ISSN No:-2456-2165

Methodology for Proposing and Planning Solid Waste Management in a Religious City: Case of Varanasi

Vikas Kumar
Department of Architecture and Regional Planning
Indian Institute of Technology
Kharagpur, 2021

Abstract:- The difficult task of efficiently planning urban utilities and services like Solid Waste Management (SWM) is further complicated when it comes to historic religious cities – places where organic roads layouts, significant in-flow of tourists, large scale religious events, and public ideologies compound the issues. The research aims to formulate an integrated methodology that can help urban planners to compare different SWM plans and then chose the most suitable SWM plan for such a religious city. The integrated methodology is formulated through a thorough review of the literature, including waste projections, waste composition, primary & secondary collection methods, secondary storage, treatment of waste, and disposal of waste. The methodology includes waste projection method (based on different typologies of the population), strategy selection method (which can rate different strategies on parameters like overall cost, environment-friendliness, responsiveness to public ideology and participation, and involvement of informal workers), and landfill projection method (for waste disposal). To demonstrate the methodology's application, the religious city of Varanasi, Uttar Pradesh, is taken as a case study. The analyses and proposals for the case study city include waste projections, waste segregation, collection mechanism, facilities for storage, treatment, and disposal using the formulated methodology.

Keywords:- *Solid Waste Management, Religious City, Multi Criterion Decision Analysis Varanasi, Religious Waste, Environment Friendly, Informal Workers, Public Participation Etc.*

I. INTRODUCTION

There are many tourism-based cities in India and solid waste management is an issue which needs to be addressed for a city of a developing country like India. things worsen for religious cities or towns. Cities like Varanasi, Haridwar, PrayagRaj (Allahabad), Ujjain, Bhubaneswar, Cochin etc. are examples of such cities that are more than tourist destinations. Cultural and religious values are also attached to them. Cultural and spiritual values attract visitors in huge numbers. These cities also have many religious events attended by thousands of pilgrims. Thus, religious tourists generate vast quantities of municipal solid waste (MSW) and increase the probability of serious negative impacts on the environment, local people's health, and tourists perceive the city as unhealthy and dirty places.

These cities have a solid waste management (SWM) system but with deficiencies and less efficiencies in solid waste management system. Inefficient SWM systems may also adversely affect the ecosystem of these cities. After the present generation, these cities might be more polluted than industrial cities; it might adversely affect the number of tourists visiting the cities and might hamper these cities' economy. India is a country where solid waste management has taken an instant twist in recent years with Swachh Bharat Mission (SBM) in 2014, yet SWM is an issue.

Solid waste management in religious cities and the typical city is different because typical cities do not witness the floating population, tourists, religious institutions, rituals, events, the composition of waste, and public ideology behind waste management.

Varanasi has a floating population of 30,000 floating population per day (SBM 2018) and 59,47,355 Tourists visited Varanasi in the year 2017 in UP tourism records. Managing municipal waste and religious waste at the same time is a task on the day of festival events (Varshney Shubham 2018)

II. AIM

The aim is to formulate an integrated methodology for proposing and planning sustainable SWM plan for a Religious City case of Varanasi.

III. OBJECTIVE

a. Designing the methodology for finding optimal Sustainable SWM plan for religious cities
b. Evaluation of existing SWM system in the case study city using the formulated methodology
c. Proposal of SWM system in Case Study City

IV. LITERATURE OVERVIEW

Waste: -Materials are identified as no longer being of value and are either thrown away. There are different typologies of wastes produces in a religious city. **Residential waste** produced by single-family and multifamily which are waste like food wastes, paper, cardboard, plastics, wood, glass, tin

