



Solid waste management: A theoretical study with reference to Bengaluru

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Abstract

The solid waste creation and management is a very challenging task ahead of the policy makers and the Government at large. The solid waste segregation and treatment is to be done scientifically and with all meticulous. The authorities encounter a lot of agitation from the public at large as far as the implication for bad disposal and public inconvenience is concerned. The present study is conceptual in nature where the solid waste management in the Bengaluru context is studied.

Keywords: solid waste, authorities, pollution

Introduction to Solid Waste Management an Urban Challenge ^[1]

Human activities create waste, and the ways that waste is handled, stored, collected, and disposed of can pose risks to the environment and to public health. Solid waste management (SWM) includes all activities that seek to minimize health, environmental, and aesthetic impacts of solid waste. In urban areas, especially in the rapidly urbanizing cities of the developing world, problems and issues of municipal solid waste management (MSWM) are of immediate importance. Most governments have acknowledged the importance of MSWM; however, rapid population growth overwhelms the capacity of most municipal authorities to provide even the most basic services.

According to a United Nations Development Programme survey of 151 mayors of cities from around the world, the second most serious problem that city dwellers face (after unemployment) is insufficient solid waste disposal (UNDP 1997). Typically one- to two-thirds of the solid waste that is generated is not collected. The uncollected waste is dumped indiscriminately in the streets and in drains, contributing to flooding, breeding of insect and rodent vectors, and spreading of diseases. Even waste that is collected is often disposed of in uncontrolled dumpsites or burned, polluting water resources and the air.

In many cities, municipal solid waste (MSW) contains human and animal excrement as well as hazardous chemical pollutants and sharps. All facilitate disease and injury, especially among children, rag pickers, and employees in the waste management sector. Studies have shown that a high percentage of workers who handle refuse and of individuals who live near or on disposal sites are infected with gastrointestinal parasites, worms, and related organisms. Contamination of this kind is likely at all points where waste is handled. Although it is certain that vector insects and rodents can transmit various pathogenic agents (amoebic and

bacillary dysenteries, typhoid fever, salmonellosis, various parasitoses, cholera, yellow fever, plague, and others), it often is difficult to trace the effects of such transmission to a specific population. The implementation of MSWM practices benefits both public health and environmental quality directly and substantially.

Overall Status of Solid Waste Sector in India ^[2]

Urban areas in India generate more than 1,00, 000 MT of waste per day (CPHEEO, 2000). A large metropolis such as Mumbai generates about 7000 MT of waste per day (MCGM, 2014). Bangalore generates about 5000 MT (BBMP, 2014) and other large cities such as Pune and Ahmedabad generate waste in the range of 1600-3500 MT per day (PMC, 2014). Collecting, processing, transporting and disposing this municipal solid waste (MSW) is the responsibility of urban local bodies (ULBs) in India. Most local bodies are struggling to provide efficient waste management services to citizens. The coverage and efficiency of waste collection is still low; waste is collected in open trucks in an unsafe and insanitary manner; there is limited waste recovery and processing; and the waste often dumped indiscriminately at open dump sited without leachate treatment (HPEC, 2011). Improper waste management has led to worsening sanitation conditions in urban areas. Recent events such as closing of landfills in Pune and Bangalore and processing plant in Thiruvanthapuram following protests by villagers highlight the severe impact of poor waste management on public health and environment.

Theoretical Background to waste Management ^[3]

Waste management is the collection, transport, processing or disposal, managing and monitoring of waste materials. The term usually relates to materials produced by human activity, and the process is generally undertaken to reduce their effect on health, the environment or aesthetics. Waste management is a distinct practice from resource recovery which focuses on

¹ Da Zhu, P. U. Asnani, Chris Zurbrugg, Sebastian Anapolsky and Shyamala Mani(2008) Improving Municipal Solid Waste Management in India A Sourcebook for Policy Makers and Practitioners; World Bank Report

² Compendium of Good Practices Urban Solid Waste Management in Indian Cities National Institute of Urban Affairs

³ Modern Technology of Waste Management: Pollution Control, Recycling, Treatment & Utilization by Asia Pacific Business Press Inc.

delaying the rate of consumption of natural resources. The management of wastes treats all materials as a single class, whether solid, liquid, gaseous or radioactive substances, and tried to reduce the harmful environmental impacts of each through different methods. Rapid industrialization last few decades have led to the depletion of pollution of precious natural resources in India depletes and pollutes resources continuously. Further the rapid industrial developments have, led to the generation of huge quantities of hazardous wastes, which have further aggravated the environmental problems in the country by depleting and polluting natural resources. In fact, man today is caught in the vicious circle of increasing wants, declining resources and increasing waste being generated by the industries and municipalities is posing a problem of enormous dimensions. The domestic and industrial effluents are contributing in enhancing this problem. It might become the biggest problem if it is not dealt with immediately. Therefore, rational and sustainable utilization of natural resources and its protection from toxic releases is vital for sustainable socioeconomic development. Hazardous waste management is a new concept for most of the Asian countries including India. The utilization of resources and generation of waste is for beyond the limit that the biosphere was made to carry.

