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"Municipal Solid Waste Management Study And Strategy In Aligarh City, Uttar Pradesh India"

Harit Priyadarshi[1] And Ashish Jain[2]
[1]Assistant Professor, Department of Civil Engineering, Mangalayatan University, Beswan, Aligarh, U.P., India. Pin: 202145,
[2]Lecturer, Department of Civil Engineering, Mangalayatan University, Beswan, Aligarh, U.P., India. Pin: 202145
[*]*Corresponding Author: Harit Priyadarshi1*

Abstract:

Abstract: *Municipal Solid Waste management is becoming a serious problem in most of the megacities of the world as waste volume continues to rise, which leads to the loss of resources and increased environmental risks. India is a religious country with ancient civilization and having population diverse in religious and cultural belief. The International standards of sanitation and cleanliness point out the poor sanitation condition in our nation. The Mahatma Gandhi had a dream of clean India. He played a great role for making Indian clean and green. Moreover, the Government of India has followed his foot prints and launched a Mission named "Swachh Bharat Abhiyan" The Mission was started by Hon'ble Prime Minister of India Mr. Narendra Damodardas Modi on 2nd of October, 2014 on the occasion of 145th Birth anniversary of Mahatama Ghandhi at Rajghat, New Delhi with an aim to make clean India. The Mission aims to provide upliftment to the maintenance of adequate disposal system of domestic sewage, cleanliness in rural and urban development, availability of safe and clean drinking water to all the citizens. Mission aim to complete sanitary India dream through "Swachh Bharat Abhiyan" by the year 2019. Some of the ministries involved in mission for the sanitary India are Ministry of Rural Development, Ministry of Urban Development, Ministry of Drinking water and Sanitation, Public Sector Undertaking, Corporations, National Government Organizations, State Governments, Defence Research and Development Organisation etc. However, it has been clearly declared that the campaign is not only the duty of the government alone but each and every citizen of the country is equally responsible to keep the nation clean and green. So let's make mission for sanitary India for the Aligarh city in Uttar Pradesh and problems encountered in the accomplishment of goal. This paper gives current scenario of India with respect to case study of municipal solid waste quantity, quality and its management strategy.*

Keywords: *MSW, Swachh Bharat Abhiyan, Sanitation, Hygiene and Sewage disposal*

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I. Introduction

Our Hon'ble Prime Minister Narendra Damodar Das Modi launched an important project "Mission for sanitary India" on 2nd October 2014 on the birth anniversary of Mahatma Gandhi. This "Clean India Campaign" is the biggest ever cleanliness drives in the country. In which Prime Minister had appealed to each Indian citizen to get involved in the mission and make it successful. The main problem in our country is open defecation. More than 72 percent of rural people in our country are used to go open for excreting behind bushes, in fields or on roadsides. Which led to various other problems like untimely deaths of children due to spread of infections and diseases and most importantly rapes of young girls who go to deserted places to relieve themselves. Above all, the project aims at creating awareness among people about the need for proper sanitation and hygienic facilities.

Mission for the Sanitary India, with the help of the Government of India, political parties, NGOs, corporations and with active people's participation, is scheduled to be completed in 2019 which will mark the 150th birth anniversary of Mahatma Gandhi who laid great emphasis on cleanliness. He himself said "Sanitation is more important than Independence". It's been 67 years of Independence, and even today, more than half of India's population does not have proper toilets.

Municipal Solid Waste (MSW) is one of the major areas of concern all over the world. In developing countries like India, there is a rapid increase in MSW due to uncontrolled urbanization, rise in living standard, population growth, and industrial growth; (Joseph, 2002). Expected generation of MSW until 2025 in India is 700 gram per capita per day (World Bank Report-2006).The urban population of India is expected to grow 45 percent of total from the prevailing 28 percent. Hence the magnitude of MSW management (MSWM) problem is likely to grow to even larger proportions. The typical rate of increase of MSW generation in India cities is

estimated around 1.3 annually (Bhide, 1998, Shekdar, 1999, Imura, 2005). Imura et.al, observed that is developed countries generation like India of solid waste is more than developing countries. Imura et.al. reported that MSW generation in less developed cities is 0.3-0.7 kg/capita-day. Rapidly developed cities is 0.5-1.5 kg /capita-day while for developed cities it is greater than 1 kg/capita-day in Asian countries like India. The quality and quantity of MSW generation by particular communities varies according to their social-economic status, cultural habits, urban structures, population and commercial activities etc. (Kansal 1998, Singh, 1998, Gupta, 1998, Rathi, 2006, Jha, 2003, Ray, 2005, Sharholy, 2008). Planning, designing operation of MSW management system can be done on the basis of composition and the quality of MSW generated shown in Table-1.

