

Perspectives of Transport and Disposal of Municipal Solid Waste in Srinagar City

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Abstract: Transport and Disposal of Municipal solid waste is one of the major environmental problems of Srinagar city. Improper transport and disposal of municipal solid waste (MSW) causes hazards to inhabitants. The amount of solid waste generated in the world is steadily increasing and every government in this world is currently focusing on methods to approach the challenge. This paper is to present a case study on municipal solid waste transport and disposal in the city of Srinagar in Jammu and Kashmir in India and its practice as lessons learnt. Srinagar has a land area of approximately 279 Sq. Kms with a population of 12.03 lacs. Over the past two decades, MSW generation in Srinagar has increased tremendously from 180 tons in 1981 to 530 tons in 2011. This is largely as a result of rapid population growth and economic development in the country. The daily per capita generation of municipal solid waste in India ranges from about 100 g in small towns to 500 gm in large towns and in Srinagar it is 271 gm. Currently 65-70% 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 and the remaining 30-35% of waste is dumped illegally into depressions, river embankments, unattended open spaces or is locally burnt both by individuals or Safia Karamcharis creating nuisance for public as well as acting as breeding centers of some diseases. In order to provide proper transport and disposal of municipal solid waste in Srinagar, this study recommends and suggests that 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: Srinagar city, Achan, landfill disposal, Solid waste management.

I. Introduction

Municipal solid waste is a heterogeneous mixture of paper, plastic, cloth, metal, glass, organic matter, etc. generated from households, commercial establishments and markets. The proportion of different constituents of waste varies from season to season and place to place, depending on the lifestyle, food habits, standards of living, the extent of industrial and commercial activities in the area, etc (Katju, 2006). Solid wastes comprise all the wastes arising from human and animal activities that are normally solid, discarded as useless or unwanted. 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 transport and disposal of solid wastes pollutes all the vital components of the living environment (i.e., air, land and water) at local and global levels. 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. Poor collection and inadequate transportation are responsible for the accumulation of MSW at every nook and corner.

According to Tchobanoglous *et al* (1993), solid waste management may be defined as the discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics, and other environmental considerations that are also responsive to public attitudes. 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 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, transport and disposal of

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

III. Methodology

The methodology adopted for collecting data with regard to generation, transport and disposal of municipal solid waste, included collection of information pertaining to solid waste management (SWM), from published documents, data available with the agencies and through consultations. It was done through primary surveys, especially on the assessment of the physical characteristics of wastes and consultations to understand the felt needs and priorities of the communities and the key stakeholders. In addition, secondary data was collected on the existing facilities available, such as sweeping staff, implements for primary collection, storage capacities, transportation facilities, existing institutional and organizational framework for SWM, operational and maintenance costs towards SWM, major wastes generating sources, existing collection routes and collection frequency.

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 weighed separately on weighing balance.

Interaction with NGOs, town area committees and notified area committees engaged with management and handling of municipal solid waste.

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. After the data had been collected it was analyzed and inferences were drawn with the help of various statistical measures.

The objectives of the present work are to gather information regarding recovery, disposal and recycling of solid waste, to know human work force involved in solid waste transport and disposal and to see the co-operation between sub-urban and the municipal department in relation to the disposal of the waste.

IV. Waste Generation

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 (1976) 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 and is shown in table 1.

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. The waste generated in planned colonies are maximum because these areas are inhabited by the economically rich people as compared to the other zones.

