Aruna.D, Byragi reddy.T, Swamy A.V.V.S / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com
Vol. 3, Issue 1, January -February 2013, pp.931-940

Study of Municipal Solid Waste Management Scenario of Kakinada City

Aruna.D[1], Byragi reddy.T[2], Swamy A.V.V.S[2]

1. Research scholar, Department of environmental sciences, AcharyaNagarjunaUniversity,Guntur,India
2. Professor, Department of environmental sciences, Andhra University,Visakhapatnam,India
3. Assistant professor, Department of environmental sciences, AcharyaNagarjuna University,Guntur,India

ABSTRACT

Kakinada is one of the fastest developing cities in Andhra Pradesh with a population of 3 lack 13 thousand in 2011 in urban agglomeration, registering a growth of 5% over the past decade. The city has around 83 thousand houses which generate 260 metric tons of solid waste per day. At present, they are not practicing any scientific processing and disposal of solid waste. The solid waste collected is being transported to the cheedelapora disposal site where is being disposed indiscriminately. The Pollution Control Board (PCB) introduced common facilitator-EVB Technologies in 2005 to collect bio-medical waste from 470 hospitals in East Godavari district out of which 121 are in Kakinada city (Annual Report on CBWTF, A.P.PCB, 2010) .Bio-medical waste dumped by clinics, hospitals and medical labs and in the district has become a danger to the environment and people. Most of the hospitals and labs dump the waste materials in the drains or near municipal garbage collection point.

Key words: solid waste, Kakinada Municipal Corporation, biomedical waste, ground water.

1. Introduction

Inefficient management of the solid waste along with increasing population (Peter Aderemi Adeoyeet al, 2011) becomes cause of environmental degradation. The Municipal Solid Waste (Management and Handling) Rules, 2000 lay down the steps to be taken by all municipal authorities for the best practice of solid waste management. Municipal authorities must follow the rules, compliance criteria and procedure which laid down respectively in schedule I and schedule II of the rules. With the increasing of population, the amount of garbage generated also increased. Municipal authorities are responsible for the implementation of MSW 2000 rules. For this purpose, municipal authorities must provide all the facilities like services and infrastructure from collection to disposal of MSW i.e. for collection, segregation, storage, transportation, treatment and disposal of municipal solid waste.

Population growth has enhanced the quantum of waste generation, leading to decrease in the quality of environment and public health. Increasing the amount of solid waste generation, especially Municipal Solid Waste (MSW), is a matter of serious concern especially in urban areas and this problem has worsen due to the improper disposal plans. Urban Local Bodies should be responsible for proper solid waste collection and disposal methods.

1.1 Description of the Study Area

The Kakinada city ($16^{o}57^{"}$ N: $81^{o}15^{"}$ E) is the capital of East Godavari District of Andhra Pradesh on the central east coast of India. Fig 1 shows the location of the study area.

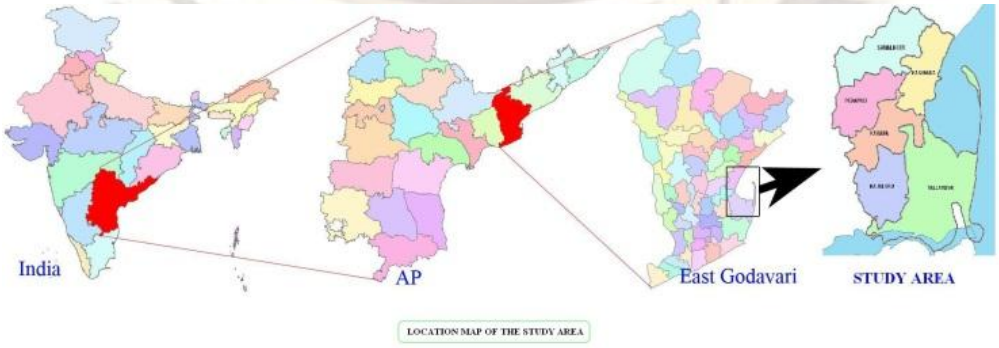

Fig. 1: Location map of the study area.

The city is influenced by the semi-arid climate. The area receives an average rainfall of 1040 mm per annum, primary during the south west monsoon (June – September) and on account of cyclonic activity in the Bay of Bengal in the post monsoon (October–November).

