

Municipal Solid Waste Management - A case study of Srinagar city

Niyaz Ahmad Khan

Lecturer, Higher Education, GDC Boys Pulwama, Jammu & Kashmir, India

*Corresponding Author: Niyaz Ahmad Khan; Email: niyazenviro83@gmail.com

Abstract: Municipal solid waste management (MSWM) is one of the major environmental problems of Indian cities. Improper management of municipal solid waste (MSW) causes hazards to inhabitants. Solid wastes constitute a growing problem and have gained increased political awareness over recent years. This paper is to present a case study on municipal solid waste management in the city of Srinagar, the capital of Jammu and Kashmir. Srinagar has a land area of approximately 279 Sq. Kms with a population of 12.03 lacs in 2011. Over the past two decades, MSW generation in Srinagar has increased tremendously from 180 tons in 1981 to 530 tons in 2011. The average generation rate of MSW in 2011 was 271 gm/capita/day. Food waste comprise of 54.99%, followed by fine earth 17%, plastics and polythene 8%, paper/cardboard 6.8%, rags 5.27% and glass/ceramics 2.97%. While all other wastes including metals, stones, bricks, rubber, leather and wood accounted for less than 4%. Currently 70% of municipal solid waste generated in Srinagar city is collected by door to door collection method and street bin systems and is transported for dumping to open landfill site which is at Syedpora Achan about 6 km from center of Srinagar city. In order to solve the solid waste management problems in Srinagar, this study recommends clear goals and timeframes need to be established, duties and responsibilities of local government, NGOs and Srinagar Municipal Authority and funding needs to be allocated in order to produce an effective waste management framework in the City.

Keywords: Municipal solid waste, Achan, Srinagar city, Landfill, Wards

INTRODUCTION

Solid wastes are those organic and inorganic waste materials produced by various activities of the society, which have lost their value to the first user. Improper disposal of solid wastes pollutes all the vital components of the living environment (i.e., air, land and water) at local and global levels [1-2]. The problem is more acute in developing nations than in developed nations, as their economic growth as well as urbanization is rapid [3].

There has been a significant increase in MSW (municipal solid waste) generation in Srinagar in the last few decades. This is largely because of rapid population growth and economic development. Municipal solid waste (MSW), commonly known as trash or garbage is a waste type consisting of everyday items we consume and discard. It predominantly includes food wastes, yard wastes, containers and packaging materials, and other miscellaneous inorganic wastes from residential, commercial, institutional and industrial sources [4-6].

Solid wastes comprise all the wastes arising from human and animal activities that are normally solid, discarded as useless or unwanted. Municipal Solid waste includes commercial and residential wastes generated in municipal or notified area, in either solid or semi-solid form excluding industrial hazardous wastes, but including treated bio-medical Wastes.

The explosion in urban population is changing the nature of solid waste management in developing countries from mainly a low priority, localized issue to an internationally pervasive social problem.

Management of municipal solid waste continues to remain one of the most neglected areas of urban development in India and same is the case of Srinagar city. Municipal solid wastes are regularly disposed off in open space dumpsite in Srinagar city which is Syedpora Achan landfill site situated at a distance of 6 Kms from city centre. Municipal solid waste generation in Srinagar has increased from 180 tons to 530 tons within last 30 years. This tremendous increase of MSW has posed great pressure on Govt. and the Srinagar municipality for proper collection and disposal of the waste. Srinagar city has been divided into 24 municipal wards from which garbage is collected by using door-to-door collection and street bin systems. The collected wastes are transported to Achan dumping Site for disposal.

The broad scope of study would be limited to the solid waste management practices in operation including manpower, organization and maintenance, generation, nature, composition, collection, transfer and transportation, processing/disposal of MSW and selection of viable alternative strategies for modernization of MSWM in the city.