Ingredients of MSW	Year 2000(%)	Year2025 (%)
Organic Waste	40	60
Plastic	4	6
Metal	1	4
Glass	2	3
Paper	5	15
Other(ash,sand,grit)	47	12

Table 1. Composition of Municipal Solid Waste. (Source: AMC Aligarh, 2014)

Government world over the making efforts to improve solid waste management in their respective countries. There are about 593 districts and about 5,000 towns in India. About 27.8 percent of India's total population of more than 1 billion (as per census 2001) lives in urban areas. The projected urban population percentage is 33.4 percent by the year 2026. The quantum of waste generated in India towns and cities is increasing day by day on account of its increasing population and increased GDP. The annual quantity of solid waste generated in India cities has increased from six million tonnes in 1947 to 48 million tonnes in 1997 with an annual growth rate of about 4.25 percent. And it's expected to increase 300 million tonnes by 2,047 (CPWB, 1998).The annual population growth rate of India 2.15 percent and GDP growth rate is 9.3 percent (RBI, 2006). The present work attempt to bring forward the direness of the situation and also seek to find out possible remedial measure and the aim of this work was to analyze the present status and future challenges of solid waste management system in India

For analysing actual distribution as well as simulating sustainable development in popular country like India where civic amenities and infrastructure development is still a problem between the numerous reasons.

II. Objective

1) To overview the present status of integrated solid waste management in Aligarh city.

2) To undertake a survey of the households in Aligarh city, in order to assess the present integrated solid waste Management practices such as waste generation and disposal by household, performing of Aligarh Municipal Corporation (Nagar Nigam Aligarh), Awareness and concern of local population on integrated solid waste management.

III. Study Area

The Aligarh city is famous for its Maratha fort, Central University, "Aligarh Muslim University" and Lock manufacturing units. Aligarh is a medium size and densely populated city of North India, which lies in the shadow of country's capital New Delhi on 27°53'N latitude and 78°4'E longitude is presented in Figure.1. Aligarh is the first major city situated in the western part of state of Uttar Pradesh on Delhi-Kolkata railway link and historical grand Trunk road. It is situated at a distance of 130 Kms south east of Delhi the capital city of India in between the alluvial plains of river Ganga and Yamuna. The Aligarh district has an area of about 5,019 square Kms with the city occupying an area of about 34 square Kms.