2. Demography

As per Census of India, population of Kakinada in 2011 is 312,255; of which male and female are 152,596 and 159,659 respectively. The sex ratio of Kakinada city is 1046 per 1000 males. Fig: 2.1 show the ward wise demography map of the study area.

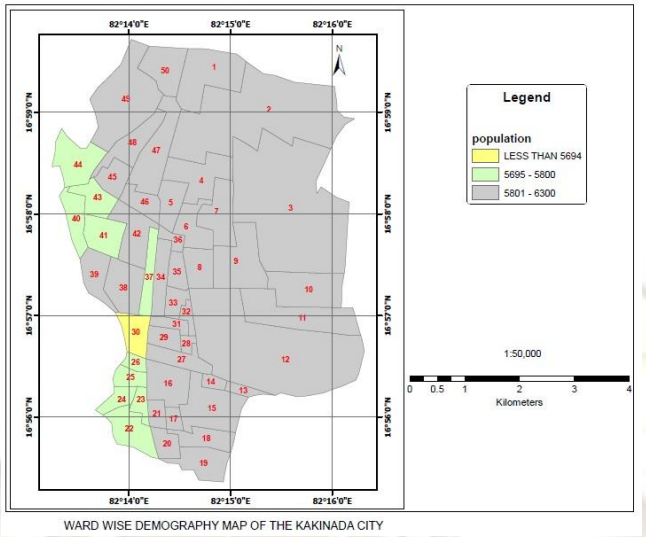

Figure: 2.1 Demography of the study area

3. Sources of municipal solid waste in Kakinada city

The solid waste generated in the form of domestic, commercial, industrial and other sources (S.Chattopadhyay et al, 2007) are one of the major environmental problems in the urban areas.

S. No	Source	No. of units
1	Domestic households	82,588
2	Hotels	43
3	Restaurants	52
4	Temples	49
5	Hospitals	121
6	Function halls	42
7	Cinema halls	21
8	Parks	09
9	Schools	233
10	Colleges/universities	96
11	Markets	03
12	Commercial establishments	6850
13	Lodges	20
14	Non vegetarian stalls	18
15	Road length in km	575
16	Drain length in km	564
17	lodges	60
18	Other food & dining	258
19	Slaughter house	01
	(biomedical waste is not handled by Kakinada municipal corporation)	

Source: Kakinada Municipal Corporation

Table 3.1: Waste Generated by Different Categories of Sources in Kakinada

4. Solid waste scenario in 2001

Kakinada Municipal Corporation has not started the implementation of the MSW rules, 2000. No proper infrastructure and services for collection, transportation and disposal of solid waste.Table-4.1 presents the Solid Waste Generation scenario in 2001.

1	Total population	2,96,329
2	No. of households	68838
3	Slum population	62,230
4	Waste generated per day (Tons)	140
5	Domestic	80
6	Non-domestic	60
7	Waste collected per day (Tons)	125
8	Waste Generation (gm/capita/Day)	0.372 kg/day
9	% waste collected to generated	91
10	frequency of solid waste collection	once daily
11	segregation	Nil
12	No. of vehicles used for transportation	motorized – 14, non-motorized – 22
13	Composting	Nil
14	Landfill	Nil
15	Other methods	Nil
16	Open dumping (tons)	125
17	Area used	Near saradamba temple, cheedelapora.

Table 4.1: Solid Waste scenario in 2001

5. Solid Waste Scenario In 2011

Rapid urbanization has led to over-stressing urban infrastructure services including Municipal Solid Waste Management because of poor resources and inadequacies of the existing systems.Table-5.1 presents the Solid Waste Generation scenario in 2011.

1	Area (sq.km) of the city	30.51
2	Total population	3,12,275
3	No. of wards	50
4	No. of circles	14
5	Length of roads	575 km
6	Length of drains	564 km
7	Waste generated per day (Tons)	250
8	Domestic	140
9	Non-domestic	110
10	Waste Generation (gm/capita/Day)	0.424kg/day
11	Waste collected per day (Tons)	250
12	% waste collected to generated	100
13	Collection type	Door to door collection
14	Segregation	In 8 divisions
15	Total quantity of waste disposed by open dumping	250
16	Dumping site	01
17	Area used	Near saradamba temple, cheedelapora.
18	Lighting facility on site	Not available
19	Composting site	Not available
20	Land fill site	Not available
21	Other methods	Not available
22	Slaughter house(goat & sheep)	01
23	No. of Burial grounds	12