Present transport system for transportation of Solid waste in Srinagar municipality:

Municipal Solid Waste collected in Community bins and other places is transported to the Achan dumping site, using a variety of vehicles. Most of these vehicles make a number of trips everyday to the disposal site through specified routes. The transfer of waste from Community bins to disposal site is done by using a variety of vehicles such as conventional trucks of non-tipping and tipping type, tractors with detachable trailers and hydraulic lifting system which directly lift the waste or relatively large sized containers to disposal sites. In Srinagar Municipality transportation cost is more than 75 per cent of the total expenditure made on solid waste management. The existing transportation fleet in Srinagar Municipality for solid waste management is shown in table 2:

Table 2: List of transport fleet Vehicles/Machines of Srinagar Municipality

S. No	Type of Vehicle	Existing Number	Actually Required
(i).	Mini Truck.	05	05
(ii).	Truck-Tipper.	24	34
(iii).	Hook Trailer (transfer station)	--	08
(iv).	1. Refuse Collector 2. Refuse Collector Bins.	01 20	10 400
(v).	1. Dumper Placer vehicle.	12	25
	2. Dumper Bins.	110	400
(vii).	Tricycle	20	500
(viii).	Hand Carts	500	500
(ix)	Wheel Barrows	1000	150
(x).	Containerized handcarts	--	2000
(xi).	Front-End-Loader	20	20
(xii).	TATA ACE for door-to-door collection of waste	-	20

(xiii).	Road Sweeping Machines	--	04
(xiv).	Compactors for dumping site.	01	03
(xv).	Snow clearance Dozer (Mini Dozer compatible to clear snow in lanes and by lanes).	--	04

During the field survey of Solid Waste Management, a number of transportation problems have been visualized in Srinagar Municipality, which are:

Inadequate transportation vehicles resulting in delayed clearance of waste, lack of trip monitoring of vehicle movement and weight of waste in transportation vehicles, poor maintenance of transportation vehicles and machinery resulting in large percentage of vehicles remaining off roads, lack of planning and poor supervision, use of open trucks and overloading of vehicles results in littering of waste during transportation and workshop facilities are inadequate for maintaining vehicles and other machines. For augmentation of municipal transport fleet the corporation has to purchase modern garbage handling machinery and equipment. Housing and Urban development has to provide funds, so that some of the machinery and equipment required for collection and transportation of solid waste is purchased and solid waste management system is improved.

V. Prevalent Administrative Set-up for Solid Waste Management

In the prevalent solid waste management organizational set-up Sanitation, transportation and other related spheres are executed under the control of Chief Sanitation Officer and Transport Officer in coordination with the Executive Officer and Health Officer to carry out solid waste collection and transportation through a team of Sanitary Inspectors, Sanitary Supervisors and Safia Karamcharis. The manpower available at present in Srinagar Municipality for solid waste management is given in table 3:

Table 3: Existing Manpower Deployment for MSW Management

S.No.	DESIGNATION	No. of Posts
1.	Health Officer	1
2.	Chief Sanitation Officer	1
3.	Ward Officer	25
4.	Compost Officer	1
5.	Sanitary Supervisors	136
6.	Sanitary Supervisor-Compost	9
7.	Sanitary Inspectors	25
8.	Chauffeurs/Drivers	62
9.	Cleaners	45
10.	Compost Coolies	5
11.	Safiawalas (regular Staff)	1765
12.	Safiawalas/Mashkie (consolidated staff)	343
13.	Safiawalas (Daily wager staff)	285

For proper Solid Waste Management and decentralization of administration Srinagar Municipality has been divided into 24 wards. One ward officer is in charge of each ward who is assisted by one Sanitary Inspector in carrying out Solid

Waste Management activities. Non Governmental Organizations also operate in some selected areas e.g. Dal, Pir Bagh Co-operative Colony and Rawalpura etc. and carry out the collection of solid wastes from houseboats/households. Thus, Srinagar Municipality is inadequately equipped to deal with the growing problems of Solid Waste Management. The existing Solid Waste Management organizational set up is under-staffed, under-trained and shouldering heavier responsibilities. 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. Safia 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. The sweeper population ratio in Srinagar is 1.25 sweepers per 1000.

The existing strength is not sufficient to cater the requirements for 100% collection of waste on door-to-door basis and sweep the city roads which consists 174 Km main roads and 860 running Km other roads. This shortage obviously affects the overall waste collection and road sweep performance of the Srinagar Municipal Corporation. At present about 530 tones of solid waste are produced within Srinagar municipal limits out of which 382 tones are daily taken care of 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 Safia Karamcharis.

