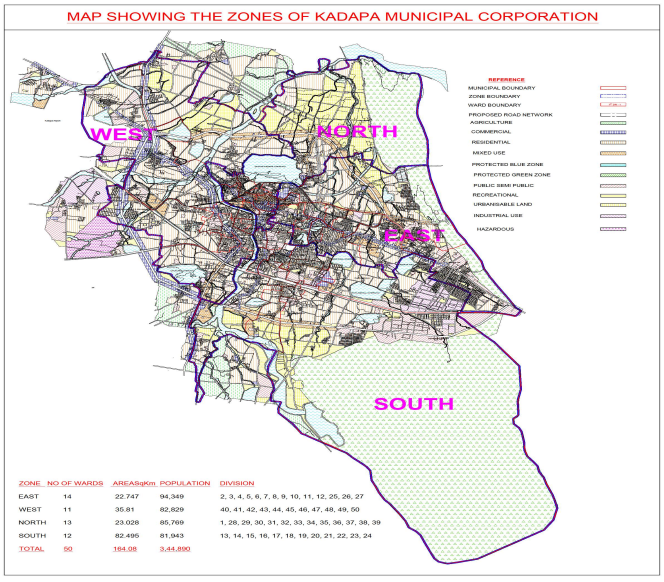

Fig. 1. Location Map of Kadapa Town

II. MATERIALS AND METHODS

The primary and secondary data were collected. House hold waste was collected and weighed separately using digital spring balance. Quantification of municipal solid waste was carried out by the method cone and quartering at the dumping sites namely Ukkayapalli, Putlampalli and Mardimadugu. To know the waste generated per day various shops were selected and the waste accumulated in a day was segregated and weighed. Quantitative analysis was carried out on the results of measurement of population projection using arithmetic, geometric and incremental method.

A) Arithmetical increase method

In this method, the average increase of population for the last three or four decades is worked out then this average is added for each successive future decades.

Difference between present and first decade = $P - P_1$
Difference between first and second decade = $P_1 - P_2$
Difference between second and third decade = $P_2 - P_3$

$$\text{Total} = \frac{P_T}{\text{----------}}$$

Average increase per decade = pT/n

The population after each successive future decade is obtained as follows:

Population after one decade = $P + P_T/n = P_{F1}$

Population after two decade = $P_{F1} + P_T/n = P_{F2}$

b) Geometrical increase method

In this method, it is assumed that the percentage increases in population from decade to decade remains constant. From the obtained census data, this percentage is fixed and then population of each future successive decade is worked out.

Percentage increase in population from decade to decade is determined as follows:

Present and first decade = $P - P_1/P_1 \times 100 = A_1$
First and second decades = $P_1 - P_2/P_2 \times 100 = A_2$
Second and third decade = $P2 - P3/P3 \times 100 = A3$
Total = An

The population after each successive future decade is obtained by adding this percentage increase as follows:

Population after two decade = $P + [p\ X\ x/100] = P_{F1}$

Population after two decade = $P_{F1} + [pF1\ X\ x/100] = P_{F2}$

Collection of Waste

c) Incremental increase method

The population of each successive future decade is worked out by the arithmetical increase method and to these values; incremental average per decade is added.

Incremental increase between successive decades is worked out as follows:

Period	Increase in population	Incremental increase
Second and third decades	$P_2 - P_3$	$(P_1 - P_2) - (P_2 - P_3)$
First and second decades	$P_1 - P_2$	
Present and first decades	$P - P_1$	$(P - P_1) - (P_1 - P_2)$
		Net = Z

Average incremental increase = Z/n
Average arithmetical increase = P_T/n
Thus population after each successive future decade is
Population after one decade = $P + P_T/n + [1\ X\ Z/n] = P_{F1}$
Population after two decade = $P_{F1} + P_T/n + [2\ X\ Z/n] = P_{F2}$
Where P = present population

P_1 = population before one decade
P_2 = population before two decade
P_3 = population before three decade
P_T = Total population
n = number of decade
P_{F1} = population after one decade
P_{F2} = population after two decade
P_{F3} = population after three decade
A_n = total increase in population
Z = Total incremental increase

III. Results and Discussion

Table 1 shows projected population by different methods. The population data from the year 2001 and 2011 was collected and was then projected for 2031, 2041 and 2051. Arithmetic, geometric and incremental increase is the three methods that have been used for the projection of population in Kadapa town (Fig. 2). The population projection was also studied in Kanpur, India (Mehra and Bhargava, 2020; Ganesh et al. 2019).

