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Public Private Partnership in Solid Waste Management in Nasik City

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Abstract: The solid waste in municipal corporations is rising in Nasik. An increase in solid waste is observed because of increase in urbanization, population density and income. The growth of industry, commercial units such as hotels, theatres, restaurants, malls are rising fast. Such units are positively contributing to the solid waste generation. Solid waste collection, segregation and disposal capacity of Municipal Corporations is low and inadequate with rising solid waste. Therefore municipal corporations must adopt scientific methods for collection, segregation and disposal of solid waste. Municipal corporations must accommodate private sector for investment and management of solid waste. It will improve the quality life of people in Nasik. The objective of this study was to assess the status, challenges, and opportunities of the existing Public-Private Partnership (PPP) in SWM in the Nasik city.

Keywords: Public-Private Partnership, Municipal Corporation, Waste Management, Nasik.

I. INTRODUCTION

The Nashik city is situated on the banks of the river Godavari. The city has rich historical background, which is amply evident from the numerous historical monuments in and around the city.

The purpose of this study is to assess the current status, challenges, and opportunities of Public-Private Partnership (PPP) in Solid Waste Management (SWM) in Nashik City. Increase in urbanization, population density and income, changing food habits, among others, positively cause rise in solid waste. Solid waste is, thus, an integral part of modern society. Human activities create solid waste.

Solid Waste Management (SWM) is an organized process of storage, collection, transportation, processing and disposal of solid refuse residuals in an engineered sanitary landfill. It is an integrated process comprising several collection methods, varied transportation equipment, storage, recovery mechanisms for recyclable material, reduction of waste volume and quantity by methods such as composting, waste-to-power and disposal in a designated engineered sanitary landfill.

Table 1: source & types of municipal solid waste

Source	Typical Waste Generators	Components of solid waste
Residential	Single & multifamily	Food waste, paper, cardboard, plastics, textiles, glass, metals, ashes, special wastes (bulky items, consumer electronics, batteries, tires & household hazardous wastes
Commercial	Stores, Hotels, Restaurants, Markets, Office buildings	Paper, cardboard, plastic, wood, food waste, glass, metals, special wastes, hazardous wastes
Institutional	Schools, govt. centers, hospitals	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Municipal Waste	Street cleaning, landscaping, parks, beaches, recreational areas	Street sweeping, landscape & tree trimmings, general wastes from parks, beaches and other recreational areas

Improper and unorganized disposal of Municipal Solid Waste (MSW) in open areas and landfills have a negative impact on the living conditions of human beings as well as the overall environment. It results in

spread of communicable and non-communicable diseases among human beings and animals, thus affecting the welfare, livelihood and economic productivity. In addition, it causes contaminations of soil, surface water, ground water and generation of toxic and green-house gases.

The purpose of this study is to assess the current status, challenges, and opportunities of Public-Private Partnership (PPP) in Solid Waste Management (SWM) in Nashik City.

II. OBJECTIVES

The study had the following specific objectives:

1) To study past and existing status (Data) of SWM system for Nasik city.
2) To analyze the above data collected and application of PPP for the same.
3) Comparison of present SWM method and develop PPP model for SWM.

III. RESEARCH METHODOLOGY

The study is assessing the status of solid waste plant and implementation of PPP in solid waste management. It is exercising a participatory approach. It offered solid waste generators (i.e. Households, hospitals, universities, hotels, etc.) and solid waste managers (i.e., municipality and private firms) the opportunity to participate in searching and examining the solid waste management challenges and opportunities. Moreover, it gives us the opportunity to be involved in the issue of solid waste management in Nasik city.

The purpose of this study is to assess the status, challenges, and opportunities of PPP in SWM in the Nasik city.The interaction among the public (municipality), private business, and community in SWM was examined by considering the following conceptual framework. Public Private Partnership (PPP) is a method of working in which the public and private sectors cooperate and partner with each other to create infrastructure and/or provide services to users.

In addition, the public perception about solid waste collection services is examined. It is carried out in nashik city. Nashik is the largest and relatively highly urbanized city in Maharashtra.

