A Review on Solid Waste Management System in Farrukhabad, Uttar Pradesh, India

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Abstract : Solid waste may be defined in simple terms as the range of garbage resulting from animal and human activities that are discarded as unwanted and useless as a product. Solid Waste can be classified based on type of material, such that plastic, paper, glass, metal, and organic waste. Categorization may also be done on the basis of toxic or hazardous potential, including radioactive, flammable and infectious. It can also be classified pertaining on the origin of waste, such as industrial, domestic, commercial, institutional or C&D (construction and demolition).

It was observed that in present time the solid waste management system practiced in Farrukhabad (Situated in U.P., India) is inappropriate and unsustainable. There is no provision for the segregation of waste by local bodies (either private or government). The collection and transportation of waste is inadequate and inappropriate. Officially, there is no provision of collection, composting and recycling of the waste originated from various sources of the city. Majority of the waste is dumped in open low lying landfill area and if it seems to overfilled then simply burning it to reduce the size of waste make the trenches ready for filling. Local Gantry are not involved in solid waste management decision making process to make it environment friendly.

The new proposal outlines a new, simple and applicable framework of waste segregation system so that it can be processes further easily. The proposed waste collection and transportation system is an improvement on the current system. The waste is categorised into biodegradable and non-biodegradable as per proposed procedure. Use of biodegradable waste and composting of non- biodegradable waste is an important feature of the proposal.

Keywords: Waste, Solid waste, Management system, segregation, Municipal Solid waste (MSW), Construction & Demolition (C & D), Composting, landfill, biodegradable, Non-biodegradable, dumping.

I. INTRODUCTION

Waste: Waste (or wastes) are unwanted or unusable materials. Waste is any substance which is discarded after primary use, or is worthless, defective and of no use. Examples include municipal solid waste (household trash/refuse), hazardous waste, wastewater (such as sewage, which contains bodily wastes (feces and urine) and surface runoff), radioactive waste, and others.
According to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal of 1989, Art. 2(1), "Wastes' are substance or objects, which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law".

Solid Waste: Solid waste refers to the range of garbage arising from animal and human activities that are discarded as unwanted and useless. Solid waste is generated from industrial, residential and commercial activities in a given area, and may be handled in a variety of ways. As such, landfills are typically classified as sanitary, municipal, construction and demolition or industrial waste sites.