Table 5.1: Solid Waste scenario in 2011

5.1 PER CAPITA MSW GENERATTION:

Per capita waste generation is the amount of waste generated by one person in one day in a country or region. High income countries generate more waste per person compared to low income countries. The average per capita waste generation in India is 370 grams/day. The per capita waste generation is increasing by about 1.3% per year in India. Generation of MSW has an apparent relation to the population of the city, due to which bigger cities produce

Year	Per Capita Urban MSW Generation (kg/day)
2001	0.372 kg/day
2011	0.424kg/day

Table 5.2: Per capita MSW generation rates

5.2 Collection of Waste in Kakinada

The collection and transportation of solid waste in Kakinada is done in two shifts. In the first shift that starts at around 5A.M early in the morning, the conservancy workers sweep the streets, clean the drains and collects the waste from small open points and transport the waste by wheel barrows or pushcarts or tricycles to nearest dumper bins or secondary open collection points. At some parts of the city, tippers go along with the sweepers and collect the waste which is being transported to transfer stations. Then from transfer station the waste is being collected and transported to the disposal site by tippers and open trucks.

Fig: 5.1 Collection system

5.2.1 Door-to door collection

KMC introduced voluntary garbage collection by providing tricycle and wheel barrows. A tricycle puller collects garbage from each house. After collection the tricycle puller dumps the collected garbage in to the nearby community dust bin. This practice is being implemented by KMC in all the wards.

5.2.2 Road Sweeping

According to the Supreme Court guidelines 2000, an efficient sweeping can support a better SWM, because one of the main problems is garbage on the roads. KMC has tried to achieve a better SWM via an efficient sweeping. The 943 strong conservancy workers consisting of the corporation staff and the private contractors sweep the city based on the formations called units (day & night) innovated by the KMC.

There are some units that sweep in the day and the others that sweep in the night. Night sweeping is done to prevent people from exposure to the dust. Of the total sweeping staff, 558 are the KMC employees, and the remaining are the employees of the private contractors who work under the control of KMC. KMC is engaging private workers for sweeping the roads. The waste collected is dumped in the nearby dust bins. Street sweeping is done manually and debris is loaded from the curb-side into the handcarts and delivered to the collection bins. Sweepers/cleaners sweep the roads and clean the drains and then place those wastes in the nearby dustbins or containers using a hand cart.

5.2.3Transportation

The collection and transportation of solid waste in Kakinada is done in two shifts. In the first shift that starts at around 6.00 am early in the morning, the conservancy workers sweep the streets, clean at drains and collects the waste from small open points and transports the waste by wheel barrows or push carts or tricycles to nearest dumper bin or secondary open collection point. At some parts of the city, tippers go along with the sweepers and collect

the waste which is being transported to disposal site by tippers and open trucks. The entire municipal corporation is divided into 50 wards. Each ward is managed by the sanitary supervisor and sanitary inspectors and is maintained by 943 conservancy staff. The garbage is being transported to the dumping site Cheedelapora dumping area located in the city.

S.no	Type of vehicle	No.of vehicles
1	Dumper placers	09
2	Dumper bins	143
3	Tippers	05
4	Vans	03
5	Blade Tractors	01
6	Tyre mounted proclaine	01
7	Chain mounted proclaine	01
8	JCB excavator	02
9	Tricycles	123
10	Wheel barrows	150
11	Truck-tipper	04
12	Tractor- trailer	26
13	Vacuum cleaner	01
14	N.S.Tanker	01
15	Fogging machines	14

Table 5.3: Solid waste Collection and transportation Infrastructure with KMC

5.2.4 Segregation of Waste at Source

Segregation of waste at source is one of the important recommendations of MoEF in its guidelines on solid waste management. Further, the source segregation significantly improves the quality of compost/processing of municipal solid waste. It is however observed that the segregation of waste at source is generally absent in Kakinada. However they are practicing segregation of waste in 8 divisions. The municipal corporation has taking actions to implement segregation of waste in the remaining 42 divisions. Segregation of MSW into dry and wet wastes is not carried out in many areas and is limited to only some areas of a few cities. Separate containers should be used for collection of dry and wet wastes.

5.2.5 Storage

The household waste is stored in the dust bins and from there it is being transferred into the community bins. Many a time the household is not transferred into the bins it is scattered around the bin or it is littered in the vacant space. The public must be educated to collect all the wet waste & dry waste separately. The same must be handover to the tricycle collection boy.

