

**A STUDY OF THE SOLID WASTE MANAGEMENT SYSTEM
IN SURAT CITY: ASSESSING THE ROLE OF WASTE
SEGREGATION AS A SUSTAINABLE LIFESTYLE
PRACTICE.**

Dr. Nikita Desai

Assistant Professor

Mahatma Gandhi Department of Rural Studies

Veer Narmad South Gujarat University, Surat-395 007, Gujarat, India.

Email Id: nikkidesai08@gmail.com

Contact No: 9825948410



Abstract:

Effective solid waste management is an essential challenge for sustainable urban development since rapid urbanization, industrialization, and population growth have significantly increased the amount of municipal solid garbage generated on daily as well as annually basis. Waste segregation at source level (household level) has become a crucial sustainable lifestyle practice that improves wet waste to composting or biogas production, dry waste recycling, resource recovery, and environmental conservation among the many elements of municipal solid waste management. Through the use of scientific waste collecting methods, Garbage collection by door-to-door collection method and cutting-edge processing facilities. Surat, one of the fastest growing industrial and commercial cities in India has made impressive strides in waste management and cleanliness of the city. However, active involvement of residents in segregation of domestic waste is essential for the success of waste management practices.

Organic waste and inorganic waste are mixed and dump it in dumping side where chemical reaction occurs that is more dangerous for natural resources and biodiversity. This study aims to assess the solid waste collection, transportation and management system in Surat city. In this study particular emphasis on the role and importance of solid waste segregation at source level is a best sustainable lifestyle practice and also help to reduce mix waste generation. Survey study examines the level of public awareness, attitudes, participation and behavioural practices of household waste. The findings are expected to provide valuable insights into the effectiveness of existing waste segregation and management practices which helps the contribution of household waste segregation towards environmental sustainability and efficient resource management.

Introduction:

Imagine garbage left uncollected at one corner of your home for few days. Imagine also that the container is uncovered. Can you visualize the odor that results throughout your house? Now assume that the society refuse collection crew is on strike. You put your refuse out, along with your neighbors, at the curbside and it stays there for the duration of the strike. How can the waste build up, and can you imagine the stench that results throughout the society? From this scenario you should be able to appreciate the importance of problems associated with solid waste management (Sincero & Sincero, 2004; Tchobanoglous, Theisen, & Vigil, 1993, Birdie & Birdie, 2011). Solid waste management may be clear as the application of techniques that will ensure the orderly implementation of functions of collection, processing and disposal of solid waste Tchobanoglous et al., 1993; Peavy, Rowe, & Tchobanoglous, 1985, Sasikumar

& Gopi Krishna, 2009). The functions are called the three basic functional elements of solid wastes management. Collection refers to the gathering of solid wastes from places such as residences, commercial, institutional and industrial establishments and public places. Processing refers to the activity applied to solid waste to prepare it for subsequent operation. Disposal refers to the placing of solid waste in its ultimate resting place (Sasikumar & Gopi Krishna, 2009). Municipal solid waste generation is dramatically increased day by day in the across the world due to population growth, industrial expansion, rapid urbanization, flexibility of resources and changing consumption habits (Singhal & Pandey, 2001). The efficient solid waste management is become more challenging issues for environmental sustainability and municipality. To degrading the urban environmental quality due to the buildup of mismanaged waste that's create major risks to ecological balance, harmful impact on biodiversity, public health and quality of life (Davis & Cornwell, 1998; Sincero & Sincero, 2004).

To maintain clean and healthy areas requires an effective and sustainable solid waste management practices and develop system. Solid waste management refers to the systematic system where collection, segregation, transportation, processing, recycling and scientific way disposal facilities. Solid waste generated from residential, commercial, institutional, industrial and public place which is manage systematic way (Tchobanoglous et al., 1993; Sasikumar & Gopi Krishna, 2009). Modern waste management systems, however, emphasize an integrated approach that prioritizes waste reduction, reuse, recycling, and resource recovery before disposal, following the internationally accepted waste hierarchy (ILO, National Solid Waste Management Strategy, World Bank, 2018).