cans, aluminum, other metal, ashes, street leaves, special wastes (including bulky items, consumer electronics, white goods, yard wastes collected separately, batteries, oil, and tires), and household hazardous wastes (Wilson et al., 2015). **Commercial waste** produced in stores, restaurants, markets, Auto repair shops, etc., waste like paper, cardboard, plastics, wood, food wastes, glass, metal wastes, ashes, special wastes (see preceding), hazardous wastes, etc. (Wilson et al., 2015). **Institutional waste** produced in schools, hospitals, prisons, governmental centers, etc. waste like same as for commercial (Wilson et al., 2015). **Industrial (non-process wastes)** produced in construction, fabrication, light, heavy manufacturing, refineries, chemical plants, power plants, demolition, etc. Paper, cardboard, plastics, wood, food wastes, glass, metal wastes, ashes, refineries, chemical plants, special wastes (see preceding), hazardous wastes, etc. (Wilson et al., 2015). **Agricultural waste** produced in field and row crops, orchards, vineyards, dairies, feedlots, farms, etc., spoiled food wastes, wastes, rubbish, and hazardous wastes. Industrial-Construction, fabrication, light (Wilson et al., 2015). **Industrial waste** produced in heavy manufacturing, refineries, chemical plants, power plants, demolition, etc.-Industrial process wastes, scrap nonindustrial waste power including food wastes, rubbish, ashes, demolition and construction wastes, special wastes, and hazardous waste (Wilson et al., 2015). **Religious waste** produced in temples, mosques, churches, religious spaces, Statues of deities, flowers, pots and ashes, food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, tin cans, aluminum, other metal, ashes, street leaves, etc., similar as residential.

There are different systems available for primary waste collections: door to door, Community bin, and Curbside side pick-ups. The primary waste collection vehicles are hand cart, cycle cart, wheelbarrow, mini truck, etc. The secondary collection vehicles are a trailer, compactor, truck, etc. Waste can also be stored at a transfer station for a short period where, in some cases, recyclable material is extracted from the mixed waste.

In India, basic waste treatment processes which are commonly used: material recovery facilities, low end & high-end composting, mass-burn field erected, mass-burn modular, RDF production, green composter, value added products (dyes, incense sticks). Disposal systems are open dumbing, monofil, and commingled landfill.

