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A Case Study on Municipal Solid Waste Generation & its Physical Composition in Three Important Towns of Tripura, India

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ABSTRACT: Collection and processing of reliable real-time data regarding waste production and characterization is one of the most important factors for designing a cost effective and fruitful waste management plan for a country. To obtain these data on a regional basis with respect to waste generation and physical composition, households and institutions are selected on a random basis in three important towns in the state of Tripura, India. Results predict that the waste generation at Agartala city will be 229.60 MT/day by the year 2021, whereas the similar data for Udaipur and Belonia will be 23.78 MT/day & 11.68 MT/day respectively. The physical composition of the waste samples shows a sharp variation for Udaipur and Belonia in comparison with Agartala. The percentage of biodegradable portion of waste for the Agartala city is 69.25% and that for Udaipur is 78.60% & Belonia 79.10%. This trend shows the impact of socio-economical structure and livelihood stratification on the quality as well as quantity of solid waste. The inadequate baseline data regarding the MSW of the towns emerges as the main challenge in the present study. Further study on the seasonal variation of the physical as well as chemical composition of municipal solid waste of these areas utilizing the output of present study will enrich the data to a complete sphere which may be utilized in formulizing the municipal solid waste management plan for the localities.

Keywords: Municipal Solid Waste, Characterization, Physical composition, Sampling.

Abbreviations: MSW, Municipal Solid Waste.

I. INTRODUCTION

The exponential increase of population compounded with rapid urbanization results in the expansion of the quantum of municipal solid waste which in course of time results in polluting the earth environment in various spheres including air, water, soil etc. Municipal Solid Waste (MSW) can be considered as a “gateway” of numerous tangible environmental problems. Solid waste disposal and management is appearing as a serious concern both for urban and rural areas [1]. It is evident from various studies that every person is a potential generator of waste and thus considered as a potential contributor to the problem of solid waste. Recently solid waste management is becoming a major public health and environmental concern in urban areas of many developing countries [2]. Unscientific disposal of solid waste leads to depredatory environmental impacts and health problems. Most of the urban bodies in both developed and developing countries are not spending more than 0.5% of their GDP on urban waste management services. It covers only about one-third of overall cost of waste management (World Bank, 1999). As per World Bank report more than 80% of the total MSW management cost is utilized in collection of waste in low income countries. It reflects that in such countries the fund allocation in waste management is not adequate enough to cope up with the increasing load of solid wastes. Solid waste management (SWM) in general refers to a wide variety of activities and practices that includes all possible activities needed to manage unwanted residues of any given culture. There is a need to develop careful management strategies to protect the environment from degradation due to solid wastes.

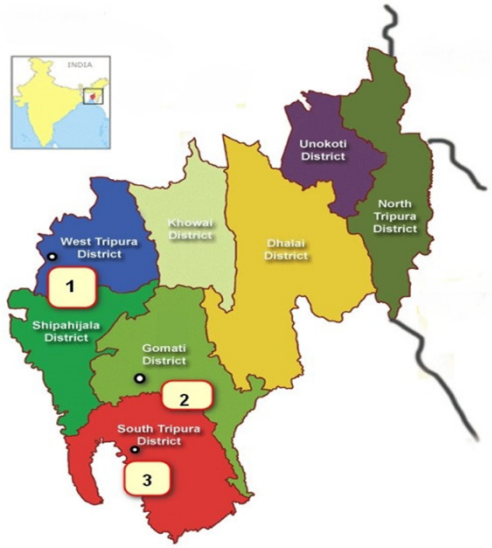
As we know that the rapid urbanization is one of the major causes that trigger the problem of solid waste. In India, solid waste is extending to larger dimensions because of the continuously increasing population and establishing new urban areas. It is estimated that about 1,00,000 MT of municipal solid waste (MSW) is generated everyday in the country. Urban Local Bodies spend about Rs. 500 to Rs.1500 per ton on solid waste for collection, transportation, treatment and disposal. Among these approximately 60-70% is spent on collection, 20 to 30% on transportation of waste and less than 5% is spent on final disposal (CPHEEO, 2000 a). The present study is mainly concentrated in a comparative review of municipal solid waste generation statistics of two newly developed municipalities of the state of Tripura with the oldest and capital city of the state i.e. Agartala [3, 4].

