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A COMPARATIVE STUDY OF SOLID WASTE MANAGEMENT PRACTICES IN SELECTED MUNICIPALITIES

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Abstract

Solid waste management is defined as the discipline associated with control of generation, storage, collection, transport or transfer, processing and disposal of solid waste materials in a way that best addresses the range of public health, conservation, economic, aesthetic, engineering, and other environmental considerations. In its scope, solid waste management includes planning, administrative, financial, engineering, and legal functions. Solutions might include complex inter-disciplinary relations among fields such as public health, city and regional planning, political science, geography, sociology, economics, communication and conservation, demography, engineering, and material sciences. In this research paper researcher focused on solid waste management practices adopted by selected municipalities in Satara, Solapur and Kolhapur districts and has done the classification of respondents by various solid waste management aspects. Researcher has set a questionnaire to the stakeholders and collected the required data for the analysis.

Keywords: Solid Waste Management, Planning, Municipalities, Stakeholders.

Introduction

Solid waste management is an essential service in any society. Solid waste refers to the range of garbage materials—arising from animal and human activities—that are discarded as unwanted and useless. Solid waste is generated from industrial, residential, and commercial activities in a given area, and may be handled in a variety of ways. As such, landfills are typically classified as sanitary, municipal, construction and demolition, or industrial waste sites.

Waste can be categorized based on material, such as plastic, paper, glass, metal, and organic waste. Categorization may also be based on hazard potential, including radioactive, flammable, infectious, toxic, or non-toxic wastes. Categories may also pertain to the origin of the waste, whether industrial, domestic, commercial, institutional, or construction and demolition.

Regardless of the origin, content, or hazard potential, solid waste must be managed systematically to ensure environmental best practices. As solid waste management is a critical aspect of environmental hygiene, it must be incorporated into environmental planning.

Objectives of the Study

1. To study the present Solid Waste Management Practices adopted by selected Municipalities
2. To do the classification of the respondents with respect to Solid Waste Management Practices adopted by selected Municipalities

Methodology Adopted for The Study

The researcher studied the existing practices of solid waste management adopted by selected municipalities. This research has both exploratory and descriptive in nature and also utilizes both quantitative and qualitative data collection tools. In view of the objectives and hypothesis stated above the methodology adopted for the present study is elaborated as under:
Firstly, before the pilot survey the researcher has decided the stakeholders which were Chief Officer of the municipality, health department employees, citizens of the municipality and organizations.

Sources of Data

The researcher has adopted Survey Method to collect the required information for the study. The researcher has used primary and secondary data collection methods for this research.
Primary Data: The researcher has collected required information from the respective officers and employees of the selected Municipalities. The primary data has been collected through questionnaire, discussion, interviews, observation and necessary field work. The researcher has selected appropriate number of samples. The data has been collected on the basis of present practice of solid waste, sources of waste generation, process of collection of waste from various places, waste transportation schedule, waste disposal process, total manpower and infrastructure deployed, management of all the types of waste at landfill site, problems with existing solid waste management system, and future plans about municipal solid waste management. The researcher has covered and refers five years data from 2008 to 2013.
Secondary Data: The researcher has collected necessary information from Books, M.Phil. Ph.D. research work, magazines, internet, different websites, newspapers, articles, Govt. publications and Govt. offices.

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Statistical Methods Used

Researcher has used appropriate statistical methods for data analysis and interpretation such as mean, percentage and Graphs etc. Researcher has also used Excel spread sheet, SPSS computerized software for finding inter relationship between and among different variables.

Sample Design

Universe of study for sample selection: In Satara district there are in total eight municipalities. Solapur district has nine municipalities and Kolhapur district also has nine municipalities. Therefore, the three districts have a total of twenty-six municipalities. Hence for the present study the size of the universe is twenty-six municipalities.