V. FRAMEWORK

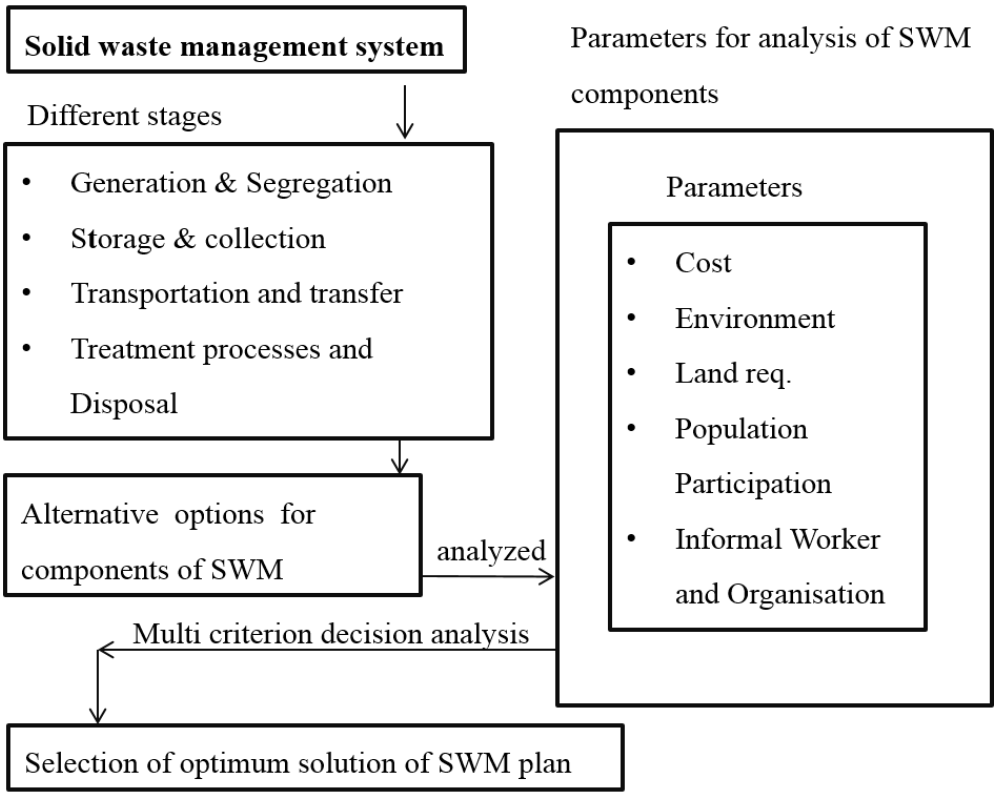

Figure 1 Framework for formulation methodology

5.1 Waste Generation projection

As this city has different population typologies, so waste generated can differ from normal cities. So, few assumptions are taken for the waste generated per capita via Central Public Health Environment and Engineering Organisation (CPHEEO) guidelines which are resident's-0.45 per capita, Floating population's -0.25 per capita, and Tourist visiting's-0.25 per capita of waste generation. Population growth is also an important aspect as it directly impacts the waste generated. Designing the different infrastructure required for the SWM plan should be estimated with respect to population projection then waste

generated can be projected. There are different population projection methods such as arithmetic projection, geometric, incremental, exponential, and logistic for population projection. The projection of population can vary if the projection method chosen is different. For a religious city like Varanasi, which has already surpassed its physical carrying capacity, it is recommended to use arithmetic population projection methods.

5.2 Waste composition

Treatment facilities estimation majorly depends on the amount of waste generated and the waste composition. It is vital to collect and analyze the waste typologies of biodegradable waste, inert waste, recyclable waste, reusable waste, and religious waste to propose optimal numbers and typologies of treatment facilities.

5.3 Weights estimation of different parameters for SWM plan Multi criterion analysis

A pairwise comparison matrix is used to estimate the weights of different parameters by interviewing experts in the study field, which can be used in the Multi criterion analysis further in the study. The estimated weights for various parameters are Cost-0.263, Environment-0.171, Land-0.098, Informal Workers-0.105, and Population participation and awareness-0.162.

5.3.1 Cost

To estimate the overall cost required in different SWM plans, we need to know the price of various equipment and systems needed for a specific SWM plan. The following table provides the cost of different equipment and systems.

Table 1 Costing for different collection and storage options

Systems	Alternatives options	Type of vehicles	Cost of vehicles (INR)
collection and storage Source: (Wilson, 2015)	door to door collection	wheelbarrow/ Hand cart	5,500
		tractor	6,50,000
		mini truck	3,00,000
		cycle cart	9,500
	community bins	hauled containers	8,00,000
	curbside pick-ups	hauled containers	8,00,000
Transfer station Source: (Wilson, 2015)	Push Pit Transfer Stations	hauled containers	8,00,000
	Lift and Load	hauled containers	8,00,000
	Surge Pit Facility	hauled containers	8,00,000

Table 2 Costing for treatment and disposal plants

Systems	Alternatives options	Establishment cost per ton waste (INR)
Treatment processes Source: (Wilson, 2015)	dumping into open space	10000
	combustion	3,00,000
	low MRFs	30,00,00,00,00
	Medium MRFs	40,00,00,00,00
	High MRFs	45,00,00,00,00
	low end composting	3,00,00,000
	high end composting	10,00,00,000
Treatment processes for floral waste Source: (Waghmode et al., 2018)	green composter	10,00,000
	value-added products (dyes, incense sticks)	20,00,000

Source: (Wilson, 2015)

5.3.2 Land requirement

To estimate the overall land required for various SWM plans, land needed for the different systems is referred to from the table mentioned below.

Table 3 Land Requirements

Systems	alternatives options	Land req.
Transfer station (Source: - Handbook on Integrated Municipal Solid waste management plan by (Wilson, 2015))	Push Pit Transfer Stations	0.5sqm/ton
	Lift and Load	0.5sqm/ton
	Surge Pit Facility	0.5sqm/ton
Treatment processes (Source: (Wilson, 2015)	dumping into open space	0.5sqm/ton
	combustion	0.01sqm/ton
	low MRFs	0.01sqm/ton
	Medium MRFs	0.01sqm/ton
	High MRFs	0.01sqm/ton
	low end composting	0.25 sqm/ton
	high end composting	0.2 sqm/ton
	mass-burn field-erected	0.15sqm/ton
	mass-burn modular	0.15sqm/ton
	RDF production	0.25sqm/ton
	monofil	0.01sqm/ton
	commingled	0.01sqm/ton
Treatment processes for floral waste Source: (Waghmode et al., 2018)	green composter	9sqm/ site
	value-added products (dyes, incense sticks)	13sqm/ site