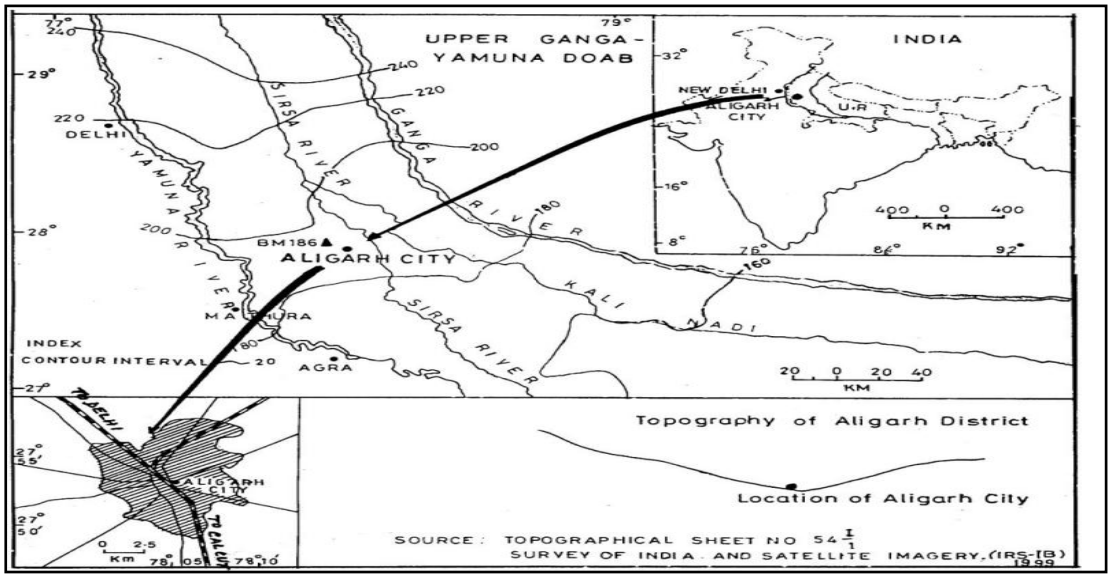

FIG.1. Location map of Aligarh city, Uttar Pradesh, India. (Source: Survey of India and satellite imagery-1999)

IV. A Case Study

A Haryana based private agency A2Z had got the contract from of Aligarh Municipal Corporation on a BOOT basis for period of 30 years. The company has been awarded contracts to handle 220 Tonnes per day (TPD) of MSW. The total project cost of Rs. 34.17 crores is to be partly funded by debt, partly by equity and balance by way of capital subsidy from the Municipal Corporations. The company had tied up for a debt of Rs.11.50 crores and operations were effected from February 2011.The scope and operations of Private Company include door to- door Collection (D2D), Transportation, Resource Recovery and Disposal of Remnants in Landfill. Private company came into existence in Aligarh in May 2010 and D2D collection started in June 2011. Land fill is vital component of any well designed MSWM system. However, this firm did not achieved its aim and in January 2014, due to financial problem this firm had limited their work of SWM from 7 zones to only 2 zones. Remaining 5 zone of the city is covered by AMC for its MSWM from January 2014. Currently AMC & A2Z both are working together for SWM and they are only collecting the wastes from the city.

Presently Aligarh has no proper disposal method. The wastes are being openly dumped onto low lying areas in the outskirts of the City. The disposal sites of Aligarh city were located within 5 Kms from the city limits. Some of the disposal sites are Chilkora, Quarsi, Mathura Road and Goolar Road. The Disposal of a solid waste in a landfill induced burning the waste and this remains a common practice in most countries. Landfills were often estabilishised in abundant or unused quarries, mining voids or borrow pits. A properly designed and well managed landfill can be a hygienic and relating inexpensive method of disposing of waste materials.

The average quantity of MSW generated per day in Aligarh city like domestic, commercial, institutional, industrial, street waste quantity is presented in Table 2.

Types of waste	Quantity in tonnes/day	Item	Percent by weight	Parameters	In % except Ph and Calorific value
Domestic	280	Organic Content	55.20	Ph	6.4-8.3
Commercial Waste	45	Inert/Stone /Ashes	19.60	Moisture content	15.0-25.0
Institutional Waste	65	Paper	12.8	Volatile Matter	28.0-30.0
Industrial waste	10	Plastic	4.5	Ash	40.0-45.0
Street Waste	15	Wood	0.6	Fixed Carbon	10.0-12.0
Total waste= 415 tonnes/day		Bones	2.3	Calorific Value	1500-1800(Kcal/Kg)
		Metal	1.8	Compostable Matter	13.0-15.0

Table-2 Avarage quantity of MSW generated per day in Aligarh city. (Source: AMC Aligarh, 2014)

This was measured by private agency under an assignment. The break-up in quantity in tonnes/day contribution to MSW quantity is given in Figure 2.

