"Municipal Solid Waste Management practices and perceptions among residents in the North Coastal Andhra Pradesh, India"

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Abstract

In many developing countries, governments are facing tremendous urban growth, primarily due to migration from rural areas as well as increased business needs and wants by natural populations. The population density of cities and towns is increasing day by day. This will also increase the demand for urban goods and infrastructure services. Due to the vast urban settlements, local governments are under socio-political pressure to provide infrastructure services and cleanliness of the surrounding area, while providing the resources and cleanliness needed for these infrastructure facilities. We are pushed to the limits of the surrounding area. As a result, the quality and suitability of the city/city's basic services are reduced, ultimately affecting the people living in the city/city's slums. A common problem with municipal corporations is waste management such as landfills, waste disposal, government environmental protection measures, budget plans, human resource plans, and solid waste transport questionnaires. Human activity produces waste, and this waste disposal, storage, collection, and disposal method can pose environmental and public health risks where intense human activity is concentrated, including in urban areas, proper and safe solid waste management (SWM) is paramount to achieving healthy living conditions for the population. This fact is recognized and this research study is entitled "MUNICIPAL SOLID WASTE MANAGEMENT PRACTICES AND PERCEPTIONS AMONG RESIDENTS IN NORTH COASTAL ANDHRA PRADESH, INDIA". In this study, waste practices used by certain municipal corporations, such as waste collection, waste transportation, waste generation, and reduction, waste reuse and recycling, waste composition, and waste separation. This research also revealed various aspects of management practices which follows suggestions for improving existing waste management practices and also to businesses to minimize the waste or to reutilize the resources.

Keywords: Solid Waste, Disposal, Per-Capita, Waste Management Hierarchy, Environment Protection

Introduction

Waste is a material that is unnecessary or unusable or a substance that is discarded after its primary use or a substance that is worthless, defective, and useless. On the other hand by-products and joint products are considered as relatively low economic value. Waste can become a by-product, general product, or resource through inventions that increase the value of waste by more than zero. Waste is thrown away because it is no longer useful. Items are considered waste only if they cannot be recycled. Waste is generally disposed of by curbside pick-up or handing over to a landfill that can be properly treated so as not to contaminate the groundwater or harm the surrounding area. Examples include municipal solid waste (household waste/garbage), hazardous waste, sewage (such as bodily waste (feces and urine) and sewage with surface spills), and radioactive waste.

What is Solid Waste Management?

Solid waste is unwanted or useless solids produced by human activity in residential, industrial, or commercial areas. It can be categorized in three ways. Dependence on its: Origin (home, industry, commerce, building, or institution), Content (organic material, glass, metal, plastic paper, etc.), Potential danger (toxic, non-toxin, flammable, radioactive, infectious). In the big cities of India, one person produces an average of 0.8 kg of waste per person per day. The average collection efficiency of MSW is between 22% and 60%. India produces 277.1 million tonnes of solid waste every year, which is likely to touch 387.8 million tonnes in 2030. However, the per capita waste generated is below the global average. The MSW typically contains 51% organic waste, 17% recyclable waste, 11% hazardous waste, and 21% inert waste. However, about 40% of all MSWs are not collected at all, so they are located around contaminated cities/towns and flow into nearby drains and waterways, causing surface water clogging and pollution. Individual collection and transportation of waste lead to outdoor dumping, producing leachate and gaseous emissions, causing an environmental nuisance. Leachate contaminates the groundwater as well as surface water in the vicinity and gaseous emissions contribute to global warming.

Need for the Study

Disposal of human waste is one of the basic services of the municipal corporation, usually under the responsibility of the authorities and seriously affected by budgetary restrictions. Traditional waste management systems in cities are not only very expensive but also require the cleanliness of areas that are often unavailable in low-income areas. This has led many municipal corporations to adopt low-cost technologies that are inexpensive for waste disposal and require a small budget for their work. In addition, the cost of operating and maintaining a waste management system is underestimated and can be borne primarily by the municipal corporation.