Sampling Method: Using Cluster Sampling Method 9 municipalities 3 each from three districts were selected.Stakeholders of the municipalities are person, group or organizations that are directly or indirectly associated with solid waste management practices of the municipalities. The groups of stakeholders selected for the research are:

1. Chief Officer of the municipality.
2. Health Department Employees of the municipality.
3. Citizens of the municipality.
4. Organisations in the municipality.

Using Purposive Quota Sampling Method 600 citizens each from the 9 municipalities were selected. All the 9 Chief Officers of the 9 municipalities were selected and 45 health department employees 5 each from the 9 municipalities were selected. In addition, 5 organizational representatives such as hotels from each municipality were selected. The sample size is calculated by using the following formula.

$$n = \frac{Z^2 * N * \sigma^2{}_p}{(N-1)\, e^2 + Z^2 * \sigma^2{}_p}$$

Where, N= Size of population. n = Size of sample.
e = Acceptable error. σ_p = Standard Deviation of population.
Z = Standard Variate at a given confidence level

The total sample size is 5499. The sample design is detailed out in Table No. 1.2 below.

Sample Design for selection of stakeholders

Sr No	Name of the District	Name of the Municipality	Sample Units to be selected			
			Chief Officer	Health Dept. Employees	People (Citizens)	Organizational Representatives
1	Satara	Satara	01	05	600	05
		Panchgani	01	05	600	05
		Mahabaleshwar	01	05	600	05
2	Solapur	Barshi	01	05	600	05
		Dudhani	01	05	600	05
		Pandharpur	01	05	600	05
3	Kolhapur	Ichalkaranji	01	05	600	05
		Murgud	01	05	600	05
		Panhala	01	05	600	05
	TOTAL	09	09	45	5400	45

Indicators of municipal solid waste collection system

Statements	Municipalities of District	Mean	S.D
Clean Public Bin sites	Satara	2.19	1.56
	Kolhapur	1.16	1.19
	Solapur	1.12	1.27
	Total	1.49	1.34
Waste Collection Frequency	Satara	1.21	1.37
	Kolhapur	1.31	1.21

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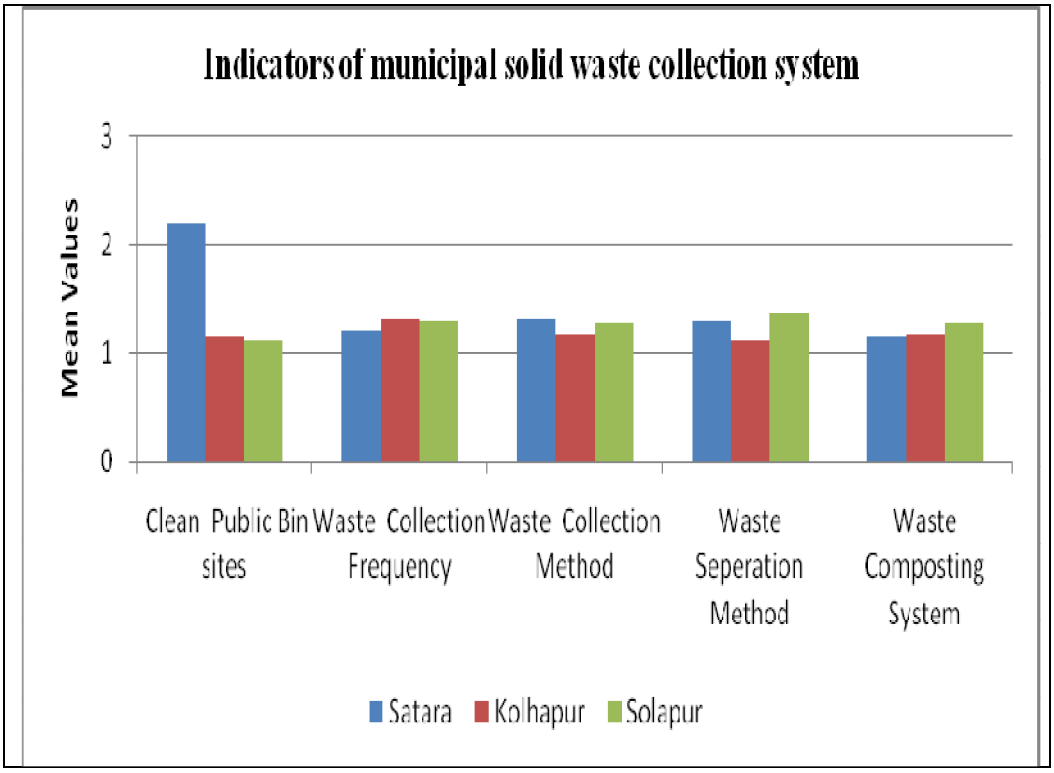
	Solapur	1.29	1.22
	Total	1.27	1.26
Waste Collection Method	Satara	1.31	1.45
	Kolhapur	1.18	1.23
	Solapur	1.27	1.21
	Total	1.25	1.29
Waste Separation Method	Satara	1.29	1.27
	Kolhapur	1.12	1.36
	Solapur	1.37	1.41
	Total	1.26	1.34
Waste Composting System	Satara	1.15	1.29
	Kolhapur	1.18	1.26
	Solapur	1.27	1.22
	Total	1.2	1.25