IV. MUNICIPAL SOLID WASTE

Garbage is generally referred to "Waste" and is also termed as rubbish, trash, junk, unwanted or undesired material. garbage is define as Municipal Solid Waste which includes commercial and residential wastes generated in a municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes Municipal solid waste consists of household waste, construction and demolition debris, sanitation residue, and waste from streets. This garbage is generated mainly from residential and commercial complexes.

1. Main Sources of Municipal Waste

- House hold waste
- Commercials:
- Street sweeping
- Hotels and restaurants
- Clinics and dispensaries
- Construction and demolition
- Horticulture
- Sludge

2. SOLID WASTE MANAGEMENT (SWM)

A solid waste management (SWM) system includes the generation of waste, storage, collection, transportation, processing and final disposal. This study will focus on disposal options for MSW in India. Agricultural and manufactured products of no more value are discarded as wastes. Once items are discarded as waste, they need to be collected. Waste collection in most parts of the world is centralized and all kinds of waste generated by a household or institution are collected together as mixed wastes. Solid waste management (SWM) is a basic public necessity and this service is provided by respective urban local bodies (ULBs) in India. SWM starts with the collection of solid wastes and ends with their disposal and/or beneficial use. Proper SWM requires separate collection of different wastes, called source separated waste collection. Source separated collection is common in high income regions of the world like Europe, NorthAmerica and Japan where the infrastructure to transport separate waste streams exists. Most centralized municipal systems in low income countries like India collect solid wastes in a mixed form because source separate collection systems are non-existent. Source separated collection of waste is limited by infrastructure, personnel and public awareness. A

significant amount of paper is collected in a source separated form, but informally. In this report, unmixed waste will be specially referred to as source separated waste, in all other cases municipal solid waste (MSW) or solid waste would refer to mixed wastes. Indian cities are still struggling to achieve the collection of all MSW generated.

3. PPP framework

Eight years have passed since the notification of MSW Rules 2000 and time limit for implementation of the rules has run out in December 2003. Yet, there are cities, which have not initiated any measures at all. Given the lack of in-house capability of municipal authorities and paucity of resources, it is desirable to outsource certain services and resort to private sector/NGO participation in providing SWM services. In developed countries, environmental concerns rather than energy recovery is the prime motivator for waste-to - energy facilities, which help in treating and disposing of wastes. Energy in the form of bio-gas, heat or power is seen as a bonus, which improves the viability of such projects. A common feature in most of the developed countries is that the entire waste management system is being handled as a profitable venture by private sector with tipping fee for treatment of waste being one of the major revenue streams. The major benefits of recovery of energy from urban wastes is to bring about reduction in the quantity of waste by 60% to 90%; reduction in demand for land as well as cost for transportation of wastes to far-away landfill sites; and net reduction in environmental pollution, besides generation of substantial quantity of energy.

The treatment and processing of wastes in Indian cities requires a mix of technologies and composting alone cannot be the favoured option. With a view to facilitate use of compost as manure, composting either through aerobic processes should be considered only in case of source segregated biodegradable organic fraction and not for the mixed waste. Besides, requirement of land can also be an issue in the selection of technological options for waste processing and treatment some PPP's activity as shown in table 2.

Table 2: PPP's for solid waste management activities

CATEGORY	MODEL	DESCRIPTION
Private participation with government ownership	Service contract	The responsibility of the private party is usually limited and work is performed only during a certain period of time The responsibility of the private party is usually limited and work is performed only during a certain period of time
	Management contract	The private party carries out supervision of operation and maintenance works under ownership of the public party
	Leasing	The private party operates and maintains the facility and shares the financial risk, as it is responsible for collecting revenues The lease duration is usually 2–5 years
Complete or partial sale of facilities		Under this arrangement, facilities might be sold fully or partially to companies who operate and maintain them
Concession	Design Build Operate Transfer (DBOT)	The private party designs the facility to achieve specific targets, constructs and operates the facility for a certain period of time, and then returns it to the government in good conditions
	Build Operate Transfer (BOT)	The private party builds, operates and then transfers the facility to the government The government pays the contractor a fee that might be fixed or linked to the output Payment are usually paid to the contractor to cover both capital and operational costs
	Build Own Operate Transfer (BOOT)	BOOT contracts are an intermediate form between BOT and BOO. The private party takes over the responsibility to finance, build and operate a facility as well as the

		property title that is then transferred back to the government at the end of the contract
	Build Own Operate (BOO)	The private party owns the facility up to the point of transfer. The private party builds, operates and owns the facilities that are not to be returned to the government

