

Municipal solid waste management challenges and health risk problematic solutions at Agra city, U. P., India

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ABSTRACT

In Agra city, a number of causative factors like uneven living standards, high population density, high degree of commercialization and also expansion of industrialization has created detrimental consequences in terms of biodegradable and non-biodegradable waste generations which is estimated at about 25 tons per day. This paper emphasizes the waste characteristics, adverse environmental impacts, health risks, poor waste management practices and also problems associated with the solid waste management system at the municipal level. The findings from this study indicates failure of the existing facilities due to apathy, high volume of waste generation, inadequate collection space, delayed sanctioning of new landfill sites and a number of open-dump sites which generate fires. An assessment of the public perception indicated that most people lack knowledge of the harmful effects of waste heaps including the fact that they are breeding grounds for flies, cockroaches, and mosquitoes and also large numbers of rodents which are responsible for transmission of germs and zoonotic infections to sanitary workers, rag-picking children as well as people living nearby. The implications of the waste management practices in the city are discussed.

Keywords: Municipal solid waste (M.S.W.), Sources of M.S.W, Component of M.S.W, Health risks and Sustainable approaches.

INTRODUCTION

Increasing population levels, booming economy, rapid urbanization and the rise in community living standards have greatly accelerated the municipal solid waste generation rate in developing countries [1].Municipal authorities usually responsible for waste management in the cities, have the challenge to provide an effective and efficient system to the inhabitants. However, they often face problems beyond the ability of the municipal authority to tackle mainly due to lack of organization, inadequate financial resources, and multi dimensional system [2,3].

Rapid industrialization and population explosion in India has led to the large scale migration of people from villages to cities which generate thousands of tons M.S.W daily. The M.S.W amount is expected to increase significantly in the near future as the country strives to attain an Industrialized nation status by the year 2020 [4,5,6].Poor Collection and inadequate transportation are responsible for the accumulation of M.S.W at every nook and corner of Agra city. The management of M.S.W is going through a critical phase, due to the unavailability of suitable facilities to treat and dispose of the larger amount of M.S.W generated daily in metropolitan cities. Improper handling of waste disposal causes an adverse impact on all components of the environment and human health [7-14]

The difficulties in providing the desired level of public service in urban centre's are often attributed to the poor financial status of the managing municipal corporations[15,16,17,18]

In India, C.P.C.B (Central Pollution Control Board) has categorized M.S.W. into eight categories namely infra-structural and building construction waste as a stones and ashes (1), leaves and vegetable(2), miscellaneous (3), grass (4), paper (5), metals(6), plastics (7), glass and ceramics (8) . The analytical survey states that recyclable content in solid waste varies from 13 to 20 % and compostable material is about 80-85 %. Per capita waste generation per day in India has been found to be 0.1 kg in small towns,0.3-0.4 kg in medium cities and 0.5 kg in large cities (C.P.C.B.).

In the study area, the main causes for the high quantum of M.S.W. generation is the continuous urbanization of the area. Over population affluence relating to the increase per capita consumption and also rapidly growing technologies for most economic goods which are changing from returnable/re-usable packing (glass containers) to non- returnable packing(plastic containers). This has resulted in increased solid waste generation and potential health hazards as well as adverse impacts on the environment.

Some of the other causative factors include, the ineffective management of huge quantum waste due to the lackadaisical approach towards waste management practices, public apathy, lack of political will, population growth and changing patterns of urbanization. Indiscriminately disposed of solid wastes which litter public spaces is commonplace in Agra city.

MATERIALS AND METHODS

Study design:

A survey of the problems of M.S.W management practices were conducted during the year 2013. M.S.W was characterized, quantified and segregated as the part of this survey. Each sampling point was obtained from the current collection route and geo-referenced with GPS . The sources of solid wastes were divided into five large units, each from the five sampling routes. The M.S.W characteristics were measured by manual sampling to determine their physical and chemical composition. Proximate analyses of the mixed waste was also conducted for major parameters like moisture content, calorific value, nature of solids, and organic carbon content following the AOAC methods (Association of Official Analytical Chemists). This was followed by the evaluation of the solid waste quantity and their characteristic to propose management options with sustainable approaches for different waste products.