II. STUDY AREA

Tripura is one of the North-Eastern seven sister states of India. Agartala is the capital city of Tripura. Geographical area and population of the city is 62.02 sq km and 512264 as per 2011 census respectively.

Existing Solid Waste Management system of Agartala city is based on the strategy adopted in the early years of eighty decade of last century. With the gradual increase in population as well as overall socio-economic infrastructure of the state the facilities of urbanization have been extended beyond the limit of capital city in last recent years, which results in the establishment of new municipal bodies in the state. Udaipur is the second important town of the state which is also the ancient capital of the state having an unparallel importance in the field of Tourism sector in Tripura. The town has the Tripurasundari Temple and many other temples having religious importance and a good number of lakes which always attracts the tourists of both state and abroad. The total geographical area of the upgraded Udaipur Municipal Council is 8.60 sq km. The population of the town as per last census is Belonia is another town situated at South Tripura District of the state having a geographical area of 5.74 sq km and population of 19,938 The town is the district headquarter of South Tripura and also a border town along Bangladesh, due to which it poses a notable importance with respect to international export and import business.

Both of the above mentioned towns have logical and strategic importance in the growth of the state and due to this the population of these towns are increasing considerably in recent years which in turns results in the uplift of Municipal Solid Waste production of these urban bodies. Fig. 1 depicts the geographical map of Tripura indicating the study areas.



1: Agartala; 2: Udaipur; 3: Belonia

Fig. 1. Map showing the study area.

III. METHODOLOGY

The total social as well as the economic stratification of the Agartala city is quite different in comparison with that of Udaipur and Belonia. As these two towns are newly upgraded into municipalities from semi-urban local bodies, thus the field study depicts the rural bias in the social structure and life style of the residents of these towns. This in course affects the quality as well as quantity of municipal solid waste generation.

It is found that the housing pattern of core area and peripheral areas of Agartala city is different. The housing pattern of the core area is mostly of Bunglow, apartment and colony type whereas the housing pattern of peripheral areas is mainly of the nature of semi-permanent and permanent. Accordingly the population density and income grouping of the habitants also varies drastically in core and peripheral zones. For Udaipur and Belonia if the housing and livelihood pattern is judged, a rational similarity can be drawn with that of the peripheral zones of Agartala city.

For sampling of wastes for the present study wastes were collected from both hoses as well as institutions. Further the analytical data were collected from available literatures and secondary sources. During the sample collection for characterization of solid waste houses were selected arbitrarily ensuring representation of all income groups and pattern of houses for all the urban bodies and for both the zones of Agartala city. During sample collection from the institutions, representation of public as well as private establishment was considered proportionately. Rational representation from different categories and sizes of institutions was also maintained. 50 nos. institutes across the three urban bodies considered in the study were identified for sampling. A total of 650 households were identified and included for sampling in the present study. Every sample household, commercial establishment & institution was asked to dispose solid wastes in different colour coded bins. For the present study three different coloured bins having green colour for biodegradable waste yellow colour for all non-biodegradable wastes and black colour for inert wastes were provided. Households were asked to preserve garden trimmings, if any separately. Numbers of resident in the sample household with the occupation and average monthly income and numbers of employees in the sample commercial establishment and institutions respectively for household and institutional category were recorded. Waste samples as collected from above process were properly segregated, weighed and measured for obtaining the characterization data [5, 6].

IV. RESULTS AND DISCUSSION

The quantity prediction of solid waste is conducted based on the data obtained from secondary sources and further statistical analysis for next 30 years i.e upto 2051 (Table 1). Table 2 indicates the predicted values of total waste production in Agartala, Udaipur and Belonia upto 2051 as per present trend assuming MSW production rate of 0.50 kg/capita/day based on the current scenario and available literatures.

Table 1: Population Prediction.

Year	2021	2031	2041	2051
Agartala	459203	518719	578234	637750
Udaipur	47560	57339	67118	76897
Belonia	23357	26718	30079	33440

Table 2: MSW Quantity Prediction (MT/day).