Study Area

Srinagar, the summer capital of Jammu and Kashmir State is situated in the heart of the oval shaped Valley of Kashmir. Srinagar is located in northern most part of India between 74°-56' and 75°-79' East longitudes and 33°-18' and 34°-45' North latitudes. Srinagar municipal area which had an area of 12.80 Sq. Kms in 1901 increased to 24.52 Sq. Kms in 1951, 41.44 Sq. Kms in 1961 and 103 Sq. Kms in 1971. The city recorded wide spread expansion from 1971 and its area has increased to 279 Sq Kms at present.

The population of Srinagar city which was 6.06 lacs in 1981 has increased to 12.03 lacs in 2011. Due to its location, pronounced primacy, migration and rapid development, it has recorded an accelerated pace. In addition, being the capital city-centre of all major functions, its floating population (both incoming and outgoing) is also very high. Compared to its population growth, provision of infrastructure facilities and basic services has been disproportionate resulting in over-straining of already inadequate infrastructure and deficiency in basic services such as sewerage/drainage system, water supply, sewage treatment and appropriate solid waste management.

The Srinagar municipality provides regular solid waste management services in about 200.49 Sq. Kms out of 279 Sq Kms area, which accounts nearly 72% of the city area. For the convenience of conducting a study of solid waste management services, Srinagar city was divided into 5 zones, which are mentioned below:

- I. Inner city.
- II. Planned colonies.
- III. Unplanned extensions.
- IV. Settlements in water bodies.
- V. Outlying urban fringes/recent extensions

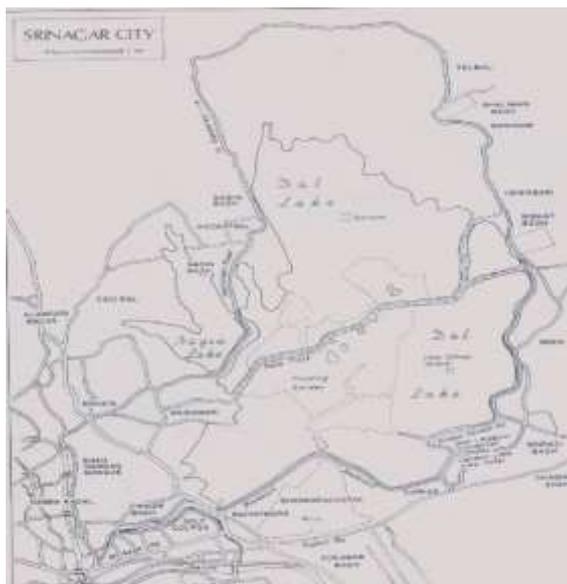


Fig-1: Map of Srinagar City

METHODOLOGY

Methodology presents the various steps that are adopted for collecting data with regard to generation, collection, segregation, processing and disposal of municipal solid waste [7-12]. It also deals with processing and analyzing of data.

1. Door to Door sample collection was carried out for 3 days to assess the waste generation at household level. The house owners were given storage bags to store their waste in the morning which were collected next day and then weight recorded separately on weighing balance.
2. Interaction with NGOs, town area committees and notified area committees engaged with management and handling of municipal solid waste.
3. Questionnaires on inventory on municipal solid waste generation, collection, treatment and disposal were given to municipalities, NGOs and all other concerned agencies with a request to return after completing the same.
4. After the data had been collected it was analyzed and inferences were drawn with the help of various statistical measures.

Waste Generation and characteristics:

The municipal authorities in Srinagar do not weigh the refuse vehicles regularly but estimate the quantities on the basis of number of trips made by the collection vehicle. It is estimated that solid waste generated in small, medium and large cities and towns in India is about 0.1 kg, 0.3 – 0.4 kg and 0.5 kg per capita per day respectively. Studies carried out by National Environmental Engineering Research Institute (NEERI) indicated that the per capita generation rate increases with the size of the city and varies between 0.3 to 0.6 kg/d. The quantity and magnitude of actual solid waste generated at various sources and reaching to local dumps and final dumping site for disposal are not same. It is determined by the efficiency of collection and transportation of waste, retrieval of recyclable material at different levels and other factors. This study involves assessment of quantity of waste generation at various functional levels viz. household level, beat/local dump level, municipal ward level, zone level besides quantity of waste actually reaching landfill site at Achan. Per capita waste generation from each household was calculated by dividing average quantity of waste generated per day to number of family members. An interesting part of the study has been that per capita waste generation in various sample areas varies from 142 grams to 396 grams with an average waste generating of 271grams which is close to the finding of NEERI.

