

Introduction

CHAPTER – I

INTRODUCTION

Waste is the most visible environmental problem in many areas. Increasing population, changing income and consumption patterns, economic development, urbanization and industrialization result in increased generation of solid waste and also a diversification of the types of the solid waste generated. (Banu,2011) Solid Waste is the term used to describe non liquid materials arising from domestic, trade, commercial, agricultural and industrial activities and from public services.

The modern world has changed to a throwaway society. With population explosion, increasing urbanization coupled with changing life styles, more and more waste of diverse nature are being generated in many cities and townships. This has resulted in the increased amount and complexity of solid waste, which results in degradation of urban environment and undermines sustainable development.

In the early days, the wastes did not create any problem to the community as quantity of waste generated was within the assimilative capacity of nature. Today, the scenario is quite different and the urban environment all over the world poses serious threat from excessive generation of solid waste. According to World Health Organization (WHO) the term “solid waste is applied to unwanted and discarded materials from houses, street sweepings, commercial and agricultural operations arising out of mass activities”.

Cities in the world are facing high level of pollution while the situation in developing countries is still more acute. Municipal corporations of the developing countries are not able to handle the increasing quantity of waste, which leads to uncollected waste on roads and other public places. (Begum 2001)

In developed countries, per capita waste generation increased nearly three-fold over the last two decades, reaching a level five to six times higher than that in developing countries. With increase in population and living standards, waste generation in developing countries is also increasing rapidly, and may double in volume in the current decade. If current trends continue, the world may see a five-fold increase in waste generation by the year 2025 (Palczynski et.al 2002).

The impact of disposed waste results in (i) the contamination of surface and groundwater through leachate; (ii) soil contamination through direct waste contact or leachate; (iii) air pollution through burning of wastes; (iv) spreading of diseases by different vectors like birds, insects, and rodents; (v) odor in landfills, and (vi) uncontrolled release of methane by anaerobic decomposition of waste.

The group at risk from the unscientific disposal of solid waste include – the population in areas where there is no proper waste disposal method, especially the pre-school children; rag pickers; and workers who produce toxic and infectious material. Other high-risk group include population living close to a waste dump and those, whose water supply has become contaminated either due to waste dumping or leakage from landfill sites. Exposure to hazardous waste can affect human health, children being more vulnerable to these pollutants. Studies have detected excess of cancer in residents exposed to hazardous waste.

In solid waste, organic domestic waste poses a serious threat, since they ferment, creating conditions favourable to the survival and growth of microbial pathogens. The direct exposure to wastes can lead to diseases through chemical exposure as the release of chemical waste into the environment leads to chemical poisoning. Uncollected solid waste can also obstruct storm water runoff, resulting in the formation of stagnant water bodies that become the breeding ground of disease. Waste dumped near a water source also causes contamination of the water body or the ground water source. Direct dumping of untreated waste in rivers, seas, and lakes results in the accumulation of toxic substances in the food chain through the plants and animals that feed on it.

In recent years, the notion of integrated waste management is applied to reduce waste at its source before it even enters the waste stream. It means that waste materials generated must be recovered for reuse and recycling, and the rest should be disposed at landfill sites.

Unfortunately, disposal is not a sustainable solid waste management solution. In the late 1990's zero emissions concept has attained its importance. The concept is reflected by the phrase 'no time for waste' because the concept envisages all industrial outputs from processing being used as input process materials or converted into value

added inputs for other processes, maximizing resource consumption and increasing eco-efficiency. This way, the production process is reorganized into a closed loop system which emulates as an industrial metabolism of the sustainable cycles found in nature ‘grown–use–waste–reuse’. Also, waste can be fully matched with the input requirements of any other processes. A perfectly integrated process management produces ‘no waste’ and it can be an innovative system of sustainable industry development, where reduction, minimization, and utilization of waste are simultaneously realized (Banu, 2011).

Solid Waste Management

Solid Waste Management (SWM) is a science associated with the management of generation, storage, collection, transportation, segregation, processing and disposal of solid waste using the best principle and practices of public health, economics, engineering, conservation, aesthetics and other environmental conditions.