Definition of Concepts

Zero Waste means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them.

Waste Management simply means the collection, transport, processing or disposal, managing and monitoring of waste materials to minimize its' consequences on humans and environment.

Effective Waste Disposal Methods ^[4]

Industrialized nations are grappling with the problem of expeditious and safe waste disposal. Non-biodegradable and toxic wastes like radioactive remnants can potentially cause irreparable damage to the environment and human health if not strategically disposed of.

Though waste disposal has been a matter of concern for several decades, the main problem has been taking massive proportions due to growth in population and industrialization, the two major factors that contribute to waste generation. Though some advancement is being made in waste disposal methods, they are still not adequate. The challenge is to detect newer and unhazardous methods of waste disposal and put these methods to use.



Fig 1

i) Preventing or reducing waste generation

Extensive use of new or unnecessary products is the root cause of unchecked waste formation. The rapid population growth makes it imperative to use secondhand products or judiciously use the existing ones because if not, there is a potential risk of people succumbing to the ill effects of toxic wastes. Disposing of the wastes will also assume formidable shape. A conscious decision should be made at the personal and professional level to judiciously curb the menacing growth of wastes.

ii) Recycling

Recycling serves to transform the wastes into products of their own genre through industrial processing. Paper, glass, aluminum, and plastics are commonly recycled. It is environmentally friendly to reuse the wastes instead of adding them to nature. However, processing technologies are pretty expensive.

iii) Incineration

Incineration features combustion of wastes to transform them into base components, with the generated heat being trapped for deriving energy. Assorted gases and inert ash are common by-products. Pollution is caused by varied degrees dependent on nature of waste combusted and incinerator design. Use of filters can check pollution. It is rather inexpensive to burn wastes and the waste volume is reduced by about 90%. The nutrient rich ash derived out of burning organic wastes can facilitate hydroponic solutions. Hazardous and toxic wastes can be easily be rid of by using this method. The energy extracted can be used for cooking, heating, and supplying power to turbines. However, strict vigilance and due diligence should be exercised to check the accidental leakage of micro level contaminants, such as dioxins from incinerator lines.

⁴ <http://www.norcalcompactors.net/6-waste-disposal-methods>



Fig 2

iv) Composting

It involves decomposition of organic wastes by microbes by allowing the waste to stay accumulated in a pit for a long period of time. The nutrient rich compost can be used as plant manure. However, the process is slow and consumes a significant amount of land. Biological reprocessing tremendously improves the fertility of the soil.

v) Sanitary Landfill

This involves the dumping of wastes into a landfill. The base is prepared of a protective lining, which serves as a barrier between wastes and ground water, and prevents the separation of toxic chemicals into the water zone. Waste layers are subjected to compaction and subsequently coated with an earth layer. Soil that is non-porous is preferred to mitigate the vulnerability of accidental leakage of toxic chemicals. Landfills should be created in places with low groundwater level and far from sources of flooding. However, a sufficient number of skilled manpower is required to maintain sanitary landfills.

vi) Disposal in ocean/sea

Wastes generally of radioactive nature are dumped in the oceans far from active human habitats. However, environmentalists are challenging this method, as such an action is believed to spell doom for aquatic life by depriving the ocean waters of its inherent nutrients.

Effective waste disposal calls for concerted efforts from all, no matter how anxious or worried they may be about our environment.

Types of Solid Waste Management

Some of the major types of solid waste management are as follows:

- a. Municipal Solid Waste (MSW),
- b. Hazardous Wastes,
- c. Industrial Wastes,
- d. Agricultural Wastes,
- e. Bio-medical Wastes,
- f. Waste Minimization.

The combined effects of population explosion and changing modern living standard have had a cumulative effect in the

generation of a large amount of various types of wastes. Solid waste can be classified into different types depending on their sources:

a) Municipal Solid Waste (MSW)

The term municipal solid waste (MSW) is generally used to describe most of the non-hazardous solid waste from a city, town or village that requires routine collection and transport to a processing or disposal site, Sources of MSW include private homes, commercial establishments and institutions, as well as industrial facilities.