Source: Primary Data



From the results presented in the table it is observed that,

- The waste collection frequency score is significantly higher in municipalities of Kolhapur district as compared to the municipalities of Satara and Solapur districts. Thus it infers that, the waste collection frequency of Kolhapur district municipalities is high.
- The waste collection method score is significantly higher in municipalities of Satara district as compared to the municipalities of Kolhapur and Solapur districts. The waste collection methods of Satara district municipalities are satisfactory.
- The waste separation method score is significantly higher in municipalities of Solapur district as compared to the municipalities of Kolhapur and Satara districts. It infers that waste separation methods of Solapur district municipalities are adequate.
- The waste composting system score is significantly higher in municipalities of Satara district as compared to the municipalities of Kolhapur and Solapur districts. It means that Satara district municipalities have better waste recycling system than municipalities of Kolhapur and Solapur districts.

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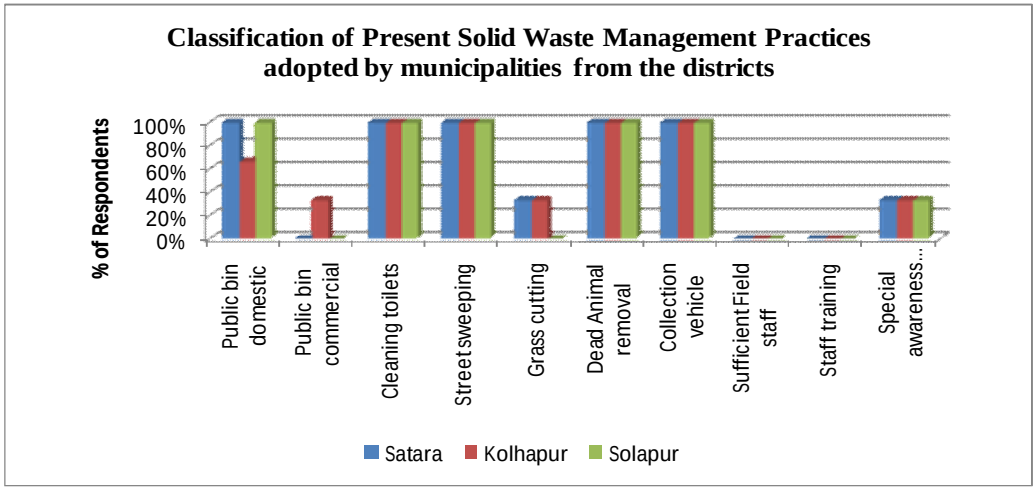
Classification of Present SWM Practices adopted by municipalities

