

An Analysis of Changing Economic Trends and Rapid Urbanisation Complicate Solid Waste Management

Madhuri Reddy, SS.Asadi

Abstract: *Urbanization and population growth are exclusively in charge of high expanding rate of solid waste and its legitimate management is a noteworthy issue of Municipal Corporation. Solid waste dumps are truly ruining the environmental conditions in creating nations. Negative environmental effects from inappropriate solid waste dumping can be effortlessly watched wherever in the creating scene. In this paper, A multicriteria decision making technique, named as Analytical Hierarchy Process (AHP), has been used to fulfill of all criterion objectives, criteria, sub criteria, and alternatives is applied in selection of an appropriate solid waste treatment technology. The obtained inputs with the help of experts have been used in pair wise comparison matrix in order to rank the technologies. These comparisons have been used to obtain the weights of importance of the decision criteria, and the relative performance measures of the alternatives. The finding of this study shows that the combination of recycling and composting technology is the most appropriate solid waste treatment technology and recommended to be implementing in Pune Municipal Council.*

Index Terms: *Population, solid waste, management, environment, etc.*

I. INTRODUCTION

Humans have produced garbage from man's soonest time. Since the beginning garbage has been managed through dumping, burning, recycling and minimization. The gathering, treating and discarding solid waste came into human history not long after the beginning of industrialization and populace development of urban zones. Today ill-advised solid-waste management can cause negative impacts on our health through episodes of illnesses and our environment through toxins. Anyway "waste" is an emotional term since some consider waste to be a general health and environment hazard and others consider it to be a vital burden that is a wellspring of salary. Solid waste is a disposed of/rejected material by the general public created from various sources which is one of the real consuming issues on the planet. The quantity of solid waste is expanding from year to year as the populace and industry is at the rising end. Inappropriate

Dealing with and heaping up of solid waste is prompting unhygienic conditions in urban and major rural environments in India. The solid waste dumping yards in India are getting to be as a rearing reason for flies and stray creatures. Therefore, a few vector borne infections are spreading on the planet. Populace rise is the real explanation

behind increment of solid waste due to escalated rural and industrial exercises. Utilization of normal assets is expanding quite a long time prompting weight on characteristic assets. As of late utilization of industrial goods are additionally expanding at worldwide dimension. This situation is prompting enormous solid waste age in all nations. Especially, the created nations are delivering more than the undeveloped nations. In any case, the kind of solid waste is fluctuating starting with one city then onto the next city. Essentially, concoction organization is likewise fluctuating from place to put.

A. Concept of Solid Waste and its types

Waste' in genuine sense undesirable or undesired material or might be any substance which is pointless in present setting. Contingent on the time and phrasing or the kind of material, it is otherwise called garbage, rubbish, trash or junk according to comfort. When it is with reference to living life forms, it alludes to undesirable substances or harmful materials which are to be removed out of their body. Waste management is the human control connected on the collection, treatment, and transfer of differed sorts of wastes. This is done to diminish the negative effects which are conceivable on the nearby or worldwide environment and society.

The rate of per capita waste generation in pune city is one and half kilogram and it is expanding with time. In the neighborhood town, in the city territory the city enterprise is the specialist to deal with the waste in the point of view zone. Pune City Corporation gathers 42 percent solid waste and dumps in the dumping destinations. Rest of the waste remains unmanaged in the source place and store locales. There was no logical management framework for the waste in Pune city and other town zone. In the Dhaka city territory 50 percent of the aggregate populace utilizes the dustbin for their waste. In basic word, solid waste can be characterized as any undesirable or disposed of materials. Human being and their exercises will produce waste. It isn't conceivable to maintain a strategic distance from waste in our life yet legitimate management is fundamental for waste to keep the environment healthy. One - fourth of the aggregate populace in the urban territory is confronting ill-advised management of the waste. The business and hospital waste are frightfully contaminating our environment. The household wastes likewise unmanaged and dumping all over consistently

Revised Manuscript Received on April 09, 2019.

Madhuri Reddy, Department of Civil Engineering., Koneru Lakshmaiah Education Foundation, Vaddeswaram ,Guntur District , Andhra Pradesh, India.