IV. ANALYSIS

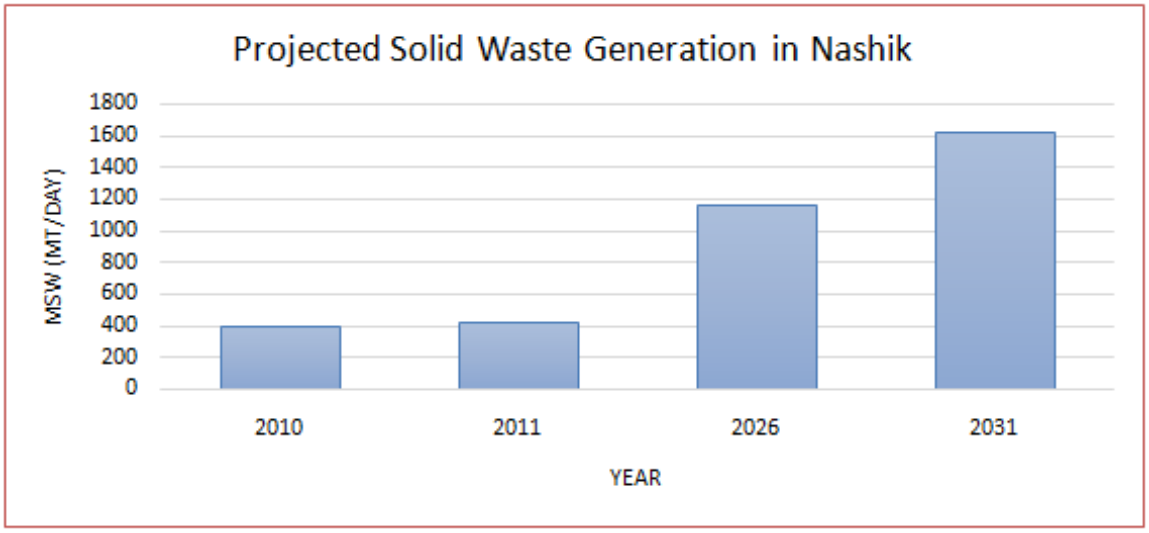
Data was collected from both the waste managers and waste generators by using scheduled semi-structured interviews. Finally, the data was analyzed on judgment basis.

According to the Census of India, 2001, Nashik had a population of 1,076,967 and present population is estimated to be 1,590,000 (projected in year 2008) with a total area of 259 km² which makes it the fourth largest urban area in Maharashtra in terms of population. Nashik is the third most industrialized city in Maharashtra after Mumbai and Pune. Nashik has been on the tourist map of India, especially Hindu religious tourism, because of the legend that Lord Rama lived here during his exile.

The Nashik Municipal Corporation is collecting 300-350 Tons MSW per day. According to DPR for SWM, 2007 the average waste generation is only 218 gm/capita per day. This situation is either due to collection inefficiencies or due to high proportion of agriculture/horticulture farming, which helps in utilization of green waste for in-situ composting. With better collection and transportation measures, the collection efficiency should increase.

of 108 wards of the city through 124 Ghanta Gadi□ s and ownership of the Ghanta Gadi□ sNMC has given contract of collection and transportation of solid waste of the 6 divisions of the city to two contractors. Contract of collection and transportation includes door to door collection of solid waste through Ghanta Gadi and transportation to Municipal Solid Waste Treatment Facility. Solid waste is collected from 2.9 lakh households is with NMC.