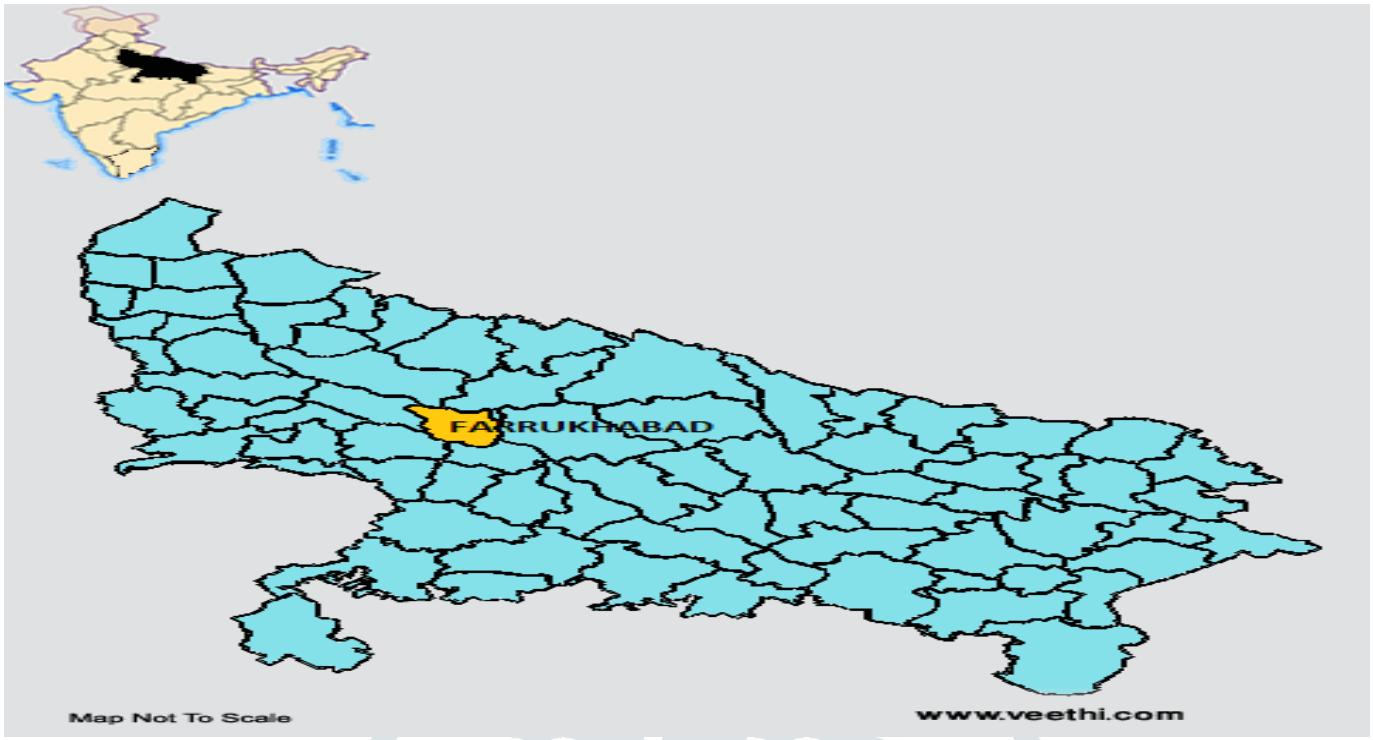
INTRODUCTION OF FARRUKHABAD DISTRICT

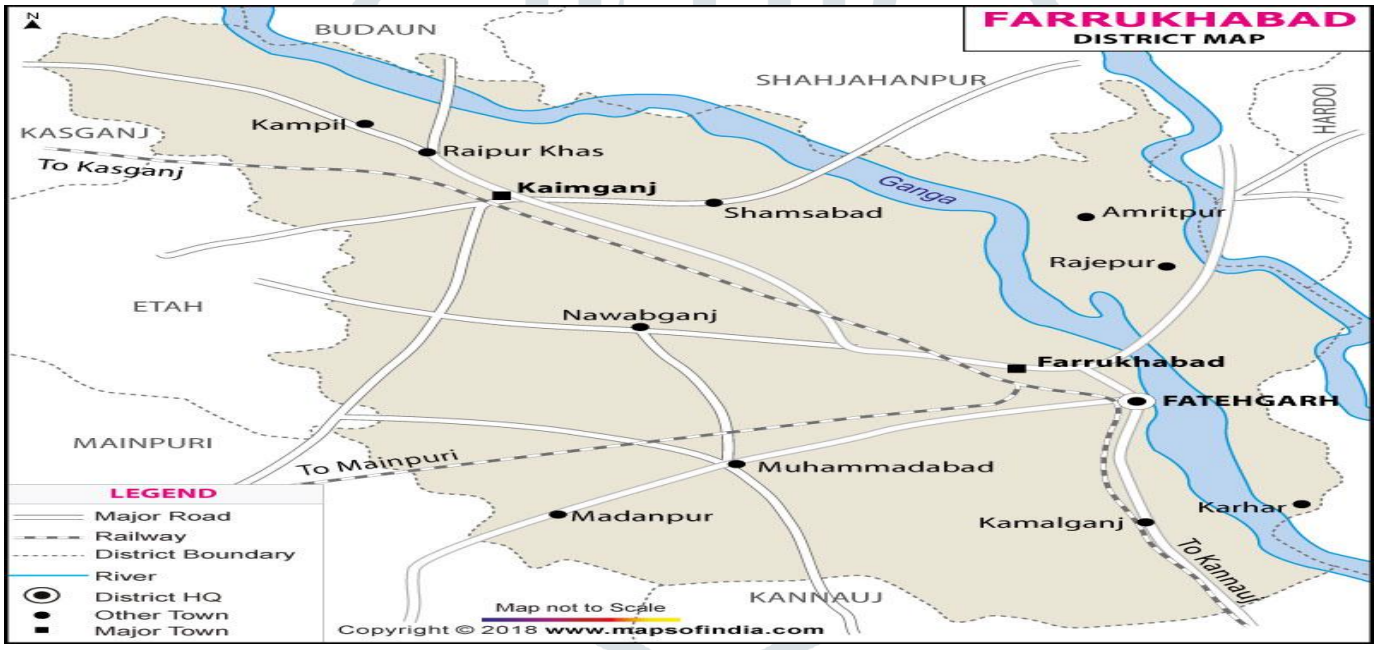
Farrukhabad district is a district of western Uttar Pradesh state in Northern India. The town named Fatehgarh is the district headquarters. The district Farrukhabad is a part of Kanpur Division.