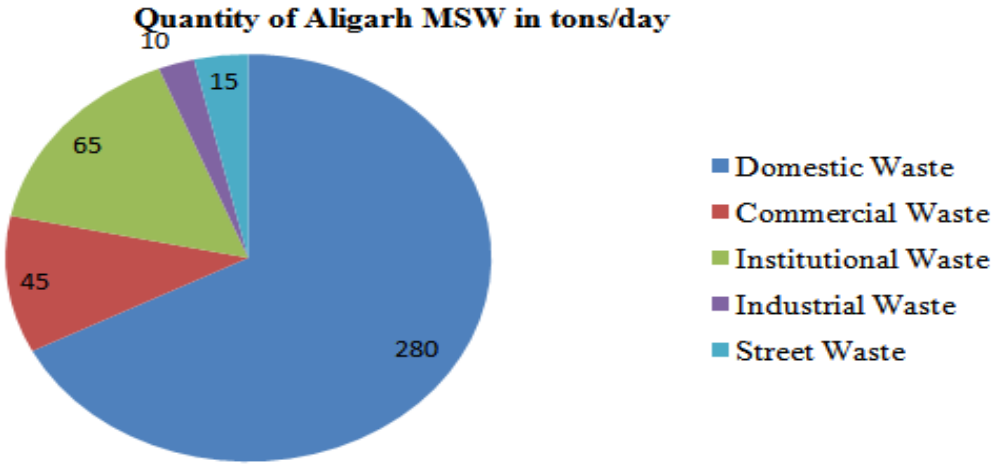

FIG.2 Quantity of Aligarh MSW in quality generated per day in Aligarh city.

V. Problems In Aligarh City

Entire city is suffering from actuate household garbage and rubbish, street sweeping, construction and demolition debris, sanitation residues, trade and non hazardous industrial refuse and treated biomedical solid-waste, open defection near railway line and colonies is scattered all around the city due to extremely poor waste management is shown in Figure 3&4.

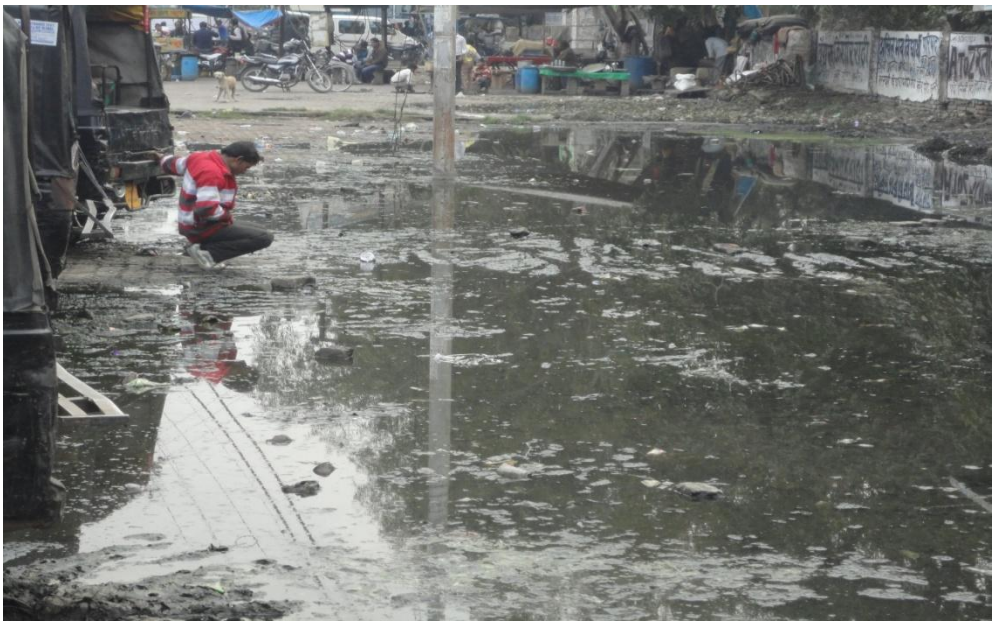

FIG.3. Open defections in Auto stand near Tasveer Mahal, Aligarh Muslim University road, Aligarh

FIG.4. Open defections in near Aligarh Junction , Aligarh

These waste scattered in city can be seen in Figure 5& 6 The Aligarh city has been generated basically three types of waste like solid, liquid and medical waste. The solid waste see all round scattered on road, lane, near school, and civic offices, Liquid waste all most all home drains are open outside, there is no proper facility and Medical waste generated hospitals, clinic and other medical facilities.

FIG.5. Accumulation of solid waste and waste water in and around residential areas, creating ideal breeding ground for insects and pests near Pratibha Colony in front of Nagar Nigam Workshop, Aligarh. (Dirty still water)

FIG.6. Liquid waste generated from factories and other sources in front of Govt. Office,near Naurangi lal School, Aligarh.