5.3 Sanitation Set-Up in Municipal Corporation of Kakinada

The health officer heads the sanitation operation and supervision of the city. The sanitary inspector, sanitary workers and sweepers work under the supervisor. Table-5 presents the human resource engaged in collection, transportation, processing on MSW

S.NO	POST	STRENGTH
1	Health officer	01
2	Environmental engineer	01
3	Sanitary supervisors	01
4	Sanitary Inspectors	14
5	Health Assistants	10
6	P.H.Drivers	42
7	P.H.Maistries	48

8	Total Public Health Workers	943
9	Public Health Cleaners	05

Table 5.4: Human resources engaged in MSWM

5.4 Processing and disposal

In Kakinada the solid waste disposal site cheedelapora is in the western side of the city with an average distance of 1km from the city. At present, they are not practicing any scientific processing and disposal of solid waste. The solid waste collected is being transported to the cheedelapora disposal site where is being disposed indiscriminately. Presently it is practicing open crude (R. Rajput et al, 2009**)** indiscriminate disposal of solid waste. At present, 260 tonnes of garbage a day is being collected from the households. It is being dumped at unauthorised dumping yard near saradamba temple - cheedelapora located amidst residential areas. Cheedelapora is the designated disposal site of municipal solid waste generated from city.

Fig: 5.2. Dumpsite

5.5 Waste Generation and Future Predictions until 2015

Kakinada city was generating 140 tons of waste in 2001 (CPHEEO, 2005) and are currently generating 250 tons, a 78.5% increase in one decade, it is estimated that the city will generate 493 tons of MSW in 2015. Projected quantities of MSW is presented in Table-3

S.No	Year	Per day in MT
1	2010	211
2	2011	250
3	2012	296
4	2013	351
5	2014	416
6	2015	493

Table 5.5: Projected Quantity of Waste

The projection estimates indicates that the quantity of MSW generated will be doubled in the next five years.

5.6 Ground water contamination

In Kakinada City, ground water is a very essential source for drinking and other purposes in households and industry. Tube wells are situated nearly 50 to 320 m away from the disposal sites and people of adjacent houses are drinking the water regularly, which is not recommended due to the high probability of ground water contamination. Kakinada is facing serious environmental degradation and public-health risk due to the contamination of water resources near uncontrolled dumping sites. Generation of leachate, gas, odour, noise, dust, potential fire hazards etc. are the common environmental problems in the existing sites that cause threats to human health and nature. The uncontrolled dumping of such wastes have not only brought about increasing number of incidents of health hazard but also causing the ground water contamination and thus posing serious environmental threat to the human being (T.V. Ramachandra and Shruthi Bachamanda et al, 2007).

The study found out that the groundwater quality has been significantly affected by leachate

percolation. It also points out that there is an urgent need to adopt credible solutions to control water pollution due to indiscriminate dumping of wastes. Water Quality Index (WQI) is a very useful and efficient method for assessing the quality of water The values of analysis of ground water at disposal site show results in table 5.12 and fig.5.2.

Fig: 5.3 Dumpsite to the adjacent houses

S.NO	YEAR	pH	Electrical conductivity	Total dissolved solids	hardness	nitrates	chlorides	sulphate	zinc	lead	copper	iron	WQI
1	2009	7.53	3680	2200	940	22.3	600	81.5	0.133	0.056	0.029	N.D	137.11
2	2010	7.47	4000	2400	880	5.6	500	122	0.586	N.D	N.D	0.154	147.47
3	2011	7.5	3950	2365	240	1.8	110	46	0.037	N.D	N.D	0.044	132.97
4	2012	8.7	3800	2465	390	10	380	102	0.082	N.D	N.D	N.D	141.54