Farrukhabad is situated between Latitude 26° 46' N & 27° 43' N and Longitude 79° 7' E & 80° 2' E. The district is bounded by Badaun and Shahjahanpur on the north, Hardoi district on the east, Kannauj district on the south, and Etah and Mainpuri districts on the west. The Ganga River and Ramganga River are located to the east and the Kali River to the south.

The district has seven blocks: Kaimganj, Nawabganj, Shamsabad, Rajepur, Barhpur, Mohamadabad and Kamalganj.

My study area is Barhpur block which covers the fatehgarh and farrukhabad cities known as twin town. During the study and review phase I inquired to Executive Officer of the Nagar Palika Parishad, Farrukhabad. As per the information provided by Mrs. Rashmi Bharti, EO, Farrukhabad, there is no existing solid waste management system while a management plan is proposed based on composting at Aamilpur, Farrukhabad (U.P.). However she provided some more information regarding the practicing procedure of NPP also to deal with solid waste.

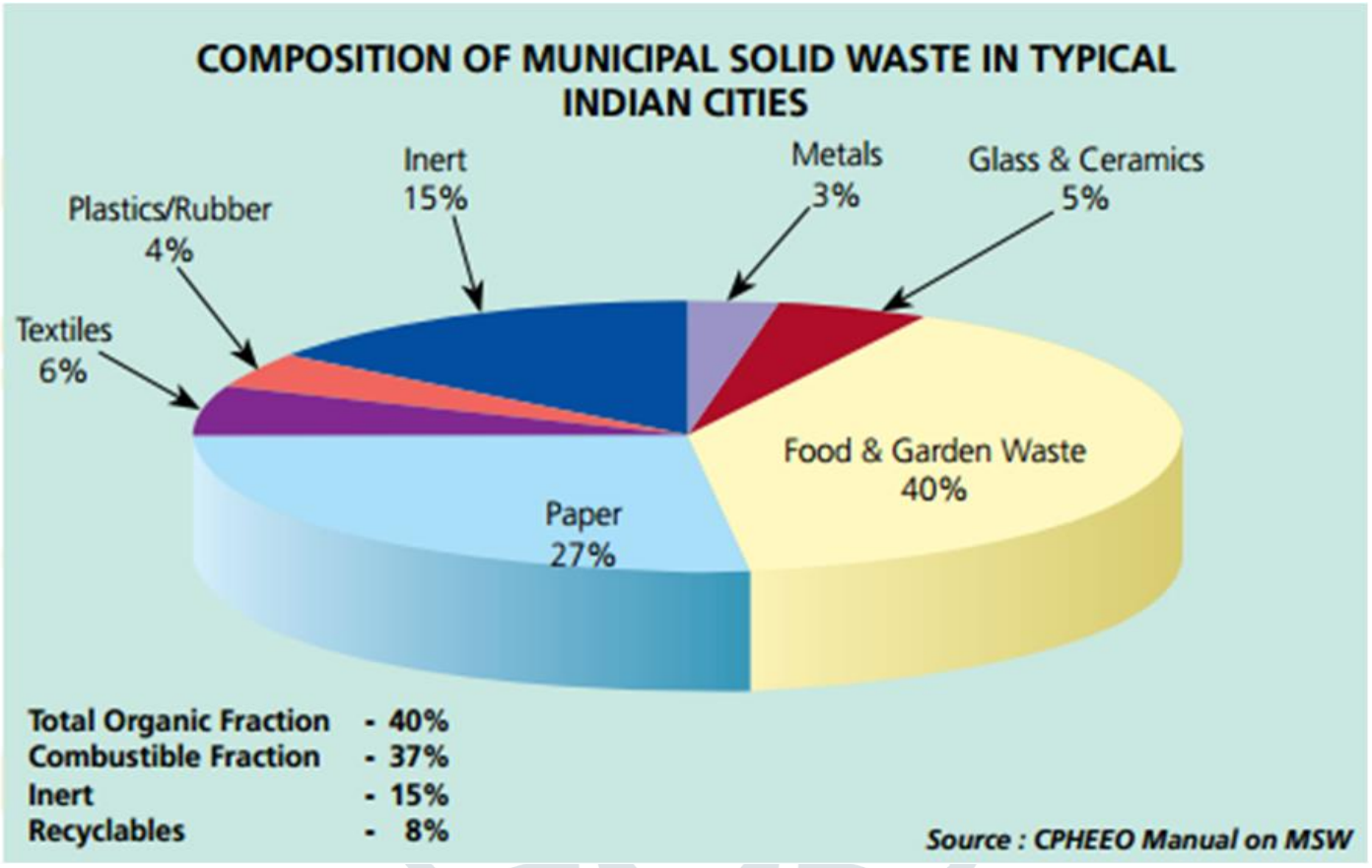




SOURCES OF SOLID WASTE: There are various sources of solid waste generation listed below.

Source	Typical waste generators	Types of solid wastes
Residential	Single and multifamily dwellings	Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g., bulky items, consumer electronics, white goods, batteries, oil, tires), and household hazardous wastes.).
Industrial	Light and heavy manufacturing, fabrication, construction sites, power and chemical plants.	Housekeeping wastes, packaging, food wastes, construction and demolition materials, hazardous wastes, ashes, special wastes.
Commercial	Stores, hotels, restaurants, markets, office buildings, etc.	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes.
Institutional	Schools, hospitals, prisons, government centers.	Same as commercial.
Construction and demolition	New construction sites, road repair, renovation sites, demolition of buildings	Wood, steel, concrete, dirt, etc.

Municipal services	Street cleaning, landscaping, parks, beaches, other recreational areas, water and wastewater treatment plants.	Street sweepings; landscape and tree trimmings; general wastes from parks, beaches, and other recreational areas; sludge.
Process (manufacturing, etc.)	Heavy and light manufacturing, refineries, chemical plants, power plants, mineral extraction and processing.	Industrial process wastes, scrap materials, off-specification products, slay, tailings.
Agriculture	Crops, orchards, vineyards, dairies, feedlots, farms.	Spoiled food wastes, agricultural wastes, hazardous wastes (e.g., pesticides).