SS. Asadi, Department of Civil Engineering. Vignan's Foundation for Science, Technology and Research, Deemed to be University, A.P, India.



The main types of wastes includes the following given below. It offers residential, municipal, mining, agricultural, manufacturing etc.

- **Household waste:** Household waste is what emerges from abodes of numerous sorts like houses, troops, houseboats, camp sites, prisons and waste from schools, universities and colleges.
- **Commercial waste:** Business waste turns out from the premises in use entirely or essentially for trade, business, sport, recreation or entertainment, yet not from household and industrial waste.
- **Industrial waste:** Industrial waste is what emerges from a manufacturing plant or industrial process yet it does exclude mining or quarry or agrarian waste.
- **Agricultural waste:** Waste from agriculture (non-natural waste) and mining or quarry as of late came into controlled waste routine.
- **Clinical waste:** Clinical waste such waste emerge from hospitals, nursing homes, dentist, surgeries, and so forth and it might cover the household waste.

B. Methods for Solid Waste Management

- The municipal solid waste can be utilized without isolation in sanitary landfill or mass consuming to produce control. Be that as it may, if mechanical isolation is done then energy-rich fuel known as RDF (reject inferred fuel) is gotten which is agreeable to influence creation through biochemical or thermal process. In biochemical course just anaerobic processing and in the warm course both pyrolysis and RDF consuming are financially reasonable.
- **Land filling:** Various basic components are considered in finding landfill destinations. Such factors incorporate both physical and social environments. McKechnie et al. (1983) reported six factors that comprise these fundamental elements: geography, atmosphere, hydrology, cover material (land cover), topography, and land employments. Because of information imperatives, we utilized geology, hydrology, cover materials, existing housing and land development (streets and so on.) of the zone as advisers for site determination
- **Incineration:** Incineration is "the way toward diminishing ignitable waste to a dormant buildup by high temperature consuming". It's anything but a total strategy for solid waste disposal; the results of ignition are ash and gases, including harmful gases, particles and warmth energy. The principle preferred standpoint of incineration contrasted and different strategies for waste treatment and disposal is the vast decrease in the volume of material requiring last disposal and the serious
- Requirements on land disposal of incinerator ash contrasted and those for untreated solid waste. Usually fitting disposal process in zones of high populace thickness
- **Reuse, Reduction and Recycling:** The business is entrenched today, comprising essentially of changing over utilized containers into filaments for material items. World Bank (1999) seen that these days, there is a general concurrence on the prescribed procedures for economical management of urban solid wastes, and

there are isolated experiences all through the world applying these standards. Nonetheless, the objective of reasonable waste management appears to be a long way from being come to. Decrease of waste creation is still more an expectation than an accomplishment in many nations. The net waste creation increments as populace develops, and the per capita generation of waste is additionally expanding, especially in developing nations.

C. Problems due to solid waste management

There is a general connection between's the generation of MSW, riches (Gross Domestic Product, GDP per capita) and urbanization. Future projections gauge that the world's waste creation could reach up to 27 billion tons by 2050, 33% of which might be created in Asia, with a huge level of that being produced in huge economies, for example, China and India. The sorts of MSW produced change as per the standard of living in the city. Wastes produced in low-and center pay urban communities have a huge extent of organic waste, though the wastes in high-salary urban areas are more differentiated with moderately bigger offers of plastics and paper. The changing composition of waste thusly impacts the decision of innovation and waste management foundation, and underscores the significance of waste detachment. You will find much more than 4 1000 rag pickers appointed by the municipal corporation for segregation. They're appointed for the 5 ghantagadis in city. Although not all rag pickers are employee of the municipal corporation plus no standard fee is provided to them. They transport door to door collection in municipal corporation region. The majority of the households spend them Rs.10 per month that is based on their area and services. Municipal Corporation is extending the services of theirs including waste storage as well as segregation to all eighteen ghantagadies in city. Though it is going to be extra financial burden on Municipal Corporation At contained in Pune Municipal Corporation, there's no particular organizational structure for solid waste storage, collection, segregation etc.