The studies selected are highly relevant and important in the current scenario. Pilot Research of various municipal corporations in the Srikakulam, Vizianagaram, and Visakhapatnam municipal corporations have revealed that these municipal authorities are suffering from Municipal Solid waste problems specifically producing by Rpid growth of markets and looking for effective Municipal Solid waste management solutions.

The main purpose of this study is to investigate existing municipal waste management practices in selected municipal corporations, identify various issues faced by municipal corporations and stakeholders, and improve waste management practices in sample areas and finally to propose a viable solution with given facts and factors. This study is also relevant and very important to the current scenario in this society.

Research Scope

The solid waste management program is an important choice for the municipal corporation. This must take into account, on the one hand, the restrictions on available disposal methods and, on the other hand, the economic feasibility of the adopted program. Despite the growing popularity of recycling programs, their actual economic feasibility remains weak. This is primarily due to

the high costs paid for recycled materials, and some specific materials do not even cover recycling costs. In addition, investment in recycling capacity is hampered by the volatility that characterizes the price dynamics of the market of the secondary product.

This thesis proposes to hedge uncertainties about the benefits of recycling by operating a flexible waste management program that allows the use of landfills when recycling is not feasible. Landfill strategies, which are usually cheaper than recycling, can act as a buffer if the price of recycling is too low. Of course, running a more complex waste management program that provides the ability to restore landfills as need and it can incur additional capital costs to the municipal corporation.

The main focus of this study is the waste management practices adopted by selected municipal corporations in the Srikakulam, Vizianagaram, and Visakhapatnam districts. In this regard, the study is limited to three districts, Srikakulam, Vizianagaram, and Visakhapatnam. The data collected as part of the study is analyzed to achieve the goal and test the hypothesis. Therefore, this research study covers various aspects of selected municipal waste management practices concerning the perceptions of both civilian and employee stakeholders of the selected municipal corporation.

Waste Hierarchy

Waste Hierarchy is accepted as an important element of the integrated SWM. The hierarchy is based on environmental principles that propose to treat waste in different ways depending on its characteristics. Certain amounts should be avoided by reducing the content of waste or reusing it. Another part of the waste flow needs to be converted to secondary raw materials. Some parts can be composted or used as an energy source and the rest can be reclaimed (Figure 1.1).

The reality does not follow this environmental order. In fact, in developing countries, large amounts of waste are dumped uncontrolled or, worse, burned outdoors. These options do not belong to the waste hierarchy because their environmental impact is unacceptably high. Therefore, these latter two options are added to the shaded area. This ranking of waste management options provides an effective foundation for policymakers, but the integrated SWM goes beyond the waste hierarchy. It is well known that hierarchies need to be applied flexibly and are intended only as a general guide to achieving the best ecological solutions in the long run. Nevertheless, the hierarchy has been repeatedly and severely criticized for a variety of reasons. First, the environmental impact ranking may be correct for certain materials, but not for all materials or products. For example, older refrigerators may be better to recycle than to reuse, as the inefficient use of energy causes more environmental damage than the burden of recycling. Second, hierarchy is only concerned with environmental impacts, not economic or social standards. Of course, these aspects should not be ignored.

Figure No 1.1: The Waste Hierarchy

Source: sketch bubble.com

Review of Literature

Rasmeet Singh (2021) in his study on "Municipal solid waste management in the City of Indore-A case study", Due to the rapid increase in population, Municipal solid waste management has become an important activity in urban localities. It is one of the obligatory responsibilities of Municipal corporations and urban local bodies to minimize solid waste and process it efficiently.

Satpal Singh (2020) in her study on "Solid Waste Management in Urban India: Imperatives for Improvement", Across India, existing systems for the collection, transportation, and disposal of solid waste are mired in chaos. The problem is more acute in the urban areas, where rapidly growing populations generate increasingly larger quantities of solid waste that urban local bodies (ULBs) are unable to manage effectively.

