

# Feasibility study on Sustainable Solid Waste Management System in Developing Countries

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**ABSTRACT:** The result of gathering of wastes can be highly dangerous for many sections of people in developing countries. In India, this issue of waste gets more serious as there are no well-defined strategies for a proper management of solid wastes, which shows serious environmental risks on people of India and degrades a considerable portion of the local economy. The above study focusses on the improvement of solid waste management in India by exploring other options by which sustainable management of solid waste could be possible, and reviewing the international models of sustainable management systems. Eventually, a strategy is formed for the sustainable management of solid waste on the India's local scale. This is reflected in the limited funds provided for solid waste management by the government, and the level of offered services for the protection of public health and the environment. Improper solid waste management somehow leads to considerable amount of negative environmental impacts, including the problems of health and safety such as diseases that are associated with different forms of pollution.

## I. INTRODUCTION

Solid waste management is forming itself as a major public health and environmental concern in most of the urban areas of developing countries. In India, the public sector has been unable to provide some of the essential services properly, as the existing regulations are still very limited and the local system of taxation is insufficient, while there is still illegal disposal of domestic and industrial waste. In general, solid waste management has been a low priority task in India so far.

### 1.1. Characterization of solid waste

Solid wastes are the undesirable solid materials collected from combined residential, industrial and commercial activities within a given area. It may be

categorized according to its origin, according to its contents, or according to its extent of hazardous potential. The term municipal solid waste (MSW) is normally assumed to have all of the wastes produced in a community, with the exception of waste generated by municipal services, treatment plants, industrial and agricultural processes.

### 1.2. Principal phases of solid waste management

The activities involved in the management of solid waste from the point of generation to final disposal can be categorized into five main stages:

- 1 Identification of waste.
- 2 Collection.
- 3 Transfer or transport.
- 4 Processing and transformation.
- 5 Disposal.

However, a proper solid waste management is achieved via development and implementation of a variety of tools such as legislations, enforcement procedures and recycling, as well as the presence of configurations and the available facilities for safe handling and treatment of such waste.

## II. SUSTAINABLE PROCEDURE FOR SOLID WASTE MANAGEMENT

A sustainable procedure for solid waste management must consider an integrated waste management system which can be defined as the selection and application of suitable techniques, technologies, and programs to achieve objectives that are specific to waste management that corresponds with the local needs and conditions.

### 2.1. Elements of integrated solid waste management

There are three basic management options that can be identified for an integrated waste management system: source reduction, recovery (by reuse or recycling), waste treatment (thermally or biologically), and land-filling.

### 2.1.1. Source reduction

A strategy for waste reduction at the point of source is one of the vital most component of any effective management system. Reduction includes any action that reduces the volume or lethality of waste prior to treatment or disposal.

### 2.1.2. Recovery of waste

Reuse and recycling of materials concern the recovery of certain types of wastes to be used in new products, along with the conversion of certain types of waste into energy.

#### A) Reuse

it delays the need & necessity for producing new products and dumping the existing ones. When reuse is possible, it is sometimes a better strategy than of recycling. Recycling requires extra energy and machinery to separate, process, and manufacture existing products into new products.

#### B) Recycling

it refers to the removal of items from the wastes to be used as raw materials in the manufacture of new products. Although recycling can be profitable and beneficent in most cases.

### 2.1.3. Landfill disposal

Waste management processes cannot completely ignore the need for landfills. still, disposal of wastes in landfills remains the least desirable strategy. However, there are two main types of landfills for proper waste disposal as listed below.

#### A) secure landfills

secure landfills are usually placed in areas where features of land act as natural cushion between the landfill and the environment, while other safety measures are united into their design to prevent disposal risks (FIG-01). secure landfills are authorized to accept toxic waste because of their stricter safety precautions.

#### B) Controlled dumps

Controlled dumps are sites for disposal which obey most of sanitary requirements but they have a capacity already planned with very few control measures. However, they are enclosed, which reduces the environmental risk of contamination.

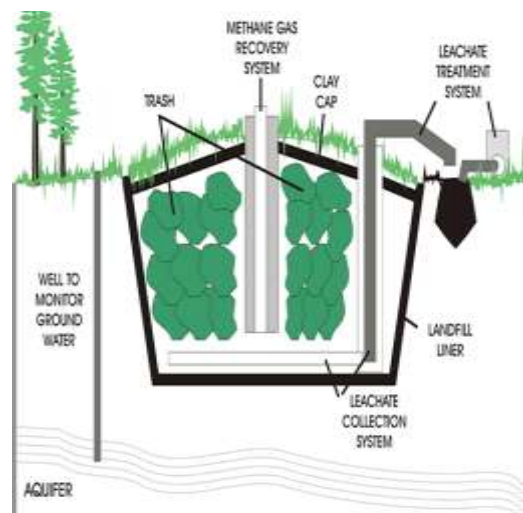


FIG-01

## III. MAJOR MODELS OF SUSTAINABLE MANAGEMENT OF SOLID WASTE

Below are the leading models from various countries that are demonstrated through the perspective of their approved strategies for management of solid wastes. The selection contains cases of developed countries like the USA, Austria, and the Greece.