D. APPLICATIONS OF AHP (Analytical Hierarchy Process)

[1] Observed that judgmental decisions involve many intangibles that need to be traded off. Decisions must be evaluated with tangible measurements to serve the objectives of the decision makers. The AHP is a theory of measurement through pair wise comparisons and relies on the judgments of experts to derive priority scales which will then measure intangibles in relative terms. The comparisons were made using a scale of absolute judgments that represents how much one element dominates another with respect to a given attribute. AHP is concerned with obtaining better consistency when judgments are inconsistent. The derived priority scales are synthesized by multiplying them with the priority of their parent nodes and adding for all such nodes. [2] suggested that importance of decisions in the housing sector is reflected in the magnitude and nature of the housing problem in Worldwide, building



material, contraction technology and skill manpower within urban and rural area to meet existing housing needs. Geophysical, environmental, political, social, economic and regulatory factors interact to define the housing possibilities. AHP has been successfully applied to cases of project planning, residents' selection, planning in the mass housing project. Researchers have integrated AHP with goal programming into a decision-support system for overall project and planning. The nature of project planning is dynamic and AHP allows for measuring the effect of change. AHP has been integrated into a decision-support system with GIS technology for residents' selection, creating a methodology for decision optimization in the existence of conflicting goals. AHP, as applied to mass housing project, offers a highly effective, proactive method of isolating areas of most likelihood for. AHP is a technique for the breaking down a complex problem with many factors by relating pairs of factors. In relating the factors, quantitative analysis and the subjective judgment of the decision makers can be connected. AHP has the flexibility to combine quantitative and qualitative factors, to handle different groups of actors, to combine the opinions expressed by many experts, and can help in stakeholder analysis. [3] proposed the use of a multi-criteria technique, namely the AHP, for the Environmental impact assessment (EIA) which is an intrinsically complex multi-dimensional process, involving multiple criteria and multiple actors. Finally, the use of AHP was illustrated for a case study involving socioeconomic impact assessment where AHP was used to capture the perceptions of stakeholders on the relative severity of different socio-economic impacts, which helped the authorities in prioritizing their environmental management plan, and also helped in allocating the budget available for mitigating adverse socio-economic impacts [4] The increasing industrialization, urbanization, and changed standard of living have prompted the process of economic development. This has enhanced the product of waste leading to enhanced threats to the environment. Recently, many countries globally have designed as well as exhibited advanced technologies which help in minimizing the quantity of waste substantially. And furthermore may generate large quantity of energy by processing solid waste. Nevertheless, solid waste management is a relatively recent development of India, and as an end result, there is fighting solutions in addition to technique routes, each 1 due to its pros and cons. In India Solid Waste Management is among most ignored places of citified advancement. Magnitude and density of metropolitan public of land is developing rapidly and accordingly the civic bodies, that may be responsible for management of solid waste item, are confronting good problems in supplying satisfactory remedies as accessibility of drinking water, electric power, highways, education and public sanitation, that consists of Municipal Solid Waste Management (MSWM). [5] Solid waste in case it's not handled properly poorly affects the earth. The waste has capacity to threat that is present to land air and soil. The terrible solid waste management leads to social, economical, eco-friendly- Positive Many Meanings- issues and wellness. Aurangabad is acknowledged for becoming traveler city of the Maharashtra declares. The issues regarding solid waste management inside the city of Aurangabad need fast action