Among the various steps of solid waste management system, waste segregation at source level is best practices for sustainable waste management. Source segregation refers to the practice of separating biodegradable, recyclable, domestic hazardous, sanitary, and inert waste at the point of generation such as households, educational institutions, commercial establishments, and offices. Proper segregation practices improve the efficiency of waste collection and transportation, enhances recycling and composting, reduces contamination of recyclable materials, minimizes landfill waste, and lowers greenhouse gas emissions. It also contributes significantly to resource conservation and supports the transition towards a circular economy. (Sasikumar & Gopi Krishna, 2009; Tchobanoglous et al., 1993).

Waste segregation is not merely a municipal responsibility but a sustainable lifestyle practice that reflects responsible environmental behaviour among citizens. Sustainable lifestyle practices involve conscious decisions and everyday actions that minimize environmental one such behavioural practice that encourages responsible consumption, efficient resource

utilization, and environmental stewardship. The active participation of households, educational institutions, commercial establishments, and community organizations is therefore essential for the successful implementation of municipal solid waste management systems (Singhal & Pandey, 2001). Solid Waste Management Rules, 2016 has revolutionized the national approach towards Municipal solid waste management by making source segregation necessary and giving shared responsibility to local bodies in India. The Rules support division of trash into biodegradable, dry recyclable, and domestic hazardous categories, so facilitating recycling, composting, scientific treatment, and environmentally sound disposal (Government of India, 2016; CPCB, 2021). Moreover, these provisions support India's commitment towards achieving the Sustainable Development Goals (SDGs), particularly SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action) United Nations. (2015).

Surat is a one of India's fastest-growing metropolitan cities and a significant commercial and industrial powerhouse in Gujarat. It has earned national recognition for its remarkable transformation in urban sanitation and municipal governance. The Surat Municipal Corporation has embraced various new measures including door to door waste collection, mechanized transportation, decentralized processing facilities, public awareness campaigns, advance technologies and monitoring system. (Surat Municipal Corporation; Centre for Social Studies, 2005).

Despite these advances, challenges remain regarding reliable waste segregation at source, public awareness, Sustainable citizen participation and behavioral compliance. In this study, "A Study of the Solid Waste Management System in Surat City: Assessing the Role of Waste Segregation as a Sustainable Lifestyle Practice," search for to examine the effectiveness of the existing solid waste management system in Surat City with particular importance on waste segregation at source. The study aims to evaluate citizens' current practices, awareness and attitudes regarding waste segregation, identify the factors influencing segregation behaviour, assess the contribution of segregation towards sustainable waste management, and suggest policy measures for strengthening sustainable lifestyle practices among urban residents (Centre for Social Studies, 2005; Desai & Maurya, 2013).

Existing Solid Waste Management System in Suart City

The main parts of solid waste management system include Collection, Transportation and Disposal of Municipal Solid waste clearly identifying in Fig 1 (Surat Municipal Corporation, 2023).