1. Projected Solid Waste Generation in Nashik



Source: DPR for SWM, 2007

The city is registering almost 20% extra growth rate compared to similar other cities in India. This is leading to rapid development of real estates, housing, complexes, shopping malls etc. Consequently the per capita MSW quantity has been estimated to reach 400 gm/day by 2011 as per DPR (2007). The population growth rate of the city during the last decade has been 63.98%. This type of growth rate may be witnessed in the

current decade also. Keeping above factors in view the projected quantity of MSW is 750 TPD by the year 2015 and 1628 TPD by the year 2031.

2. Transportation of Municipal solid waste

There are various vehicles provided for transportation of solid waste from city to the solid treatment plant by NMC Nashik.

Table 3: Details of Solid Waste Transportation Vehicles

Sr. No.	Types of Vehicles	Total No.	Capacity (T)	Tons/ month
1	Lorries/Trucks	4	3	360
2	Mini Lorries/Trucks	3	1	90
3	Tracer Trailers	18	3	1620
4	Tipper Trucks (GhantaGadi)	124	3	10890

Source: NMC Nashik.

The area is divided into various wards according to their area and population. The various lorries or trucks are distributed in each area. The waste is collected and stored in bins which are located in that area.

Some amount of waste are been collected through tipper trucks which are known as ghantagadi on daily rout by municipality workers or small contractors. Then the waste is transported to the solid waste management plant for processing and disposal.

3. Estimated population and waste generation of Nashik city

According to present ward wise survey of Nashik city population is estimated to be 1,540,497 with a total area of 259 km² which makes it the fourth largest urban area in Maharashtra in terms of population. There is more waste calculated in Panchavati area, because outsiders visiting ratio of peoples is more in that particular area. Below table 4 shows the ward wise population. And table 5 shows Solid waste Generation and Collection of waste with number of vehicles division wise.

Table 4: Population of Nashik city (Ward wise population)

WARD NO	AREA	TOTAL POPULATION
1	Mhasrul & Adgaon	16294
2	Konark Nagar, Amrutdham, Nandur Manur	16202
3	Rasbhihari School, Hirawadi	18021
4	Data Nagar, Hamalwadi, CDO Meri office Area	18401
5	Kishor Surywanshi road, Gorakshanagar	16225
6	Makhmalabad, Mehardham	15969
7	Ramwadi, Hanumanwadi, Kranti Nagar	19344
8	Bhakti Dham, Chichban, Rajpal Colony, Indrakunda	17186
9	Phule Nagar, Kalika Nagar	18397
10	Mahalaxshumi Cinema Hall area, Valmik Nagar, Hirawadi Road	15929
11	Krushna Nagar ,Ganesh Wadi ,Tapovan area	16386
12	Shri Ram Mandir, Shri Kapaleshwar Mandir Area	17113
13	Raviwar Karanja , WakilWadi	17963
14	KTHM College Area, Pandit Colony	17985
15	Pumping Station, Akashwani Area	19305
16	Anadwali ,Gangapur Area	17239
17	Shivaji Nagar	18528
18	Pimpalgaon Bahula area	19342
19	Maharashtra Colony Area	19172
20	Satpur MIDC area	18872
21	Kale Nagar, Kamgar Nagar,	18348
22	Mahatma Nagar, Disuza Colony, PDC Area	16311