However, MSW does not include wastes from industrial processes, construction and demolition debris, sewage sludge, mining waste or agricultural wastes. MSW is also called as trash or garbage. In general, domestic waste and MSW are used as synonyms.

Municipal solid waste contains a wide variety of materials. It can contain food waste (like vegetable and meat material, leftover food, eggshells etc., which is classified as wet garbage as well as paper, plastic, tetra-pack, plastic cans, newspaper, glass bottles, cardboard boxes, aluminium foil, meta items, wood pieces, etc., which is classified as dry garbage. The different types of domestic wastes generated and the time taken for them to degenerate is illustrated in the table given below.

Table 1: Domestic Wastes and their Degeneration Time

Common Domestic Wastes	Approximate Time Taken For Degeneration
Organic kitchen waste vegetables, fruits	1-2 weeks
Paper, cardboard paper	15 days-1 month
Cotton clothes	2-5 months
Woolen clothes	about a year
Metal cans, tin, aluminium	100-500 years
Plastics	1 million years

India's urban population slated to increase from the current 330 million to about 600 million by 2030, the challenge of managing municipal solid waste (MSW) in an environmentally and economically sustainable manner is bound to assume gigantic proportions.

The country has over 5,000 cities and towns, which generate about 40 million tonnes of MSW per year today. Going by estimates of The Energy Research Institute (TERI), this could well touch 260 million tonnes per year by 2047.

The Functional Elements of MSW Management

The municipal solid waste industry has four components: recycling composting, land-filling, and waste-to-energy via incineration. The primal) steps are generation, collection, sorting and separation, transfer and disposal/utilisation.

1. Waste generation encompasses activities in which materials are identified as no longer being of value and are either thrown out or gathered together for disposal.
2. The functional element of Collection includes not only the gathering of solid waste and recyclable materials, but also the transport of these materials, after collection, to the location where the collection vehicle is emptied. This location may be a material processing facility, a transfer station or a landfill disposal site.
3. Waste handling and separation involves activities associated with waste management until the waste is placed in storage containers for collection. Handling also encompasses the movement of loaded containers to the point of collection.

Separating different types of waste components is an important step in the handling and storage of solid waste at the source. The types of means and facilities that are now used for the recovery of waste materials that have been separated at the source include curbside collection, drop off and buy back centers.

4. Transfer and transport involves two main steps. First, the waste is transferred from a smaller collection vehicle to larger transport equipment. The waste is then transported, usually over long distances, to a processing or disposal site.
5. Today the disposal of wastes by land filling or land spreading is the ultimate fate of all solid wastes, whether they are residential wastes collected and transported directly to a landfill site, residual materials from materials recovery facilities (MRFs), residue from the combustion of solid waste, compost or other substances from various solid waste processing facilities.

A modern sanitary landfill is not a dump; it is an engineered facility used for disposing of solid wastes on land without creating nuisances or hazards to public health or safety, such as the breeding of insects and the contamination of ground water. Municipal solid waste can be used to generate energy.

Several technologies have been developed that make the processing of MSW for energy generation cleaner and more economical than ever before, including landfill gas capture, combustion, pyrolysis, gasification, and plasma arc gasification. While older waste incineration plants emitted high levels of pollutants, recent regulatory changes and new technologies have significantly reduced this concern.

In USA, EPA regulations in 1995 and 2000 under the Clean Air Act have succeeded in reducing emissions of dioxins from waste-to-energy facilities by more than 99 percent below 1990 levels, while mercury emissions have been by over 90 percent. The EPA noted these improvements in 2003, citing waste-to-

energy as a power source “with less environmental impact than almost any other source of electricity”.

Municipal solid waste management is more of an administrative and institutional mechanism failure problem rather than a technological one. Until now, MSW management has been considered to be almost the sole responsibility of urban governments, without the participation of citizens and other stakeholders.

The Centre and the Supreme Court, however, have urged that this issue be addressed with multiple stakeholder participation. Cities in India spend approximately 20% of the city budget on solid waste services.

b) Hazardous Wastes

Hazardous wastes are those that can cause harm to human and the environment.