The study revealed that there is an active informal sector collecting recyclable materials at various stages from individual households to final disposal sites is shown in Figure 7

FIG.7 Solid waste and discarded materials in drain affect the Ecosystem, near Jamalpur, Aligarh.

The majority of the materials that can be recycled or reused are recovered from the individual households by itinerant buyers. Waste that finds way onto the road side open dumps or bins is picked by waste pickers. Generally women and children are involved in waste picking activities. The buyers and waste pickers sell their recyclable materials to the middlemen who then sell them to the different recycling units. A typical solid waste management materials flow diagram for Aligarh city is shown in Figure 8. The Aligarh MSW waste consist of Organic content (55.2 percent), inert material (19.6 percent), paper (12.8 percent), plastic (4.5 percent) , bones (2.3 percent) , textile (2.7 percent) , metal (1.8 percent) and wood (0.6 percent). Estimate 30 percent of the total waste is being recycled. Approximately 80 percent of the collected waste is disposed as open dumping. There is no sanitary landfill in Aligarh city. The contamination of medical waste and contamination of construction and demolition waste are associated with MSW in Aligarh city. The common composition of MSW materials flow diagram for Aligarh city is shown in Figure 8. The Aligarh common MSW waste consist of Organic (50%) ,recyclable (15%), silt and sand (15%) construction waste (10%) and other waste (10%.) is presented in Table 3.

Ingredients of common MSW	Percentage (%)
Organic	50
Recyclable	15
Silt and Sand	15
Construction	10
Other waste	10

Table 3. Composition of common Municipal Solid Waste.
(Source: AMC Aligarh, 2016)

Methodology:

A medium size city, Aligarh, having population of about 0.8 million and situated 130 Kms from the capital city of India, Delhi was selected for this study. A theoretical framework and a protocol; were developed to conduct this study. Essential information needed within the framework and protocols were collected from various sources. The study focus on Mission for the sanitary India is completely ineffective or not in Aligarh city Uttar Pradesh, India. Figure7 shows solid and liquid waste of different location in study areas such as Jamalpur, Shahgarh, and Jeevangarh etc., which face a lot of problems related to solid and liquid waste have been collected, and secondary data were collected directly from concerned office, research papers, newspapers, journals and articles etc. Personally make visit in the city and to the waste disposal site to assess the solid waste management system. The population of Aligarh City is about 1, 33,729,723 based on the latest united nation estimates (3 January-2017).The aim of this work were to analyze the present status and future challenges of solid waste management system in India. Within this aim Aligarh city was examined for its solid waste management system. Total number of slums in Aligarh city numbers 42,682 in which population of 258,841 resides. This is around 29.60 percent of total population of Aligarh city.

1) STRATEGIES FOR SUSTAINABLE MUNICIPLE SOLID WASTE MANAGEMENT IN ALIGARH CITY:

1 Bringing the attitudinal and behaviour changes among the population about segregation of waste and sanitation improvement.
2) Public awareness through informing and educating the masses on various aspects of solid waste management and achieve the target of receiving segregation waste from each household.
3) Bringing down the involvement of NGOs.
4) Awareness program started in the schools level.
5) Publishing of the magazines and buck lets in the newspaper.
6) Creating public participation in planning and management of MSW activities.
7) Integration and involvement of private sweepers and rag pickers in improving management.
8) Social Mobilization.

STRATEGIES FOR CREATING AWARENESS:

1. Selection of key target audience plays a key role in generation effective awareness and cities like Aligarh need more careful planning for this purpose.
2. Some of the target audience can be form sectors of particular interest including the female head of the family, children, and youth which require some form of role model to influence their behaviour.
3. Group discussion
4. Inter personal communication
5. Audio-visual aids.
6. Other local popular media
7. Functionary's attendance.
8. Two days communication between Citizens and administration
9. Time management.

The MSW collection conducted in Aligarh city basically two types.