and interest. At the kitchen counter the sources for incorrect solid waste management integrate growing community along with population. However these are simply a number of the causes. The paper presents the state of solid waste management as well as therapy techniques in Aurangabad city. The paper throws light on the scenario of solid waste generation source, handling, treatment as well as disposal. The statement is concluded by providing ways to deal with the problem of solid waste. [6] This newspaper stresses on existing solid waste management methods in Indapur municipal place of Pune district of Maharashtra state, India. Exponential growth of population as well as in round advancement of contemporary society & industries are responsible for enhanced solid waste improvement in city. Whereas unrestrained & mismanaged healthy waste cause unwanted ecological impacts on public health and therefore are time frame of extra socio financial problems also. For decreasing the paying on Solid Waste Management (SWM), road website for compilation of solid waste is primary element. The objective of this particular newspaper is providing a far better choice for solid waste disposal management procedure by path see utilizing Geographical Information. System due to the neighborhood. This might gain not only to the skilled conscientious authorities to come down with municipal solid waste management but also the experts in this specific place to enhance the useful strategies as well as planning in this specific region. [7] Purpose: To have understanding concerning utilization of misuse Methodology: Survey of utilization of waste at worldwide quality with particular reference to Pimpri Chinchwad place of Pune Findings: Garbage can easily be utilized for making manure, vermin garden compost, producing electric energy etc. Social/ Academic Implications: Clean India Greenish India Originality/Novelty of article: Recycling of most sorts of waste for productive utilization. Start of our society generated advancement around river banks. Things may be managed during those times as people have been living in tranquility with the dynamics. The scenario evolved with industrialization which started producing havoc in the realization of 19th century if the industrial revolution obtained the earth of consumer by leaps and bounds, which resulted in concentration of public packets in and near the manufacturing parts. This fast change in the advancement brought forth many issues when the preparation authorities especially the provision of fundamental amenities as well as hygienic website of living. The largest obstacle before the administration was and it is managing the waste created by this large public. The solid waste advancement has transformed into a regular global problem at all levels through the world. [8] The abysmal express of & trouble in municipal solid waste management (MSWM) in citified India may be the ideas of the present study. Urbanization contributes enhanced municipal solid waste (MSW) development as well as unscientific management of MSW degrades the citified environment as well as results in health threats. In this particular paper, an attempt is designed to evaluate the primary key details of MSWM, furthermore to

a comprehensive introduction to MSW advancement, its characterization, collection, together with remedies as practiced within India. The present condition of MSWM in Indian states as well as important cities of India is described. The key issues for harnessing benefits that are great from the options for public private partnership along with issues thereof and unnoticeable task of rag pickers can also be discussed. The analysis concludes that set up of decentralized healthy waste processing products in metropolitan growth as well as cities/towns of regular recycling business industry is going to be the need on the hour within building nations as India.

II. RESEARCH SIGNIFICANCE

To study the importance of Analytical Hierarchy Process in Solid Waste Management Practices.

Evaluate the Solid Waste Management using Analytical Hierarchy Process in Pune City

III. METHODOLOGY

The current study will consist on sample survey of 801 from home, MCF/NGO workers, industries, commercial establishments, health institutions and also rag pickers. These involves 532 sample of households, seventy three samples of business activities along with sixteen sample of sector which have been selected proportionately (according to size of households, commercial industries and establishments) from the localities of many financial level groups i.e. extremely small (slum), low, high income group and moderate

A. Study Area

Pune City is select for current study. Pune city disposed the waste at Mantarwadi (Urali Devachi depot). About 1000 2000t of solid waste is produced in Pune municipal location at Urali Devachi village. During the first time, MSW was easily disposed of in lower lying areas with huge open land space.

IV. DATA ANALYSIS

A. Development of Hierarchy Structure Model

Knowledge on choice of solid waste treatment technological innovation which acquired from several sources has been structured into hierarchy. The AHP method is done with the aim to decide on a suitable good waste treatment technological innovation which is going to be ready to create the optimum and best outcome in long term. You will find six important criteria resulted from within the hierarchy structure namely, market potential, environmental impact, technical expertise, political support, cost and community involvement. So, location, public acceptance, feasibility, experience, water pollution, public health, estimates cost, financial management, cooperation, interest message, operation cost and capital expense, were selected as the sub criteria to help the primary criteria which was selected before. The parts of Recycling, Incineration and Composting had been selected as individual technology alternative. Furthermore combination of Recycling Composting, mixture of Recycling Incineration, combination of Composting Incineration as well as mix of

Recycling Composting Incineration was selected as the mixture technology option in the General Hierarchy Model Structure (GHSM).