TABLE 1
Population Trends and Forecasting of Kadapa Town

Year	Arithmetic Mean	Geometric Mean	Incremental Increase	Average
1991				1,21,463
2003				2,87,093
2013				3,44,893
2023				3,89,195
2033	4,40,246	4,91,297	5,42,343	4,91,295.33
2043	4,53,412.175	3,28,225.183875	615382.33921	4,65,673.2327
2053	4,26,748	4,77,28.996	5,28,836.502	3,34,437.8327

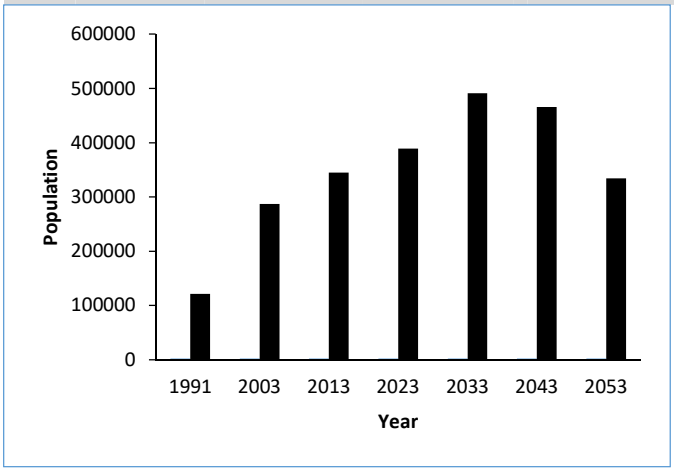

Fig. 2. Population Trends and Forecasting

The average value are calculated which will be further used to known the waste generation in the Kadapa town.

TABLE 2
Present Scenario of Municipal Solid Waste in Kadapa Town

Quantity of solid waste generated per head	450 GMs/cap/day
Total quantity of solid waste generated per day	173 MTs
Quantity of solid waste collected (Approx)	164 MTs per day
Quantity of domestic waste (MT)	103 MTs
Quantity of commercial and market Industrial SW	70MTs
Total No. Hand trolleys available	250
Vehicles	90 Autos 04 Big compactors 10 Mini compactors
Present water supply	49.92 MLD

Source: KMC, Kadapa

Components			
	HIG (%)	MIG (%)	LIG (%)
Kitchen waste	27.44	30.57	22.08
Paper	6.98	15.57	16.5
Plastic	12.26	7.08	13.34
Metals	7.12	5.57	5.33
Glass	11.41	6.83	5.82
Cloth	12.61	10.79	12.62
Rubber	3.23	2.69	4.61
Earth and Ash	9.37	8.63	6.79
Miscellaneous	9.54	12.23	12.86

Quantification in Dumping Site

Composition of solid waste generated at household level: the solid waste composition was categorized into kitchen waste, paper, plastic, metal, glass, cloth, rubber and miscellaneous. The data was collected from 10 household based on the different income groups of Kadapa town. The dustbin of different houses was collected and the wastes were separated. The data clearly explains that the kitchen waste i. e. organic waste have the 30.57 % for middle income group, 27 % for high income group and 22 % for low income group respectively (Table 4) followed by plastic and paper. Similar study was reported in solid waste composition of Kirtipur municipality (Awasthi et al. 2023).

Number of household members: Table 3 clearly shows that majority of household member ranged between 2 and 7.