1) FIRST STAGE:

DOOR TO DOOR COLLECTION:

The waste collected from door to door is transported to dustbins and open dumps. In this stage collection is not very efficient even through large number of private garbage collectors is engaged in waste collection from door to door at a nominal rate. Due to lack of awareness most of the people drop the waste outside their residence which normally turns into small dump points and becomes difficult to collect. A part of such garbage is blown into drains which choke them. Such garbage is swept away by street sweeping and lifted by means of hand cart, rickshaw trolley by Nagar Nigam workers and private bodies to the nearby dump points which are known as secondary dump point.

2) SECOND STAGE:

- Waste filled bins are replaced with empty bins with the help of dumper placer and transfer to the dump site.
- Waste from open dumps is collected in tractor manually or by JCB sand loader and finally transported to the designed dumpsite.

RECYCLING WASTE:

The recyclable wastes are segregated manually by junk dealers and rag pickers. The junk dealers purchases recyclable waste from residential commercial establishments while rag pickers collected recyclables from market places , dustbins, and dumping sites and sort them before selling off majority of such groups are located.

NON- BIODEGRADABLE WASTE:

A few private agencies are involved in collection of non biodegradable waste, but the collection achievement is not more than 50%.So a large part of such waste is being mixed with MSW.

BIODEGRADABLE WASTE:

Street sweepers and drain sites major constituents of the non biodegradable waste. This type of waste is disposal off at the dumping sites along with other wastes without any prior processing. This is creating the problems in processing of MSW.

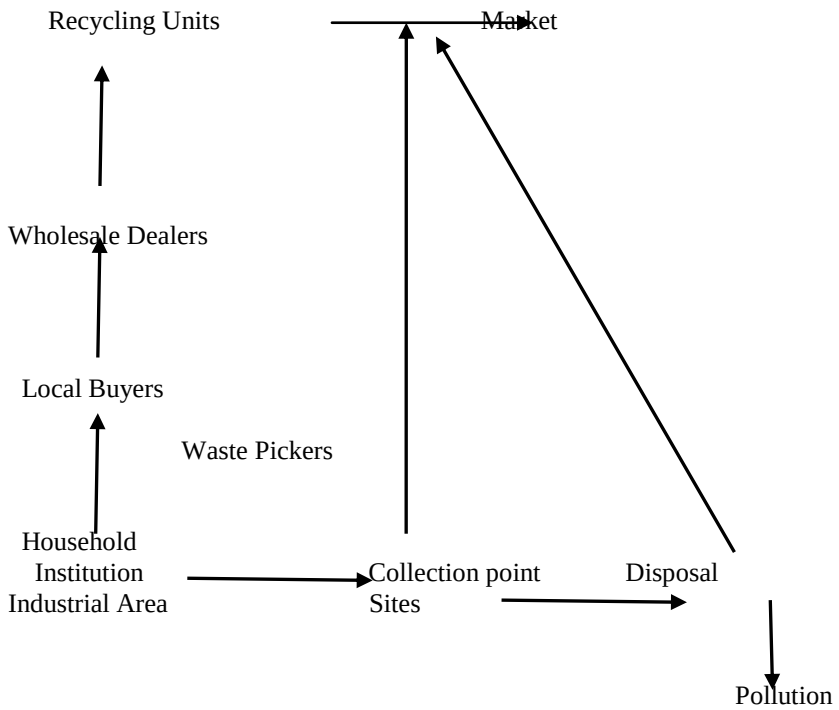

FIG.8. Solid Waste Management flow diagram in Aligarh city.