23	Patil Colony, Laxshumi Nagar, Vise Mala, Sharampur Road, HPT College	17757
24	Racca Colony, Ved Mandir, Tidke Colony, Sambhaji Chock	18792
25	Panchashil Nagar	16726
26	Gajmal, Mahatma Phule Market	18092
27	Bhadrakali Mandir Area	16841
28	Mohta Rajwada, Bohiwada	17778
29	Kumbhar Wada	17531
30	Dwarka, Khate Colony	16544
31	Agartakli Area	18382
32	Dasak Area	17509
33	Panchak Area	16158
34	Chehandi Area, Gorewadi	16138
35	Central Jail Area	16300
36	Nehru Nagar, Indira Gandhi jopadpati	18314
37	Gandhi Nagar, Upanagar	17796
38	DGP Nagar, Vadalagaon	18683
39	Babha Nagar	17761
40	Dipali Nagar, Indira Nagar	18476
41	Untawadi, Mahale Mala, Govind Nagar, Sadguru Nagar	17739
42	Sundarban Colony, Zinad Colony	17770
43	Vijay Nagar, Datta Chock, Swami Vivekanad Nagar	17200
44	Sahyadri Nagar, Akshin Nagar, CIDCO	18951
45	Uttam Nagar, Merwadi Rameshwar Nagar	16598
46	Raigad Chock, Patil Nagar, Sawata Nagar	18328
47	Pawan Nagar, Torna Nagar	19083
48	Trimurti Chock, Indra Nagar, Abhiyanta Nagar, Kamatwada	18888
49	Khutwat Nagar, Gopalnagar, Mhalaxumi Nagar	18234
50	Satpur and Chuchale Area	18661
51	Ambadgaon, Ambad MIDC, Datta Nagar	18896
52	Pandavleni Area, Pathardi Phata Area, Kishor Nagar	17564
53	Rajiv Nagar, Rane Nagar	19255
54	Military Area, Guru Gobin Shing college	18631
55	Jaibhawani Road area	16664
56	Motwani factory area	16109
57	Sinnar Phata area, Chehati Pumping Area	17342
58	Shubhas Road Area	15301
59	Nashik Road, Taran Talaw	16320
60	Deolaligaon	17306
61	Vihitgaonvadner Area	16483
TOTAL POPULATION OF NASHIK CITY=		**1540497**

Table 4: Division wise waste collection for each month (2015)

MONTH	**DIVISIONS**						**TOTAL WASTE(MT)**	**DAILY WASTE AVG.(MT)**
	EAST NASHIK	**WEST NASHIK**	**NASHIK ROAD**	**PANCHAVATI**	**CIDCO**	**SATPUR**		
JAN	2138	1269	2106	1978	1895	1193	10579	341
FEB	1943	1076	1845	1721	1652	1038	9275	331

MAR	2163	1242	2064	1930	1917	1166	10482	338
APRIL	2034	1258	2012	1834	1846	1122	10106	337
MAY	2279	1392	2158	2101	1997	1212	11139	359
JUNE	2313	1459	2220	2082	2109	1329	11512	374
JULY	2517	1408	2226	2007	2098	1301	11478	370
AUG	2370	1965	2272	2098	2663	1355	12723	410
SEPT	2388	1487	2222	2104	2116	1353	11670	389
OCT	2590	1535	2292	2222	2109	1283	12031	388
NOV	2432	1150	2122	1990	2330	1320	11344	365
DEC	2312	1325	2091	2119	2019	1119	10985	354

Below fig shows the graphical representation of municipal solid waste generation of various divisions for every month in Nasikcity. It shows more waste generated in month of July, august and October.