(All sources mentioned in the table)

5.3.3 Environmental Rating

For rating of every subsystem of various SWM plans rating criterion is formulated Here, I have tried to assess the impact of various equipment and facilities on environment and soil on a Likert scale of very high, high, moderate, low, very high and marked 1, 2, 3, 4, 5 respectively for both air and soil impact. For estimating environmental impact average score of air and soil is estimated. The impact was marked with reference to CPCB (Central Pollution Control Board), SPCB (Central Pollution Control Board).

5.3.4 Informal Workers Analysis

In India, there is an informal group[s] who are present in the system for their livelihood. In this parameter all informal workers are identified in the city and the rating is based on the number of informal workers be formalised by the waste handling agency. So percentage informal workers will be marked as (1-20)%-1, (21-40%)-2, (41-60%)-3, (61-80)%-4, (81-100%)-5.

5.3.5 Population participation

For rating this parameter all the household are consider in the city. In this percentage households covered under door-to-door collection, percentage households giving user charges and percentage households practicing source segregation. The average percentage of all the sub parameters is marked as 1- (1-20) %, 2- (21-40) %, 3-(41-60) %, 4- (61-80) %, 5-(81-100) %.

5.3.6 Landfill site area estimation

Estimation of the landfill site area is done by following steps mentioned in the annexure -1 chapter -17 of Manual on solid waste management by (CPHEE 2000), n.d.) which takes into account waste generation per year, design year of the landfill site, total waste generating compounded till the design year, the total volume of waste in n years, the total volume of daily cover in n years, Total volume required for components of liner system and of the cover system (on the assumption of 1.5m thick liner system, the volume of waste which is likely to become available within ten years due to settlement/biodegradation of waste and Possible maximum average landfill = Hi (typically between height (first estimate) 10 to 20 m, rarely above 30 m)

VI. DATA COLLECTION

The primary collection included primary surveys such as Household surveys for waste generation Waste compositions on the festival (Deepavali) and stakeholder's (Funding agency, planning agency, waste managing agency) surveys related to Waste Management in Varanasi.

Secondary Data collection for different data like Demographic data collected from the census of India. Tourist data collected from the tourism department Uttar Pradesh State's website. Floating population data collected from Swachh Bharat Website. Landfill and various infrastructure required for the city's waste management system data are collected from the municipal corporation and Varanasi Development Authority. Pollution data collected from the State pollution board and central pollution board websites.

VII. VARANASI SWM PLAN ANALYSIS USING THE METHODOLOGY

7.1 Waste Generation on regular days

The arithmetic progression is considered for the population prediction over Geometric and incremental growth because the growth rate has slightly declined. The city has already developed, which indicates it has already crossed the limits of its physical carrying capacity.

Therefore, the estimated growth rate for the different typologies of populations: the local population's growth rate is 17%, for floating population growth rate is also 17%, and the tourist growth rate is 3%. According to the above assumptions, waste generated estimation is 860 tonnes per day.

7.2 Waste composition

The composition of waste in Varanasi as per VMC is 51% is biodegradable, 15% is recyclable waste, and the remaining 34% includes inert waste, construction waste, etc. Among 15% of recyclable waste 33% is paper waste, polythene is 25%, plastic is 17%, metals are 16% and glass is 9%. Biodegradable waste has 46% of food waste, 18% of flower waste, leaves are 13% and others are 23%.

7.3 Waste generation after festivals

Waste generation is compounded on the day next to festive events. Next morning of Dev Deepawali, IL&FS has to collect three times the waste generated on regular days in 14 wards, according to VMC officials. Waste generated on different religious events and festivals such as on Makar Sankranti-699.6 T, Mahashivratri-763.2 T, Shravan Maas-826.8 T, Dev Deepawali-1081.2 T, Annakut-699.6 T, Rangbhari Ekadashi-699.6 T, Holi-763.2 T, Diwali-795 T, Buddha Mahotsav-667.8 T, Ram Leela-655.08 T, and Ganga Dussehra-826.8 T.