Disposal of Municipal Solid Waste:

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, nallahs, or river embankments, unattended open spaces or is locally burnt both by individuals or Safia Karamcharis. Municipal solid wastes is 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, having an area of about 30.63 hectares and is in operation since 1985.

A detailed study of the dumping sites to analyze the prevalent dumping practices at Syedpora Achan and at other adhoc dumping sites within the city was also carried out. At the Achan dumping site proper separation and segregation of waste is not practiced. Rag pickers indulge in the activity for personal gains and are collecting heaps of few saleable items, spoiling the surroundings. The rags, papers, packing materials, polythene bags and others find their way to Achan landfill and create problems of compaction. This has further added to the problem of midway dumping within Achan landfill site and blocking the entry to the site. The waste to Achan landfill site is brought by vehicles and it is leveled occasionally by bulldozers. At the site proper soil cover is not applied as a result the site has become major public nuisance.

A detailed survey of Syedpora Achan landfill site was carried out to get information about the existing dumping practices in Srinagar. The study of the landfill site has revealed the following facts:

The landfill site must necessarily be away from the inhabited area and should be easily accessible and approachable. The Syedpora Achan site has appropriate location, however, has difficult approach through built up area. The expansion of residential houses has started towards the landfill site which needs to be checked.

In land filling separation and shredding are very important requisites. In Syedpora Achan and adhoc dumping sites of Srinagar Municipality separation and shredding are not being properly done. At Achan dumping site soil cover is not applied properly. Huge heaps of soils have been brought to the site but unfortunately it is not spread over the waste. The soil cover is also not used in adhoc sites and has become public nuisance.

The waste is brought by tippers/tractors to the Achan dumping site, while as it is brought by wheel barrows/hand carts to adhoc dumping sites. After tipping the waste at Achan it is leveled occasionally by bulldozers. In the absence of soil cover and shredding whatever little compaction is achieved is done by plying trucks progressively over the extending waste surface. In the absence of appropriate compaction and leveling, wastes were visualized at the site.

The site presents a picture of heaps of waste with stray animals, birds and unauthorized rag pickers moving over the heaps. The odor from the site invades inhabited areas and dust/smoke flying from site often engulfs large areas around it causing danger of a number of health disorder and damages to the standing crops.

Achan landfill site spread over an area of 30.63 hectares of land. Dumping of Municipal solid waste is in process there since 1985. During the last 25 years 45% of area has got filled. It has enough capacity to serve the purpose for next 10-15 years, if same process continues. However, if dumping process is modernized and if disposal of waste is done in more scientific manner; it has sufficient capacity to absorb the full volume of wastes of the city for about next 20-25 years.

Municipal Administration at Dumping Site:

At the dumping site, there is a Chowkidar hut/record room which records vehicles coming to landfill site for dumping of waste, about 17 staff members have been posted at this site. But there is no technical municipal staff to take care of dumping and development of site on scientific lines. The number of waste trucks coming daily to Achan Dumping Site is about 48 trucks /day. In the absence of proper landfill development facilities heaps of waste have been piled which restrain manoeuvrability of vehicles and compels them to unload the waste at the entry point. The manpower available at dumping Site is given in table 5:

Table 4: Manpower available at site

S.No	Designation	Existing number
1.	Sanitary Supervisor	2
2.	Driver/ cleaner	2
3.	Sanitary workers	8
4.	Chowkidar	1
5.	Disinfectants	1
6.	Pump Operator	1
7.	Anti Rag picker Squad	2
Total		17

The manpower available at the site is insufficient and is not properly trained about the proper procedure, information regarding equipments, use & maintenance of equipment. They are also unaware about the health hazards caused by unhygienic handling of waste. Lack of education and training severely limits proper disposal of waste.