Characteristics of Hazardous Wastes

Wastes are classified as hazardous if they exhibit any of four primary characteristics based on physical or chemical properties of toxicity, reactivity ignitability and corrosively.

i) Toxic wastes

Toxic wastes are those that are poisonous in small or trace amounts. Some may have acute or immediate effect on human or animals. Carcinogenic or mutagenic causing biological changes in the children of exposed people and animals. Examples: pesticides, heavy metals.

ii) Reactive Wastes

Reactive wastes are those that have a tendency to react vigorously with air or water are unstable to shock or heat, generate toxic gases or explode during routine management. Examples: Gun powder, nitro glycerin.

iii) Ignitable Waste

Are those that burn at relatively low temperatures (< 60 °C) and are capable of spontaneous combustion during storage transport or disposal. Examples: Gasoline, paint thinners and alcohol.

iv) Corrosive Wastes

Are those that destroy materials and living tissues by chemical reactions? Examples: acids and base.

v) Infectious Wastes

Included human tissue from surgery, used bandages and hypoderm needles hospital wastes.

Sources of Hazardous Wastes

Chemical manufacturing companies, petroleum refineries, paper mills, smelters and other industries. Plastic industries thousands of chemicals are used in industries every year. When used incorrectly or inappropriately they can become health hazards.

PCBs (Polychlorinated biphenyls) are resistant to fire and do not conduct electricity very well, which makes them excellent materials for several industrial purposes. Rainwater can wash PCBs out of disposal areas in dumps and landfills thus contaminating the water.

PCBs do not break open very rapidly in the environment and thus retain their toxic characteristics. They cause long-term exposure problems to both human and wildlife. Many household chemicals can be quite toxic to humans as well as wildlife.

Most of the dangerous substances in our homes are found in various kinds of cleaners, solvents and products used in automotive care. When these products are used incorrectly they have the potential to be harmful.

Effects of Hazardous Wastes

As most of the hazardous wastes are disposed of or in land, the most serious environmental effect is contaminated ground water. Once ground water is polluted with hazardous wastes, it is very often not possible to reverse the damage. Pesticides form residues in the soil that are washed into streams which then carry them forward.

The residues may persist in PCBs (poly chlorinated biphenyls) are concentrated in the kidneys and liver and cause damage; they cause reproductive failure in birds and mammals. The soil or in the bottom of lakes and rivers.

Exposure can occur through ingestion, inhalation and skin contact, resulting in acute or chronic poisoning. Lead, mercury and arsenic are hazardous substances which can often refer to as heavy metals. Most of the lead absorbed by people is stored in the bones.

Lead can affect red blood cells by reducing their ability to carry oxygen and shortening their life span. Lead may also damage nervous tissue, resulting in brain disease. Mercury is used in production of chlorine and as a catalyst in the production of some plastics.

Mercury build up in body over long period of time is known to cause brain damage. Minamata disease occurs due to mercury poisoning. Vinyl chloride is a chemical that is widely used in plastic manufacture. A long continuous exposure in humans it can cause deafness, vision problem circulation disorders and bone deformities.

Control of Hazardous Wastes

Common methods for disposing of hazardous wastes are land disposal and incineration Industries need to be encouraged to generate less hazardous waste in the manufacturing process. Although toxic wastes cannot be entirely eliminated, technologies are available for minimizing recycling and treating the wastes.

Integrated pest management practices (IPM) reduce the usage of pesticides. Substitute the use of PCBs and vinyl chloride with chemicals that are less toxic. Polyvinyl chloride use can be lowered by reducing the use of plastics.

c) Industrial Wastes

These contain more of toxic and require special treatment.

Source of Industrial Wastes

Food processing industries, metallurgical chemical and pharmaceutical unit's breweries, sugar mills, paper and pulp industries, fertilizer and pesticide industries are major ones which discharge toxic wastes. During processing, scrap materials, tailings, acids etc.

Effects of Industrial Wastes

Most common observation is that the health of the people living in the neighborhood of dumping sites is severely affected. The exposure may cause disorders of nervous system, genetic defects, skin diseases and even cancer.

The liquid effluents discharged by the industries contain inorganic and organic pollutants and they enter into water bodies causing destruction of fish, formation of sediments, and pollution of ground water and release of foul odours.

Control of Industrial Wastes

Waste minimization technologies have to be developed. Source reduction recycling and reuse of materials need to be practiced on a large scale. Hazardous waste should not mix up with general waste. Source reduction involves altering the design, manufacture or use of products and materials to reduce the amount and toxicity of materials that get thrown away.