Present Solid Waste Management Practices adopted	Municipalities of Districts		
	Satara	Kolhapur	Solapur
Public bin (domestic use)	18 (100%)	12(66.66%)	18(100%)
Public bin (commercial use)	0(0%)	6(33.33%)	0(0%)
Cleaning toilets	18(100%)	18(100%)	18(100%)
Street sweeping	18(100%)	18(100%)	18(100%)
Grass cutting	6(33.33%)	6(33.33%)	0(0%)
Dead Animal removal	18(100%)	18(100%)	18(100%)
Collection vehicle	18(100%)	18(100%)	18(100%)
Sufficient Field staff	0(0%)	0(0%)	0(0%)
Staff training	0(0%)	0(0%)	0(0%)
Special awareness campaign	6(33.33%)	6(33.33%)	6(33.33%)

Source: Primary Data



The above table and graph, it is observed that the most common present solid waste management practices adopted by the municipalities are provision of public bins for domestic households, provision of public bins for commercial establishments, cleaning the public toilets, street sweeping, grass cutting, removal of dead animal carcasses, provision of house to house waste collection vehicles, provision of special awareness campaign for the citizens.

Classification of the respondents with respect to types of waste collected in the house

Type of waste	Municipalities of Districts			Total
	Satara	Kolhapur	Solapur	
Plastic waste	1194(65.1%)	1459(79.6%)	1035(56.5%)	3688(67.06%)
Paper waste	323(17.6%)	55(3.0%)	659(36.0%)	1037(18.85%)
Fiber material	78(4.3%)	103(5.6%)	22(1.2%)	203(3.69%)
Glass material	45(2.5%)	136(7.4%)	5(0.3%)	186(3.39%)
Food waste	70(3.8%)	36(2.0%)	50(2.7%)	156(2.83%)
Vegetable waste	69(3.8%)	44(2.4%)	23(1.3%)	136(2.48%)
Clothes (Rags)	54(2.9%)	0(0.0%)	39(2.1%)	93(1.70%)
Total	1833(100%)	1833(100%)	1833(100%)	5499(100%)

Source: Primary Data

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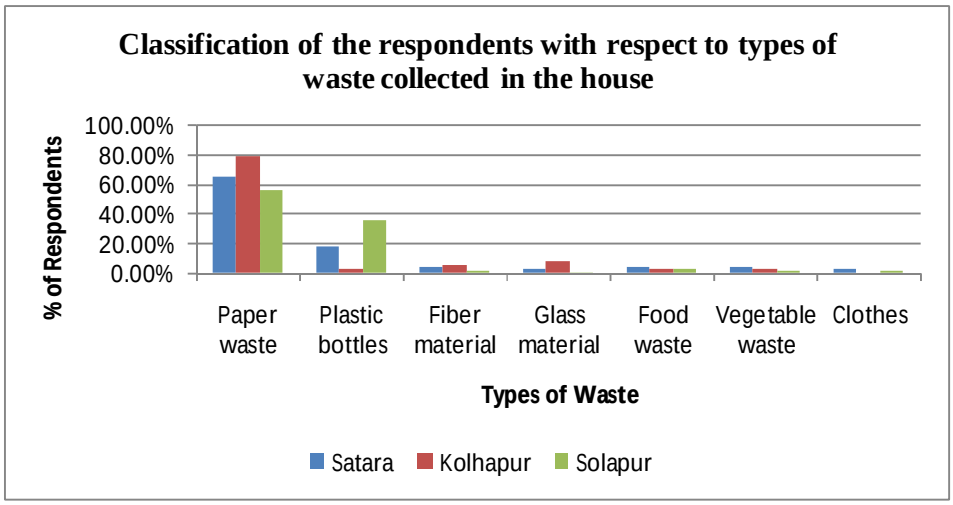

The above table and graph shows district wise type of solid waste collected. 79.6% of the solid waste collected from municipalities belonging to Kolhapur is plastic waste, 56.5% of municipalities of Solapur and 65.1% of municipalities of Satara districts followed by other types of waste.