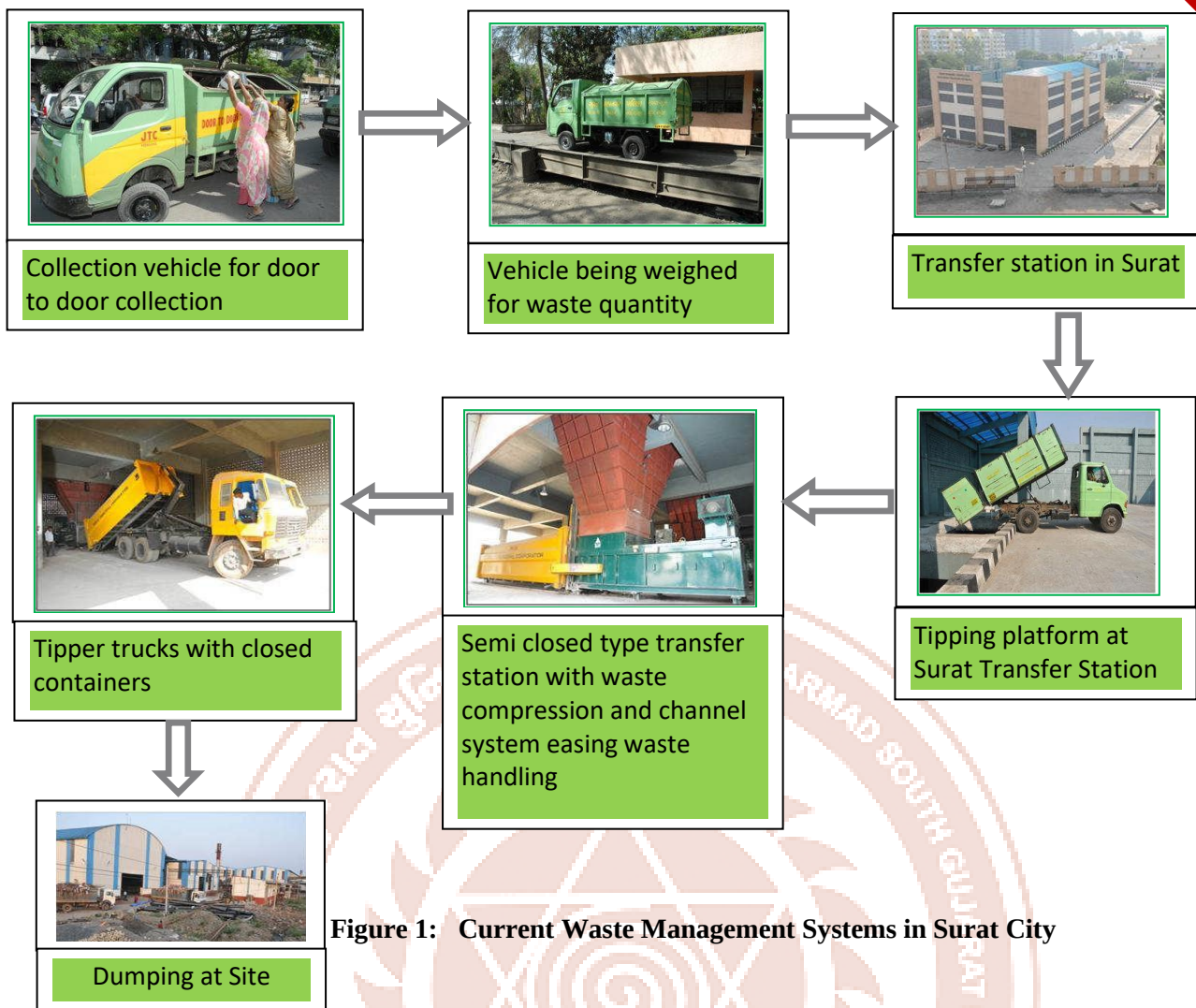


Figure 1: Current Waste Management Systems in Surat City

Methodology:

Solid Waste Collection and Segregation:

50 houses were selected for Solid waste collection. The group was divided on the basis of peoples living in house i.e. 7, 6, 5, 4, 3, 2. After collection waste was segregated like Food waste, Paper waste, Plastic waste, Cardboard waste, Wood waste, Rubber waste, Leather waste, Tin, Can, Metal waste, Dirt, Brick, Ash waste.