Local communities and voluntary organizations should educate the industrialists as well as the public about dangers of pollution and the need to keep the environment clean. Land filling, incineration and composting technologies to be followed. Biogas is obtained from solid waste treatment of industrial and mining waste is done for the recovery of useful products.

d) Agricultural Wastes

Sources of Agricultural Wastes

The waste generated by agriculture includes waste from crops and live stock. In developing countries, this waste does not pose a serious problem as most of it is used e.g., dung is used for manure, straw is used as fodder. Some agro-based industries produce waste e.g., rice milling, production of tea, tobacco etc. Agricultural wastes are rice husk, degasses, ground nut shell, maize cobs, straw of cereals etc.

Effects of Agricultural Wastes:

If more C: N ratio wastes like paddy husk or straw may cause immobilization of nutrients if applied on the fields. It occupies to large land areas if not properly disposed.

Management of Agricultural Wastes

i) Waste to energy

a) **Gasification:** It is the process in which chemical decomposition of biomass takes place in the presence of controlled amounts of oxygen, producing a gas. This gas is cleaned and used in an internal combustion engine to produce electric power.

Without clean up also, the gas can be used in boilers to produce electric power. This technology is highly suited to generate electric power from agricultural wastes like rice husks, groundnut shells etc.

b) **Pyrolysis:** It is similar to gasification except that the chemical decomposition of biomass wastes takes place in the absence or reduced presence of O₂ at high temp. Mixtures of gases result from decomposition including H₂, NH₄ Co, CO₂ depending on the organic nature of waste matter. This gas used for power generation.

ii) Biogas Production

Animal wastes, food processing wastes and other organic matter are decomposed anaerobically to produce a gas called biogas. It contains methane and CO₂. The methane can provides gas for domestic use. The byproduct of this technology is slurry, settled out the bottom of the digester. This can be used as manure.

iii) Agricultural

waste like corn cobs, paddy husk, bagasse of sugarcane, waste of wheat, rice and other cereals, cotton stalks, coconut wastes, jute waste etc. can be used in making of paper and hard board.

e) Bio-Medical Wastes

Bio-medical waste means any waste, which is generated during the diagnosis, treatment or immunisation of human beings or animals or in research activities pertaining thereto or in the production or testing of biological.

Segregation, Packaging, Transportation and Storage

1. Bio-medical waste shall not be mixed with other wastes.
2. Bio-medical waste shall be segregated into containers/bags at the point of generation prior to its storage, transportation, treatment and disposal. The containers shall be properly labelled.
3. Notwithstanding anything contained in the Motor Vehicles Act, 1988, or rules there under, untreated biomedical waste shall be transported only in such vehicle as may be authorised for the purpose by the competent authority as specified by the government.
4. No untreated bio-medical waste shall be kept stored beyond a period of 48 hours. Provided that if for any reason it becomes necessary to store the waste beyond such period, the authorised person must take permission of the prescribed authority and take measures to ensure that the waste does not adversely affect human health and the environment.

Categories of Bio-medical Wastes

Table 2: Categories of Bio-medical Wastes

Option	Treatment and Disposal	Waste Category
Cat. No. 1	Incineration/deep burial	Human Anatomical Waste (human tissues, organs, body parts)
Cat. No. 2	Incineration/deep burial	Animal Waste Animal tissues, organs. Body parts carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals/ colleges, discharge from hospitals, animal houses)
Cat. No. 3	Local autoclaving/micro waving/ incineration	Microbiology and Biotechnology waste (wastes from laboratory cultures, stocks or specimens of micro-organisms live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of biological, toxins, dishes and devices used for transfer of cultures)
Cat. No. 4	Disinfections (chemical treatment /autoclaving/ micro waving and mutilation shredding	Waste Sharps (needles, syringes, scalpels blades, glass etc. that may cause puncture and cuts. This includes both used and unused sharps)
Cat. No. 5	Incineration / destruction and drugs disposal in secured landfills	Discarded Medicines and Cytotoxic drugs (wastes comprising of outdated, contaminated and discarded medicines)
Cat. No. 6	Incineration, autoclaving/micro waving	Solid Waste (Items contaminated with blood and body fluids including cotton, dressings, soiled plaster casts, line beddings, other material contaminated with blood)
Cat. No. 7	Disinfections by chemical treatment autoclaving/ micro waving and mutilation shredding	Solid Waste (waste generated from disposable items other than the waste sharps such as tubing, catheters, intravenous sets etc.)
Cat. No. 8	Disinfections by chemical treatment and discharge into drain	Liquid Waste (waste generated from laboratory and washing, cleaning, housekeeping and disinfecting activities)
Cat. No. 9	Disposal in municipal landfill	Incineration Ash (ash from incineration of any bio-medical waste)
Cat. No. 10	Chemical treatment and discharge into drain for liquid and secured landfill for solids	Chemical Waste (chemicals used in production of biological, chemicals, used in disinfection, as insecticides, etc.)