VI. Result And Discussion

In order to meet the challenges of municipal solid waste management there is a need to develop a better technology or method through which the waste can be converted into useful material. The biodegradable organic waste can be processed into ecofriendly organic manure. Organic manure nourishes the soil fertility, increases the soil aeration and also minimizes environmental pollution. Now, it has been realized throughout the world that the use of chemical fertilizers and other chemicals is harmful to soil productivity and also a cause of water and air pollution. Municipal solid waste is suitable for composting because of the presence of high percentage of biodegradable organic matter, acceptable moisture content and C/N ratio in the waste. Composting has a lot of benefits like: reduce landfill space, reduce surface and groundwater contamination, reduce methane emissions, reduce transportation costs , reduce air pollution from burning waste, provide more flexible overall waste management, enhance recycling of materials and can be carried out with little capital and operating costs. It is an environmental friendly, wealth creating and sustainable method rather than directly dumped into earth and is useful to convert organic waste to useful products. Study has revealed that the amount of municipal solid waste collected by the private body in Aligarh city is one of the order of 415 tonnes per day. Depending on the type of locality like in thickly populated commercial areas and posh colony , the frequency of collection is at least once in a day , while in other areas it is only once in 3-5- days. Present practices of SWM in Aligarh city are very weak. Approximately 80 percent of the collected wastes are disposed as open dumping. There is no sanitary landfill in Aligarh city. The city is no exception and management of solid waste disposal is passing a problem of this rapidly developing city of western Uttar Pradesh, on most accounts. Aligarh city is regarded to be one of the most polluted cities of the country due to its cultural and physical setting. Primarily, an old city like Aligarh with low relief and slope, with dense urbanization and cozy pathways and ever increasing uncontrolled population load, modern civil engineering projects with state of art GIS and GPS technology can be prove to be a boon for planning, maintaining, formulating, and simulation along with models that may come out for next 10, 20 and 50 years. Sustainability requires most modern technology tool like LIDAR survey along with total station survey of entire city and thus a chain of all sanitary like can be made which can be further joined and rejoined keeping with the slope aspect minimal. A GIS database generated inform of polygon, point and line with feature information of number of household, family groups ; linked up can serve to plan for other civil projects such as all underground sewage system or installation of real time monitoring system at selected places .

Rainfall in Aligarh occur in between June to September where additional rainwater gets drained into sewage system with no scope of conserving them, thus minimize the chances of ground water recharge that cannot percolate through concrete urban state and flows forward or gets evaporated. For sustainability sanitary system of India should be aimed at rain water harvesting as well, for old cities or urban centres like Aligarh. Civic projects structure design and methodology for sanitation and efficient waste treatment with techniques and methods of rainwater harvesting for recharge of aquifers accordingly to geological standards for sustainability adopted for Aligarh can be adopted all over the globes with similar condition.

Environmental sanitation envisages promotion of health of the community by providing clean environment and breaking the cycle of diseases. It depends on various factors that include hygiene status of the people, types of resources available, innovative and appropriate technologies according to the requirement of the community, socioeconomic development of the country, cultural factors related to environmental sanitation, political commitment, capacity building of the concerned sectors, social factors including behavioural pattern of the community, legislative measures adopted, and others. India is still lagging far behind many countries in the field of environmental sanitation.

Health and disease related issues in Aligarh slum area (Figure 9) adversely affect the health status of inhabitants due to lack of basic infrastructure and health services. Overcrowding in slums is common cause of psychological stress and increases the rate of disease transmission due to frequent contact.

FIG.9. Both children's Open defections near slum area Jamalpur fatak, Aligarh

There is intense need for addressing vector born, water born diseases, in informal settlements and mobilization of health services for these urban poor. The health and medical facilities in the households of slum was found to be negligible. The accessibility and utilization of the healthcare services among a population from community was very poor. The illnesses among children aged under-5 years in study region were identified as respiratory tract infections, diarrhoea, malaria, dengue, skin problems and malnutrition.

The Aligarh city people is not aware of the poor waste management which will lead to various deceases diarrhoeal diseases, cholera, typhoid fever, amoebiasis, hookworm infections, conjunctivitis, and malaria, acute upper and lower respiratory infections, Chronic obstructive pulmonary diseases, asthma, prenatal mortality, pulmonary tuberculosis, low birth rate weight, eye irritation and contract (J.N. Medical collage Report 2014). The entire Aligarh city is suffering due to large amount of solid waste management problems because non existence of nongovernmental organization, non availability of well qualified persons among the Aligarh, lack of education, lack of public awareness etc but we can improve or resolve the poor waste management issues from Aligarh city if development of National Government organisation, development of charity, general awareness of waste and its impact of human life. There are some common problems in Aligarh city like:

1) Present Practices of SWM are very weak in Aligarh. Wastes are not collected and transported effectively.
2) Approximately 80% of the collected wastes are disposed as open dumping.
3) Study shows that that solid waste management of Aligarh city has been significantly improved after the involvement of private sector.

We can improve if we take the responsibility and work together to the Aligarh city if we development of NGO / charity based on the donation, NGO can work along Aligarh Municipal Cooperation, general awareness of water and its impact on human life etc.