Table 1: (Group1) Survey for Solid Waste Materials Generation

Sr. No.	1
No of People	
Components	7
(gm)	
Food Waste	1600
Paper	20
Plastic	10
Cardboard	10
Wood	25

Rubber	10
Leather	-
Tin, Can, Metals	40
Dirt, Brick, Ash	-
Total (gm)	1715

Table 2: (Group- 2) Survey for Solid Waste Materials Generation

Sr. No.	2	3	4	5	6	7
No of People						
Components (gm)	6	6	6	6	6	6
Food Waste	1200	900	800	670	490	400
Paper	25	20	20	20	10	5
Plastic	10	15	-	10	-	3
Cardboard	-	-	15	-	-	-
Wood	-	100	50	-	10	20
Rubber	-	-	-	5	5	5
Leather	-	-	-	-	10	-
Tin, Can, Metals	-	20	20	-	-	-
Dirt, Brick, Ash	25	-	10	5	10	-
Total (gm)	1260	1055	915	710	535	433

Table 3: (Group- 3) Survey for Solid Waste Materials Generation

Sr. No.	8	9	10	11	12	13	14	15	16	17	18	19	20
No of People													
Components (gm)	5	5	5	5	5	5	5	5	5	5	5	5	5
Food Waste	1800	1200	1000	900	700	600	600	600	500	500	400	300	-
Paper	20	10	10	20	15	10	10	10	20	-	10	-	-
Plastic	22	40	10	40	10	50	20	10	5	20	20	5	-
Cardboard	10	25	-	10	20	10	-	10	-	-	-	-	-
Wood	-	10	20	-	30	90	50	10	-	30	10	-	-

Rubber	-	-	10	-	-	20	15	-	10	10	-	-	-
Leather	-	-	-	-	-	-	-	-	-	-	-	-	-
Tin, Can, Metals	-	70	40	-	-	-	-	-	10	20	-	-	-
Dirt, Brick, Ash	-	20	-	15	5	10	10	10	-	10	5	-	-
Total (gm)	1852	1375	1090	985	780	790	705	650	545	590	445	305	0

Table 4: (Group- 4 Persons in House) Survey for Solid Waste Materials Generation

Sr. No.	21	22	23	24	25	26	27	28	29	30
No of People Components (gm)	4	4	4	4	4	4	4	4	4	4
Food Waste	500	500	500	500	500	430	420	200	200	-
Paper	5	5	5	10	-	10	40	10	-	-
Plastic	10	20	10	5	10	5	20	15	-	-
Cardboard	5	20	-	-	-	10	-	-	-	20
Wood	40	-	20	-	-	-	-	-	-	-
Rubber	10	-	-	-	-	-	-	-	-	-
Leather	5	-	-	-	-	-	-	-	-	-
Tin, Can, Metals	20	-	-	-	-	-	-	-	-	-
Dirt, Brick, Ash	10	10	-	-	-	5	5	5	-	5
Total (gm)	605	555	535	515	510	460	485	230	200	25

Table 5: (Group- 5) Survey for Solid Waste Materials Generation

Sr. No.	31	32	33	34	35	36	37	38	39	40
No of People Components (gm)	3	3	3	3	3	3	3	3	3	3
Food Waste	450	400	400	400	400	315	310	-	-	-
Paper	-	5	10	10	-	5	5	-	-	-
Plastic	10	5	5	10	-	20	10	-	-	-

Cardboard	-	-	5	5	-	-	5	15	-	-
Wood	70	-	-	5	-	-	10	-	-	-
Rubber	-	10	-	-	-	-	-	-	-	-
Leather	-	-	-	-	5	-	-	-	-	-
Tin, Can, Metals	10	-	10	-	-	-	5	10	-	-
Dirt, Brick, Ash	5	10	5	5	-	-	5	10	-	10
Total (gm)	545	430	435	435	405	340	350	35	0	10

Table 6: (Group-6) Survey for Solid Waste Materials Generation

Sr. No.	41	42	43	44	45	46	47	48	49	50
No. of People										
Components (gm)	2	2	2	2	2	2	2	2	2	2
Food Waste	800	400	300	200	200	150	150	-	-	-
Paper	5	20	-	-	5	20	-	-	5	-
Plastic	5	-	5	5	10	5	10	-	-	-
Cardboard	-	-	10	30	5	-	-	10	-	-
Wood	-	-	-	-	-	-	-	-	-	-
Rubber	-	-	-	-	10	-	-	-	-	-
Leather	10	-	-	-	5	-	-	-	-	-
Tin, Can, Metals	20	-	-	10	20	-	-	-	-	-
Dirt, Brick, Ash	-	-	-	10	5	-	-	-	-	-
Total (gm)	840	420	315	255	260	175	160	10	5	0