Study area:

Agra (the former capital of Hindustan) is a city situated on the banks of the river Yamuna in the northern state of Uttar Pradesh, India. It is 363 kilometres west of the state capital, Lucknow, and 200 kilometres (124 mi) south of the national capital New Delhi. This city has a approximately 1,686,976 inhabitants (2010 census), one of the most populous cities in Uttar Pradesh and the 19th most populous in India. Agra can also refer to the administrative district that has its own headquarter in Agra city. It is a major tourist destination because of its many splendid Mughal-era buildings, most popular the Taj Mahal, Agra Fort and Fatehpur Sikri three of which are categorized as UNESCO World Heritage Sites. Agra is known as the Golden Triangle tourist circuit, along with Delhi and Jaipur. In the study area, the twelve dump sites (sampling sites) and their rout characteristics is shown in Fig.1. The sampling sites were chosen due to the improper waste disposals and population density in such areas.

Climate:

Agra city has a semi-arid climate that borders on a humid subtropical climate. The city is characterized by mild winters, hot and dry summers and a monsoonal climate. However the monsoons, though substantial in Agra, are not quite as heavy as the monsoon in other parts of India.

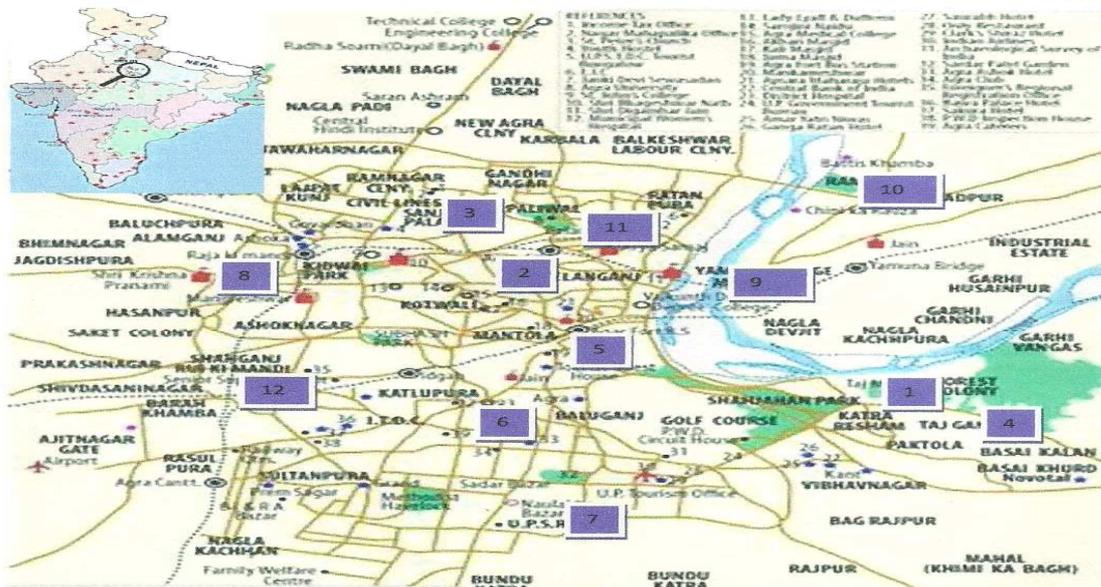


Fig-1: Sampling Sites at Agra City, (1) Eastern Gate of Taj Mahal (2) Near Agra College (3) Sanjay Palace (4) Tanga Stand (Taj Ganj area) (5) Shri Ram Dwar(Agra Fort) (6) Hunuman Dwar (7) Bijili Ghar near Busstand (8) Loha mandi (9) Under the over Bridge Bhagwan cinema Takij (10) Ram Bagh (11) Railway crossing near Agra College (12) Shahganj market

RESULTS AND DISCUSSION

The sampling sites where the M.S.W. were collected are presented in Fig. 1. viz; two sites near fort, one site of Taj Mahal, five sites in and around markets, two sites in residential area and also two sites nearby education institutions. In the study area, collection processes are starts from 2.00 a.m to 11.30 a.m. The total sampling points were 312 consisting of 710 bins for formal collection by the municipal authorities. Three modes of waste collection system specific for different location were employed viz; (a) door-to-door with direct collection available for households in the narrow area and industries.(b) curb side with secondary collection available for roadside communities and (c) a container for commercial area and internal market sites.