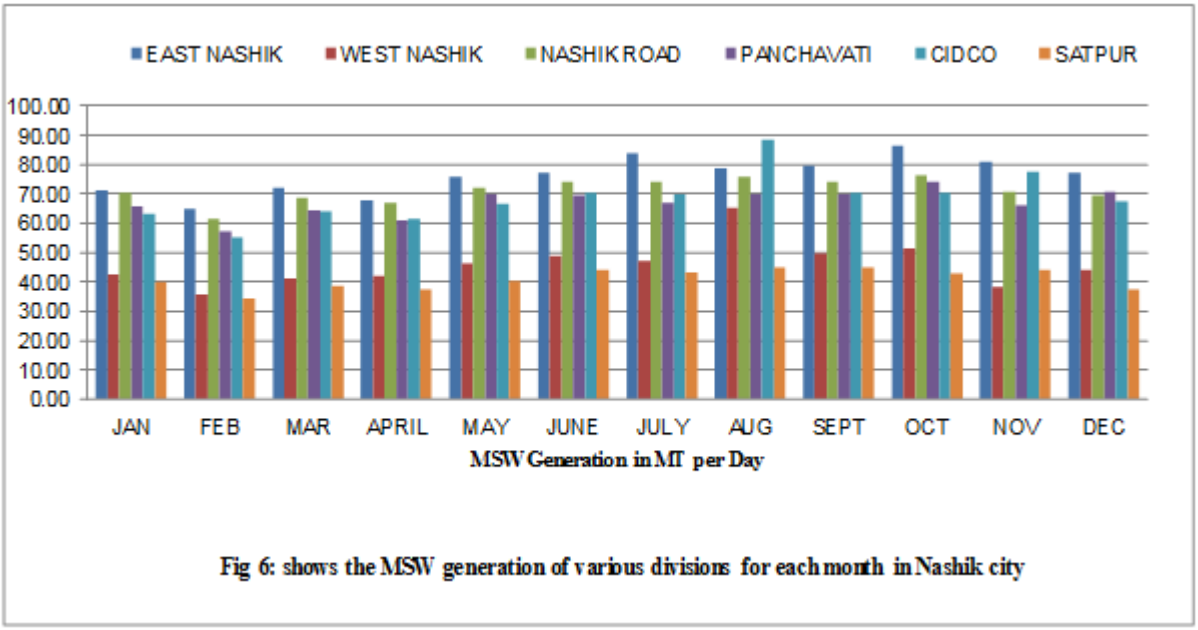


Fig 6: shows the MSW generation of various divisions for each month in Nashik city

V. PUBLIC PRIVATE PARTNERSHIP (PPP) MODEL

At present, the role of the private sector in municipal service delivery is negligible. A small stretch of street light maintenance on the Main Road has been contracted out and has not been running successfully. Similarly, a limited area has been given out for private sweepers for cleaning. However, even this has not been properly managed and is not a successful experience.

1. NEED OF PPP

The existing dump site in nashik city at Khat Prakalp, Pathardi Naka, Nashik,that is receiving waste from all around the city for a long period of time. The dump site has its commercial value as it could be used for other development alternatives. The waste dumped in the past has its biodegradable fraction which will degrade over time. The closure plan of this dump site is to be planned by NMC after having detailed study of the site pertaining to ground water contamination, surface runoff, degradation of waste, production of gas etc. The site could be developed on public private partnership (PPP) basis with some private operator. The yield and sale value from the development of the commercial and residential property by this land shall be sufficient for the

closure cost of the dump site. Therefore the closure cost of the dump site is not being included in the cost estimates and should be considered on PPP model for its development.

The need for improvement in waste management by NMC in terms of efficiency, advance technology's for collection of waste and its effectiveness. The deficiency in the existing system is due to lack of infrastructure, appropriate technology, lack of accountability, higher administrative and salary expenses. Public awareness and community participation needs to be encouraged.

2. VEHICLE TRACKING SYSTEM

FEATURES :

- Wed based solution
  - Locate Vehicles real-time on a map
- Query vehicle's current position
- Set alerts on
  - speed
  - stoppage
- Exception reporting
  - Forward alerts to mobile devices and e-mails
- Access vehicle location information from mobile device

Technologies used GPS:

Mobile unit

This unit is mounted on the vehicle that needs to be tracked.

The mobile Q VTS service

Servers to receive position information from the mobile units.Servers to serve out position information to the fleet managers.

VI. RESULTS AND DISCUSSION

A) Comparison of the existing and new solid waste management system

Sr. No.	Existing System	New System
1. Type of System	Biogas and Biomass Production	Energy Production
2. Components of the Unit	Pre-sorting Unit, Aerobic Composting Unit, Inert processing unit, Leachate treatment plant, Refuse Derived Fuel (RDF) Plant, Animal Carcass Incinerator, Sanitary Landfill	Mass Burn Incinerator, Mass Burn plants, combustion unit, heating unit, generator, transformers

3. Collection system	Nashik has door to door collection system and no public dust bins	Door to door collection system, street sweeping on daily basis by advance vehicles and techniques. effective collection is possible.
4. Present Status for transportation of solid waste.	Present system has 179 Ghantagadis for collection and transport.	In new system numbers of vehicles used for transportation are increased, so that the total waste is collected and transported from all areas of nashik city due to which city appears more clean and hygienic.
5. Investment cost	Low	High
6. Operation and maintenance cost	Low	High
7. Fuel Consumption	Low Electricity Generation	The Electricity generation by this process is much higher than any other although extra fuel is needed to run the process