IMPACT OF SOLID WASTE

i. Impacts of solid waste on human health, animals and aquatics life- As they feed directly or inhalation of toxic gases due to polluted air, or by drinking polluted water because of solid waste.
ii. Impacts of solid waste on environment- It degrade environment by pollution air, water, soil, aquatic life, animals and human hazard.

DISPOSAL METHODS OF SOLID WASTE

The various treatment methods practiced for MSW and other similar type of waste are:
Composting, landfills, Thermal processes (incineration, pyrolysis) etc. However, the same is not effective for hazardous industrial waste. There must be separate consideration to handle hazardous waste. Common methods which are adopted for hazardous waste are chemical fixation, volume reduction, detoxification, degradation, encapsulation etc.

II. REVIEW AND STUDIES ON SOLID WASTE MANAGEMENT

Relevant research work and studies are reviewed here:

1. **AHMED IMTIAZ et al. (1998):** They have done an evaluation based on technical, environmental, and economic factors indicated that reclaimed paving materials, coal fly ash, blast furnace slag, bottom ash, boiler slag, steel slag, and rubber tires have significant potential to replace conventional materials for various applications in highway construction and should be projected for future construction. Technical economic, and environmental problem associated with various applications of waste materials, identified under each waste material and briefly discussed must be addressed before extensive use of these waste products in highway construction.

2. **Lau H. H. et al. (2008):** Through this pilot study, a better understanding of construction waste generation in Miri City, Sarawak was achieved and the common causes and sources of construction waste generation for residential projects were determined. As a result, a database of information concerning the quantification of construction waste generated by residential housing projects was developed. An appropriate methodology for performing construction waste assessment was produced and deemed appropriate for further waste assessment studies. An investigation into case-study sites was effectively undertaken with regards to construction waste generation. The results obtained shall help improve current waste management practices in Malaysia by providing useful information concerning representative quantities and the potential for reusing and recycling local construction waste.