TABLE I: Data Analysis For Selection of Criteria In Solid Waste Management

Criterion Variables		
Political Hold Up	Total	Percentage (%)
locality	6.61	18.3
Public approval	5.7	16.4
Technical proficiency	Total	Percentage (%)
viability	6.4	18.7
Expertise	6.05	17.9
Impact on Environmental	Total	Percentage (%)
Status of Water	4.87	13.7
Pollution	4.61	12.8
Health of People		
Possible Market Scope	Total	Percentage (%)
estimation Cost	4.93	13.8
Financial Management	4.67	13.6
Participation of Community	Total	Percentage (%)
collaboration	8.75	26.3
Expenditure	Total	Percentage (%)
Operation Cost	9.78	30.6
Capital Cost	9.27	30.1

Table I informs about the data analysis for selection of criteria in solid waste management

Where

- R: Recycling
- C : Composting
- I : Incineration
- R+C : Combination of Recycling + Composting
- R+I : Combination of Recycling + Incineration
- C+I : Combination of Composting + Incineration
- R+C+I : Combination of Recycling + Composting + Incineration

B. Application of Pairwise Comparison Matrix (Pcm)

In order to apply pair wise comparison technique, at step which is first that we have to develop a pair wise comparison matrix for each one of the key elements. The level of choice of the decision makers within the preference for every pair wise are quantified dependent holding a ratio scale of (1/9, 9). The scale was originally since the comparison would be produced within a small range where perception is delicate enough to create a distinction. The interpretation of this scale is supplied in Table II.



TABLE II: Scale of Preference

Verbal judgment of Significance	Numerical rating
Equally Significant	1
Very moderate Significance	2
Moderate Significant	3
Moderate to strongly Significant	4
Strongly Significant	5
Strongly to very Strongly Significant	6
Very strong Significance	7
Very strong to extremely strong Significance	8
Extreme Significance	9

Source: [14]

To find out the weight, at first we determined the largest Eigen value λ_{maks} . Then the weight w_i 's are determined by solving the following system of linear simultaneous equation:

$$W_i = 1/\lambda_{maks} \sum_{j=1}^n a_{ij}w_j, i = 1, 2, \dots, n$$

for uniqueness, we normalize the set of weight such that

$$\sum_{i=1}^n w_i = 1$$

The consistency index is defined by

$$C_i = \lambda_{maks} - n / n - 1$$

As usual,

$$CR = C_i / RI$$

=<0.1=Acceptable

=>0.1=Not Acceptable

V. RESULTS & DISCUSSION

This evaluation relies on information from the person namely policy maker at the Pune Municipal Council who keep the position as a director under the Department of Environmental Health that responsible in managing solid waste management throughout the overall result from Table III demonstrates the combined recycling and composting science is placed first for Pune municipal solid waste treatment technology with weight of 0.15. Others technologies such Incineration is weighted 0.14, Incineration and combination recycling is weighted 0.12, combination technology incineration and composting is weighted 0.10, recycling is weighted 0.09, composting is weighted 0.06 technologies with final ranking is combination recycling, composting and incineration with weight of 0.05. Consequently, it's anticipated the finding from this research is utilized as decision support system and also rule in term of choosing a suitable good waste treatment technology for Pune Municipal Council and also minimizing the issues regarding to solid waste management in Pune Selangor.

Table III informs about solid waste treatment technology weights and ratings.

Table III: Solid Waste Treatment Technology weights and Ranking

Solid Waste Treatment Technology	Weight	Ranking
Recycling + Composting	0.15	1
Incineration	0.14	2
Recycling + Incineration	0.12	3
Composting + Incineration	0.10	4
Recycling	0.09	5
Composting	0.06	6
Recycling + Composting + Incineration	0.05	7

VI. CONCLUSION

This paper centers on enhancing the SWM system in Pune city using AHP. These papers basically focus on the evolution of selecting solid waste treatment technology using AHP approach. The selecting of an appropriate solid waste treatment technology consists of multiple criteria and alternatives that were evaluated by a decision maker in order to achieve an objective. The Analytic Hierarchy Process (AHP) is a theory of relative measurement on absolute scales of both tangible and intangible criteria based on the paired comparison judgment of knowledgeable experts. This was finished by investigating the most essential indicators for estimating SWM performance on the basis of combination of Recycling + Composting, combination of Recycling + Incineration, combination of Composting + Incineration and also combination of Recycling + Composting + Incineration which were selected as the combination technology alternative in the General Hierarchy Model Structure (GHSM). The obtained results were showing positive weight decision is almost same with what they will make to Pune Municipal Council for the future planning.