Martin Oteng-Ababio (2020) & others were studied on Cost-Benefit Analysis of Urbanization challenges in Accra, Ghana: Ghana Priorities in May 2020. In this study, researchers analyzed 3 interventions aimed at overcoming the issue, namely the construction of retention ponds, storm drain widening, and community-led solid waste management. Construction of retention ponds leads to direct economic benefits of avoiding or reducing flood damage; and indirect economic benefits gained through less transport and business interruption – a total value stream of benefits equivalent to GHS 284 million over several decades.

Judith Kiende Mugambi (2020)& others, had conducted a review on Setting the stage for the circular economy- Waste resource recovery opportunities in Naivasha, Kenya, September 2020. In this article, Judith Kinde Mugambi and Konstanze Windberg explain that 65% of Kenya's city dwellers do not have access to basic sanitation and 17% do not have access to safe drinking water.

Objectives of the Research

1. To study the various waste management practices followed by the selected municipal corporations of the north coastal Andhra Pradesh
2. To study the perceptions of stakeholders on solid waste management in the municipal corporations of the study area
3. To study the municipal corporation's performance concerning waste management practices concerning stakeholder perceptions
4. To propose feasible solutions for the effective implementation of solid waste management practices in the municipal corporation

Research Hypothesis

H_{01}: There is no significant difference in the perceptions on the type of solid waste generated in stakeholder's house in the selected municipal corporations

H_{02}: There is no significant relation between the education level of resident and segregation of the Solid Waste practices of the selected municipal corporations.

Methodology

Researchers applied the Research method to gather the information needed for the Research and used both primary and secondary data for this Research. Primary data is collected through standardized questionnaires from both the general public in the selected municipal corporation and employees involved in waste management in the selected municipal corporation and secondary data is reports from the Municipal Corporation and local governments which are collected through the journal, websites, submission of early thesis, etc. Therefore, the next section briefly describes the primary and secondary data.

Primary data

Primary data is direct data collected by the researcher himself. These include Research, observations, experiments, Research, and personal interviews. In this process, researchers gathered the necessary information from staff and the general public in selected municipal corporations in the Srikakulam, Vizianagaram, and Visakhapatnam districts. Primary data was collected through questionnaires, discussions, interviews, observations, and required fieldwork. To this end, researchers used separate questionnaires for each group. The general public of the selected municipal corporation and the solid waste disposal staff of each municipal corporation. The investigator selected the appropriate number of samples. For this purpose, the quota

sampling method was adopted when selecting samples from both the general public of each municipal corporation.

Secondary data

Secondary data is data previously collected by someone else and can be found in government publications, websites, books, magazine articles, internal records, and so on. Therefore, the researcher gathered the information needed for this study from Books, M. Phil. and Ph.D. research papers, journals, various websites, newspapers, articles, government reports, publications, and internet sources from government agencies.

Research Tool- Questionnaire for Municipal Corporation Residents

The main purpose of this study is to analyze the effectiveness of solid waste management policies and practices in various municipal corporations on the North Coastal Andhra Pradesh. In this regard, the timeline was designed by researchers to extract the attitudes and perceptions of the selected municipal corporation's general public towards the implementation of solid waste management policies and practices at their respective locations.

Statistical Tools used

SPSS-18 and Excel worksheets are used for data analysis. And tests like Chi-square, F-Test, Spearman Rank Correlation, Cross table analysis, Percentage analysis is used to study the entire collected data.

Sampling design

The criteria for selecting municipal corporations to which cities belong together in time are, firstly, for the convenience of researchers covering them, and secondly they should have relevant municipal corporations to engage in waste management. Therefore, the districts of Srikakulam, Vizianagaram, and Visakhapatnam meet established criteria and this study considered a total of 3 municipal corporations.