The equipments which are available at the Site include two D50 Chain Dozer, which have been provided by J&K ERA (used for compacting and leveling of garbage), one JCB-DX-2007 make Loader (being used for earth moving and soil covering at dumping site) and one Tipper is being used for carrying of earth inside the Achan Dumping Site for soil cover. The equipments are not enough to carry out proper compaction, leveling and soil covering of the waste at the site.

VI. Conclusions and Recommendations

Srinagar city generates a large amount of MSW. In 2011, 530 tons of MSW was generated, with an average generation rate being 271gm/capita/day. Major contributing factors to increasing MSW generation are urban population growth and good economic conditions. 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 70% of waste daily rest remains unattended or unauthorized disposed in open spaces, depressions, nallahs and 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 has 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. Therefore, there is an urgent and undeniable need to improve the present Solid waste Transport and Disposal System through modernization and adoption of appropriate technologies. Based on the field studies on various aspects of the Transport and Disposal of Solid Waste in Srinagar, following conclusions and recommendations have been drawn.

- Srinagar Municipality has a long history of providing Solid Waste Management service since 1886. The area of Srinagar city has 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 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.
- 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
- 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. In Syedpora Achan and adhoc dumping sites of Srinagar Municipality separation and shredding are not being properly practiced and there is absence of appropriate compaction and leveling. The wastes were visualized at the site; present a picture of heaps of waste with stray animals, birds and unauthorized rag pickers moving over the heaps.
- The present system of Waste disposal in Srinagar Municipality includes collection and transportation followed by insanitary land filling. This disposal system of Municipal Solid Waste is becoming increasingly costly for the Srinagar Municipality especially with the increase in transportation expenditure. Unfortunately no processing plant for Municipal Solid Waste has so far been established in Srinagar. Therefore, the informal sector which is one of the principal sectors of recovering Municipal Wastes is exploited maximum and such a situation also raises a number of complicated issues that need to be resolved and redressed.
- Wrong vehicle selection, shortage of collection vehicles, inadequate transfer points and traffic congestion are the factors affecting collection efficiency, resulting in low waste collection rates. Vehicles which are used for transportation are not designed as per requirement. In Srinagar city, proper garages are not provided for the vehicles for protection from heat and rain. These vehicles are highly capital cost intensive and due to inadequate budget, older vehicles are deployed for Solid Waste transportation. This results in an uneconomic operation of the system. The maintenance facilities for these vehicles are inadequate, which adversely affect operational schedule of transport of waste. During the day time the traffic remains very congested in the city. From many parts of the city, a waste collection truck can make only one journey to the disposal site in one shift.
- Disposal of waste by SMC is only through land filling at Achan Dumping site and no resource recovery from waste is attempted. Recycling, reuse and reduce concept is also missing. Dumping at Achan is indiscriminate, unscientific without compaction, shredding, separation leveling and measures to control bird menace entry of rag pickers, water and air pollution and basic dumping site facilities are missing at Achan. Legal support for enforcement of MSW services is weak and difficult to enforce. There is lack of Public awareness and poor participation of citizens in Municipal Solid Waste Management.
- Environmentally sound facilities for the treatment and disposal of MSW are in great shortage. The current administrative system, sharing both the duties of handling and legislation in the municipal area for SWM, is a major disadvantage of this system.
- 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.

- Vehicles used for transportation of wastes shall be covered. Waste should not be visible to public, nor exposed to open environment preventing their scattering. The storage facilities set up by municipal authority shall be daily attended for clearing of wastes. The bins or containers wherever placed shall be cleaned before they start overflowing. Transportation vehicles shall be so designed that multiple handling of wastes, prior to final disposal is avoided.
- Land filling shall be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. Land filling shall also be carried out for residues of waste processing facilities as well as pre-processing rejects from waste processing facilities. Under unavoidable circumstances or till installation of alternate facilities, land filling shall be done following proper norms. Landfill sites shall meet the specifications as per Standards.
- 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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