Solid waste is collection from Surat cities peoples. Total 50 houses were selected for solid waste collection. After collection segregation of solid waste materials and result of analysis is shown in Table 1 to 6. Here, we can see that overall amount of solid waste generated in houses is directly proportional to the number of people living in house but some of them are exceptional i.e. amount of solid waste generated is not in proportional to No of people living in the house but related to individual life style.

Looking to the above Table results is clearly reflect that the amount of wasted food is very much higher compare to other kind of waste and another most hazardous and carcinogenic plastic waste was found in form of 40 microns size polythene bags which could be avoided by

using cloth bag. Looking to the present scenario of India's poverty and agriculture status such a big amount of food should not be wasted; rather it can be given to needy people. Looking to the present scenario of environmental pollution, S.M.C and higher authorities of State and Central level should implement strict rules for not to use plastic bags.

Solid waste was collected from 50 houses from Surat city and segregated like- Food Waste, Plastic Waste, Paper Waste, Wood Waste, Tin, Can, Metal Waste, Cardboard Waste, Dirt, Brick, Ash Waste, Rubber Waste, Leather Waste. Total and Average waste generation rate of every segregated waste material was calculated.

Table 7: Total and Average Solid Waste Material Generation

Ranking	Waste material	Total Waste Generation	Average Waste Generation (by each person)
1.	Food Waste	23 Kg 845 gm	120 gm
2.	Plastic	490 gm	2.48 gm
3.	Paper	430 gm	2.17 gm
4.	Wood	360 gm	1.8 gm
5.	Tin, Can, Metals	325 gm	1.64 gm
6.	Cardboard	250 gm	1.26 gm
7.	Dirt, Brick, Ash	230 gm	1.16 gm
8.	Rubber	120 gm	0.6 gm
9.	Leather	35 gm	0.18 gm
10.	Total	26 kg 085 gm	131.7 gm

