



Trends of Urban Solid Waste Management in Agartala City, Tripura, India

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Abstract:

Environmental friendly disposal of Municipal waste is not often practiced in developing nations like India. With the rapid growth of population along with the expansion of residential areas and infrastructure development our inhabiting environment is getting affected. Poor management and lack of scientific approach in dumping process are the major hindrances on the way of MSW process. However, unsuitable placement of dumping yards at inappropriate areas is another obstacle found in case of Agartala city as it is growing very fast. As per 2011 census, population of this city was 399,688 with density of 6,251/Sq km. Around 260 MT (metric ton) urban solid waste is generated every day from more than 90,000 households including house hold (10%) commercial including industrial (12%) construction debris including thrown sweeping (50%), electronic wastes (2%) respectively. Present study of Agartala city has been conducted to assess the latest scenario of Municipal solid waste management process.

Keywords: Urban solid waste management, Environmental Impact, Environmental Awareness, Agartala city.

1.0 Introduction:

This is the era of urbanization with rapid industrial growth and because of this effect there is a huge decrease in the non-renewable resources that causes disposal of effluent which is resulted by toxic waste generation. Urban waste is a major environmental issue which is directly related with human health (Alen et al., 1997). In most of the developing countries, municipal solid waste (MSW) disposal has been a chronic problem, particularly in areas with high concentration of population (Karak et al., 2012). The study done by (Kumar & Gaikwad, 2004) the amount of MSW production will increase from 46 million tons per year to 65 million tons per year in the year 2001 to 2011. As per the estimated report by (Shekdar, 2009) metropolitan cities of nation alone generate about 14 million tons of MSW yearly. The estimated amount of waste generation in Agartala city was approximately 200 ton per day which was lower than the range among class 1 cities in India survey done by (FICCI, 2009). It has been noticed that, urban population of India has increased from 26% in 2001 to 32% in 2011 (Census of India 2011) which results to the rapid increase of waste generation. It is because of the negligence of the municipalities towards the solid waste management process today it has become a serious environmental issue almost for every

budding city of our nation. Generation of Municipal solid waste (MSW) in Asia during 1998 was 0.76 million tons per day (Jin et al., 2006). The per capita waste generation of Indian cities ranges between 0.2 and 0.6 kg per day which is lower than compare to developed countries. The Energy Resources Institute (TERI) has estimated that waste generation will exceed 260 million tons per year with in the 2047. The problem of waste management is becoming more complicated due to the improper and unscientific disposal of solid wastes mostly in open dumping site (Rajkumar, et al., 2010) which may result contamination in ground water (Kamboj. N, & Choudhury. M, 2013). As it is also noticed that, Open dumping sites generally attract birds, rodents and fleas which results unhygienic conditions to surrounding area of dumping site (Suchitra, 2007). The degradation of the solid waste results in the emission of carbon dioxide (CO₂), methane (CH₄) and other trace gases (MeBean. et al., and Dhere, 1995). Municipal solid waste management (MSWM) involves six basic principles. As per the international standards they are as waste generation, storage, collection, transfer and transport, processing and disposal respectively (H.R. Sharma, et al., 2013). But it is found in most of the nations, the MSWM process consists of four steps only i.e., waste generation,

collection, transportation and disposal only. In India, the solid waste management rule 2013 presents an improved solid waste management process as per the international standard. The main objectives of this present study are as 1) To access the present scenario of solid waste management of the city 2) To provide a glimpse of present municipal waste management of city. 3) To evaluate its problems, possibilities and recent management trend. 4) To make citizens aware about the better waste management with the cooperation of municipal authorities.

2.0 Materials and Methods:

The evaluation of the existing situation of urban solid waste management system of a particular city is very important for an environmental concern (Den Boer et al., 2007). The present study is based on primary data collection which comprises of both qualitative and quantitative estimation of wastes. 1) Field study is conducted at city as well as in disposal site. 2) Direct communication with the municipal authorities 3) Direct interaction with the local residence of the city. 4) For secondary data sources previous research work taken as reference.