VII. Solution:

We can minimize waste and manage is better if we follow the some important steps:

1) Minimize packaging waste by taking own cotton bags to the market and the grocery store.
2) Do not by pre-packaged items. Buy the reusable or refillable containers.
3) Avoid supermarkets and if we do shop in them, take your own beg.
4) Refuse the large plastic carry bag offered by the shop.
5) Do not through away toxic materials like batteries, thermometers and insecticides in to garbage.
6) Avoid buying dangerous substances like mosquito repellents, insect sprays, chemical cleaners, detergents etc. use as for as possible natural or organic substances.
7) Donate old cloths, books etc. to NGOs for redistribution.

8) Buy recycled products (paper, stationery items, etc)
9) Buy rechargeable batteries, if can afford them.

Any organization or government as its own level cannot achieve the goals of sustainable development until the public has a participatory role in it. Public participation is possible only when the public is aware about the environment issues or problems related to environment. The public has to be educated about the fact that if we are polluting own environment we are actually harming ourselves.

"*Waste prevention is far better than waste management"*

VIII. Conclusion

The Municipal Solid Waste generated in Aligarh city depends upon the population, climate, uncontrolled urbanization, socio-economic condition. The entire Aligarh city is suffering due to acute waste management problem, even though it is not being addressed by the single community person due to non existence of NGO, Aligarh community is careless towards the responsibilities to clean city, lack of general awareness regarding effect of waste is very poor among the residential. Aligarh MSW has a very similar composition to that of other medium-sized Indian cities. Organic content in the waste was found highest Organic content (55.20 percent), Inert (19.60 percent), paper (12.8 percent), plastic (4.5 percent), cloths (2.8 percent), bones (2.3 percent), metals (1.8 percent), wood (0.6 percent), and others (0.4 percent), shown in Table 2. The study has revealed that collection efficiency of the private operator and Aligarh Municipal Corporation is approximate 80 percent. According overall aspects shows that the solid waste management in Aligarh city has been significantly improved after the involvement of private sector.

The study of concluded that the present policy and infrastructures are inadequate in dealing with the enormous quantity of MSW generated in the city.MSWM in Aligarh city is unsatisfactory and thereby needs immediate attention. Increase in the quantities of MSW due to rapid urbanization, commercialization and inability of providing daily collection service cause nuisance and health hazards. A2Z Pvt.Ltd. (NGO) had taken a big step towards improving MSWM practices by privatizing the collection and transportation of MSW.

A Nationwide Real Time Monitoring system has also been launched by the Government of India in order to construct toilets under this campaign aiming to attain 100% open Defecation Free India by 2019. We should participate in this mission by meeting our hands together and taking this cleanliness mission as an important part of our life with the vision of clean India achievement through the effort of each and every Indian citizen and not by the effort of government only. Beside all these the government imposed Mission for the Sanitary India Cess at the rate of 0.5 percent on all services, which are presently liable to service tax from 7th November 2015. This will also be helpful in achieving the goal of cleanliness and hygiene by the due date 2nd October 2019 on 150th anniversary of our beloved Father of Nation Mahatma Gandhi and towards his biggest dream.

"Clean India Green India: Dream of Mahatma Ghandi"

The view and comments expressed and notified in the paper are the personal view of the author and suggestion and critical review will be appreciated.

The aim of this study is to present the status of MSW and other important aspects like challenges for integrated SWM, intricacy of PPP mode, role of rag-pickers, prevailing practices of MSWM, and the rules pertaining to waste management in India. In developing countries like India, it is important to plan and implement sustainable low-cost SWM strategies. Lack of awareness, inappropriate technical knowledge, inadequate funding, unaccountability, implementation of legislation and policies are major reasons for the failure of MSWM. Issues like proper site selection, adequate financial support, and improper human resource management, can be overcome with enhanced capacity, improved procedures and training. The solution to the problems associated with development and adoption of appropriate technologies and lack of trained manpower will require at realistic time frame and not only central government bodies, but state governments also have to take various actions for strengthening MSWM in the country. The intricacies that could arise during implementation should be taken into account, so that decisions and strategies can be based on ground actualities.

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