Table 1.1: Sample of municipal corporations' study

Districts	Municipal Corporation	Residents
Srikakulam	Srikakulam	200
Vizianagaram	Vizianagaram	200
Visakhapatnam	GVMC	500
	Total	900

Source: Municipal Corporation profiles of Srikakulam, Vizianagaram and Visakhapatnam – 2021

Data Analysis I:

H_{01}: There is no significant difference in the perceptions on the type of solid waste generated in stakeholder's house in the selected municipal corporations

Table –1.2: Difference between the various perceptions on type of solid waste generated in the house

Demographic Groups	Variables	N	Mean	Std. Dev	Std. Error	f-value	p-value
Municipal corporations	Srikakulam	200	12.08	3.308	0.234	0.033	0.968
	Vizianagaram	200	12.13	3.363	0.238		
	Visakhapatnam	500	12.15	3.321	0.149		
	Total	900	12.13	3.324	0.111		
Gender	Male	450	12.18	3.291	0.155	0.501	0.616
	Female	450	12.07	3.36	0.158		
Marital Status	Married	713	12.09	3.296	0.123	0.659	0.510
	Unmarried	187	12.27	3.434	0.251		
Age	Below 30 Years	233	12.24	3.437	0.225	0.177	0.912
	31 - 40 Years	325	12.12	3.277	0.182		
	41 - 50 Years	152	12.14	3.437	0.279		
	Above 50 Years	190	12.00	3.191	0.231		
	Total	900	12.13	3.324	0.111		
Educational Qualification	Secondary	84	12.18	3.44	0.375	0.505	0.679
	Higher Secondary	207	12.31	3.304	0.23		
	Graduation	382	11.98	3.33	0.17		
	Post Graduation and above	227	12.19	3.3	0.219		
	Total	900	12.13	3.324	0.111		
Occupation	Student	217	12.24	3.449	0.234	0.187	0.945
	Employee	253	12.11	3.134	0.197		
	Business Person	220	12.06	3.247	0.219		
	Artisan	105	11.95	3.673	0.358		
	House wife/unemployed	105	12.24	3.353	0.327		
	Total	900	12.13	3.324	0.111		
Monthly Income	Nil	261	12.27	3.258	0.202	0.365	0.873
	Less than 10 thousand	107	12.16	3.484	0.337		
	10-20 thousand	168	12.23	3.353	0.259		
	20-30 thousand	146	12.02	3.358	0.278		
	30-40 thousand	147	11.85	3.267	0.269		
	40-50 thousand	71	12.10	3.373	0.4		
	Total	900	12.13	3.324	0.111		

The perceptive differences among the awareness of various type of solid waste generated in the house are presentedin the Table- 1.2, It is observed that among three municipal corporations the average perceptive score of Visakhapatnam is 12.15 found higher than the other municipal corporations groups and the least average score of Srikakulam is 12.08 and their

standard deviation are 3.321 and 3.308 respectively and the calculated f-value 0.033 indicates that there is no significant difference because the p- value is 0.968. These infers that the there is no significant difference in the municipal corporations, towards the solid waste management of Municipal corporations.

According to various genders wise group it is shows that the average score of male 12.18 found higher than the female 12.07 and their standard deviations are 3.291 and 3.36 respectively. Since the calculated f-value 0.501 which indicate that there is a no significant difference because p-value is 0.616. This infers that there is a no significant difference in the perception of various male and female groups related to solid waste generated in the house.

It is found that the repetitions of unmarried is 12.27 percent found higher than the married person of 12.09 and their respective standard deviation are 3.434 and 3.296. With these mean and standard deviation difference the calculated f-value 0.659 which indicated that there is a no significant difference because p-value is 0.510. This infers that there is no significant difference in the perceptions of various marital status groups on solid waste generated in the house.

Reading to various age groups it shows that the average score of 12.24 perceived by below 30 years age group found higher than the other age group and the least average score of 12.00 perceived by above 50 years age-group and their standard deviation are 3.437 and 3.191 respectively. Since the calculated f-value 0.177 which indicate that the there is a no significant difference level because p-value 0.912. This infers that there is no significant difference in the related to solid waste generated in the house.