### 3.1. The United States of America (USA)

In the current time, most American communities use an integrated waste management system to deal with their solid waste. The U.S. Environmental Protection Agency (EPA) has compiled and reported data on the production and disposal of waste in the U.S for more than 30 years. The data was used to measure the success of waste reduction and various recycling programs across the country. In 2011, out of 250 million tons of generated solid waste, almost 87 million tons were recycled and composted; equivalent to recycling rate of 34.7%. The strategy for solid waste management of Americans includes the following major elements

- A) Promoting awareness of source reduction
- B) Escalating recovery rates
- C) Empowering community recovery programs

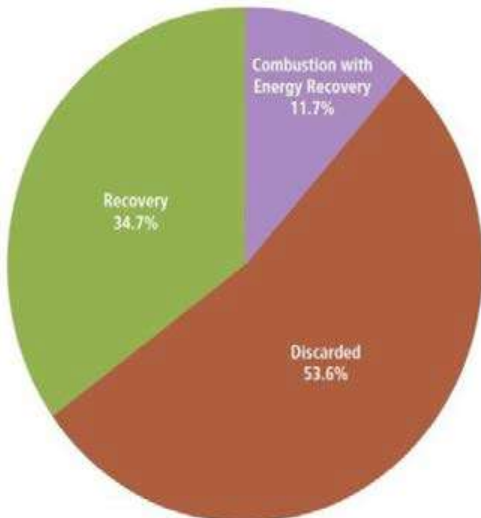
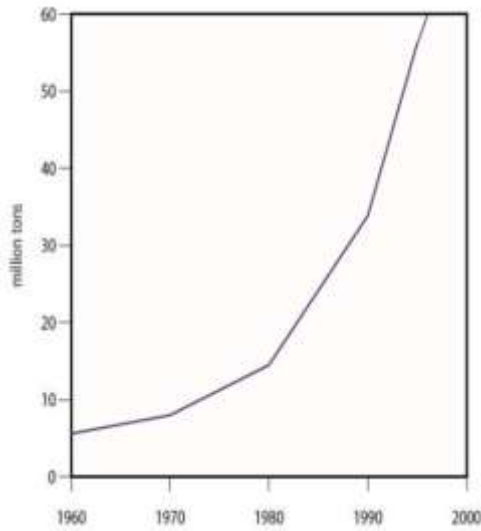


FIG-02

- D) Thinking beyond waste
- E) Federal landfill regulations

### 3.2 Austria

The solid waste management system of Austria is based on directive 2008/98/EC by the EU, which was transposed into a national law through the existing waste management law of 2002. The priority of the given system of solid waste management is the safe keeping of humans and the environment. A participative approach was adopted, where the whole population, private companies, and stakeholders were involved. Austria has recorded remarkable successes in the past twenty years in the field of integrated solid waste management, which directs them into the list of leading countries, with a recycling rate that reaches up to 69%. The strategy for solid waste

management in Austria includes the following major elements

- A) reduction of waste through waste prevention
- B) High rates of waste collection and recycling



FIG-03

- C) Comprehensive strategic planning
- D) Safe and economic disposal of non-recyclable waste

### 3.3 Greece

Greece relatively delayed the adoption of complete practices of solid waste management. However, in the last few years it was urged by international and European associations to follow a solid strategy in order to limit unfavorable waste disposal. The finance from the European union together constitutes the main resources for the current Greek national strategy for solid waste management. Generally, 85% weight of municipal solid waste is collected and transported by an organized system of collection, with an average rate of recovery that reaches up to 18% (FIG-04). The Greek strategy for solid waste management includes the following major elements

- A) National and regional planning

- B) Legislative, authoritative, and institutional roles
- C) Waste minimization
- D) Dealing with uncontrolled waste disposal

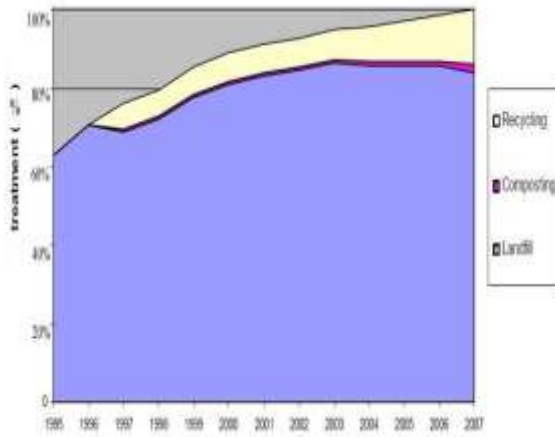
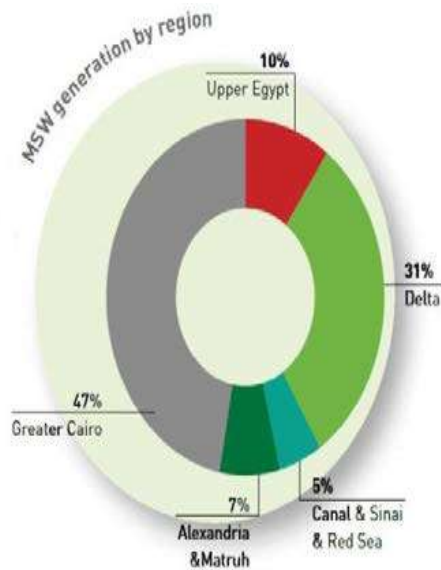
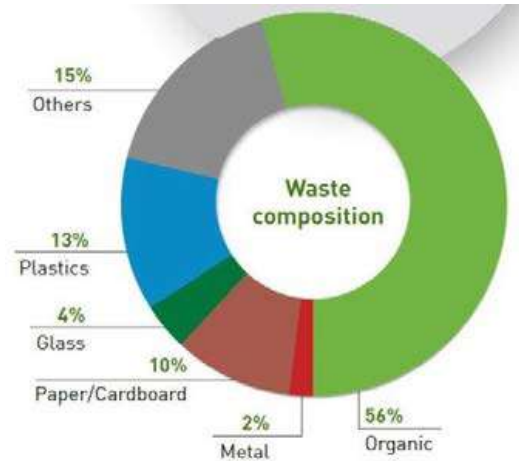