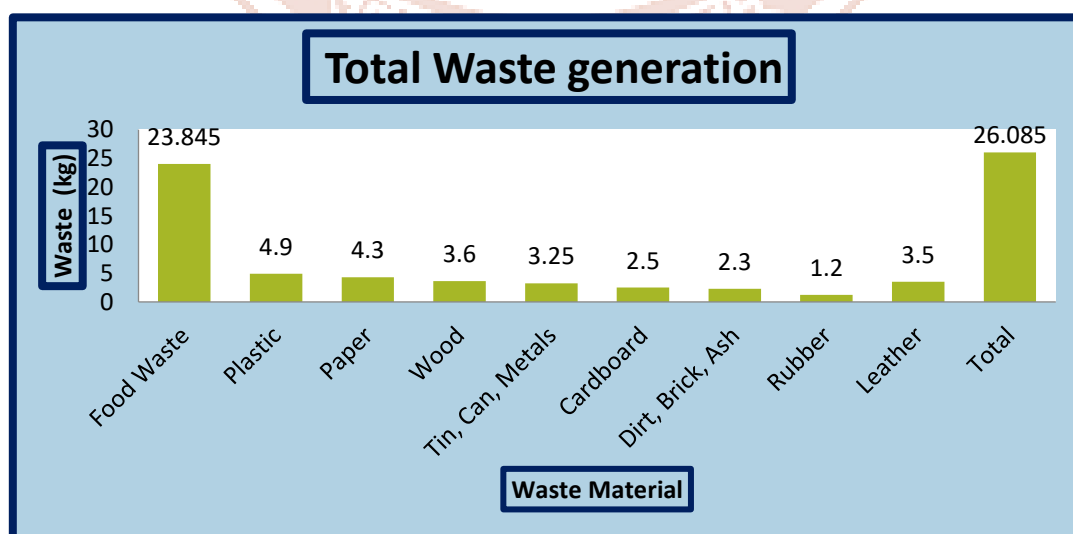


Figure 2: Total Waste Generation of Solid Waste Material

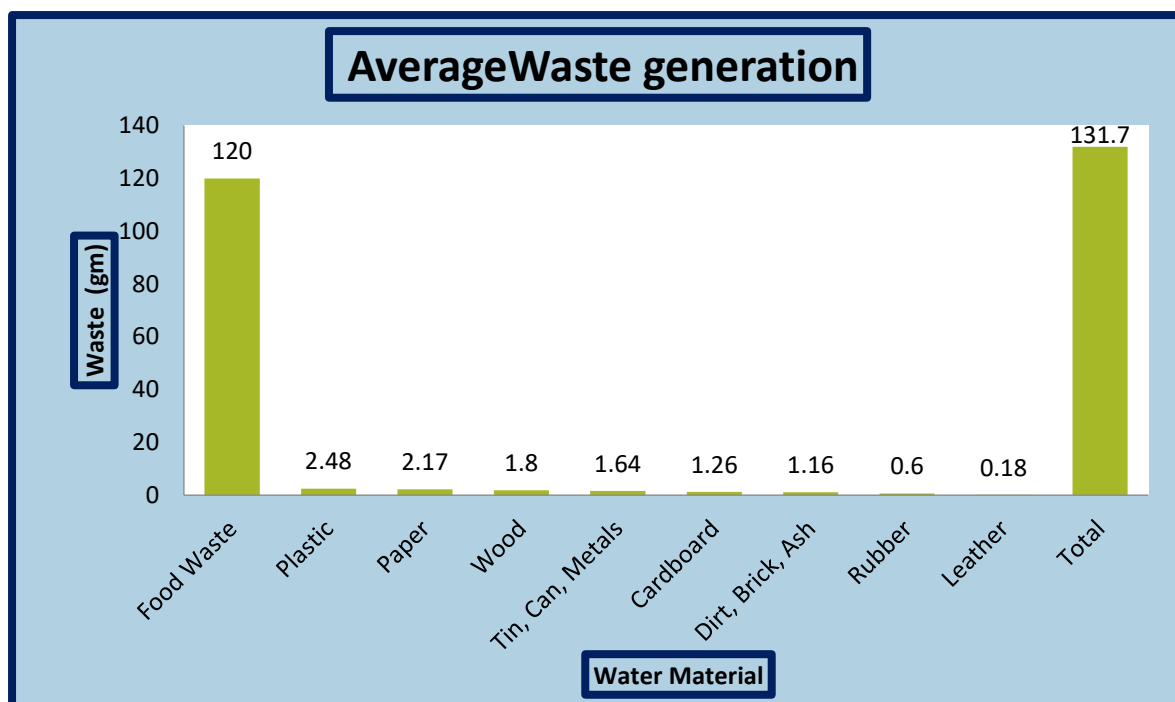


Figure 3: Average Waste Generation of Solid Waste Material (per person)

The aim of survey carried out was to determine the amount solid waste generation. The Table 7 represents amount of total and average waste generation i.e. food waste, plastic, paper, wood, (tin, can, metals), cardboard, (dirt, brick and ash), rubber, lather. Amount of Total waste generation from 50 houses were 23 Kg 845 gm, 490 gm, 430 gm, 360 gm, 325 gm, 250 gm, 230 gm, 120 gm, 35 gm and Amount of average Waste generation by each person were 120 gm, 2.48gm, 2.17 gm, 1.8 gm, 1.64 gm, 1.26 gm, 1.16 gm 0.6 gm, 0.18 gm, respectively which is shown in Fig 2 and 3. From the above data it is clear that maximum food waste generation from all houses i.e. 23 Kg 845 gm and 120gm food waste generation by each person. Here second maximum waste generation rate of plastic waste. The manual separation of solid waste material can be segregated at source level (where solid wastes are generated). Manual sorting at the source of generation is most positive way for recovery and reuse of materials. For above Table 7 it is clearly visible that food waste is a major problem. The maximum food waste can be minimized by people through their changing working tendency.

