

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Auditing Waste Management Practices in an Indian City

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ABSTRACT

The present paper focuses on the solid waste management of Trichy city, India. The development of India has led to massive urbanization and hence crowding of the city. Trichy is one of the biggest cities in South India and hence is experiencing a massive population growth. This has led to major environmental damage especially in municipal solid waste management (MSWM). The paper critically reviews the existing solid waste management procedure. The data were collected from several sources such as municipality and by interviewing with people as well as through direct perception. Though the solid waste management has improved slightly, there are still many problems. Some suggestions have been provided.

Keywords: Solid waste management, Audit, Physical composition and Chemical composition.

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INTRODUCTION

Tiruchirappalli better called as Trichy, is situated in the center of the state. Trichy city is the fourth largest city in Tamil Nadu. It is well known for its high Academic Institutions, continuous perennial water flow, and high monuments of major religions. Trichy is located geographically between 10 to 11-30' North latitude and between 77-45' to 78-50' East longitude. There are 1 International Airport and 4 Railway stations in the city. The town and its famous landmark called Rockfort Temple were built by the Nayaks of Madurai. The other main landmarks are Sri Rangam, Cauvery River, Coleroon River, Thiruvanaika Kovil, Samayapuram, Vekkalliamman Kovil. The city is famous for artificial Diamonds, Handloom clothes, Glass Bangles and wooden and clay toys. This Corporation has earned first place in Sanitation among the cities in Tamil Nadu and sixth place among the cities in India. The present population of Municipal Corporation is 1082975 with total 70 wards.

Solid wastes are waste materials originate from a predominantly urbanized set up. The waste management is a complex process because it involves many technologies and disciplines [1]. There are various conferences which laid down detailed guidelines and also appealed for a sustainable management of the waste. There are various processing techniques like anaerobic digestion, windrow composting, recycle and reuse [2-3]. There are energy recovery processes like biochemical conversion and biogasification [4-5]. The present work assess the waste management option Trichy city is using and provide a qualitative suggestion for the healthy improvement of solid waste management.

Ariyamangalam Compost Yard Descriptions

The estimated MSW generation in Trichy city is about 400 to 600 tons per day, which is facilitated by an open dumping yard namely Ariyamangalam garbage ground. The dumping site is positioned at 10°48'N and 78°43'E. The ground altitude of the dumping site is 75.875m above Mean Sea Level (MSL). It covers a total surface area of 47.7 acres. The dump site is in poor condition as site is freely accessible and hence visited by rag pickers as well as assortment of animals. Figures show the description of dumping site. The City Corporation collects the waste daily in all wards during 630-1030hrs and 1430-1730hrs. They use Coconut brooms, Long handle spread brooms, Scrap plates and Bamboo baskets.

METHODS

The Table 1 gives the various resources used for data collection.

Table 1: Resource Material

Trichy Corporation	Trichy ward map Ward wise population details Number of vehicles in use Number of instruments used
Others	Trichy Corporation Archives Central Pollution Control Board, Thuvakudi. Exnora (Social Service Committee) SVR Industries

RESULTS AND DISCUSSION

The waste generated in this city is 435 MT per day; this corporation is collecting and transporting 416 MT daily. Garbage is collected through the medium of 1880 Sanitary Workers. Apart from that the corporation uses various push carts, bins and steel containers with different capacities. Tippers and Dumper placers are also being used. These vehicles are used daily for garbage transportation. Besides, Chain Poclin and Chain Dozers are being used for handling garbage in compost yard. Municipal Solid Waste collection in Trichy includes collection from residential areas, hospitals, market areas and industrial wastes. At present, manual methods are used to collect residential waste. At present, M/s. IWMUST has been preparing manure from the dumped garbage.

There is increasing trend in solid waste generation (data not shown). It can also be noted that in most cases, solid waste generation is more or less uniform throughout the year. This could be because Trichy has a uniform climate throughout the year. Even in winter, temperature remains as high as 35⁰C. Like other metropolitan city, however, the solid waste generation has steadily increased from 12000 tons/year to 15000 tons/year.