Solid waste has become one of the major problems in India in recent years. As there is continuous increase in industrial growth, waste has been increasing in variety and volume. Indian cities are invariably filled with huge amounts of garbage and solid waste in open places and corners. The stray dogs, rats and cats meddle with this open disposal of garbage, which spreads diseases. Garbage disposal is severe in slum areas where people live in acute poverty, poor housing and unhygienic conditions without basic facilities. In our society very few people have the civic sense of using dustbins to throw garbage.

SWM involves activities associated with generation, storage and collection, transfer and transport, treatment and disposal of solid wastes. But, in most Indian cities, the Municipal Solid Waste Management (MSWM) system comprises only four activities, i.e., waste generation, collection, transportation, segregation and disposal.

Solid Waste Generation

The quantity of MSW generated depends on a number of factors such as food habits, standard of living, degree of commercial activities and seasons. The change in lifestyles has caused considerable alterations in the composition of MSW generated in India too. The percentage of plastics, paper and metal discarded into the waste stream

increased significantly and the amount of inerts in the collected waste stream decreased likewise due to changes in collection systems.

Since economic reforms in 1991, India has undergone rapid urbanization, which changed material consumption patterns, and increased the per capita waste generation rate. Waste generation increased from 440 grams/day to 500 grams/day depicting a growth rate of 13.6 percent. Generation of MSW has an obvious relation to the population of the area or city. Bigger cities with more population generate huge quantity of waste. In 2011 the metropolitan area of Kolkata generated the largest amount of MSW (11,520 tonne per day(TPD) or 4.2 million tonne per year (TPY)). Among the four geographical regions in India, Northern India generated the highest amount of MSW (40,500 TPD or 14.8 million TPY and 30 percent of all MSW generated in India) and Eastern India generated the least (23,500 TPD or 8.6 million TPY and 17 percent). Among the states, it was the order of Maharashtra (22,200 TPD or 8.1 million TPY), West Bengal (15,500 TPD or 5.7 million TPY), Uttar Pradesh (13,000 TPD or 4.75 million TPY), Tamil Nadu (12,000 TPD or 4.3 million TPY) and Andhra Pradesh (11,500 TPD or 4.15 million TPY) which generated waste. Among Union Territories, Delhi (11,500 TPD or 4.2 million TPY) generated the highest and Chandigarh (486 TPD or 177,400 TPY) generated the second highest amount of waste (Annepu 2012).

The principal sources of solid waste are household waste, commercial waste, institutional waste, hospital waste, non biodegradable waste, bio- degradable waste, hazardous waste, compostable waste, combustible waste, inert waste. Urban solid waste is normally a mixture of household, commercial and construction. The municipal solid waste refers to all waste generated by domestic, institutional, commercial, industrial, construction and street source and collected by local authority.(Anand 2010) Solid waste management represents a heavy financial burden for local governments in developing countries. Many of environmental goods and services are provided freely. Therefore, they have zero prices because no market place exists in which their true values can be revealed through acts of buying and selling. Projects and programmes appraisal cannot be sufficient or adequate without valuation. (Pearce, 1993). The amount of fees charged depends on the assessment of management or service provided. Assessment analysis is based on the individual preferences of the

products or services. The value of a product or service for a person is depending on the extent to which he was able to afford to pay to obtain a product or service. Basic idea in this assessment is the community people's willingness to pay (WTP) for better waste management services. The amount of willingness to pay or sacrifice to get the products or services usually depend on wealth of a person, or in other words the wealthier he is, the greater his willingness to pay for the improved services (Field and Field, 2006). Economic valuation of environmental goods has found vast application in determining compensatory payments for environmental damage (Willis and Corkindale, 1995). Valuation techniques are also applied to the solid waste management to meet the cost in the management process.