Year	2021	2031	2041	2051
Agartala	229.60	259.36	289.12	318.88
Udaipur	23.78	28.67	33.56	38.45
Belonia	11.68	13.36	15.04	16.72

The characterization of household wastes as found from sample analysis reveals notable variation between the three urban bodies [7-9]. The solid waste samples collected from different sampling sources are broadly classified into following categories:

— Food & kitchen waste
— Recyclable waste
— Plastic waste
— Glass & metals
— Inert materials
— Garden & yard waste

Table 3: Average Physical Composition of Municipal Solid Waste.

Component	Agartala	Udaipur	Belonia
Glass & Metals	1.51%	1.35%	1.34%
Food & Kitchen Waste	56.15%	59.00%	58.80%
Garden & yard waste	13.10%	19.60%	20.30%
Plastics	8.65%	4.00%	4.10%
Recyclable matters	2.90%	2.10%	1.97%
Inert materials	16.20%	13.10%	12.67%
Moisture Content	35.97%	37.00%	37.20%

Among these types' food and kitchen waste is mainly bio-degradable in nature and has the highest fraction in total mass waste for all the three study areas. It shows the rural bias in lifestyle in the study area. For Agartala city also the biodegradable portion is quite predominant and its quantum increases from core zone towards peripheral zones. The quantity of garden and yard waste is higher in newly established towns compared to Agartala city. Whereas the plastic waste which is one of the main concerns of the experts now a days due to the increased risk of eco-degradation is higher in institutional sources and Agartala city. The quantity analyses of other types of wastes are also realistic and rational if considered based on the overall scenario of the state. The overall characterization analysis of municipal solid waste for all three urban bodies considered in the current analysis are shown in Table 3 for Agartala, Udaipur and Belonia. The overall result shows the correlation among the solid waste quantity and quality for the three different towns of the state. Moisture content of MSW is another important factor determining the disposal process selection of the waste. In the present study the moisture content of the MSW samples are also tested and the average values of the moisture content are presented in Table 1 for the three towns considered in the study. The results regarding moisture content show a significant correlation with other physical parameters for all the three towns under study. The highest moisture content is found for Belonia which is 37.20%. Whereas, for Agartala and Udaipur the values are 35.97% and 37.00% respectively.

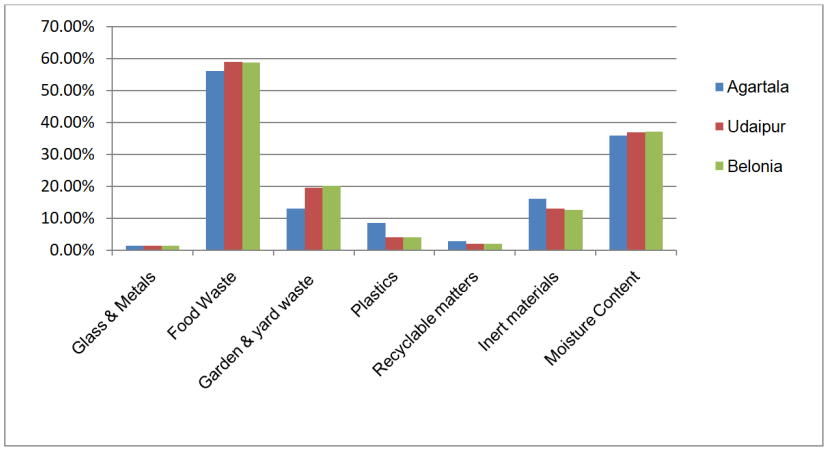


Fig. 2. Charecterization Report of Municipal Solid Waste**.**

V. CONCLUSION

The present study of ascertaining solid waste generation trend and characterization will immensely assist policy makers to chalk out appropriate strategy to effectively tackle the solid waste collection; transportation and disposal issue of the city of Agartala as well as for the two newly established municipalities i.e. Udaipur & Belonia with a paradigm shift from existing practices. The results obtained through the present study will help in minimizing the data gap of MSW in the study area. Study result indicates that lion share of the solid wastes of all the three study locations are biodegradable in nature and can be used for composting. If appropriate quantum of the waste is used for composting, the pressure on sanitary landfills can be reduced drastically. Steps for economic collection and transportation of wastes from source to disposal grounds may also be taken on the basis of the study results. Further study on the chemical characterization of the waste will surely enrich the data resource and more appropriate design can be framed for complete waste management plan for the study areas.

Conflict of Interest. No.

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