7.3.1 Religious Institutions or Temple Waste

Waste generated in the temples is accountable as there are 3000 temples in Varanasi. The average daily footfall per temple 250-300, and assuming 0.25 kg of waste is generated per capita, approximately 150tonnes of waste is generated on a daily basis by these religious institutes. Waste from each temple can be sorted and dealt with at a site. The below table shows the amount of garbage generated daily around temples.

7.4 Strategy selection tool

7.4.1 Different SM Scenarios

Assumptions for forming different scenarios are every Informal worker has retained their job, every household practice source segregation and giving user charges, vehicle allocation for collection is based on the accessibility of roads, MRFs for recyclable waste, ttemples deal with their religious waste on their own, and ccompositing plant for biodegradable waste

Table 4 Different strategies for analysis and their respective percentage share in total waste produced

Varanasi strategy	Alternative options	Varanasi Strategy	Strategy p1	Strategy p2	Strategy p3	Strategy p4	Strategy p5
collection and storage	wheelbarrow/ Hand cart	0.33	0.33	0	0	0	0
	tractor	0	0	0	0	0	0
	mini truck	0.2	0.2	0.2	0.2	0.2	0.2
	cycle cart	0.1	0.43	0.59	0.59	0.59	0.59
	bins	0.37	0.37	0.21	0.21	0.21	0.21
	curbside pick ups	0	0	0	0	0	0
Secondary collection and transfer	PTC	0.1	0.2	0.3	0.3	0.3	0.3
	permanent	0.6	0.6	0.7	0.7	0.7	0.7
	temporary	0.2	0.2	0	0	0	0
	Open Ground	0.0	0	0	0	0	0
treatment processes	dumping into open space	0	0	0	0	0	0
	combustion	0.1	0	0	0	0	0
	low MRFs	0.2	0.2	0.2	0.2	0.4	0.4
	Medium MRFs	0	0	0	0	0	0
	High MRFs	0	0	0	0	0	0
	low end composting	0.1	0.1	0.1	0.1	0.1	0.1

	high end composting	0.4	0.4	0.4	0.4	0.4	0.4
	mass burn field erected	0.3	0.4	0.4	0.4	0.4	0.4
	mass burn modular	0	0	0	0	0	0
	RDF production	0	0	0.1	0.1	0.1	0.1
	monofil	0	0	0	0	0	0
	commingled	0.6	0.5	0.5	0.5	0.5	0.5
	green composter	0	0.05	0.05	0.05	0.05	0.05
	value-added products (dyes, incense sticks)	0	0.05	0.05	0.05	0.05	0.05

(Source: Author)

7.4.2 MCD Analysis for different strategies

Using Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), we can analyze and calculate the ranking for different strategies

Table 5 Strategy's MCD analysis

Strategy	Cost (in INR crore)	environment	land	Informal Sector	Pop participation
Varanasi Strategy	54.37	10.42	1499.86	1.00	1.00
Strategy p1	54.37	10.42	1499.86	5.00	5.00
Strategy p2	56.16	11.78	1516.73	5.00	5.00
Strategy p3	56.19	13.78	1196.93	5.00	5.00
Strategy p4	34.65	13.38	1167.61	5.00	5.00
Strategy p5	34.62	13.38	1150.21	5.00	5.00

(Source: Author)

Table 6 Normalized- Weighted Matrix, Performance score, and Ranks

Normalized- Weighted Matrix, Performance score, and Ranks									
Strategy	**Cost**	**environment**	**land**	**Informal Sector**	**Pop participation**	**Si best**	**Si Worst**	**performance score**	**Rank**
Varanasi Strategy	0.11803	0.05929	0.0446	0.00943	0.01447	0.08415	0.003913	0.04443763	6
Strategy p1	0.11803	0.05929	0.0446	0.04716	0.07235	0.048038	0.069202	0.59025677	4
Strategy p2	0.12192	0.06705	0.0451	0.04716	0.07235	0.049283	0.069525	0.58518645	5
Strategy p3	0.12197	0.07844	0.03559	0.04716	0.07235	0.046768	0.072322	0.60728823	3
Strategy p4	0.07522	0.07616	0.03472	0.04716	0.07235	0.002335	0.085711	0.97347824	2
Strategy p5	0.07515	0.07616	0.0342	0.04716	0.07235	0.002278	0.085811	0.97413876	1