Municipal solid waste management varies widely among different countries and regions. Most of the management services can be done through the application of waste hierarchy which refers to the "3 Rs" reduce, reuse and recycle. This hierarchy classifies waste management strategies according to their desirability in terms of waste minimization aimed at extracting the maximum practical benefits from products and to generate the minimum amount of waste. (Arivukkarasu and Lakshmi; 2014)

Collection and Transportation

Waste collection is a part of the process of waste management. It is the transfer of solid waste from the point of use and disposal to the point of treatment. The efficiency in collecting solid waste and segregating it decides how well solid waste is managed. Collection includes not only the gathering of solid waste, 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.

The first stage of collection includes door-to-door collection of waste. Most collection is done by garbage collectors who are employees or firms under contract to the government. Garbage collectors employed by local governing bodies manually collect the waste generated at the household level and dump it in the community bins at specified street corners. People are required to deposit their wastes in communal containers or community bins (stationary or haul types), from which it is collected by

municipal crews. The vehicle used in this stage for collection, is small and simple and varies from place to place.

The second stage of collection process includes waste collected from non point source deposited to definite point sources namely communal bins. Placing communal bins at appropriate locations for deposit and storage of waste is important to manage waste properly. Communal bins are placed near markets, in apartment complexes, shopping complex, hotels, public places like gardens, religious places and other definite locations. For better MSW management garbage should be lifted frequently from these point sources. Frequency in lifting garbage from these points really matters otherwise garbage pile up and create other problems. Manually or mechanically loaded compactors are often used in this stage.

The third and final stage of collection process is the movement of waste or materials from collection points to disposal sites. Transportation of waste from collection point to disposal sites is carried out by using different types of vehicles depending on the distances to be covered by them. Larger vehicles carry the waste from the collection points to the disposal sites. Comparatively small vehicles discharge waste at transfer stations where the wastes are loaded into larger vehicles for transportation to the disposal sites.

In India, the community bin collection system is the main practice used for waste collection. In this system, residents deposit their waste into the nearest community bins located at street corners at specific intervals (NEERI Report, 2005). Waste segregation at the source is minimal. Segregation of MSW into dry and wet waste is carried out only in limited areas of few cities, and in these areas, separate containers are used for collection of dry and wet wastes. Waste generated in households are generally accumulated in small containers (often plastic buckets) and then disposed off into community bins. Containers for household storage of solid waste are of many shapes and sizes, and are fabricated from a variety of materials. Residents usually store waste in plastic buckets. The type of container generally reflects the economic status of the waste generator. The containers generally are made of metal, concrete, or a combination of the two. Various types of community bins, such as RCC bins, masonry bins, metallic containers, and plastic containers, are used in India, although RCC and

masonry bins are being gradually phased out. Metallic containers of 4.5–6 m³ capacity are now being promoted in various cities.

These containers are carried to the disposal site by dumper placers, and after discharging the material at the disposal site, the containers are placed back in their original positions. This system avoids double handling of waste. Commercial sector like shops, offices, hotels etc all use the community waste bins and their wastes are also collected along with the household wastes except in a rare number of commercial complexes where they pay a negotiated fee to the Municipal authorities for collecting waste from their premises. Most of the shops do not open before 9 am and so do not put out their waste out, until that time, which will be left mostly on the street until the next day's collection. In short, even if there is regular collection services wastes are always seen on the streets.

Community storage may reduce the cost of waste collection and can minimize problems associated with lack of on-site storage space. However, unless these community storage arrangements are conveniently located, householders tend to throw their waste into the roadside gutters for clearance by street sweeping crews. Even where storage arrangements are conveniently located, waste tends to be strewn around the storage area, partly due to lack of discipline and partly as a result of scavenging by rag pickers and stray animals.

In India collection and transportation may either be done by municipal staff or outsourced to Self-Help Groups or other similar agencies or a mix of these two ensuring that collection is done on daily basis. The local bodies concerned may finalize the strategy in terms of method to be used. Different types of vehicles, varying from bullock carts to compactors, are used for waste transportation. However, the general-purpose open body trucks of 5 to 9 tones capacity are in common use. In smaller towns, tractortrailers are used despite being noisy and inefficient. In a few cities, compactor vehicles are also being used. The waste is transported mostly by municipal vehicles; though, in some large towns, private vehicles are also hired to augment the fleet size. (Shekdar,1999).