TABLE 3
Solid Waste Generated in Different Income Groups of Kadapa Town

No	High Income Group		Middle Income Group		Low Income Group	
	Household waste (g) D/W	No. of Inmates	Household waste (g) D/W	No. of Inmates	Household waste (g) D/W	No. of Inmates
1	2.17	3	0.124	4	0.045	4
2	0.486	4	0.141	3	0.073	4
3	0.375	5	0.128	4	0.087	3
4	0.284	2	0.143	4	0.069	4
5	0.844	8	0.165	4	0.036	6
6	0.85	6	0.147	5	0.059	5
7	1.25	7	0.128	3	0.062	3
8	0.8	3	0.088	2	0.075	4
9	0.783	2	0.122	2	0.087	4
10	0.55	6	0.078	2	0.089	4
	8.392	**46**	**1.264**	**33**	**0.682**	**41**

TABLE 4
Percent Composition of Residential MSW in Kadapa Town

The major issue observed during the study of municipal solid waste management of Kadapa town are due to the rapid growth of population, migration and changes in the lifestyle which drastically raised waste generation rate. Where the dump site capacity cannot accommodate the sudden raise in waste quantity. The selection of municipal solid waste dumping site is important to reduce the issue of waste management. Regardless of the waste generation, the segregation of waste at the source itself is the bottleneck (Anunay et al. 2023). As per municipality, Door to door collection vehicles were practised in and around the Kadapa town in order to create public awareness of segregation of waste at the source. Different types of vehicles owned to collect the waste from their respective locations and transport it to the dumping site after segregation (Table 2). Kadapa municipality segregate the waste and the biodegradable waste was treated by vermicomposting method.

It also presents that the generated waste are sent to dumping sites, there are three dumping sites in the Kadapa town such as Ukkayapalli, Putlampalli and Mardimadugu. Paper was found to be 34 %, 26 % and 22 % at Ukkayapalli, Putlampalli and Mardimadugu dump site respectively followed by plastic, earth and ash and rubber (Table 5; Fig. 3).

Transportation of MSW

Treatment of Biodegradable Waste

Generation of waste in commercial area

The waste accumulated was collected and segregated after 24 hrs, the shops were selected in B.K. M street, Y. V street and flower shop in old bus stand. Higher quantity of paper and plastic were reported (Figure 4) (Sumithra et al. 2014). The amount of non biodegradable waste generated provides opportunity for recycling.

TABLE 5
Percent Composition of Municipal Solid Waste at the Dumping Sites in Kadapa Town

Characterization	Ukkayapalli (%)	Putlampalli (%)	Mardimadugu (%)
Paper	33.84	26.2	21.83
Plastic	15.43	9.13	16.64
Metals	4.44	3.41	5.9
Glass	4.63	3.31	5.01
Cloth	15.8	20.76	7.44
Rubber	2.71	11.71	13.71
Earth and Ash	15.82	13.61	12.88