B) Discussions

1. Themunicipalitieshavetoworkmoreeffectivelybyincreasingthecapacityofwastetreated&collected on daily basis by strengthening the partnerships with PPP projects.
2. The Private waste management companies should be given tax evasions and relaxations on loans on investments made for business operations to increase the entrepreneurial initiatives.
3. Reducing the amount of garbage tipped in the landfills should be regulated by checking that the waste has been strictly passed through segregation and treatment process to reduce the carbon foot print and pollution of the environment.
4. Collection of garbage from source and segregation of garbage from source so that the quality of garbage procured for recycling is good. As the waste gets more contaminated or decomposed for days the treatment of the garbage for recycling gets ineffective and difficult.
5. For a successful PPP competition, transparency and accountability are necessary which must be encouraged by municipalities.
6. For waste management to work well, the city needs to address underlying issues relating to management structures, contracting procedures, labour practices, accounting, cost recovery and corruption.
7. Municipal Solid wastes produced in Nashik Municipal Corporation may be used as a renewable clean energy source.
8. An instant decision is required to be taken by the NMC specialist as well as the Government of Maharashtra to implement waste-energy production scheme as a substitute option of power generation to meet the power shortage of the country.
9. A review seminar should be held with ecologist, healthcare facility providers, waste handlers, and municipal specialists to select proper place and technology of producing energy from MSW.
10. Solid waste-energy production skill should also be measured as effluence reduction as well as greenhouse gases reduction tools in building conclusion on fulfilling of waste-energy production project.
11. Consideration of the limitation of imported fossil fuels should also be taken into account in making the viability of the project.

VII. CONCLUSION

1. The solid waste management solves the problem of disposal and waste to energy creates the energy from waste while recovering the energy from the waste materials with the significant benefits of environmental quality, increasingly accepted as a clean source of energy.
2. Research and technology development focusing on corrosion occurrences, flue gas control, fly ash management and beneficial reuse of residues will further drive the growth of Waste to energy industry.

3. Waste to energy incineration needs to be implemented to make greater contribution in supplying renewable energy in Maharashtra, while helping solving the country's Municipal Solid Waste management problem in the coming decade.
4. The challenge of Municipal Solid Waste disposal and the demand for alternative energy resources are common in many developing countries.
5. Experimentally a 4-5 MW power plant may be installed based on the quality and current generation of solid wastes in Nashik.
6. The private operators are responsible for collecting solid waste from households, hospitals, hotels, and university. We practice door-to-door solid waste collection.
7. There are no communal solid waste containers where waste generators dump their waste for it to be collected by waste service providers. Rather, the solid waste generators have their own containers such as waste bins, plastic and metal barrels, etc.
8. The municipality also placed dust bins along the major streets for storing waste for collection. Waste generators do not pay user fees for such collection system. The system is characterized by absence of communal solid waste containers in the residential areas.
9. As a result, the residential areas are full of different solid wastes dumped here and there. Only private operators practice households' door-to-door and office collection of solid waste in Nashik City; however, micro enterprises are confined only to the street solid waste collection.
10. Households and offices are encouraged to apply plastic waste container according to their preference where solid waste is stored for collection. Waste is moved straight from the source to a collection vehicle at a given time.
11. The study revealed that there is written contractual agreements between the private operators and the municipality; the private operators and the micro enterprises; and the private operators. Thus, when and how services were rendered to the beneficiaries was the discretion of the municipality. However, the private operators are not accountable to households for the door-to-door services.
12. There is the need for continuous efficient collaboration between the municipal authority and the private sector, i.e., involving participation from the private sector in order to establish a solid-waste management partnership.
13. Thus, the municipal authority should put in place mechanisms such as stakeholders forum, performance review meetings to facilitate the process of data and information sharing on solid waste management among the parties responsible for solid waste management. This is essential for experience sharing and avoidance of duplication of efforts.

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