As per the educational qualification the perception score of higher secondary was 12.31 found highest than the remaining groups and the least average score of post graduation and above are 11.98 and their respective standard deviations 3.304 and 3.33. With these mean and standard deviation difference the calculated f-value 0.505 indicates not significant difference level because the p-value 0.679. This infers that there is no significant difference among various educational qualification groups on solid waste generated in the house.

According to the occupational wise distribution the average perceptive score of students and house wife/unemployed was 12.24 found highest than the remaining groups and the least average is 11.95 are artisan and their respective standard deviations 3.449 and 3.673. With these mean and standard deviation difference the calculated f-value 0.187 indicates not significant difference level because the p-value 0.945. This infers that there is no significant difference among various occupational qualification groups on solid waste generated in the house.

According to the family income of the solid waste generated in the house, it is observed that the maximum average score of 12.23 was perceived income of 10-20 thousand and the minimum average score of 11.85 are getting of Rs.30-40 thousand incomes and their respective standard deviation are 3.353 and 3.267. Therefore, the calculated f-value is 0.365 indicates that there is no significant difference level because the p-value 0.873. This indicates that there is no significant difference in the various income level of solid waste generated in the house.

Hence Null hypothesis accepted that there is no significant difference in the opinions on type of solid waste generated in stakeholder's house in the selected municipal corporations

Data Analysis II:

H_{02}: There is no significant relation between the education level of resident and segregation of the Solid Waste practices of the selected municipal corporations.

Education level		Bins have cover		Segregation of Dry and wet waste	
		YES	NO	YES	NO
10th	84	13	71	41	43
12th	207	25	182	123	84
Graduation	382	215	167	184	198
Post graduation	227	146	81	150	77
Total	900	399	501	498	402

Table-1.3: Relation between the education level of resident and Segregation of the Solid Waste Management practices of the selected municipal corporations by Chi square ($\chi 2$) test

	Chi Square ($\chi 2$)	P Value @ LOS 5%
Bins have cover	174.44	0.00001
Segregation of Dry and wet waste	21.3876	0.000087

Table 1.4: Chi Square analysis

A significant relation is observed between the education level of resident with respect to the responses of Segregation of solid waste management practices i.e. bins have covers ($\chi 2 =174.44$, *p 0.00001) & also a significant relation is observed between the education level of resident with

respect to the responses of Segregation of solid waste management practices i.e segregation of solid waste ($\chi2$ =21.3876, *p 0.000087).

Hence Null is rejected @ ($\chi2$ =21.3876, *p 0.000087). it can be concluded that there is significant relation between the education level of resident and segregation of the Solid Waste and practices of the selected municipal corporations.

Suggestions

1. The government should strictly initiate waste management hierarchy system and educational programs strongly in Municipal Corporations to be followed by stakeholders of Municipal Corporation at every point of waste generation.
2. Residents are not properly aware of solid waste treatment systems, and it is proposed to raise public awareness about the correct composition of waste. Active participation in municipal solid waste management systems is the responsibility of every resident.
3. Business corporations are also responsible for the success of municipal solid waste management and therefore to implement Extended producer responsibility initiatives which is suggested by Confideration of Indian Industries(CII) .

Conclusion

This study helps to understand awareness of the impact of waste management on sound environmental and sustainable development which appears to be low. It is important to develop waste management from the first level. Storage and primary disposal of waste are major means of waste management. Therefore, it has posed a significant challenge in the research field. Therefore, household-level waste segregation, proper storage, more efficient waste collection systems, and sustainable collection and disposal practices are identified as necessary processes in the study area. Given the types and composition of waste generated by households and businesses, waste reduction, reuse, recycling and composting practices are better suited to address this challenge. These management options should be integrated into a sustainable framework. Careful attention should be paid to the monitoring process. Public education and well-designed waste management programs should also be introduced into current waste management systems. In particular, awareness raising programs should be implemented to improve knowledge on the importance of waste management for the healthy environmental development of the region. Authorities should ensure the introduction of supplemental programs and the development of guidelines.

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