Analysis of the data obtained has been done to assess the present urban solid waste management scenario of the city. The data were collected in and around different part of the city along with sources of waste generation and assessment of public consciousness regarding the urban solid waste; some photographs were also taken from the different parts of city during the time of survey. Authors did a ground field survey to understand the complete collection and disposal process of solid waste management process. The main intention of the study is to assess the present solid waste management scenario of the city that will give an account of present MSW scenario of Agartala city and it will clear the present situation of Municipal authority and its capabilities towards waste management process. The present study is based on following details 1) Waste collection process 2) Record keeping details 3) Transportation process 4) Monitoring process 5) Staff involvement in collection, and disposal process 6) Technical equipments and management process observation. Here is a glimpse of the proper methodology prescribed by the guidelines of government of India for the solid waste management and its handling rule (2000), the

steps are given as, Step 1-Collection of wastes, Step 2- Separation of wastes, Step 3- Storage in bin/container, Step4-Transportation by closed vehicle, Step 5-Processing of wastes, Step 6- Disposal of wastes, Step 7-Landfill with scientific process.

2.1 Study site:

Capital Agartala was founded in 1838 AD by Maharaja (King), Krishna Kishore Manikya (1830-49 AD).Agartala is the capital of the Indian state of Tripura and is the second largest city in North-east India after Guwahati, both in terms of both municipal area and population. Agartala city is the capital of state Tripura of India; the city is situated in 23° 45'- 23° 55' N latitude and 91°15'- 91°20' E longitude which is a centre for commerce, education, and administration as well. The Municipal board of Agartala was established in 1871 AD during the time of "Maharaja Chandra Manikya" (1862-96 AD). British Political Agent, Mr. A.W.B. Power was appointed for hill Tipprah in 1871 AD, who was given the honor of being the very first Chairman of the Agartala Municipality. The Municipal board in Agartala was started in 1874 A.D and the city became a planned city under the guidance of the then "Maharaja Bir Bikramanikya Bahadur" in 1940s. The area of AMC is 58.84 sq km as per AMC. Municipal council is divided in four zones as south, north, east and central. Agartala lies on the bank of Haora River and is located 2 km from Bangladesh. From 1901 to 1971 the city remained in a negligible development progress with only 8 sq km area but from 1981 Agartala started to expand and increase its connectivity in various fields along with its city area with 58.84 sq km at present. "Haora" is the most important rivers in Tripura. Agartala city lies on the banks of the "Haora River" which actually originates in "Baramura Hills" and merges into the "Titlas River" across the Bangladesh border. The river basin catchment area is approximately 488sq km. The city of Agartala is located lower elevations than areas surrounding it, specifically making it look like a saucer. Agartala is Located on NH-44. It is the Capital & Main City of Tripura State and also the hub of all administrative, Business, industrial, Educational & Health Centre, it is also well connected with Airport and Railway with rest of India.