REFERENCES

1. Saaty, "Decision making with the analytic hierarchy process", *Int. J. Services Sciences*, Vol. 1, Issue 1, 2008, pp. 83-98.
2. Chauhan, N.C. Shah and R. Venkata Rao, "The Analytic Hierarchy Process as a Decision-Support System in the Housing Sector: A Case Study", *World Applied Sciences Journal*, Vol. 3, Issue 4, 2008, pp. 609-613.
3. Ramanathan, R., "A note on the use of the analytic hierarchy process for environmental impact assessment" *Journal of Environmental Management*, Vol. 63, 2001, pp. 27-35.
4. Prof. Mansi Khadke and Dr. Smita Sovani, "Solid Waste Management: Current Practices and Future Strategies by Pune City", *International Journal of Research and Innovation in Applied Science (IJRIAS)*, Vol. 3, Issue 2, 2018, pp. 25-29
5. Gauri Kallawar, Rekha Tiwari, Sushen Jadhav and Mahesh Joshi, "Solid Waste Management: A Case Study of Aurangabad, Maharashtra", *International Journal of Science, Engineering and Technology*, Vol. 6, Issue 4, 2018, pp. 182-188



6. M. S. Lawand, S. S. Bansode and Dr. P. D. Nemade, "A Gis Based Route Optimization For Solid Waste Management: A Case Study On Indapur Municipality", Vol. 5, Issue 12, 2017, pp. 1427-1436.
7. Dr. Harsha Chatrath, "Waste Management In The Pimpri Chinchwad, Pune, India", *Green Chemistry & Technology Letters eISSN*, Vol. 3, Issue 1, 2017, pp 01-08
8. Rajkumar Joshi and Sirajuddin Ahmed, "Status and challenges of municipal solid waste management in India: A review", *Cogent Environmental Science*, Vol. 2, 2016, pp. 1-18.
9. Nitin Mundhe, Ravindra Jaybhaye and Bhalachandra Dorik, "Assessment of Municipal Solid Waste Management of Pune City using Geospatial Tools", *International Journal of Computer Applications*, Vol. 100, Issue 10, 2014.
10. Mane T. T and Hingane Hemalata N, "Analytical Study Of Solid Waste Management In Pune, India", *Journal of Environmental Research And Development*, Vol. 9, Issue 4, 2015.
11. Rode, Sanjay, "Integrated approach to solid waste management in Pune city", 2018.
12. G. S. Jadhav, K.R. Takale, N. R. Kokane, P. D. Bhilare, A. B. Sondkar, S. V. Kank, "Present Status of Solid Waste Management in Bhor, Pune, India: Practices and Challenges", *International Journal of Innovative Research in Science, Engineering and Technology*, Vol. 4, Issue 4, 2015, p.2059-2064.
13. Mrs. S. A .Nikam, "Municipal Solid Waste Management In Pimprichinchwad City, India-An Overview", *International Journal of Innovations In Engineering Research And Technology [Ijiert]*, Issn: 2394-3696 , Vol. 2, Issue 9, 2015, pp. 1-6
14. Saaty, "T.L. Fundamentals of decision making and priority theory. 2nd ed. Pittsburgh", *RWS publications*, 2000.

He is the life member of various International & National professional bodies.

AUTHORS PROFILE



Madhuri Reddy ME (Construction & Management) . Completed her Bachelors degree from Osmania University, Masters in construction and Management from Pune University. Part time Research Scholar at KL University and Currently Working as Assistant Professor in International Institute of Information Technology Pune, Maharashtra.



Dr. SS. Asadi working in Department of Civil Engineering, Vignan's Foundation for Science, Technology and Research, Deemed to be University, A.P, India. He received his Ph.D in Environmental Technology and M.Tech in Remote sensing & GIS from Jawaharlal Nehru Technological University (JNTU) Hyderabad. He has more than 22 years of teaching and Research experience in remote sensing & GIS and Environmental Technology. He has published more than 220 Research Papers in many International and National journals besides undertaking various National projects sponsored by different Government departments and organizations. Received 3 National Awards. Visited number of countries around the world and presented Research work in USA, Sweden and Japan. Presented and participated more than 100 International and national conferences, seminars, workshops. He guided research work of 3 students leading to award of Ph.D. Authored 4 books.