Results and Disscution

Environmentally sound management of increasing amounts of difficult-to-treat organic wastes is major concern today in city. Waste segregation refers to keep separate the categories of waste i.e. recyclable and biodegradable at source. The complete procedure of solid waste separation is shown in Fig 4. At the point of generation, to facilitate reuse, recycling, redesign and reduce the amount of waste dumped at site will solve the problem of landfill management to some extent.

WASTE SEGREGATION CHART	
Wet Waste  vegetable & Fruit Peel, Food Remains, expired food item, Meat, Bone, Egg Shell, flower, Tea Bag & Coffee Powder, Coconut Shell & Fiber etc.	 Do not Put in Plastic cover They can be composted
Dry Waste  Plastic, Paper, Wood, Glass, Rubber, etc Items not having medical or sanitary residues	 Clean and Store Give it to Recyclers
Sanitary Waste  Used Sanitary Napkins, Diaper, Dead Pest, Ear Buds, Dental Floss, Bandage	 Do not throw as is, wrap in Newspaper, Mark it with red Cross (x) before disposal
Garden Waste  Large Quantity of Leaves, Branches, Dried Plants	 Handover Separately to SMC Collection Trucks
Hazardous Household Waste  Medicines, Pesticides, Old Paints, Hair Colour, Mosquito Repellent, Syringes, Cosmetics	 Do Not Mix with other waste Store Carefully Hand it over to specific Recyclers
Debris/Rubbish  Construction Debris, Demolition Waste, Broken glass, Broken Furniture	 Call SMC or other Agencies for Pickup
E-Waste  Tube Lights, Cd's, Batteries, Computers, Televisions, Mobile Phones, Laptops, Printer Cartridges, Cables	 Do not Mix with other waste Store Carefully Hand it over to specific Recyclers

Figure 4: Waste Segregation

Conclusion

In this chapter the survey of the solid waste generated in Surat city is carried out which give us idea about total solid waste generated and each solid waste generation rate. Currently, the majority of solid waste generated in Surat is disposed off in open dumping site without any segregation process, which threats public health and environmental quality in Surat city, Door to Door Waste collection system is in practice without any segregation. So, the Waste generation from Surat city is suggested to be segregated into organic food waste, paper, plastic, cardboard and dry material at source level. It is not only necessary to segregate the material for the purpose of processing but it is most necessary in order to achieve consistent finished product quality of recycled product made out of waste.

Moreover, the duty of every individual is that not to pollute the city by throwing plastic, paper, food waste etc. Anywhere Instead, they can segregate waste at source level which reduce waste quantity and even sale it to the recycler company so this material will be used again.

Now, in 2027, the Surat municipal corporation has given importance to waste segregation at source level. Waste Management is not only responsibility of government but also the responsibility of every citizen. Citizens will start practicing to segregate waste at source. It is easy to manage segregate waste instead of mix all organic as well as inorganic waste. When citizens and the government work together, they can help keep Surat clean, healthy and environmentally sustainable.

Recommendation

Based on the survey work, food waste and recyclable waste was generated in large amount from houses, which will be segregated at source level. We have a great opportunity that waste will reuse and recycle which can save the cost for final disposal of the waste; it is also reducing the public health issue and environmental risk. It can be possible to provide better public awareness through waste segregation and recycling but wet and dry waste has to be separated by at an individual level. Special Dustbin should be designed for household waste segregation and street area of the city in different zones in Surat city.

The different kind of waste has to be disposed with given coded color dustbin is shown in Fig 2.4.