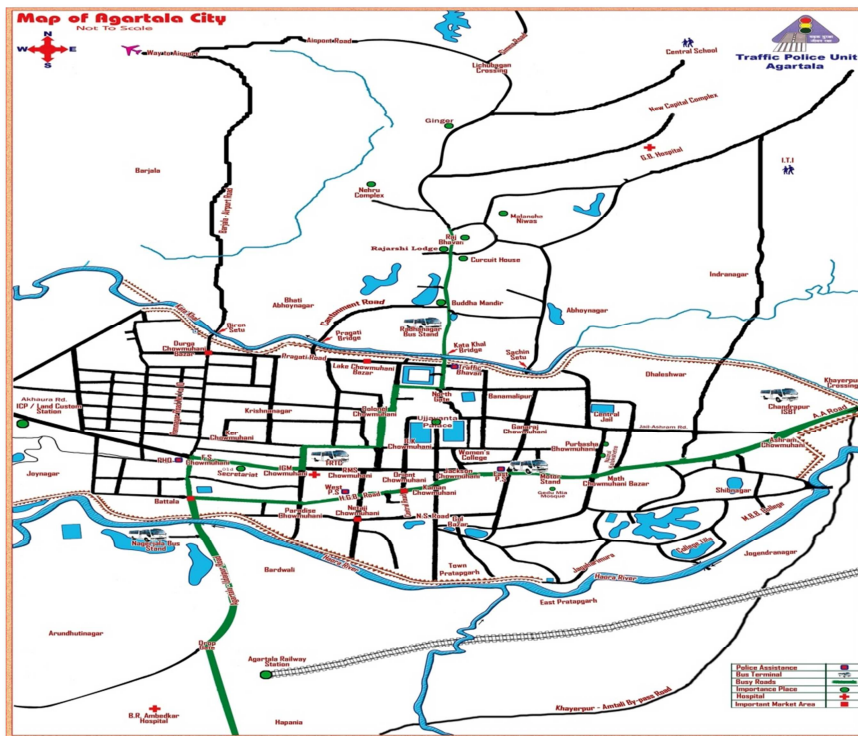


Fig. 1: Map of study Area (Agartala City), Source: Department of town planning

3.0 Results and Discussion:

Recent Scenario of municipal solid Waste management process of Agartala City:

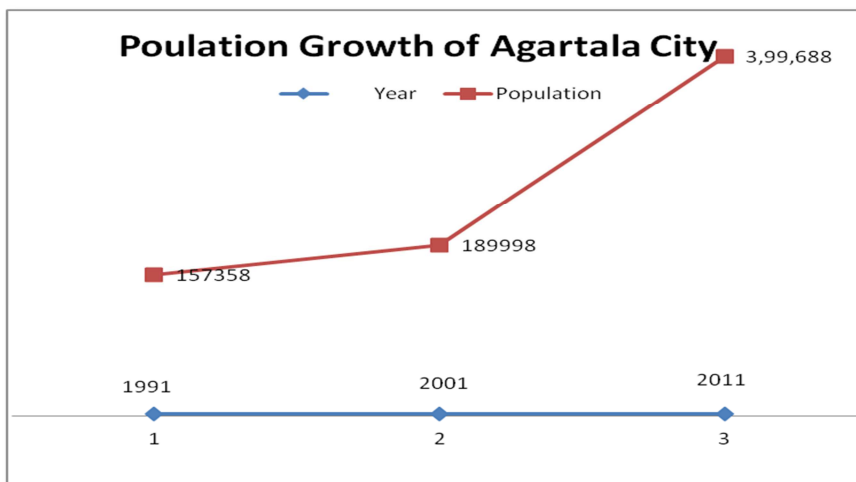


Fig. 2: Population data according to year wise census data, Source: Census report Government of India.

Data are collected from Agartala Municipal Corporation (AMC) and other secondary data collected from filed survey along with public questioner, these data are analyzed according to MSW management and handling rule 2000. The main intension of present study is to assess the recent trend, Scope and challenges of AMC towards management of municipal solid waste as with the rapid growth of population the amount of waste generation is also increased in the city. Currently there are 35 wards in the city which produce estimated 260 MT (metric tons) of waste

per day which was 200MT in the year 2009 reported by FICCI. The data clearly state that there is a significant increase in solid waste generation per day from 2009 to present day. Municipal Wastes generally consists of house hold, commercial, construction debris, electronic wastes, biomedical waste etc. The details of the qualitative and quantitative composition of urban municipal waste generation of Agartala city are given in table 1 and 2 below.

Table 1: classification of waste for Agartala city

Category of waste	Materials present	Source of generation
Municipal waste	Waste from household, cooking and thrown food, market refuse, storage ,slaughter house, remains of fires used for cooking, automobile parts, tyres, tree, branches of foliage ,street sweeping, dirt, tree leaves, dead animal bodies, lumbers, construction debris , pipe wires..	Households, market ,hotels, commercials, departmental stores etc.
Industrial waste	Solid waste resulting processing and manufactures; as food processing remains, boiler house, wood etc.	Small scale factories and industries etc.
Hazardous wastes	Biomedical waste, explosive ,chemical wastes from labs, documents papers etc	Households, hospitals ,institutions, stores and industries etc.
Agricultural and animal wastes	Crop residue, manures ,paddy husk, fodder , corn residue etc.	Farms, feed lots, livestock areas.
Domestic	Waste paper, plastic carry bags, bottles, cooking and serving waste, cloths etc.	Households.

