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Municipal Solid Waste Management (MSWM): A Case Study of Nagaon Town in Assam, India

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Abstract: ***Municipal solid waste management (MSWM), mostly an urban phenomenon, is undoubtedly an important issue of global concern today that invites attention of engineers, activists, academicians, researchers, students and citizens interested in and working on environment. Disposal of waste in an eco-friendly and sustainable way stands as a big problem even in small towns nowadays. Ceaseless migration of people to urban centres from neighbouring rural and semi urban areas has resulted in exponential growth of population in towns and cities. There is a continuous shift of economic activity from agrarian to industrial and service sector as well. Most people have sought for the so-called modern 'made-easy' lifestyle with the abandonment of rural traditional life and adopted the 'throw-away' culture. Plastics have replaced traditional cotton and jute culture in day today life from market to kitchen and garden to bedroom. It has inevitably led to the generation of huge amount of municipal solid waste (MSW). Small cities and towns are also no exception. The present study is an attempt to examine the status of MSWM in Nagaon, a class I town in Assam. Both primary and secondary data were used. For collection of primary data, 5 separate questionnaires were specifically designed for households, ragpickers, commercial establishments, hospitals, and Municipal Board. It was found that the status of MSWM in the town is not satisfactory from collection to disposal, the main causes being the inefficiency of the municipality and the absence of community participation.***

Keywords: MSW, MSWM, collection, transportation, disposal, Nagaon town.

1. Introduction

One of the adverse consequences of development and urbanization is the generation of municipal solid waste (MSW) in large quantities. 'One of the most obvious impacts of rapidly increasing urbanization and economic development can be witnessed in the form of heaps of municipal solid waste (MSW)' (Nehra, 2010, p. 1). Small cities and towns are also no exception. 'Small cities and rural communities also face significant waste disposal problem, which may be somewhat different from those of metropolitan centres' (Haque and Hamberg, 1996, p. 247). Towns are also embracing the bulk of population migrating from neighbouring rural and semi-urban areas and increasing very fast leading eventually to generation of huge quantity of MSW. As a consequence, the issue of municipal solid waste management (MSWM) gets more complex.

Nagaon town is the administrative head quarter of the district of Nagaon in Assam, India. Located in the middle part of the Brahmaputra valley, it is a non-industrial town with an area of 9.22 square kilometer extending from 26^0 $20^/$ $14^{//}$ North to 26^0 $22^/$ $05^{//}$ North latitude and from 92^0 $40^/$ $02^{//}$ East to 92^0 $42^/$ $56^{//}$ East longitude. The urban local body (ULB) to which the responsibility of MSWM goes is Nagaon Municipal Board (NMB). It has 26 wards having 26,483 households with a population of 1,16,355 according to 2011 census. According to the general classification of towns, Nagaon gained the class I status in 2001 with a population of 1,07,667.

2. Methodology

Primary data were collected by conducting five field surveys through 5 questionnaires specifically made for households, ragpickers, shop and commercial establishment, hospitals, and ULB. Field observation and interviews were proved to be of great use in this regard. Pilot surveys were conducted with a view to adding some more relevant questions omitting the unnecessary ones. For household data, 12 wards were selected from total 26 wards, a total of 240 respondents were chosen for interview through questionnaire taking 20 respondents from each of these wards. The numbers of respondents selected from the lower income group (LIG), middle income group (MIG), and higher income group (HIG) were 80 each. The criteria for division of LIG, MIG and HIG were fixed arbitrarily as up to Rs. 10,000, Rs. 10,001 to 50,000 and Rs. 50,001 and above respectively per month. Household data were collected so as to know about community perception, community awareness, community participation of/in MSWM process, the relation between the household income and rate of waste generation, etc. The value of Karl Pearson's 'r' was calculated to determine the nature of correlation between household income and quantity of waste generation. For the data on ragpickers, 50 respondents were chosen randomly, out of them 18 in the spot while collecting rags, and the rest 32 from slum colonies settling amidst the town. Owners/managers of 30 shops/commercial units were selected as respondents. For collection of data on bio-medical waste management, 6 hospitals/nursing homes were selected one of which was government civil hospital and the other 5 were private. MSW samples were collected from different parts of the town and the samples were analysed for some chemical parameters. Bulk density of MSW was measured from heaps of garbage collected from market areas and residential areas.