Many of the workers engaged in waste collection and transportation were unaware about the dangers in their work. They are all illiterate and desperate for

employment, their choice is clear either die of hunger or engage in any kind of activity. They collect waste plastic, iron scrap and glass bottles, shifting the mountains of litter dumped. These wastes were responsible for occupational health risks to workers and health risks to residents and workers. In developing countries, a significant portion of the waste pickers found at open dumps are children and pregnant women. Confounding this image is the reality that residents around solid waste disposal sites include infants, young children, women, child - bearing age and seniors. Children are particularly vulnerable to toxins because they ingest more water, food and air per unit of body weight; their metabolic path ways are less developed to detoxify and excrete toxins; and any disruption during their growth years can easily disrupt development of their organ, nervous, immune, endocrine and reproductive systems. Waste collection includes high occupational health risks mainly risk from contact with human fecal matter, paper that may have become saturated with toxic materials, bottles with chemical residues, metal containers with residue pesticide and solvents, needles and bandages from hospitals etc. The most commonly experienced diseases among waste pickers are Tuberculosis, Bronchitis, Asthma, Pneumonia, Dysentery, Parasites and Malnutrition. They were also exposed to fumes of highly concentrated acid. Safety gear such as gloves, face masks and ventilation fans are virtually unheard of, and waste collectors often have little idea of what they are handling. (Devi, 2014)

Waste Segregation

Waste segregation is the first step towards waste diversion and reduction. In order that the MSW management systems and waste treatment facilities work efficiently and for extending the life of the waste disposal facilities, it is imperative that waste is properly segregated early in the systems management. To encourage citizens, municipal authorities shall organize awareness programmes for segregation of wastes and shall promote recycling or reuse of segregated materials. Segregation mainly at collection point, separation at site by rag pickers for recycling and incentives for segregation need to be organized.

Municipal authorities shall undertake phased programme to ensure community participation in waste segregation. For this, regular meetings at quarterly intervals may

be arranged by the municipal authorities with representatives of local resident's welfare association (RWAs), NGOs and representatives of other informal sector (such as rag pickers). In the MSW management, the informal sector plays a very important role and it should be recognized and efforts to improve their work environment could go a long way in establishing sustainable MSW management systems.(MoEF, 2010)

Disposal

The two leading innovative mechanisms of waste disposal being adopted in India include composting (aerobic composting and vermi-composting) and waste-to-energy (WTE) (incineration, pelletisation, bio methanation). WTE projects for disposal of MSW are a relatively new concept in India. Although these have been tried and tested in developed countries with positive results, these are yet to get off the ground in India largely because of the fact that financial viability and sustainability is still being tested [Khan(1994) ; Lal (1996)].

Different methods for the disposal and treatment of MSW have been discussed in the subsequent sections.

Land filling

In many metropolitan cities, open, uncontrolled and poorly managed dumping is commonly practiced, giving rise to serious environmental degradation. More than 90 percent of MSW in cities and towns are directly disposed of on land in an unsatisfactory manner. Such dumping activity in many coastal towns has led to heavy metals rapidly leaching into the coastal waters. In majority of urban centers, MSW is disposed of by depositing it in low-lying areas outside the city without following the principles of sanitary land filling. Compaction and leveling of waste and final covering by earth are rarely observed practices at most disposal sites, and these low-lying disposal sites are devoid of a leachate collection system or landfill gas monitoring and collection equipment [Bhide and Shekdar (1998), Gupta et al., (1998)]. As no segregation of MSW at the source takes place, all the wastes including infectious waste from hospitals generally find its way to the disposal site. Quite often, industrial waste is also deposited at the landfill sites meant for domestic waste (Datta, 1997). Sanitary land filling is an acceptable and recommended method for ultimate disposal of MSW. It is a necessary

component of MSWM, since all other options produce some residue that must be disposed off through landfilling. However, it appears that landfilling would continue to be the most widely adopted practice in India in the coming few years, during which certain improvements will have to be made to ensure the sanitary landfilling [Dayal, (1994), Das et al. (1998), Kansal, (2002)].