Table 2: Physical composition of municipal solid waste in Trichy

Types	Ponmalai	Ariyamangalam	Sri Rangam	Abishekapuram
Vegetable waste	30%	45%	18%	17%
Fruit waste	17%	20%	8%	12%
Dead leaves	13%	5%	3%	6%
Animal waste	-----	7%	3%	3%
Paper	15%	10%	18%	20%
Wood pieces & Cloth	-----	-----	3%	1%
Plastic & rubber	-----	-----	10%	6%
Polythene bags	20%	12 %	15%	16%
Plastic bottles	-----	-----	10%	15%
Glass	-----	-----	-----	0%
Sand & hard	3%	-----	6%	3%
Inert materials	1%	1%	6%	1%

There are four zones in Trichy corporation (Table 2). While collecting samples, maximum area are covered evenly. Apart from the four zones, samples are collected from dump site at Ariyamangalam, because all zones of municipal solid waste are dumped here. In the dump site all types of wastes are there. Second sample zone is market area located at Ariyamangalam South uthra street at Sri Rangam constitute the third zone. Sri Rangam temple is one of the most revered sites all over South India and hence there are influxes of tourists daily. Fourth sample zone is Sundar nagar main road at Ponmalai and finally fifth one is Central bus stand at Abishekapuram. In this place all areas people are assembled. Sample collection is done in all these zones.

Physical composition of municipal solid waste

Physical composition of municipal solid waste collected is shown in Table-2. It can be noted that Vegetable waste and fruit waste is more in market area in Ariyamangalam when compared to other three zones. Animal wastes are also more in Ariyamangalam zone when compared to other three zones. Paper and plastic waste are more in Abishkapuram zone because schools are more in that areas and center of the city is Abishekapuram zone. Inert materials are more in Srirangam zone. Polythene bags are more in Ponmalai zone because railway station and yard was there.

Chemical composition of municipal solid waste

Chemical characteristics are important part of waste analysis as they indicate the pollution potential. Selection and design of the waste processing and disposal facilities is dependent on pollution potential. These analyses include pH values, Nitrogen- Phosphorus - Potassium (N-P-K) values, carbon values, C/N ratio and calorific values. Table 3 shows the chemical characterization of Municipal Solid Waste in Tiruchi. The tests were conducted on the samples collected randomly from different wards of the city covering the areas like residential areas, hotels and restaurants, bus stands, railway stations, public areas and industrial areas. From Table, we can observe that the organic content is the main component of the Municipal Solid Waste quantity which is nearly 65% of total waste generated in the city. The inorganic waste is only 35% of total waste. Inorganic waste are mainly the construction wastes which are about 35%. Sample two contains more Carbon content. Sample one contains more Calorific value and in Ponmalai zone pH value is more. The carbon contains 45.4% which includes the ash and other carbon-containing materials. Nitrogen content is 1.42% which contains mainly the kitchen waste and market waste. The phosphorous content is 0.41% and the potassium content is 1.33%. These values indicate that the organic waste may be used as a fertilizer through composting.

Table 3: Chemical characterization of each sample

Sl.No	Chemical parameter	Ariyamangalam	Sri Rangam	Ponmalai	Abishekapuram
1.	pH	6.55	6.22	6.98	6.70
2.	Total Carbon	12.90	11.30	10.70	10.50
3.	NPK Value	1.42, 0.41, 1.30	1.30, 0.85, 1.07	1.55, 0.70, 1.01	1.30, 0.55, 1.25
4.	Calorific values (Kcal/Kg)	950.70	900.90	890.70	987.55
5.	C/N Ratio	9.10	9.45	9.67	9.00

Disposal at Ariyamangalam dump yard

The municipal solid wastes from all around Trichy are brought to the Dump yard at Ariyamangalam by the municipal lorries. The waste are dumped and leveled in the yard by means of JCB's. The dump yard has total area of 185807 m², while the area assigned to

IWMUST is 32654.7sqm. The average Height of the solid waste dumped in the compost yard is presented in Table 4.