Table 2: Estimated waste generation of City

Source	Quantity (MT Per day)
Waste generated from door to door collection	25MT
Waste generated from (Vegetable Markets, Fish Markets, etc)	60MT
Waste generated from (Workshops/Garages/E-Waste)	4.5MT
Dead Animals	0.5MT
Waste thrown collected by Sweeping and construction debris	130MT
Commercial waste	30MT
Others	10MT
Total urban municipal waste	260MT

As per 2001 census, Population of Agartala city was 1,89,998 which was 3,99,688 as per 2011 and its increased by double shown in figure (2). Though the percentage of literacy according to 2011 census was 93.88, which is higher than the national literacy rate. The overall area of the Agartala Municipal Corporation was 58.84 square Km before 2011 now it rose to 76.504 Square Km after the completion of the restructuring into Agartala Municipal Corporation at the end of 2013 and now grater Agartala is planned which will be much larger than the present area and having present population is around 438,408. There are 35 wards under AMC with population density of 6,251 Squire Km and around more than 90,000 households. It is estimated that per capita rate of waste generation ranges between 0.2 kg and 0.6 kg per day in the Indian cities which is about 1.15 lakh MT of waste per day and 42 million MT annually the city expands (NEERI 1995), where in case of Agartala city at present the average per capita waste generation is estimated as 0.5 to 0.6

kg per day, which is significant with respect of class I cities however as per report (MOUD Report 2005) Population range which more than 0.1 million generates a major portion of wastes in the country. These cities contribute alone 72.5% of total wastes of nation which followed by other 3955 urban centers producing only 17.5% of respectively given table (4) which shows waste generation in urban centers in India. General characteristic of wastes of Agartala city is given above table (1) and the amount of residential waste is half of the total amount which includes waste thrown from swiping and construction debris which shown in table (2). It has been also noticed that due to increasing construction activity in the city, proportion of construction debris is also increasing day by day. The major components of municipal solid wastes of city include food, vegetables, fruits, polyethylene, paper and cloths. Among these, food and vegetables wastes comprise the major component of the city wastes

both in the residential and the commercial areas, source which covers 33% percent of total wastes 85MT tons per day rest are drain slit, E waste 4%, and 2% respectively shown in figure (3) where same reported by (Lakhimi, Gogoi., 2013) for the capital city Guwahati which is the largest city in north eastern India that estimated around household/dust bin collected wastes around 40% and 11% of thrown wastes in road side area.

Table 3: Ranges of per capita waste generation status with respect of population, **Source:** (NEERI 1995)

Population range (millions)	Per capita waste generation in average (gms/capita/day)
0.1 to 0.5	210
0.5 to 1.0	250
1.0 to 2.0	270
2.0 to 5.0	350
5.0 and above	500

Table 4: Waste generation trend in urban centers of India, **Source:** MOUD Report (2005)

Types of urban centers	Tons per day	% of to total waste
7 Mega cities	21,100	18.8
28 Metro cities	19,643	17.1
388 Class I cities	42,635	37.1
3955 Urban centers	20,125	17.5

3.1 Municipal Solid Waste Collection of AMC System:

3.1.1 Primary collection process:

It has been observed that there is a primary collection system at Agartala City. Proper storage bins or centers are placed at different location of the city which is widely used for throwing wastes of nearby localities. NGOs are involved in collection process as in every ward one NGO is

involved for collection of waste. The process of waste collection done by AMC is generally from the source of generation which comprises of waste collection from house to house. Collection of wastes from commercial points viz. shops, hotels and restaurants, roads etc. Here in photo showing the dust bin/container that used for waste collection. But it is still facing problem in respect of segregation of wastes as in case of bio-degradable and non-biodegradable waste as per report by (MoEF,2010) most of cities in India still facing problem for separation of wastes. However, it has been reported that 40% of all municipal wastes remain uncollected and hence lies littered in urban area and which cause its way to nearby drains and water bodies that cause choking of drains and pollution of surface water bodies.