Table-1: Zone wise per capita daily generation of solid waste.

S.No.	Zones	Description	MSW in (gms)
1.	A	Inner City	264
2.	B	Planned Colonies	323
3.	C	Unplanned Colonies	248
4.	D	Settlements in Water Bodies	271
5.	E	Out-laying Urban Fringes/ Recent Extensions	249

The zone-wise waste produced indicates that maximum waste is generated in planned colonies which form medium density areas. The generation is

comparatively less in outlying fringes, unplanned colonies and high density inner areas.

Table-2: Ward wise Daily per capita waste generation from households of Srinagar city

S. No.	Ward area	Population (2011)	Quantity (Tons)	Generation grams/capita
1	1	40632	24.09	221
2	2	24067	19.96	198
3	3A	17755	17.33	326
4	3B	41715	26.65	396
5	4A	50293	29.25	276
6	4B	35567	21.52	389
7	5A	68103	32.25	295
8	5B	60586	30.21	274
9	6	44905	25.23	305
10	7	19504	15.36	223
11	8	30107	21.32	285
12	9	38432	22.52	234
13	10	32020	19.23	302
14	11	53295	32.18	271
15	12	41928	22.74	253
16	13	53254	31.41	308
17	14	44969	23.58	282
18	15A	37509	21.52	276
19	15B	28452	19.25	292
20	16A	31061	19.84	324
21	16B	17874	13.24	268
22	17	28369	21.06	142
23	18	25337	19.25	178
24	19	16766	13.23	181
	Average			271

For delivery of various urban services to the urbanites, Srinagar City has been divided into 24 wards and each ward also forms a major spatial unit for delivering solid waste management services. Quantity of waste generated from each ward is determined by size of population and functions of the wards. As per 2011 census the total population of Srinagar Municipal

Area was 12.03 lacs. From the estimated ward-wise population, Ward-wise quantity of waste generation has been established which is highly varying. The per capita waste generation varies from 142 grams/capita to 396 grams/capita with lowest in municipal ward 17 and highest in ward 3B and the average is 271 grams/capita.

Table-3: The physical composition of the waste is obtained as a percentage of the different constituents

S. No.	Parameters	Percent Composition for Srinagar	Permissible range (%)
1.	Metal (Ferrous/Non-ferrous)	0.47	0.0-1.55
2.	Earth/Stone/Bricks	2.73	0.5-10.0
3.	Glass/Ceramics	2.97	0.0-6.0
4.	Fine earth	17.0	15.0-49.0
5.	Paper/Cardboard	6.80	2.0-8.5
6.	Wooden matter	0.0-6.5	1.05
7.	Rags	5.27	0.0-6.0
8.	Rubber/Leather	0.93	0.0-10.0
9.	Plastics/Polythene	8.17	3.25-15.5
10.	Food Waste/Grass, Leaves	54.99	30.6-69.0

Physical analysis shows that the percentage of Food waste comprise of 54.99%, followed by fine earth 17%, plastics and polythene 8%, paper/cardboard 6.8%, rags 5.27% and glass/ceramics 2.97%. While all other wastes including metals, stones, bricks, rubber, leather and wood accounted for less than 4%.

The Biodegradable waste include leaves, grass clipping and most forms of discarded food stuffs this kind of waste consists of about 67.06% of municipal solid waste (MSW) in Srinagar city. Combustion waste is a portion of waste stream having a heat value and which under combustion technology is converted into useable energy. In Srinagar city about 22.22% of MSW constitutes of combustible waste. Inert material, including fine earth from street sweeping and ash from conventional heating elements, constitutes 22.70% of MSW. It is neither biodegradable nor combustible hence can be used for land filling to check leachates and for capping of landfill.