(Source: Author)

VIII. PROPOSAL FOR A SOLID WASTE MANAGEMENT PLAN FOR VARANASI

8.1 The proposal from the methodology

Since we have the points of the optimal solution for solid waste management plan via methodology. It has the following points

At Source -Source Segregation-100%**,** User Charges-100%, and Religious Institutions- Treat their biodegradable waste. **Primary Collection-** Cycle cart & Bins**,** Tata tipper for collecting 41% of waste which is accessed by it. **Secondary storage & collection-** PCTS**,** Permanent Storage points**,** Secondary segregation, and At Kardasa Plants. **Treatment of waste-** Composting**,** MRF**,** Mass Burn field erected, and value-added products agencies.**Final Disposal a**t Kardasa Landfill Site

8.2 Detailing of the SWM plan for Varanasi

Source Segregation

The current situation at source is that only 6% of households practice source segregation after providing two bins from VMC for wet and dry waste. In the proposal, waste segregation is 100%, and for achieving 100%, usage of bins should be changed, 1 for kitchen and other bin for rest of the house.

User Charges

Currently, 9% pay the user charges, for achieving 100%, Alliance can be formed with an electrical board and Rs 1 per unit. The electrical Board (Purvanchal Vidhyut Vitaran Nigam Ltd., PUVVNL Varanasi) pays back to VMC.

Religious Centres

Currently, religious centres give their waste to the collecting agency. In the proposed strategy, religious centres treat their organic waste at the site using a green composter, which can be installed on the site. The religious centres that do not enough space should appoint an agency that can treat their flower waste, and the collecting agency collects the rest.

Primary Collection

D2D, community bins, Curbside pick-up- Currently, 64% of households have accessibility through cycle cart. Still, only 46% of homes are under the door-to-door collection, so the rest 18% of the household should also be covered in the door-to-door collection through cycle cart. The waste collection is done by wheelbarrow, cycle cart, and Tata Tipper. In the proposal, the waste collection should be done through cycle cart and Tata Tipper only as it has low risk of degradation of waste quality and has segregation chambers. One hundred sixty-two cubic meters of waste are stored in community bins, but the requirement is 200 cubic meters of waste, so community bins should be installed for the remaining garbage volume. Sweeper cleans the street and dumps the waste in any bin nearby; this is 15% of the total waste generated in the city, which lies on the streets, so in the proposal, curbside pick-ups should be installed for easy dumping and collection of it.

Rag Pickers

The majority of the rag pickers appointed by A2Z private Ltd for D2D collection of waste had lost their job as collecting agencies changed in 2016. Rag pickers, who had lost their livelihood, can be employed in the primary collection of waste via a cycle cart. The rag pickers' income can be 8000 rupees monthly as a rag picker can earn around 150-700 rupees per day, those who will be appointed on a contractual basis can be paid 275 rupees a day.

Secondary Storage

Thirty storage points with a storage capacity of around 600 tonnes per day might not be enough to cater to the future's waste. They are not sufficient for waste generated on religious events. For the future, approximately ten sites more are required. Permanent storage collection points should replace all temporary storage sites. Every site should have a portable compact container service.

8.3 Secondary segregation

Karsada plant, is used for it. Currently, 550 tonnes per day is segregated, and in the future, demand is around 900 tonnes per day. As Karsada Plant is in a remote area with no land use specified, land use around it can be changed and used for the plant's extension. The plant would require 1 acre more for waste segregation and transfer of waste to other treatment plants. So the extension of Karsada plant is a good option, till now.

8.4 Waste treatment.

Treatment of waste can be done with help of various treatment facilities. Material Recovery Facilities for treating 15 % recyclable waste. Mass Burn field-erected for treating11% combustible and hazardous waste. Private agencies to be encouraged to make value added products and treating flower waste - from religious centers. RDF facilities- for 12% of non-combustible materials and those can't be recycled, can be used in RDF facilities

8.5 Waste Disposal.

Karsada Plant- Landfill site is funded by: National Thermal Power Corporation and operating agency: M/s. IL & FS Environmental Infrastructure and Services Limited. Karsada is the waste disposal site, with 22 acres of land, but the requirement of a sanitary landfill site with all infrastructures for the design year 2031 is around 36 acres of land. So the 14 acres of land should be procured for future expansion of the disposal site.