- 1) Wet Waste like Vegetable and Fruit Peel, Food Remains, Expired food item, Meat, Bone, Egg Shell, Tea Bag, Flower, Coffee Powder, Coconut Shell and Fiber etc. are daily useable products which do not put in plastic cover or bag but that should be composed.
- 2) Dry Waste includes Plastic, Paper, Wood, Rubber etc. are recyclable product and that should be store with clean dustbin and give it to recyclers as per weekly basis. Even segregated plastic waste can be used to make RDF (Reused Derived Fuels) and it can be sale. These will generate revenues to S.M.C and also decrease the disposal load.
- 3) Sanitary Waste is also known as Biomedical Waste which includes Used Sanitary Napkins, Diaper, Ear Buds etc and that will create major disease and contamination. These wastes should be stored separately with coded color dustbin and sanitary napkins must be wrapping in newspaper with Red Cross marking before disposal. These all waste should be handover to specific authority.
- 4) Garden Waste includes large quantity of Leaves, Branches, Dried Plants, etc. should be handover separately to S.M.C.
- 5) Hazardous Household Waste includes Medicine, Pesticides, Hair color, Mosquito Repellent, Cosmetic and Syringe etc. Should not be mixed with other waste and should be stored carefully. Hazardous household waste will create environmental issue likes air, water and soil pollution so every fifteen days it should be handover to specific recycler.
- 6) Debris/ Rubbish – Construction Debris, Demolition Waste, Broken Glass, Broken Furniture etc should be given to SMC or any other private agencies for pick up the debris.
- 7) E-Waste includes Tube lights, CDs, Batteries, Computer, TV, Mobile, Printer, Laptop, etc should not be mixed with other waste and should be stored carefully and after specific time it should be handover to recycler.
- 8) The segregated dry mass can be sale as a fuel-material will also generate revenues.

Reference

1. Sincero A., Sincero G., Environmental Engineering: A Design Approach, Prentice Hall of India Pvt. Ltd, ISBN-089-116-626-2, (2004).
2. Tchnobanoglous G., Theisen H., and Vigil. S., Integrated Solid Waste Management, McGraw-Hill, ISBN- 0070632375, 2nd Edition, (1993).
3. Singhal S. and Sunnel P., Solid Waste Management in India: Status and Future Directions. TERI INFORMATION MONITOR ON ENVIRONMENTAL SCIENCE, 6(1), 1-4, (2001).
4. Peavy H., Rowe D. and Tchnobanoglous G., Environmental Engineering, McGraw-Hill, 0-07-049134-8, 1st Edition, (1985).
5. Birdie G., and Birdie J., Water supply and Sanitary Engineering, Dhanpat Rai Publishing Co Pvt. Ltd, ISBN 13, 9789384378134, 1st Edition, (2011).
6. Sasikumar K., Sanoop Gopi Krishna. Solid Waste Management. PHI Learning Pvt. Ltd, ISBN-978-81-203-3869-2, (2009).
7. Davis M., Cornwell D., Introduction of Environmental Engineering, McGraw Hill, ISBN 0-07-015918-1, 4th Edition, 1998.
8. Tchnobanoglous G., Theisen H., and Eliassen R., Solid Wastes; Engineering Principles and Management Issue, McGraw-Hill, ISBN 0-07-063235-9, (1977).
9. Solid Waste Management- Midterm Evaluation of Door To Door Garbage Collection Programme in Three Municipal Zones of Surat. Centre for Social Studies, (2005).
10. Desai H. and Maurya Y., Consequences of Municipal Solid Waste Management in Valsad City- Thesis Report, TIFAC-CORE in Environmental Engineering, Sarvajani College of Engineering and Technology, Surat-India, (2013).
11. Surat Municipal Corporation. (2023). Annual Administration Report 2022–23. Surat Municipal Corporation.
12. United Nations. (2015). Transforming our world: The 2030 Agenda for Sustainable Development.
13. World Bank. (2018). What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050.
14. Government of India, Ministry of Environment, Forest and Climate Change. (2016). Solid Waste Management Rules, 2016. Gazette of India.