Prevalent SWM practices in Srinagar municipality:

Solid Waste Management is one of the most essential services for maintaining the quality of life in the Urban Areas & for ensuring better standards of health & livelihood. Section 261 of the Municipal Corporation Act, 2000 confers the duty on Srinagar Municipal Corporation to make reasonable provision inter alia for constructing, maintaining and cleaning public streets, sewers, drains, drainage works, slaughter houses etc. including all places not being private property and for removing filth, rubbish, night soil or any other obnoxious or offensive material. Proper storage at the source of waste generation is first essential step towards appropriate solid waste management.

In Srinagar city storage at all levels has been one of the neglected aspects. At present proper management for primary storage of waste is missing and no segregation of waste at source of generation is done. In the absence of storage facilities, households, shops, commercial establishments and others dispose off waste on the streets, depressions, nallahs and open

spaces at random hours. Sometimes the waste is collected in polythene bags and is disposed off in nearby dustbins or identified open municipal bins adjacent to streets/ roads, footpaths and open spaces or is thrown in water bodies. Some of this waste is attended by Srinagar municipality while some remains unattended and creates public nuisance as well as environmental problems through chocking of drains, attraction of stray animals, foul smell etc.

In absence of primary storage and lack of appropriate secondary storage facilities for collection of MSW, street sweeping has attained considerable importance to upkeep the health of the Srinagar city. Safai Karamcharis sweep the streets/roads using long handled brooms and collect heaps of waste at suitable locations on the road sides. Thereafter, the waste is collected and transferred on wheel barrows or tricycles and taken to the nearest community bin or open collection point for further transfer to disposal site. In Srinagar, at many places sweepers are carrying out the routine sweeping on beat basis consisting of 100 to 200 households including main roads, link roads and lanes. In some cases, work is assigned on the basis of road length which varies from 250 running meters to 500 running meters of main road, inclusive of various links which join these roads. The sweeper population ratio in Srinagar is 1.25 sweepers per 1000. In Srinagar 80 per cent of the population is attended regularly under street sweeping and collection of solid waste, leaving 20 per cent of the population unattended especially in outside and urban fringes. In these areas and certain slum pockets, heaps of solid wastes are seen at number of places.

Srinagar Municipality has started a pilot project for door-to-door collection of garbage from houses and provided 40-litre green dustbins to each household to collect waste daily on a nominal payment of Rs.1/day. About 15000 buckets have been provided so far by Srinagar Municipality in different areas.

The Community bin system which is a widespread practice in Srinagar is also not available at

convenient locations for collection of Municipal Solid Waste. Appropriately designed/covered bins are grossly inadequate, as a result in most cases waste is dumped at open collection points which generates public nuisance. Also due to shortage of space and community bins,

people throughout the city deposit the solid waste on open ground/street and sweepers also are compelled to dump the waste at such places. The proposed collection of Municipal Solid Waste for different areas by Srinagar Municipality is given in table:

Table-4: Proposed Collection of MSW for different areas by Srinagar municipality

S.NO.	SOURCE OF GENERATION	COLLECTION SYSTEM	AUTHORITY
1.	Residential Areas Low Income Group Middle Income Group High Income Group	Community bins Door step House to House	Srinagar Municipality. Own arrangement/ Srinagar Municipality Own Arrangement
2.	Construction and Demolition Waste	Transportation Vehicles	Srinagar Municipality on payment basis/own arrangements
3.	Garden Waste	Community bins/ Compositing	Srinagar Municipality
4.	Shops/Commercial establishments	House to House Door step	Own arrangements/ Srinagar Municipality
5.	Vegetable Market	Community Bin	Srinagar Municipality
6.	Hotel/Restaurants	House to House Door step	Own arrangements/ Srinagar Municipality
7.	Bio Medical waste	As per guidelines of State Pollution Control Board.	Srinagar Municipality