IX. CONCLUSION

The current solid waste management system in Varanasi had the scope of improvement and finding the gaps and inefficiency in the SWM plan is a difficult task compounded with the dynamism of a religious city. The methodology allows the user to compare the current SWM with different other possible SWM plans in the city. The

methodology also estimates cost, land required, environment friendliness, informal workers analysis, and participation. The methodology also provides the rankings of different SWM plans by using multi-criterion decision analysis. A sustainable SWM plan is proposed for the oldest religious city in India with the help of methodology.

REFERENCES

[1]. Basak, Sayantani Mukherjee. 2015 . *Ghats of Varanasi-an emerging centre of pollution.* Varanasi: International Journal of Humanities and Social Science.
[2]. CPHEE. 2000. *Manual on solid management by CPHEE.* New Delhi: CPHEE.
[3]. FUREDY, CHRISTINE. 1984. *SOCIO-POLITICAL ASPECTS OF THE RECOVERY AND RECYCLING OF URBAN WASTES IN ASIA.* Ontario M3J 1P3: Division of Social Science, York University.
[4]. Graeme J. Inglis, Barbara J. Hayden,Alex H. Ross. 2000. *An overview of factors affecting the carrying capacity of coastal embayments for mussel culture.* Christchurch: National Institute of Water & Atmospheric Research Ltd.
[5]. 2016. *HYATTRACTIONS SYSTEM.* march 3. Accessed july 24, 2019. https://hyattractions.wordpress.com/.
[6]. india, census of. 2011. *http://censusindia.gov.in/DigitalLibrary/Archive_home.aspx.* Accessed 2019. http://www.censusindia.gov.in.
[7]. Institute, Br. MSME-Development. 2018. *Brief Industrial Profile of Varanasi District (updated).* Varanasi: Government of India.
[8]. Kasam. 2019 . *Management of municipal solid waste in religious tourism park based on reduce, reuse and recovery: An Indonesian Attraction Case Study.* Indonesia: EDP Science.
[9]. nigam, Nagar. 2016. *banaras nagar nigam.* 10 2. http://nnvns.org/.
[10]. Rai, Praveen Kumar. 2018. *Problems of Sustainable Solid Waste Management in Urban Area: A Case Study. Varanasi.* Varanasi: Institute of Science, Banaras Hindu University.
[11]. SBM. 2018. *Swacch Bharat Misson.* 5. https://sbm.gov.in.
[12]. Tourism, UP. 2017. *Uttar Pardesh toursism department.* 8 1. http://uptourism.gov.in.
[13]. Varshney Shubham, Dr. Bharat Nagar. 2018. *Municipal solid waste and its management (A Study on Varanasi City).* Varanasi: IJTSRD.
[14]. (on the assumption of 0.85 t/cm.m density of waste) V. (n.d.). li.
[15]. Waghmode, M. S., Gunjal, A. B., Nawani, N. N., & Patil, N. N. (2018). Management of Floral Waste by Conversion to Value-Added Products and Their Other Applications. Waste and Biomass Valorization, 9(1), 33–43. https://doi.org/10.1007/s12649-016-9763-2
[16]. Wilson, D. C. (2015). Benchmark Indicators for Integrated and Sustainable Waste Management (ISWM) Presentation. October, 26. http://nswaienvis.nic.in/Waste_Portal/wasteportalpdf/Benchmark Indicators for Integrated and Sustainable Waste Management (ISWM).pdf
[17]. Wilson, D. C., Rodic, L., Cowing, M. J., Velis, C. A., Whiteman, A. D., Scheinberg, A., Vilches, R., Masterson, D., Stretz, J., & Oelz, B. (2015). "Wasteaware" benchmark indicators for integrated sustainable waste management in cities. Waste Management, 35, 329–342. https://doi.org/10.1016/j.wasman.2014.10.006