Conclusions

It is concluded that, among the indicators of municipal solid waste collection system waste separation methods and waste recycling systems in selected municipalities are adequate.

It is concluded that, sufficient field staff should be recruited for the effective solid waste management. It is also concluded that regular training for waste handling is required for field workers.

It is concluded that, the majority type of waste collected from the municipalities is plastic waste than any of the other types of waste.

Suggestions

- **Efficient Waste Transportation**: Garbage may be collected by small garbage trucks and dropped in a hopper, compressed in containers and reloaded onto larger trucks. In this transfer station, garbage collected by three trucks can be compressed in one container. The container is then transported to a disposal site or incineration plant on a large container truck. In this technology, use of machinery for compressing is required to be installed.
- **Municipal Waste Incineration:** A safe and sound advanced municipal waste incineration facility may be installed**.** Wherein high-efficiency power generation is possible. However in the area selected for the study the concerned authorities may have to design and develop this facility for a scale suitable for their size.
- **Sanitary Disposal of waste:** For safe and appropriate disposal of especially medical waste, proper construction and management of disposal site with the use of incinerators is suggested so as to achieve high-environment preservation.
- **Technology to Recycle Plastic waste:** Municipal waste predominantly comprises of plastics of different types and grades. Therefore segregation of plastics be done at the point of dumping or generation. The various types of material be handed over to contractors for recycling into plastic granules and pellets for manufacture of recycled products including material used for building roads as a substitute for tar.
- **Technology for Recycling of Home Appliances:** Municipalities may segregate with the help of contractors or rag-pickers, the discarded home appliances and equipment like electronic gadgets, electrical waste, ferrous and non-ferrous waste and hand over this waste to appropriate contractors for recycling.
- **Technology for Recovery of Energy:** Biomass waste generated in small towns and villages comprising of low moisture biomass is combustible and may be used for recovery of energy. High moisture content biomass when buried without treatment generates Methane and Hydrogen Sulphide that causes environment pollution. Hence it may be recycled into Methane or Bio Diesel Fuel (BDF). Cooking oil waste with low moisture content may be effectively recycled as BDF, and energy can be recovered from wood debris incineration. Waste treatment, such as composting, methane fermentation, and use as animal feed, that best suit the features of the selected municipal areas.
- **Landfill Disposal Technology:** The municipalities discontinue the practice of burning the municipal waste in the open. They should build semi-aerobic landfill structure for landfill that is sanitary and does not amount to environment pollution. Compared to

anaerobic landfill, the semi-aerobic landfill technology quickly stabilizes landfill sites after the land has completed its role as landfill, enabling it to be used for parks and open space for sports. Further proper care should be taken to ensure control of seepage and leach ate because landfill waste may decompose and pollute the environment.