Source: Municipal Solid Waste Collection and Disposal Site Development for Srinagar by Economic reconstruction Agency: 2006

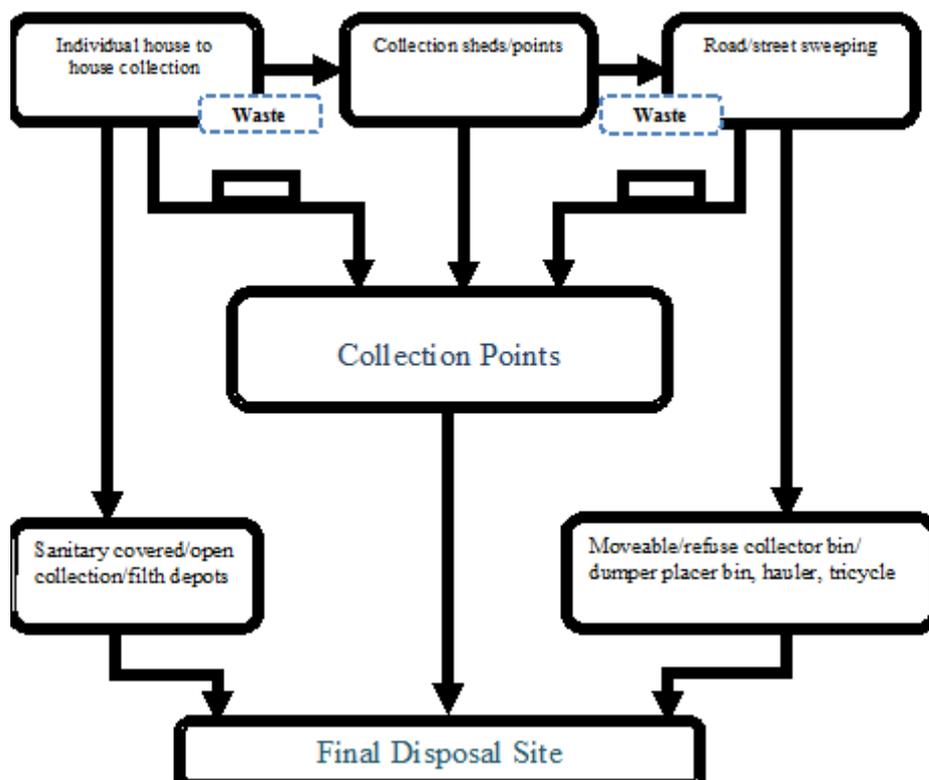


Fig-2: Existing Solid Waste management in Srinagar City.

Srinagar city generates large quantities of waste which is unscientifically and indiscriminately disposed. At present about 530 tones of solid waste is produced within Srinagar municipal limits out of which 382 tones are daily taken care by Srinagar municipality and disposed off at Syedpora Achan dumping site without any resource recovery. The remaining 148 tons of waste is dumped illegally into depressions, river embankments, unattended open spaces or is locally burnt both by individuals or Safai Karamcharis. This indiscriminate dumping within residential areas or at the periphery of settlements is generating environmental problems of degradation of land, contamination of water, air and unpleasant surroundings. The individual household/sweeping staff also quite often burns the waste in the street corners and back yards leading to the release of toxic chemical compounds in the air within the residential areas. Thus the present SWM practices in Srinagar are not adequate and appropriate.

CONCLUSIONS AND RECOMMENDATIONS:

Srinagar City, the largest urban agglomeration of the Jammu and Kashmir State, generates large magnitude of waste. Srinagar Municipality is able to take care of 72.07 per cent of waste daily rest remains unattended or unauthorized disposed in open spaces, depressions, nallahs, water bodies. This inadequacy in the Management of Solid Waste has generated a lot of problems which have inflicted irretrievable damages to the environment and declined sanitation condition of the city.