3. Results and Discussion

Generation of MSW

The generation of MSW in Nagaon town has been increasing with the increase both in number of household

and population. The following table shows the upward trend in number of household, population and quantity of MSW generated in Nagaon town.

Table 1: Increase in number of household, population and waste quantity

Year	No. of household	Population	Waste generated (metric ton) /day
2001	21,243	1,07,667	28
2011	26,483	1,16,355	36
2014	28,055*	1,30,012*	42*

Source : Census of India. *estimated

The quantity of MSW generated in Nagaon town was estimated to be about 42 metric tones per day in 2014. The generation rate was 0.32 kg/capita/day and 1.50 kg/ household/day. Both dry and wet types of MSW were generated by 91.2 % of the LIG respondents, 95 % of the MIG, 88.7 % of the HIG, and 91.2 % of the total respondents.

Table 2: Economic groups and types of MSW generated

Type of MSW generated	% of LIG respondents	% of MIG respondents	% of HIG respondents	% of Total respondents
Dry	1.3	1.3	6.3	2.9
Wet	7.5	3.7	5.0	5.4
Both dry & wet	91.2	95.0	88.7	91.7
	Total 100.0	Total 100.0	Total 100.0	Total 100.0

As calculated from the figures as reported by the respondents, the LIG families have an average monthly income of Rs. 10712.5, the MIG families Rs. 26000/- and the HIG families have an average income of Rs. 70,087.5 per month. For the total 240 respondents, it is calculated as Rs. 35,600/- per month.

The LIG households generated 0.8 kg/day in average, while the average values for the MIG and the HIG households were 1.4 kg/day and 2.1 kg/day respectively.

Table 3: Correlation between income and amount of waste generated, N=240

	Mean	Std. Deviation	Pearson Correlation Coefficient (r)
Monthly income	35600.00	29095.615	**.650****
Amount of waste generated/day(kg)	1.43292	.766506	

** Correlation is significant at the 0.01 level (2-tailed).

Table 3 shows the value of the 'r' (Karl Pearson's coefficient of correlation) is 0.65 indicating a positive correlation between monthly income of the household and quantity of wastes daily generated, the relationship is significant at 0.01 level.

Characteristics of MSW

Of the physical characteristics of MSW, only the bulk density was measured. A wooden box of 0.028 m^3 volume, a larger box measuring 1m^3, and a digital weighing machine with 50 kg. weighing capacity were used to measure density, i.e. weight of MSW per cubic meter. It was found that the MSW generated in market areas of the town had density of 132.639 kg/m^3 while it was 294.207 kg/m^3 for the residential areas.

Waste samples were collected from different parts of the town applying the Quartering Method. The MSW samples were analysed for some chemical parameters and the values obtained were: moisture content 30% , organic matter 30%, ash content 42% , total organic carbon 23.97, total nitrogen 1.12% and C/N ratio 21.4.

Collection of MSW

As yet door to door collection of waste was not a practice in the town. About 27% of the residents disposed of their household wastes in the dustbins provided by the ULB, 19% in open land, 16% in roadside, 2% in town drains and 5% in riverbank of the Kalang, the only river flowing across the town. Majority of the shops and commercial establishments engaged some persons on daily/weekly/monthly payment basis to collect and dispose of their wastes into the nearest dustbins.

The animal wastes from about 45 slaughterhouses in the town were disposed of into the river Kalang every day posing threat to water quality. It was alleged by the butchers that some ULB personnel collected Rs. 10 every day from them but did not collect the slaughterhouse wastes for disposal.

The ULB bears no responsibility of the biomedical wastes generated by the medical and health care establishments. The hospitals in the town including the only govt. civil hospital entered into an agreement with Fresh Air, a Guwahati-based NGO for collection and disposal of biomedical wastes generated in respective medical establishment.