3.1.2 Secondary collection process:

The waste is directly collected from the collection centers or places where, the dust bin containers placed for waste collection. Around 500 numbers of medium and large size Bins/containers are placed in different parts of city mainly in the major market areas, roads and commercial areas etc. These wastes are further collected by vehicles to the disposal site. As the wastes are collected again from the collection centers to the disposal site thus, the process is called as secondary collection process. Every day more than 400 numbers of sweeping employees sweeps the major places and accumulate the wastes in the container/bin. Stationary container, manually loaded trucks and mechanically loaded trucks are used during secondary collection, transportation and disposal of waste. Some advanced mechanical sweeping vehicles are also involved in the sweeping process. Details of such vehicle are given below in table (4).

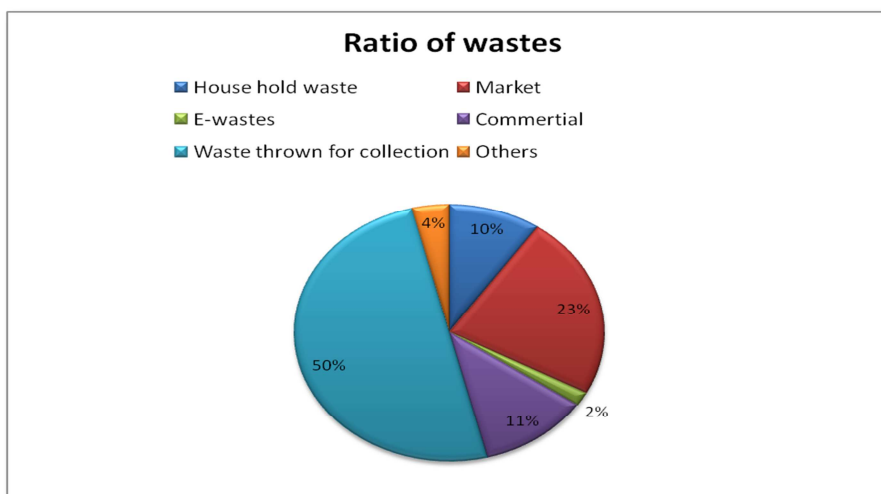


Fig. 3: Percentage ratio of Wastes generation with respect of sources, **Source:** AMC



Fig. 4: Bin/containers used for waste collection.

3.1.3 Transportation system process:

Solid Wastes generated by Agartala city is transported to the dumping site by both covered and uncovered trucks and other modern vehicles. The dumping site is situated about 15 km away from the main city Agartala known as Debendra Chandra Nagar. There are around 25 vehicles and all these are managed by AMC which are working daily by rotation of twice or thrice to the dumping site for disposal process.

Table 4: Vehicles involved in the complete MSW process, **Source:** AMC

Types of vehicle	Numbers of vehicles
14 Meter Refuge Compactors	3
8 Meter Refuge Compact powerful de-silting machines ors	10
skid steer loaders	4
powerful de-silting machines	2
Sweeping machines	1
Auto trucks for biomedical waste collection	5
Total	25