References

1. Wang (2011), Municipal solid waste management in small towns: An economical analysis conducted in Yunnan, China by Hua Wang, Jie He, Yoonhee Kim, Takuya Kamata WPS 5767 Policy Research Working Paper, The World Bank Development Research Group Environment and Energy Team August 2011
2. Assessing the solid waste management practices in Bacolod city, Philippines by Ma. Teresa B. Ballados. 4th Asian Rural Sociology Association (ARSA) International Conference, September 2010 , page 37-44, 4th Asian Rural Sociology Association (ARSA) International Conference, September 2010
http://arsa1996.org/pictures/pdf/ARSAIVPRCDGSVOL2/ANALYSISOFPOLICIESRELATEDTOAGRICULTURENATURALRESOURCESMANAGEMENTANDRURALDEVELOPMENT/4.BALLADOS37-44.pdf
3. Rodic (2010), Comparing solid waste management in the world's cities by Ljiljana Rodic, Wageningen University, Wageningen, Netherlands Anne Scheinberg, WASTE, Gouda, Netherlands David C. Wilson, Imperial College, London, UK March 2010, ISWA World Congress 2010, Urban Development and Sustainability – a Major Challenge for Waste Management in the 21st Century, Hamburg, Germany, 15-18 November 2010, http://edepot.wur.nl/169383
4. Visvanathan (2006), Solid Waste Management in Asian Perspectives http://dste.puducherry.gov.in/envisnew/books&reports7.pdf
5. Themelis (2004), Solid Waste Management in Vietnam by Prof. Nickolas J.Themelis, An Industrial Ecology Study by Thao Nguyen School of International and Public Affairs, Columbia University 2004, page 8-20
http://www.seas.columbia.edu/earth/wtert/sofos/Nguyen_Vietnam_Waste_management.pdf
6. Sarkar (2003),Solid Waste Management In Delhi – A Social Vulnerability Study by Papiya Sarkar Proceedings of the Third International Conference on Environment and Health, Chennai, India, 15-17 December,2003. Chennai: Department of Geography, University of Madras and Faculty of Environmental Studies, York University, Pg 451– 464.
7. Achankeng (2003), Globalization, Urbanization and Municipal Solid Waste Management in Africa by Eric Achankeng African Studies Association of Australasia and the Pacific 2003 Conference Proceedings - African on a Global Stage
8. Urban Solid Waste Management in Low-Income Countries of Asia, How to Cope with the Garbage Crisis by Christian Zurbrugg, Presented for: Scientific Committee on Problems of the Environment (SCOPE) Urban Solid Waste Management Review Session, Durban, South Africa, November 2002.http://slunik.slu.se/kursfiler/TN0280/20155.0910/Zurbrugg_waste_dev_.pdf
9. The Economics of Residential Solid Waste Management by Thomas C. Kinnaman, Don Fullerton. Working Paper 7326. http://www.nber.org/papers/w7326 National Bureau of Economic Research. 1050 Massachusetts Avenue, Cambridge MA02138 August 1999.
10. Technical EIA Guidance Manual for CMSWMF,September 2010
11. Central Pollution Control Board, Management of Municipal Solid Waste, Published: Member Secretary, CPCB
12. Municipal Solid Waste Management, http://mahenvis.nic.in/Pdf/MSW_.pdf, Archana Shirke, December, 2009
13. Environmental Status Report 2008–2009, Kolhapur Municipal Corporation
14. Mahabaleshwar Municipal Council,IMPROVEMENTS TO GLEN OGAL DAM Prepared By: Varad Ent., 2013, 27th march 2014 12.30pm
http://mhmc.in/Links/ProjectReport(DPRGlenOglDam).pdf
15. Barshi Environmental Status Report 2008-09, 24th march 2014, 2.45pm http://mpcb.gov.in/images/pdf/Barshi_ESR_12March10.pdf
16. http://trimbakeshwar.in/maharashtra/Solapur/Pandharpur/Pandharpur-Municipal-Council.aspx
17. Environmental Status Report of Pandharpur (During Ashadi Ekadashi) Prepared by Sub -Regional Office, Solapur and Regional Office Maharashtra Pollution Control Board PUNE August 2005 http://mpcb.gov.in/images/pdf/envstatusreportpandharpur.pdf
18. Techno Economic Feasibility Study of Sanitation and Sewage Management for Pandharpur Town, http://ecosanservices.org/pdf/Project_Pandharpur%20Town.pdf
19. Solid Waste Management System in Ichalkaranji: Approach and Mechanisms, All India Institute of Local Self Government, Mumbai May 2010 By- Mahadev Jadhav
20. Introduction to Solid and Liquid Waste Management, Report on Technical Note on Solid and Liquid Waste Management
21. Solid waste management, http://www.cyen.org/innovaeditor/assets/ Solid waste management .pdf, 28th March 2014, 12.40pm
22. Municipal Solid Waste Management, http://mahenvis.nic.in/Pdf/MSW.pdf, 28th march 2014, 12.10pm
23. Sustainable Solid Waste Management in India by Ranjith Kharvel Annepu,January 10, 2012http://swmindia.blogspot.in/2012/06/definition-of-solid-waste-management.html
24. Handbook on Scaling up Solid and Liquid Waste Management in Rural Areas
25. MINISTRY OF ENVIRONMENT AND FORESTS NOTIFICATION New Delhi, the 2"' July, 2013, The GAZETTE OF INDIA: EXTRAORDINARY (http://www.indiaenvironmentportal.org.in, 24th march 2014, 5.29pm)
26. State of Environment Report: Maharashtra, by Indira Gandhi Institute of Development Research, Mumbai, page 151, 25th march 2014,11.45am. http://moef.nic.in/soer/state/SoEreporoMaharashtra.pdf
27. ENVIS centre on Urban Municipal Solid Waste Management, 24th March 2014, 6.00pm, http://www.nswai.org/index.php
28. Identification of Tourism Circuits across India, Interim Report (Revised) – Maharashtra February – 2012, Submitted to: Ministry of Tourism, Government of India, 24th march 2014, 5. 15pm.http://tourism.gov.in/writereaddata/CMSPagePicture/file/marketresearch/Tentavelyidentifiedircuitforvariousstates/new/Mahrashtra.pdf
29. Performance Benchmarking of urban water supply and sanitation in Maharashtra: Data Bool (2008-09), Meera Mehta, Dinesh Mehta, CEPT University Ahmedabad, India, April 2011, page 18. http://www.pas.org.in/Portal/document/ResourcesFiles/pdfs/ClasswiseCityProfiles Maharashtra / City Profiles ClassCMaharashtra.pdf
30. Local bodies status- Maharashtra Pollution Control Board, MPCB