Sources of Waste from different generated sectors:

In the Agra municipal area, some of the specified locations with particular waste collections includes residential areas, institutional/community areas, vegetable markets (retail wholesale), hotels and restaurants , commercial areas, hospitals and dispensaries, domestic/stray animals/dairies, industries, historical place and also street cleansing materials (Table 1).

From the total 25 TPD of M.S.W generation in Agra city,65% of the waste generation comes from residential/tourist areas, 18% from commercial areas, 13% from institutional areas and 4% from industrial sectors.

Waste Characterization: The approximate percentage various components of M.S.W in Agra city is given in (Table.2). Earth construction materials constitutes majority of the wastes generated in the City.

Table-1: M.S.W generation and their composition of different sites in Agra city (year-2013)

S.No.	Location of Sampling Sites	Un-segregated Composition of Waste Generation	Quantity Tones/Day
1	Eastern Gate of TajMahal	Paper , plastic, thermal cards, mineral bottles, horticulture waste, garbage, leaves	2
2	Near Agra College	Leather cutting, other leather product,as waste	1
3	Sanjay Palace	Glass, fruits cover, vegetable waste, plastic and papers, thermocol shop waste, horticulture waste, cigrate packing domestic waste, plastic coated visiting cards, carbon papers.	3
4	Tanga Stand (TajGanj area)	Domestic waste, plastic waste, papers, vegetable waste , packaging for chips, cigarettes, shampoo bottles, leaves, egg shells.	2
5	Shri Ram Dwar(Agra Fort)	Domestic waste, papers , pulps, tree leaves, plastic andpolythenes, horticulture wastes, rubbish and garbage	1.5
6	HunumanDwar	Paper cardboards, textiles, Rubbers, leather, plastic containers, carcuss of animals, Slaughter house, Bone chipings, construction waste	3
7	BijiliGhar near Busstand	Polythene, plastics, packing for cigarettes, fruits packing horticulture waste	2.5
8	Lohamandi	Slaughter house, horticulture wastes	2
9	Under the over Bridge Bhagwan cinema Takij	Plastic and papers, vegetables and petha waste, domestic waste	2
10	Railway crossing near Agra College	Industrial waste, leather cutting thermacol, papers and plastics, domestic waste, Tree leaves, egg shells.	4
11	Ram Bagh	Garbage, rubbish, agriculture waste, dry fruit covers, horticulture wastes, crockery metal glass	1
12	Shahganj market	Shopping materials, fruits covers, cartoons and papers, electric wires , horticulture waste	1
Total Solid Waste Generation			25

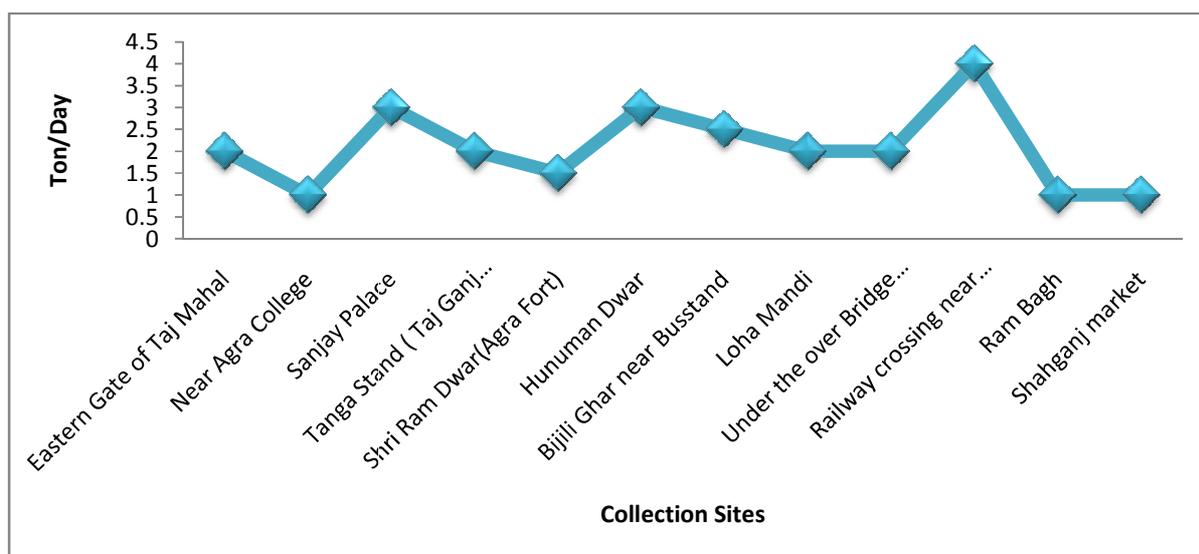


Fig- 2- Showing the M.S.W.generation at different sites in Agra city

Table-2: Approximate physical composition of M.S.W in Agra city (2013).