The MSW was collected from the community bins, street sweeping and roadside garbage irregularly and transported to the disposal site. Wastes were not segregated at source. The ULB did not provide the residents with colour-coded bins for segregation of wastes at source. The ULB also did not have its own scheme of segregation.

Transportation

The ULB transported the MSW by 1 tipper truck, 3 tractors with trailer and 1 tractor mounted dumper placer. The tipper truck carried 9 metric tones (volume 12 cubic meter) per day while 3 tractors with trailer carried 13.5 metric tones (18 cubic meter) and the tractor-mounted dumper placer carried 9 metric tones (12 cubic meter) per day. These made a total of approximately 32 metric tones (42 cubic meter) of MSW transported per day to the dumping sites.

Treatment and disposal

The ULB did not practice any method for treatment of waste. There was no any sanitary landfill. There is no even a composting plant for processing of organic wastes into biomanure. The plants like 'waste to energy (WTE)' or 'refuse-derived fuel (RDF)' are a remote dream for the ULB.

Any technological options for thermochemical conversion processes viz. Incineration, pyrolysis/ gasification, and for biochemical conversion processes viz. anaerobic digestion/biomethanation were not started.

State pollution control board, Assam provided NMB with a self-powered garbage disposal system, SWATCH-SP 500, which could destroy any type of organic waste up to 500 kg. daily without using fuel or power. By-product is normal ash just 1% of the input waste. But only one system in the town generating more than 40 metric tonnes/day was definitely insufficient. Due to the high moisture content in the organic MSW in the rainy season, the performance of the SWATCH proved to be very low and the system was likely to be abandoned.

Open dumping was the only means for MSW disposal adopted by the ULB. Roadsides within the town were also chosen for dumping. The disposal sites were also some plots of land taken out on lease by the ULB at a distance about 7/8 km. from the heart of the town and they were frequently changed. The latest was that wastes were disposed of near No. 37 Highway bypass in the outskirt areas of the town.

Community participation and awareness

Community participation in the MSWM process was found to be absent in the town. A good percentage of the respondents were seen to possess awareness of some environmental/waste related aspects. But it was mostly theoretical, a very minimum number of them followed it in practice. The ULB also did not organize any awareness programme among the residents for segregation of MSW at source or for treatment by vermicomposting etc. No NGOs were found to be involved in MSWM in the town.

Ragpickers

The ragpickers played a vital role in recycling process of the MSW. But they were not having any support from the ULB/govt. and collected rags without any protective wears like boots, gloves, masks etc. A significant aspect was that 52% of the respondents were in the 7-14 year age group and 28% were female. The teenagers were invlolved in the ragpicking job to earn pocket money by selling the segregated recyclable paper/cardboard/plastic/glass/metal items.

4. Conclusion And Recommendations

The ULB failed to manage MSW in a sustainable or environment friendly way. It was continuing collection and transportation activities improperly. Door to door collection and segregation were not a practice. Plastic and polythene bags were in vogue. The ULB also did not have any waste treatment/disposal practice such as recycling, composting, sanitary landfill or incineration etc. It was common complaint of the ULB that it did not possess any land of its own for waste disposal. The ULB did not experience any public private partnership (PPP) model of MSWM. The ragpickers were found to be the only informal stakeholders working at the base level in the of recycling hierarchy. The following recommendations might prove fruitful for an efficient MSWM in the town:

(1) The residents be provided with colour coded bins for segregation at source. (2) Door to door collection of MSW should be a practice. (3) The ULB should adopt composting for organic MSW and train the residents to practice vermicomposting. (4) Some government lands distant from residential area and water bodies be scientifically chosen for sanitary landfill. (5) The ragpickers be trained up and supported until the ULB itself adopt recycling. (6) The ULB should organize awareness campaign to enable residents choose 'Refuse' and 'Reduce'. (7) Penalty be imposed for littering. (8) Technical personnel be sent for training under ULBs proved efficient in MSWM.

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