Table 4: Height of solid wastes in different locations

Location	Height (m)
South east side	3.5
South west side	5
North east side (opposite to Weigh Bridge)	9.15
North west side	4.2
Middle (south east)	4
Middle (South west)	6
Average height	4

Volume and density of the solid waste collected are 610000m^3 and 170 kg/m^3 respectively. This leads to the weight of solid waste = $610000 \times 170 = 103700000\text{ kg}$. Density of waste is needed for designing solid waste management system. 25% of the volumes are reduced by compaction. Significant changes in density occur as the waste moves from source to disposal, as a result of handling, scavenging, wetting and drying by the weather, vibration in the collection vehicle and decomposition.

The observations made on the site are

- The fire accidents are occurring often due to the emission of methane gas.
- The JCB and other equipments at the site are not sufficient.
- The workers and the rag pickers don't have any precautionary measures like gloves, masks, etc.,
- There are several occupational hazards associated with waste handling. It can lead to skin infections, eye and respiratory infections and intestinal infections. The infections may result from direct contact with waste or other processes as the bites of animals feeding on the waste. The incineration operation may lead to chronic respiratory diseases because of frequent contact with toxic compounds.
- The ground water and the drinking water are contaminating due to waste dumping in surroundings.
- Air pollution is also affecting the neighboring people.

Agencies responsible for MSWM

Health Department

Trichy Municipality is responsible for the Municipal Solid Waste Management at Trichy district. The Chief Health Officer is the head of the Department in charge of Solid Waste Management System. Trichy city has been divided into four zones. Each zone has been administered by the Zonal Health Officers. The Deputy Health Officers are there to assist them.

The Medical Officer for Health, Health Inspectors and Sanitary Daffedars are there to work under them.

NGOs / CBOs

Public grievance meetings are conducted by the NGOs/CBOs to identify the problems in solid waste management systems. This will help to improve the waste collections. They used to conduct public meetings to educate them to segregate the waste at source itself.

Private informal sector

The EXNORA is doing the SWM in Sri Rangam residential area at smaller level. They have given the two different colour dustbins for bio-degradable and non-biodegradable to all houses in that area. They collect the waste separately and do composting at smaller level.

SUGGESTIONS

Collections

More number of light weight pushcarts, and high capacity HDPE buckets are the immediate requirements. Similarly large number of low capacity HDPE buckets with different colors (For segregating biodegradable and non-biodegradable) should be arranged. Safety apparatus for personnel involved in waste collection should be procured. 8 m³ capacity compactors are much more convenient to enter inside the narrow streets. Presently they do not have these compactors. These should be purchased along with the bins and SS containers. The approximate numbers for these instruments could be (Table 5).

Table 5: Approximate numbers of proposed equipment's

Type of Instruments Proposed	Numbers
Light weight pushcarts with 50 liters capacity HDPE buckets	100
10 liters capacity HDPE buckets in Red & Green colors	2,50,000
Safety equipment sets for Garbage Recovery Personnel such as Safety Gloves, Face Mask, Safety Shoes	500
Compactors with 8 m ³ capacity	25
Bins with 1.10 m ³ capacity	1000
Dumper placer vehicles with 4 m ³ capacity	10
SS containers with 4 m ³ capacity	450
containers with 6 m ³ capacity	25

The plastics wastes are difficult to be biodegraded. The collected garbage yields 7% plastic waste, which amounts to approximately 29 tons. The purchase of shredding machines can help cutting the plastic wastes, which can be further used for some commercial purposes. The present waste disposal leads to bad odour and health hazard considerably. It is suggested



that garbage shall be compacted using HDPE sheets and gravel filling. The organic nature of waste necessitates generation of power. This will also serve the purpose of waste stabilization. Health study of waste workers should also be undertaken as they are dealing with hazardous materials.

CONCLUSIONS

This audit presents a narrative of solid waste management practices in Trichy. The sampling result shows that the waste contains sizable fractions of organic components and can be properly utilized. The proper education and proper training can help people and administration to facilitate proper discharge of the waste and its segregation. Open dumps must be avoided. Recyclables can be easily collected and a formal sector can institutionalize such collections. This will also lead to increased revenue for the city administration. The financial incentives coupled with education to the recyclers can motivate them for effective waste management practices. Though there is a limitation in our audit in terms of broader environment perspectives, still the audit has raised some of the issues that need to be addressed.

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