For this purpose near about 280-300 numbers of staffs are appointed from MSW section of AMC. Wastes collected from roadside, drains and also from various centers/dustbins, which are placed in different location of city shown in photo above. At present all wastes of the city are carried to the dump yard at “Debendra Chandra Nagar” but, the dumping site is not up to the level from scientific point of view and also insufficient. As a result, maximum amount of the wastes are dumped without processing because almost 50% wastes are unsuitable for recycling. As per the report 50-90% of major cities and about 50% small towns having problem with insufficient MSW system which includes lack of technical staff, shortage of

funds for process and management (NIUA1989) . Though, a processing plant is in operation for conversion to manure from waste but it was found insufficient. AMC has already introduced some modern sophisticated Vehicles which are used for better waste management process that reduce manual cleaning of city drains and other places details given in table (4). The silt is being disposed in the landfill at the dumping site. These machines will ensure speedy cleaning of covered drains of Agartala city; with these vehicles the collection and transportation of MSW under AMC shall become more efficient and economical which save money, time as well as a positive step towards environmental friendly waste management system. AMC also started to spread awareness among all citizens for better SWM system. AMC is spreading awareness among common people for extending cooperation towards AMC for Sweeping, Cleaning, and lifting the waste and also for house to house waste collection. Which will may bring changes in the attitude of common people so that the people may stop throwing wastes on roads, drains, or water bodies and will use the dust bin or container provided by AMC and also co-operate the staffs/NGOs during collection of wastes.

3.1.4 Biomedical waste disposal process:

Bio-Medical wastes is being collected almost from all the Government, private hospitals, nursing homes, medical colleges, pathology laboratories on daily basis as per guideline given by Government of India rule 1998(Biomedical waste handling rule 1998) . The bio-Medical wastes which are being collect regularly and send for incineration in the Diesel incinerator which is situated at “Hapania area”.

3.1.5 Disposal process:

At present all the wastes from the city Agartala is being dumped in open dumping ground as a landfill site which is situated outside form the city about 15 km and known as “Debendra Chandra Nagar” where total waste of city generally dumped in site which is not found scientifically improved. Though AMC has already started waste manure recycle plant but, it is not possible to manage 260MT of wastes with one single plant. The wastes of entire city include both bio-degradable and non-biodegradable waste products that create problem in recycling process and conversion in to manure.



Fig. 5: Covered modern trucks used for waste transportation and other waste disposal process

3.1.6 Waste management process and its limitations:

As Agartala city does not have an underground sewage collection and sewage treatment system. The untreated sewage directly mixing into several drainage channels of the city and finally going to the “Haora River”, “Khatakhal River”, and “Akhaura” channel. Which resulting degradation of water quality severely, which is also reported by monitoring the physic-chemical and bacteriological parameters of the river water upstream and downstream of the City of Agartala (Subhro, Sarkar.& Umesh, Mishra. 2014). Central Pollution Control Board (Report 2010) identified the river side along the City of Agartala for the “Haora River” to be one of the polluted minor river basins in India and suggested that measure should take immediately. Open dumping ground is also creating problems from environmental point of view as because of dumping of wastes which, resulting contamination of ground water as well as surface water, as it was reported at “Hapania area” area is more risk in respect of risk assessment index (Debasree, Purkayastha. & Sumanta, Chakrabarti. 2014). As this area has been used for solid waste dumping ground for last 40 years and now it is used for biomedical waste disposal site.

4.0 Conclusion:

Management of urban solid waste is a major issue for any administration especially in growing city like Agartala, which is a typical task because of growing population and rapid urbanisation. This present study gives an account of existing solid waste management process of Agartala city. There is a need to improvement of technical expertise

and proper manpower management for solid waste management process because of huge rose

in waste generation per day and now it is exceeding 260MT per day. Though AMC under took a project for recycling of wastes but, only nearly 50% of total wastes can use for this process because rest are either non bio-degradable or not suitable for recycling process. Thus wastes are remained and accumulating gradually so, AMC have to take some advanced technical measure to handle this problem further. Probability of gas production from wastes of Agartala city was reported by FICCI, (2009). Segregation of wastes is very important and need to take care during and before the collection time as it is observed there is no such measures adopted so far in this regard. AMC has taken many measures as per rule 2000 MSW and trying their best to tackle the solid waste management system and improving the situation, and it can be concluded that the management situation is better than compare to other cities of India and citizen should more aware and cooperative in respect of waste management process so, that a safe and better environment can be achieved for every citizen.

5.0 Acknowledgement:

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