S.No.	Components of waste	Quantity(%)
1	Earthen construction waste(stone, sand ,silt and ash)	41
2	Organic materials as a green waste (sagasse, Straw and leaves)	37
3	Dead animals/ carcasses	8
4	Plastics	7
5	Wood material	4.6
6	Rags	1.5
7	Metals	0.3
8	Rubber	0.2
9	Other	0.4

From the above component characteristics of solid waste in Agra city, it reveals that the majority of earthen construction waste has 41% including stones, pebbles, sand, silt and ash in the form of non-biodegradable nature followed by 37% organic materials as green wastes like bagasses, straw, leaves and 8% as dead animals with discarded leathers. It is usually seen during the based on survey observations that the high income socio-economic group in relation to the amount of solid waste generations specially plastic, glass and metals is more as compared to the low and middle income groups. Those high income group (HIG) acts like unsustainable manner indicating the positive correlation in respect to the domestic solid waste generation has been noted.

Problematic Practices of M.S.W Management :

The municipal workers and contractors of municipality of Agra city are engaged in collection of un-segregated garbage (biodegradable and rubbish (non biodegradable) from bins irregularly resulting as a over dumping of disposals in the existed bin beyond capacity. This over dumping was due mainly to regularly discarded household wastes, industrial and commercial areas refuse. It is usually seen that the lack of awareness and carelessness by the municipal authorities are the principal causes of excessive waste dumps and pollution. In the study area, insufficient number of waste transport vehicles causes overloading of trucks and spreading of various wastes on the roads through which they move. Open land disposal of solid wastes is associated with the emission of inflammable gases like methane (CH₄), ammonia (NH₃) and H₂S and also illegal incineration practices.

The worst is that very often, unable to clear them out, the municipal workers and contractors set them on fire only to produce toxic smoke polluting the surrounding air which creates the adverse impact on health. Indiscrimination dumping of waste in and around the city is rampant.

The different types of municipal solid waste generated mostly from houses, streets, public places, shops, offices and hospitals. Management of these types of waste is most often the responsibility of municipal or other governmental authorities. Except in the metropolitan cities, M.S.W. is found only the transportation work. The activity of mostly oriented labour intensive and 2-3 workers are provided per 100 residential served. The municipal agencies spend 5-25% of their budget on M.S.W. A typical waste management practices performed by the sections of lower and middle income community specially in Agra city. It was observed during the field studies that waste management workers were engaged for only 3 to 4 hours while the prescribed working hours is 8 hours from 8.00 a.m. to 6.00 p.m. per day with also no average working time per vehicle maintained by municipality of Agra city.

Some of the following important measure elements considered under some activities such as, waste generation and storage, segregation, reuse and recycling should be worked at the household level. Primary waste collection and transport to a transfer station with the help of community bin from the street sweeping and cleansing of public place. Secondary waste collection and their transport to the waste disposal sites, were selected and finally some disposal as landfills in specified areas.

But in most of the Indian cities, illegally open dumping is the common practices which adversely affecting on environment and public health also.

Occupational health risks:

In the study area, the great concern in collection transportation and disposal methods are improper and find the absence of standards and their norms for handling the M.S.W management which invites the occupational health hazards impact on rag-pickers and workers. An open dumping is mostly found as a wasteland disposal site along the road (street), railway line, river side and by lanes (in front of the residence) in a improper manner and also do illegal practices that does not protect the environment due to the open burning and are observed unsystematic and unsuitability exposed to invite toxic elements, vectors and scavengers in favors of growth related germ related conditions.