3. **Safiuddin Md. et al. (2010):** In the analysis during different industrial, mining, agricultural and domestic activities, huge quantity of solid wastes are being generated as by-products, which pose major environmental problems as well as occupy a large area of lands for their storage/disposal. There is a tremendous scope for setting up secondary industries for recycling and using such huge quantity of solid wastes as minerals or resources in the production of construction materials. Environment-friendly, energy-efficient, and cost-effective alternative materials produced from solid wastes will show a good market potential to fulfill people's needs in rural and urban areas.
In order to maximize the use of alternative construction materials produced from different types of solid waste and to make the lab-based production processes feasible in real world, the technology-enabling centers are needed to facilitate entrepreneurs for effective commercialization. Good mechanical and durability performance of the newer products, dissemination of technologies emphasizing cost-benefit analysis, and feasibility assessment report will significantly contribute to the successful commercialization of the innovative processes.

4. **Cole C. et al. (2011):** This paper was the part of an ongoing research project that aims to improve the efficiency and effectiveness of household waste collections. The UK has traditionally relied on disposal at landfill sites whilst the rest of Europe has used incineration. The environmental concerns regarding the use of landfill are well documented, as are concerns about the long term impact of the high temperature residues from incineration. The move towards more sustainable approaches to household waste management, with waste increasingly seen as a resource, has seen widespread changes in kerbside collection methods to encourage separation of waste for recycling, reuse and bio-treatment.
This paper examined household waste management drivers, current practices and challenges within the United Kingdom (UK) context.

5. **Christian Fischer (2012):** Included his main objectives Based on historical MSW data for Germany and EU targets linked to MSW the analysis undertaken includes:
    - The historical performance on MSW management based on a set of indicators;
    - Uncertainties that might explain differences between the countries' performance which are more linked to differences of what the reporting includes than differences in management performance;
    - Relation of the indicators to the most important initiatives taken to improve MSW management in the country; and
    - Assessment of the future possible trends and achieving of the future EU targets on MSW by 2020.

6. **Upadhyay Vipin et al. (2012):** On the basis of their study more emphasis needs to be laid on segregation and collection of waste at door step. Segregation of recyclable material from mixed waste not only is Tedious but also wasteful, therefore the residents should be sensitized towards the importance of segregation of wastes at source. Rather than considering the solid waste simply as residue to be thrown away, it should be recognized as resource materials for the production of energy, compost and fuel depending upon the techno-economic viability, local condition and sustainability of the project on long term basis.
A better management for recyclable and biodegradable waste utilization provides the facility to reduce the waste disposal up to 60-70 % of the total waste dispose at present.

7. **Kolisetty R.K. et al. (2013): A**nalysed that the problem of disposing these waste materials became a big environmental problem, the proper utilization of these materials again in construction activities will be a great relief to the society. Some of the important elements in this respect are the reduction of the consumption of energy and natural raw materials, systematic consumption and use of waste materials to a great extent. Research & Development activities have been taken up even in India for proving its feasibility, economic viability and cost effectiveness for the use of waste materials in all the construction activities.

8. **Pamnani Arti et al. (2014):** Municipal solid waste generated depends on population climate, urbanization, socioeconomic criteria etc. Overall MSWM practices adapted in India at present are inadequate. It is also noted that efforts are made to improve MSWM in major cities but due attention is not paid for MSW of medium and small-scale towns. The current regulations (MSWM rules, 2000) are very stringent.
Many deficiencies are identifying in the implementation of policy. Non compliances in MSWM are largely due to lack of training, financial constraints, lack of proper planning and leadership. For developing country like India having 71%, population residing in small-scale towns and villages proper waste management policy should implement in these areas. Optimization studies should be carried out to explore the feasibility of integrated waste management through clustering and their surrounding villages for better MSWM. of small towns.

9. **M. Nelles et al. (2015):** In this paper the new German Closed Cycle Management Act is aimed to turn the waste management into a resource management. The realisation that waste can be a useful source of raw materials and energy is not new; metals, glass, and textiles have been collected before and put to new use. The waste management policy, which has been adapted in

Germany over the past 20 years, is based on closed cycles and assigns disposal responsibilities to manufacturers and distributors of products. This has made people even more aware of the necessity to separate waste, led to the introduction of new disposal technologies, and increased recycling capacities. Today, 14 per cent of the raw materials used by the German industry are recovered waste. Modern closed cycle management contributes, with a share of approximately 20 per cent, to achieve the German Kyoto targets on the reduction of climate-relevant emissions.