Recycling of Organic Waste

If the organic waste is left unattended, it will tend to decompose by natural process giving rise to odors, hosting and feeding a variety of insects and pests, which in turn, form the carriers of disease creating severe health problems. The segregation, decomposition and stabilization of the organic waste by biological action forms the basis of recycling through different natural cycles.

The bacterial conversion of the organics present in MSW in the presence of air under hot and moist conditions are called composting, and the final product obtained after bacterial activity is called compost (humus), which has very high agricultural value. It is used as fertilizer, and it is non-odorous and free of pathogens (Khan, 1994; Ahsan, 1999). As a result of the composting process, the waste volume can be reduced to 50 to 85 per cent.[Chakrabarty et al. (1995) ,Bhide and Shekdar, (1998)].

Vermi composting involves stabilization of organic waste through the joint action of earthworms and aerobic micro-organisms. Initially, microbial decomposition of biodegradable organic matter occurs through extra cellular enzymatic activity (primary decomposition). Earthworms feed on partially decomposed matter, consuming five times their body weight of organic matter per day. The ingested food is further decomposed in the gut of the worms, resulting in particle size reduction. The worm cast is a fine, odor-less and granular product. This product can serve as a bio-fertilizer in agriculture. [Khan, (1994), Gupta et.al.(1998),Sannigrahi and Chakraborty (2002), Bezboruah and Bhargava (2003), Jha et al. (2003), Ghosh, (2004)]

If the organic waste is buried in pits under partially anaerobic conditions, it will be acted upon by anaerobic microorganisms with the release of methane and carbon dioxide; the organic residue left is good manure. This process is slower than aerobic composting and occurs in fact naturally in landfills. However, thermophilic digestion for biomethanation is much faster and has been commercialized. Anaerobic digestion leads

to energy recovery through biogas generation. The biogas, which has 55 to 60 percent methane, can be used directly as fuel or for power generation. It is estimated that by controlled anaerobic digestion, one tone of MSW produces two to four times as much methane in three weeks in comparison to what one tone of waste in landfill will produce in six to seven years [Khan, (1994), Ahsan, (1999)].

The larger proportion of organic matter in MSW (Municipal Solid Waste) indicates the desirability of biological processing of waste. Though composting was a prevalent biological processing practiced in India, in the past due to non-availability of adequate space in the urban centers and poor segregation of wastes, composting has been discontinued as a practice. Recently efforts are being taken to popularize waste segregation and composting. Characteristics of the Indian MSW bring out the fact that a self-sustaining combustion reaction cannot be obtained in a majority of Indian MSW and auxiliary fuel will be required to aid waste combustion. (Ready Rocker Report, 2008)

Thermal Treatment Techniques of MSW

The destruction of MSW using heat energy is called thermal treatment. Although there are many thermal processes, incineration is the most widely used at present. Incineration is the process of control and complete combustion, for burning solid wastes. It leads to energy recovery and destruction of toxic wastes, for example, waste from hospitals. The temperature in the incinerators varies between 980 and 2000 °C. One of the most attractive features of the incineration process is that it can be used to reduce the original volume of combustible solid waste by 80 to 90 percent. (Peavey et al., 1985; Ahsan, 1999; Jha et al., 2003) Unfortunately, in Indian cities, incineration is not very much practiced. This may be due to the high organic material (40 to 60 percent), high moisture content (40 to 60 percent), high inert content (30 to 50 percent) and low calorific value content (800 to 1100 kcal/kg) in MSW [Chakrabarty et al.(1995) Jalan and Srivastava (1995), Sudhire et al.(1996), Bhide and Shekdar (1998), Joardar (2000), Kansal,(2002)]

Incineration of solid waste under oxygen deficient conditions is called gasification. The objective of gasification has generally been to produce fuel gas, which would be stored and used when required. In India, there are few gasifiers in operation,

but they are mostly for burning of biomass such as agro residues, sawmill dust, and forest wastes. Gasification can also be used for MSW treatment after drying, removing the inerts and shredding for size reduction.