Along any road or by lanes, huge heaps of garbage and rubbishes would be the usual thrown out sight and these are taken without any objection or concern either by the residents who live nearby the pedestrians generally encounter them every day. They are accepted as a matter of fact that the most people even not knowing that these harmful heaps are the base of breeding grounds for flies causes typhoid, cholera, amoebic dysentery, tuberculosis and anthrax. The special attention of feeding sites of large number of animal rates depending upon the M.S.W which may also cause plague, salmonellosis, trichinosis endemic typhus like diseases through direct bite. Municipal solid wastes including scrap tyres may also choke the drains and gully pits resulting in water logging which in turn results

in the ideal breeding ground for mosquitoes and thus danger of malaria, filarial, dengue and encephalitis. Besides these a number of cockroaches breeds which could contaminate every food in the household and also physically transmit germs of various diseases from one household to another.

At the dumping sites in the Agra city, some of the sanitary workers and rack-pickers child were examined medically and also survey based that suffering from various diseases like eye problems, respiratory ailments, gastrointestinal ailments and skin lesions affected by the occupational health hazards from ingesting particulate matters and also bio-aerosols which direct contact with contaminated materials. Sometimes we seen that the dangerous conditions arises when the biomedical waste dump along with the domestic and commercial waste though out the city.

The aesthetic value has also in danger to the surrounding environment due to the stray animals and scavengers invade the garbage dumps of roadsides and by lanes area. Obnoxious odours also pollute the air due to decomposition of organic solid waste. Sometimes the percolation of decomposed garbage dumps as a contaminated leachates into soil may result into pollution of groundwater for unfit drinking water to the general public.

Sustainable approaches management of M.S.W:

The conservation of our natural resources now-a-days has been needed to applied enhance efficiency technological approaches for the reducing waste materials in the place of generating huge amount of waste in Agra city to the production of different yields as the huge recycled products for human use should be eco-friendly. The development and utilizations of various wastes into different forms as a composting biodegradable heterogeneous organic municipal waste into humified fertilizer, production of methane biogas by methanogenic bacteria for fuel purposes pyrolysed resultant gases stored by dry waste incineration in absence of oxygen, substitute of coal designated as RDF(refuse derived fuel) in the form of pellets without evolving toxic gases specially for poor section of villagers and also combustible wastes which produces tremendous heat which utilizing for generating electricity purposes. Feasibility management system that is suitable for Agra municipality should be an integrated system between separation system and biological treatment technologies before final disposal at landfill. Thermal treatment may not be suitable regarding the high moisture content, low calorific value and also the low management capability of Agra municipality at present.

Technologies which are simple not required high operating skills, but able to operate at low cost is necessary in order to achieve sustainable management system. For the save of our natural limited resources, a necessity of numbers of recycling plants should be setting up as reutilizing purposes of wastes in large scale for different forms. In context to the potential for landfill production of biogas methane treatment plant utilized as greenhouse gas in a large quantity emission for the different purposes like heating, cooking, electricity generation and also street lighting . From the slaughterhouse, meat of pigs, sheep and others animals have thrown out as a solid waste dumps illegally which subjected to anaerobic digestion by methanogenic bacteria to produce methane fuel gas using different purposes in the form of energy. It is known that one tone of municipal waste can produce 130-260 cubic meter of biogas with high methane fuel concentration. India is one of the worlds largest emitters of methane from solid waste disposal producing around 16 mega tones (MT) of CO₂ equivalent per year and is predicted to increase to almost 20 mega tones CO₂ equivalent per year by 2020. Methane constitutes about 29% of the total Indian GHGs emissions while the global average is 15% [19]. GHGs are measured by their relevant strength compared to CO₂ methane has a global warming potential GWP of 21 times that of co₂ [i.e., 1 mega tone of methane=21mt CO₂eq]

CONCLUSION

Increasing urbanization and industrialization are bound to increase the amount of waste produces in a Agra city. Proper management of solid waste by the government organization has not been successful and is somewhat poor in this urban centre. The amount of uncollected waste is most likely to increase day-by-day with increasing urbanization. Among the possible scenarios, it is clear that the most two clear options for efficient solid waste management either centralized or decentralized. However, to achieve financial solid waste management, some is a need to systematically analyses through the strengths and weaknesses of the community as well as the municipal corporation based on which an effective decentralized system can be evolved with the participation of various stakeholders in Agra city.

Sensitization of the community is also essential to achieve the above objective. The public can be altered by awareness building campaigns and educational measure . We need act and act fast as the city is already a hotbed of

many contagious diseases most of which are caused by ineffective waste management. To prevent any epidemic and to make the city a healthy city with economically and environmentally, there is an urgent need for a well-defined strategic waste management plan and a strong implementation of same.

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