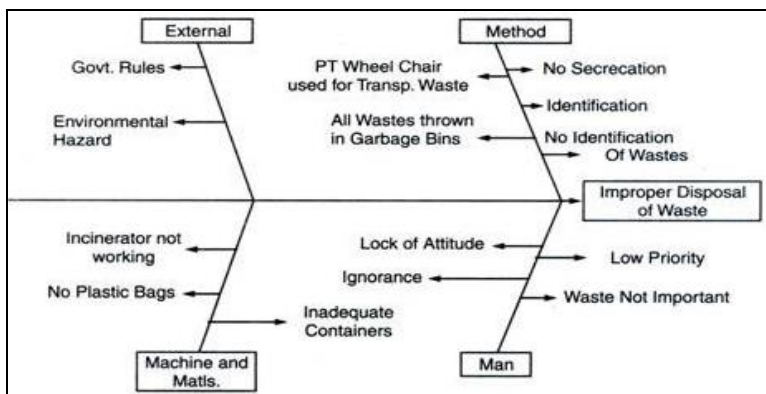


Fig 3: Waste Management Flowchar

f) Waste Minimization

Waste production can be minimized by adopting the 3 R's principle: Reduce, Reuse, and Recycle.

- a. Reduce the amount and toxicity of garbage and trash that you discard.
- b. Reuse containers and try to repair things that are broken.
- c. Recycle products wherever possible, which includes buying recycled products i.e., recycled paper books, paper bags etc.

These are processes that involve integrated waste management practices (IWM). They can reduce the wastes generated by approximately 50%.

Reduce (Waste Prevention)

Waste prevention, or "source reduction," means consuming and discarding less, is a successful method of reducing waste generation. Backyard composting, double sided copying of papers, purchasing durable, long-lasting environmentally friendly goods; products and packaging that are free of toxics, redesigning products to use less raw material production and transport packaging reduction by industries are the normal practices used and have yielded substantial environmental benefits.

Source reduction prevents emissions of many greenhouse gases, reduces pollutants the need saves energy, conserves resources, and reduces wastes for new landfills and combustors. It reduces the generation of waste and is generally preferred method of waste management that goes a long way toward saving the environment.

Reuse

Reuse is the process, which involves reusing items by repairing them, donating them to charity and community groups, or selling them. Reusing products is an alternative to recycling because the item does not need to be reprocessed for its use again. Using durable glassware, steel using cloth napkins or towels, reusing bottles, reusing boxes, purchasing refillable pens and pencils are suggested.

Recycling

The process of recycling, including composting, has diverted several million tons of material away from disposal. Recycled materials include batteries, recycled at a rate of 93%, paper and paperboard at 48%, and yard trimmings at 56%. These materials and others may be recycled through drop off centers, buy-back programs, and deposit systems.

Recycling prevents the emission of many greenhouse gases that affect global climate, water pollutants, saves energy, supplies valuable raw materials to industry, creates jobs, stimulates the development of greener technologies, conserves resources for our children's future, and reduces the need for new landfills and combustors. For example, by recycling of solid waste in 1996, the United States prevented, the release of 33 million tons, of carbon into the air roughly the amount emitted annually by 25 million cars.

Recycling can create valuable resources and it generates a host of environmental, financial, and social benefits. Materials like glass, metal, plastics, and paper are collected, separated and sent to processing centers where they are processed into new products.

The advantages of recycling are it conserves resources for future generation, prevents emissions of greenhouse gases and pollutants, saves energy, supplies valuable raw, materials to industries, stimulates the development of greener technologies, reduces the need for new landfills and incinerators.

Conclusion

The organic, biodegradable component of municipal solid waste is important, not only because it constitutes a sizable fraction of the solid waste stream in a developing country but also because of its potentially adverse impact on public health and environmental quality. One major adverse impact is its attraction of rodents and vector insects, for which it provides food and shelter. Impact on environmental quality takes the form of foul odors and unsightliness. These impacts are not confined merely to the disposal site; they pervade the surrounding area and anywhere that wastes are generated, spread, or accumulated. Unless organic waste is managed appropriately, its adverse impact continues until it has fully decomposed or otherwise stabilized.

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