The main purpose of the refuse derived fuel (RDF) method is to produce an improved solid fuel or pellets from MSW. Gasification–combustion seems to be promising as it can reduce pollution and increase heat recovery. RDF is another promising technology, which is used for producing power. In addition, the RDF plant reduces the pressure on landfills. Combustion of the RDF from MSW is technically sound and is capable of generating power. RDF may be fired along with the conventional fuels like coal without any ill effects for generating heat. Operation of the thermal treatment systems involves not only higher cost, but also a relatively higher degree of expertise.

Recovery of Recyclable Materials

A number of recyclable materials, for example paper, glass, plastic, rubber, ferrous and non-ferrous metals present in the MSW are suitable for recovery and reuse. It has been estimated that the recyclable content varies from 13 percent to 20 percent (for example, in Mumbai 17 percent and in Delhi 15 percent of MSW is recyclables). The role of the informal sector in MSWM is very important because it provides livelihood to many immigrants and marginalized people. The informal collection avoids environmental costs and reduces capacity problems at dump-sites. [Khan, (1994), Kansal, (2002), CPCB, (2004), Srivastava et.al (2005) Agarwal et.al. (2005), Joseph, (2006), Rathi,(2006), Sharholly et.al.,(2005, 2006, 2007)]

MSW management encompasses planning, engineering, organization, administration, financial and legal aspects of activities associated with generation, storage, collection, transport, processing and disposal in an environmentally compatible manner adopting principles of economy, aesthetics, energy-conservation and opportunities. The management of MSW requires proper infrastructure, maintenance and up gradation for all activities. This becomes increasingly expensive and complex due to the continuous and unplanned growth of urban centres. The difficulties in providing the desired level of public service in the urban centres are often attributed to

the poor financial status of managing municipal corporation. It is one of the important obligatory functions of urban local bodies and municipal authorities.

According to the Indian Constitution, SWM falls within the purview of the State list. Since this activity is non-exclusive, non-rival and essential, the responsibility for providing the service lies within the public domain. The Urban Local Body undertakes the task of solid waste service delivery, with its own staff, equipment and funds. In few cases, part of the said work is contracted out to private enterprises.

Theoretical Background

The Economic Input-Output Life Cycle Assessment (EIO-LCA) method estimates the materials and energy resources required for, and the environmental emissions resulting from, activities in our economy. The EIO-LCA method was theorized and developed by economist Wassily Leontief in the 1970s based on his earlier input-output work from the 1930s for which he received the Nobel Prize in Economics. The Leontief input-output model has been applied for macro environmental analysis since 1970, and life cycle analysis has been used in industrial design over the last decade.

LCA assesses the use of resources and the release of emissions to air, water, land and the generation of useful products. All these inputs (material and energy resources) and outputs (emissions and products) have to be identified and quantified during the life cycle inventory (LCI) phase of the LCA (ISO 14040, 2006).

In every solid management stage, products are presented in green boxes while residues from each management stage end up in the landfill. The end of the life cycle of MSW is when it ceases to be waste by becoming a useful product, residual landfill material or an emission to either air or water (McDougall, 2001). Landfill, therefore, is an end of the MSW life cycle. The production of useful products resulting from material or energy recovery is also an end of the life cycle of MSW. (Abeliotis 2012)

The LCA system boundary is the interface between the waste management system and the environment or other product systems. The life cycle starts once a material or product becomes waste, i.e. its owner discards it in the waste collection bins. MSW is collected either via mixed-bags or via separate collection. Each collection method requires its own infrastructure, i.e. bins and collection vehicles. The transportation stage follows. In the MSW management system of developed countries,

the mixed bag waste can either go to the landfill, the waste-to-energy facility or to the Mechanical Biological treatment plant (MBT). The source-separated waste, if it is a dry stream (paper and cardboard, plastics, glass, tin, aluminum, etc.), can go to the material reclamation facility or if it is a wet stream (kitchen leftovers, garden trimmings, etc.) can go directly to the biological treatment facility. It is on this same line the functioning or the modality of the process from generation to recycling is carried out in the current study too.