10. **Sheth Jil et al. (2016):** Based on their analysis it can be deduced that a radical paradigm shift is need of the hour to boost this waste management scenario in Ahmedabad, and to position its future as a contemporary, clean, enticing and live able city. Decentralization and segregation at source can be beneficial as compared to current cost of INR1000 per ton for solid waste management, cost can reduce to Rs. 418 per ton and also can lead to better standard of living of society. Out of 4000 MT generated daily only 800 MT would be needed to dispose daily which would lead to 80% volume reduction then current scenario. As only 800MT tones would be disposed, it would further lead to reduction in GHGs emission and thus would lower carbon footprint. Henceforth, adopting segregation at source can thus lead to cleaner and better environment. Thus a sustainable, preventative and comprehensive approach towards waste is needed.

11. **Rai V. K. et al. (2017):** They concluded that solid waste management in Varanasi city is in very bad shape. The present work reveals that municipal corporation is unable to meet the requirement of increasing population due to inadequate manpower and modern equipments. Proper disposal of bio-medical wastes from hospitals, diagnostic centers and pathological labs could not be takes place in the city. Such wastes not only cause threat to environment by contaminating the land, air, and water resources but also believed to cause intestinal, parasitic and skin diseases among sanitary workers engaged in collecting refuse .In the city Due to lack of adequate capacity to transport wastes and there are no sanitary landfills to dispose of the waste. The existing landfills are neither well equipped nor well managed. Also, they are failed to protect against contamination of soil and groundwater. At present most of the Municipal solid waste in the city is disposed of unscientifically. Waste treatment and disposal sites can create health hazards for the neighborhood. Improperly operated incineration plants cause air pollution and improperly managed and designed landfills attract all types of vectors, insects and rodents that spread diseases such as dysentery, diarrhea etc. which affects the health of human beings. To minimize the solid waste generation adopt the policy of 4R's. That is Refuse, Reuse, Recycle and Reduce. The current regulations (MSWM Rules, 2000) are very stringent.

12. **Ahluwalia Isher Judge et al. (2018):** This study analyses the environmental and financial sustainability of solid waste management in Indian cities. It presents an assessment of the rapidly rising volume of municipal solid waste, its changing composition, the continuing practice of mixing biodegradable (wet) waste with dry waste at the source of generation, and the growing volume of plastic in the waste. The present system is focussed on collection and transportation of largely mixed unsegregated waste. Resource recovery from the waste and safe disposal of the residual waste in scientifically designed landfills are grossly neglected. Rules have now been put in place for sustainable solid waste management, but the capacity to plan and manage the system and ensure the enforcement of the rules is a major challenge.
This study also presents the sources of greenhouse gas emissions from the solid waste sector. Besides presenting some mitigation choices to respond to the growing challenge, it also suggests mechanisms for ensuring that the system is financially sustainable.

Ⅲ. CONCLUSIONS

This paper reviewed the solid waste management system at various places in different countries. Most of the literature cited above showed emphasis on 3Rs i.e. Reduce, Recycle and Reuse. Hence this practice may reduce the adverse effect of solid waste to the environment. A scientific approach need to be developed for the various processes in the plant so that less manpower will be required for the various operations. The non-biodegradable waste can be utilized in various other industries such as in various fields of construction industry, light weight-low strength equipment making etc. The biodegradable waste can be utilized in rural and agricultural areas, as manure by farmers in their fields. So there should be a cost effective and sustainable solid waste management model for Farrukhabad city with the consideration of Waste Management 2016 rules. And to propose various engineering applications of solid waste in construction activities for the city such as rural construction and low cost housing point of view using solid waste etc.
Hence in Farrukhabad district my study concentrate on the area of Farrukhabad & Fatehgarh (known as Twin town), the people are not so aware and literate to take care about segregation of waste at home. Hence there is a need to develop a simple segregation procedure and a sustainable, self-recovery 'Solid Waste Management Plan' for this city.

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