FIG-04

#### IV. MANAGEMENT OF SOLID WASTE IN INDIA

The challenges of Solid Waste Management in India have always been one of the most concerning challenges faced by the Indian authorities. In the 1990s, India followed the Structural Adjustment Program (SAP) that was introduced by the International Monetary Fund (IMF). One of the prime objectives was to slacken the economy by increasing the participation of the private sector in operating public projects. Within this context, the private sector started involving in the management of solid waste in India. After years of participation of international private sector, the situation has worsen as admitted by the Minister of State for Environmental Affairs in a report issued in 2009. The report estimated that the yearly generated solid waste in India reached nearly 75 million tons, while the municipal waste was 20 million.



#### 4.1. Indian Municipal solid waste generation and treatment

Municipal waste represents nearly 25% of the produced solid waste in India. The waste generation and disposal statistics in India can be undependable, since there are no weighing facilities at disposal sites and no tradition of analyzing and sampling of waste. moreover, the varieties and quantities of waste vary widely according to locations and urban patterns.

#### 4.2 Concerns about the situation of solid waste management

1. The entire annual municipal solid waste production in India has increased by more than 36% since 2000.
2. Less than 60% of the generated waste is utilized by public and private sectors. The rest assembles on streets and actionable dumping sites, which

indicates that the management system is mostly incompetent.

3. Most of the generated municipal solid waste in India is simply dumped, as the overall recovery rate has not outstripped 11.5%.

4. Solid waste management in India is scattered among more than one ministry that lack the vision of cooperation and planning, as each ministry approaches every management process separately.

5. Although the Indian government inaugurated several initiatives to develop the waste management quarter by the beginning of the new serenity, the actual efforts resulted in very minute improvement.

## V. SUSTAINABLE STRATEGY FOR SOLID WASTE MANAGEMENT

In context to the previously studied leading models in various countries, as well as the present situation of the case of India, a sustainable strategy for integrated solid waste management in India can be shown in the following table.

## VI. RECOMMENDATIONS

1. Minimization of solid waste at the source: in order to efficiently realize this target in Indian urban centers, an effective collection system is essential, while local authorities, private sectors, etc. must work together to improve the current practices and develop policies within this area.

2. Establishment of proper landfill sites: a safety upgrade is required for all current Indian disposal sites to apply modern land-filling features, in addition to the need for establishing new sites according to appropriate standards.

3. Waste management as part of the initial infrastructure: for any type of construction, either residential or commercial, basic requirements should be enforced for the reduction and segregation of waste at the source (municipalities could consider measures such as the inclusion of separate containers for composting and recycling before approving a construction proposal for a new building).

4. Greater participations of local communities: as previously demonstrated, public awareness is a main key to the upgrade of waste management. However, it is mostly the government responsibility to organize public participation and initiate awareness programs.

5. Monitoring while supporting private sector partnership: due to the limitations of government finances and resources, engaging waste management service providers from the private sector is a viable option. However, to avert past

deficiencies, a proper and just investment environment must be granted, and necessary policy measures must be made for the authorities to monitor and assess the performance of private sector partners.

6. Involving local recycling businesses in waste management planning: local dealers in this business have the experience that could improve the planning process and its outcomes.

7. Incentives and tax waivers for recycling activities: waste recovery could be highly encouraged by waiving government taxes for any recycling business in every Indian municipality. Moreover, competitions and valuable awards should be offered for the best practices.

8. Greater efforts for community composting: composting is the best option for treating organic waste, especially in agricultural developing countries like India, where the highest percentage of solid waste is of an organic nature.

9. Simple and dedicated programs for specific kinds of waste: for inorganic waste like plastic, glass, paper, and metal, local municipalities should provide the tools for effective separation, storage, and transportation (such as the use of coded bins and appropriate trucks, etc.).

10. Empowerment of low-income communities for recycling: low-income communities, if properly trained, could recycle their own waste themselves in their areas, thereby allowing them to make extra income, besides improving the public perception of waste management.

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