The rapid and accelerated growth have brought radical transformations in the city especially on the state of physical environment and infrastructure, civic services in particular have been under a tremendous strain. Despite large scale changes and development, solid waste management practices have retained their indigenous and conventional nature and no efforts have been made to modernize them and have remained grossly inadequate and deficient. Therefore, there is an urgent and undeniable need to improve the present SWM system through modernization and adoption of appropriate technologies. Based on the field studies on various aspects of the SWM in Srinagar, following conditions/findings and recommendations are drawn.

1. Area of Srinagar increased from 82.88 Sq Kms in 1971 to 202 Sq Kms in 2000 and up to 279 Sq Kms at present and has been divided into 24 municipal wards. The population of the Srinagar Municipality has increased from 4.23 lacs in 1971 to 6.06 lacs in 1981 and 12.03 lacs in 2011 including floating population. Magnitude of waste generation at present is 530 tons/day with an average per capita waste generation of 271 gm/capita/day. The anticipated population for 2021 has been estimated 24.93 lacs which would generate about 1271 tons of MSW daily with an average per capita per day generation of 510 gm.
2. Physical analysis shows that the percentage of Food waste comprise of 54.99%, followed by fine earth 17%, plastics and polythene 8%, paper/cardboard 6.8%, rags 5.27% and glass/ceramics 2.97%. While all other wastes including metals, stones, bricks, rubber, leather and wood accounted for less than 4%. The Biodegradable waste includes leaves, grass clipping and most forms of discarded food stuffs. This kind of waste consists of about 67.06% of municipal solid waste (MSW) in Srinagar city. In Srinagar city about 22.22% of MSW constitutes of combustible waste. Inert material, including fine earth from street sweeping and ash from conventional heating elements, constitutes 22.70% of MSW.
3. The MSW management is carried out at ward level through unskilled and professionally unqualified personnel. Lack of monitoring, accountability and co-ordination are the common features of SWM staff which reduce their efficiency and performance. Shift and Night sweeping is completely missing in the city. House to house collection system is extended to small number of households covering less than 5 per cent of the population of the city. The manpower distribution at ward level is not rational and standardized in accordance with population and waste generation. Out of the total number of primary collection points 41 are covered and 270 uncovered. The open community bins which are mostly along the road sides generate public nuisance
4. Of total waste generated 70% is regularly collected and taken to Achan dumping site while as 30% is either dumped in adhoc dumping site or remains unattended generating unhealthy conditions in the city. Transportation vehicles are inadequate and with more hauling distance due to unplanned routing of vehicles. Recycling, reuse and reduce concept is also missing. There is lack of Public awareness and poor participation of citizens in Municipal Solid Waste Management.
5. Introduction of house to house collection system through active cooperation of citizens to enable segregation at source of biodegradable and non-biodegradable and to lessen the burden on Srinagar Municipality is needed. There should be Continuous monitoring and systematic accountability of the SWM staff. Research, which involves systematic investigation and monitoring of composition, magnitude and collection, sweeping and transportation and disposal practices to identify weaknesses and alternatives, should be done.
6. MSW shall be collected, stored, segregated, transported and disposed separately without mixing with bio-medical, slaughter and construction/demolition waste. Srinagar Municipality shall provide separate space for disposal of bio-medical hazardous waste and carcasses. It shall extend collection and

transportation services at cost recovery basis and users pay principal.

7. Srinagar Municipality shall provide covered community bins/ Garbage sheds to avoid public nuisance and effective collection of waste. Srinagar Municipality shall give incentives to dealers to prepare specially designed storage bins which shall have no problem of odor, leakage of moisture and access to birds and animals with a mark of Use Me or Reduce, Reuse and Recycle. Citizens shall be motivated to form ward-wise committees and representative for efficient functioning and accountability. Mechanical composting plant shall be installed at Syedpora Achan for disposal of biodegradable waste. The compost obtained shall be sold .and Srinagar Municipality should arrange for marketing of the product. Adequate legal backing to enforce and implement sanitation laws to provide adequate protection to SWM worker and make punitive measure more operational.

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