31. Brief Note for Dialogue on Solutions to Local Problems in Municipal Solid Waste Management Submitted to The Urban India Reforms Facility By The Resources And Livelihoods Group, Prayas, Pune 2011

32. Performance Benchmarking of urban water supply and sanitation in Maharashtra: Data Bool (2008-09), CEPT University April 2011. Research Thesis

33. Shantha Rashmi Parthan (2012), Improved Cost Estimation for Solid Waste Management In Industrialising Regions, Department Of Civil And Natural Resources engineering University Of Canterbury (Uc), 2012. http://ir.canterbury.ac.nz/bitstream/10092/7279/1/thesis_fulltext.pdf, 24th march 2014, 4.50pm

34. Ranjith (2012), Sustainable Solid Waste Management in India by Ranjith Kharvel Annepu, submitted in partial fulfillment of the requirements for the degree of Master of Science in Earth Resources Engineering Department of Earth and Environmental Engineering Fu Foundation School of Engineering and Applied Science Columbia University in the City of New York January 10, 2012

35. Jonathan (2005), Approaches toward Sustainable Urban Solid Waste Management: Sahakaranagar Layout by Jonathan Elisha Mull, Thesis submitted in partial fulfillment of the requirements of the Degree of Master's in International Environmental Science at Lund University, Lund, Sweden, May 2005.http://www.lumes.lu.se/database/alumni/03.04/theses/mull_jonathan.pdf

36. Tang (2004), A Case Study of Hotel Solid Waste Management Program in Bali, Indonesia by Janeen Tang, Thesis presented to the University of Waterloo in fulfillment of the thesis requirement for the degree of Master of Environmental Studies in Planning Waterloo, Ontario, Canada, 2004, https://uwspace.uwaterloo.ca/bitstream /handle/10012/983/jtang2004.pdf

37. Tsiboe (2004), A look at urban waste disposal problems in Accra, Ghana by Isaac Alfred Tsiboe, Ernest Marbel, Master's thesis Roskilde University May 2004, http://dspace.ruc.dk/bitstream/1800/322/1/A_Look_at.pdf

38. https://www.thebalancesmb.com