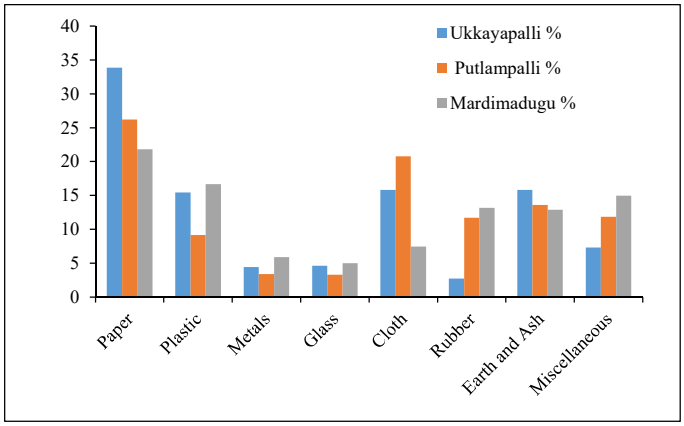

Fig. 3. Quantification of Total MSW in the Disposal Site

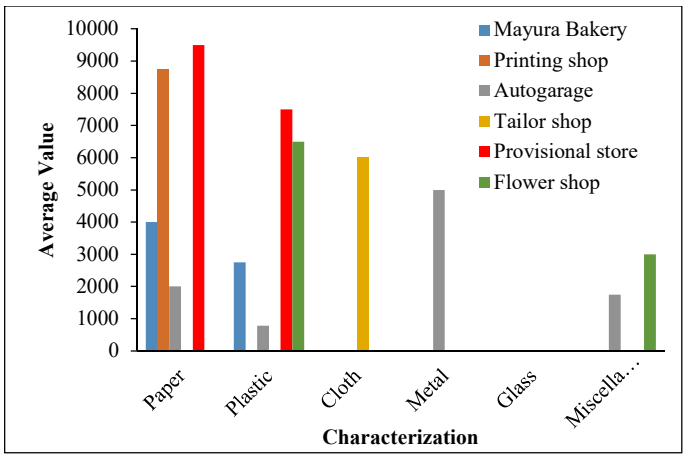

Fig. 4 Average Waste Studied in Commercial Area

IV. Conclusion

Municipal waste management is a challenge for the developed countries. Waste generated from Kadapa town has been disposed in Ukkayapalli, Putlampalli and Mardimadugu dumping site. The present study showed the trends of population from 1991 to 2053 were estimated. The segregation of waste at the source itself should be followed to make foremost use of non biodegradable and biodegradable wastes separately. The entire resident follows practice of waste collection then later regularly collected by municipal vehicle. Waste did not be treated as a throw away material instead it is able to sustain part of living needs.

Acknowledgement: The authors are gratefully to the Municipal Corporation of Kadapa for providing information and help to carry out this work.

V. References

Alonso, M.G.V.P., Themelis, N. Generation and disposition of MSW in Mexico and potential for improving waste management in Toluca municipality. In department of Earth and Environmental Engineering Columbia University, Columbia University, New York, NY, USA. (2011).

Anuway, A.G., Singh, S.K. Solid waste management in India: A State of the Art Review. *Environ. Eng. Res*. 28, (2023). 1 – 18.

Awasthi, P., Chataut, G., Khatri, R. Solid waste composition and its management: A case study of Kiritpur Municipality -10. *Heliyon*. 9, (2023). 1- 10.

Darda, S., Papalas, T., Zabaniotou, A. Biofuels journey in Europe: Currently the way to low carbon economy sustainability is still a challenge. *J. Clean Prod*. 208, (2019). 575 – 588.

Dutta, K., Daverey, A., Lin, A. J. G. Evolution retrospective for alternative fuels: First to fourth generation. Renew. *Energy*, 69, (2014). 114 - 122.

Ganesh, K.M., Prasad, A.C.S.V., Vara Prasad A.S.S. Municipal Solid Waste Management in India with special reference to Narasapur town in West Godavari district, Andhra Pradesh, India. *International J. of Recent Technology and Engg*. 8, (2019). 311 – 318.

Garibay – Rodriguez, J., Laguna – Martinez, M.G., Rico – Ramirez, V., Botello – Alvarez, J.E. Optimal municipal solid waste energy recovery and management: A mathematical programming approach, *Comput. Chem. Eng*. 119, (2018). 394 – 405.

Mani, S., Singh, S. Sustainable Municipal Solid Waste Management in India: A Policy Agenda. *Procedia Environ. Sci*. 35, (2016). 150 -157.

Mathur, V. Scope of recycling municipal solid waste in delhi and National Capital region (NCR). *Integral Rev. – J. Manag*. 5, (2012). 27 – 36.

Mehra, A., Bhargava, A. Sustainable Municipal Solid Waste Management – A case study of Kanpur, India. *J. of New Developments in Chemistry*. 3, (2020). 12 -22.

Municipal Solid Waste (Management and Handling) Rule, India. (2016). Ministry of Environment Forest and Climate Change- Govt. of India.

Rathore, P., Sarmah, S.P. Economic, environmental and social optimization of solid waste management in the context of circular economy, *Comput. Ind. Eng*. (2020). 145.

Shahab, S., Anjum, M. Solid Waste Management Scenario in India and Illegal Dump detection using learning: An AI approach towards the sustainable waste management. *Sustainability*, (2022). 14, 1 -28.

Sridhar K.S. (2016). Solid Waste Management in Asia Pacific. Public Work. Manage. Policy. 21, 53 – 70.

Sumithra, S., Sunitha, V., Nagaraju, G. Municipal Solid Waste management in Kadapa town: A case study. *J. Environ. Science and Engg*. 56, (2014). 123 – 126.

Wilson, D.C, Rodic L., Modak, P., Soos, R., Carpintero, A., Velis, K., Iyer, M., Simonett, O. (2015). The global waste management outlook. Report, United Nations Environmental Programme, UNEP, Nairobi, Kenya.