Table 5.6 : Result Table

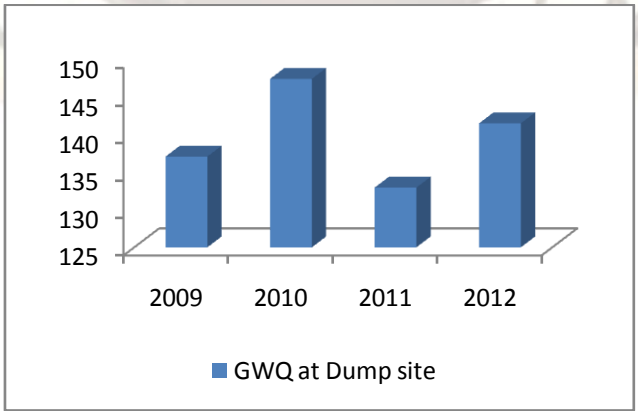

Figure: 5.4 Ground water quality Index at dumpsite

1	Total no.of HCFs being covered	121
2	Total no.of beds covered	2825
3	Quantity of BMW (kg/month)	16050
3	BMW treatment site	EVBTechnologiesSy.No.560,kanavara,pallakadiyam(v), Rajanagaram(M),East Godavari district.
4	Quantity of different categories of BMW treated/day(in kg or ltrs as applicable)	Incineration-650 Autoclaving-50 Effluents treated-1 KLD
5	Cost of treatment of BMW charged (RS/Kg/day)	RS.2.50-3.50
6	Treatment facilities installed at site	Incinerator-225 kg/hour Autoclave-175 Ltrs Shredder-10 kg/hour ETP-5 KLD
7	Air pollution control systems attached with the incinerator	Cyclones followed by venturi scrubber
8	Method of disposal of treated wastes	Incineration ash: storing in lined tanks. Sharps: stored in concrete lined pitted. Plastics: sold to recyclers
9	Compliance status	Attained required temperatures in the primary and secondary chambers and SPM in the stack emissions is meeting the standards

Table 5.7: Treatment of Biomedical Waste

3.12.2 Health impacts of Poor Medical Waste Disposal

Several health centres mainly primary health centres, community health centres, dental clinics and diagnostic centres are not disposing the bio-medical waste in Kakinada, causes health problems to the rag pickers, public and sanitation workers (The Deccan Chronicle, 2011).A good number of hospitals subscribe to the common bio-medical waste treatment facility (CBWTF) located at PallaKadiam village for the safe disposal of hospital waste. A large number of dental clinics, primary health centres and community health centres are reportedly disposing the biomedical waste in open drains and garbage bins which are maintained by sanitation workers of the municipal corporation in urban areas.

Conclusion:

From overall study and analysis, it is concluded that the solid waste disposal methods at cheedelapora dumping yard generate many environmental as well as health hazards within the surrounding area. Lack of cooperation, funding, legislation and other co-variables result in inefficient SWM system. This shows that an improvement to existing system is needed to meet the MSW (Management & Handling) rules 2000.

References

1. A Support Manual for Municipal Solid Wastes (Management and Handling) Rules, 2000, Central Pollution Control board (CPCB), Ministry of Environment and Forests, New Delhi.
2. Annual Report on Common Bio-Medical Waste Treatment Facility (CBWTF), A.P. Pollution Control Board, March, 2010.
3. Census of India 2011, East Godavari district, Directorate of Census Operations, Andhra Pradesh.
4. Hand Book of Statistics 2009-2010, East Godavari District-Chief planning Officer, East Godavari District, Kakinada.
5. Kakinada City Development Plan, Report Prepared by Municipal Corporation of Kakinada, Kakinada.
6. Manual for Bio-Medical Waste (Management and Handling) Rules, 1998, Central Pollution Control board (CPCB), Ministry of Environment and Forests, New Delhi, July 1998.
7. Peter Aderemi Adeoye, Mohammed Abubakar Sadeeq, John Jiya Musa, Segun Emmanuel Adebayo, Solid waste management in Minna, North Central Nigeria: present practices and future challenges, Journal of Biodiversity and Environmental Sciences (JBES) Vol. 1, No. 6, p. 1-8, 2011
8. R. Rajput, G.Prasad and A.K.Chopra, Scenario of solid waste management in present Indian context, Caspian Journal of

Environmental Sciences 2009, Vol. 7 No.1 pp. 45-53

9. S.Chattopadhyay, A.Dutta and S.Ray, " Existing Municipal Solid Waste Management of Kolkata- Deficiencies and its Solutions". Journal of Indian Association for Environmental Management, vol. 34(3), 161-167, (2007)
10. Statistical Volume on Status of Water Supply, Sanitation and Solid Waste Management in Urban India, Central Public Health and Environmental Engineering Organisation,(CPHEEO), Ministry of Urban Development, Government of India,June,2005.
11. T.V. Ramachandra* and ShruthiBachamanda , Environmental audit of Municipal Solid Waste Management, Int. J. Environmental Technology and Management, Vol. 7, Nos. 3/4, 2007 Page no: 369-391
12. The Deccan Chronicle, Date: 10/01/2011