Need for the Study

Urbanization creates unusual pressure on civic amenities. With rapid pace of urbanization the situation is becoming more and more critical with passage of time. A common feature of the most of the developing countries is an unprecedented urban expansion. Apart from dynamic demographic and socio-economic changes, this expansion has a number of physical and environmental consequences locally as well as on large scale. Studies reveal that major portion of Municipal Solid Waste in our country is disposed off in open dumps and landfills. The current practices of uncontrolled dumping of waste on the outskirts of towns or cities have created serious environmental and public health problem. Most of the areas so are congested that even disposing household waste requires a great deal of exercise.

As of today, solid waste has emerged as a major environmental concern from local level to global level. At the household level people are discarding their waste in an improper manner. The methods of collection, segregation and transportation of waste are not up to the mark and have resulted in creating an unhygienic condition in surrounding environment. The waste is carried as a burden for the future generation, as landfills. This practice is against the basic principles of sustainable development.

Sustainable solid waste management requires not only efficient collection, proper disposal but also waste reduction, reuse and recycle. Despite the numerous efforts and measures taken by the government it is still a major concern for the community with respect to the deteriorating conditions of the environment. The important aspect which requires priority is to improve management and organizational capability and enhance the people's participation in appropriate manners. Now, it has become a critical issue in Coimbatore, which requires high level planning and management. The overall goal of

waste management programmes must be welfare oriented and must safe guard the public health, waste minimization, maximization of waste recovery and protection of environmental quality.

Scope

Rapid industrialization and population explosion in India has led to the migration of people from villages to cities, which generate thousands of tons of MSW daily. The Municipal Solid Waste (MSW) amount is expected to increase significantly in the near future as the country strives to attain an industrialized nation status by the year 2020 [Sharma and Shah, (2005), CPCB, (2004); Shekdar et al., (1992)]. Poor collection and inadequate transportation are responsible for the accumulation of MSW at every nook and corner. The management of MSW is going through a critical phase, due to the unavailability of suitable facilities to treat and dispose the larger amount of MSW generated daily in metropolitan cities. Unscientific disposal causes an adverse impact on all components of the environment and human health [Rathi, (2006), Sharholly et al., (2005), Ray et al. (2005), Jha et al.(2003), Kansal, (2002), Kansal et.al.(1998), Singh and Singh (1998), Gupta et al. (1998)].

Solid Waste Management starts with the collection of solid waste and ends with their disposal. Improper disposal of waste creates enormous problems. This necessitates management of solid waste at generation, storage, collection, transfer and transport, processing and disposal stages in an environmentally sound manner in accordance with the best principles of health and environment. A general scanning of the literature available from different sources indicates that very few studies have been conducted on all issues covering solid waste like generation, collection, transfer and recycle. It is against this background the current study is taken to focus on all aspects of solid waste management.

Research Gap

Solid waste has emerged as a major environmental concern from local level to global level. The methods of collection, segregation and transportation of waste have resulted in creating an unhygienic condition in living environment. In waste management care must be taken to safeguard public health, maximise resource recovery and protect

environment. Therefore, it is necessary to conceive an integrated solid waste management plan.

The studies related to the solid waste generation were carried out by Misra and Mani (1993), Hingco (2000), Sujauddin et.al (2008), Hoornweg and Tata (2012), Belel and Mahmoud (2013), Srivastava (2014) etc. who pointed out the fact that the largest share of refuse comes from residential area. The second phase of SWM includes collection and transportation and studies associated with these were being done by Sarkar (2003), Ray et.al (2005), Tiwari (2008), Dhakal (2010) Roopa et.al (2013), Awpoetu (2014) , which also looked in to health hazards of those involved in the work. A host of studies were carried out on disposal and recycling. To cite a few Joseph (2002), Erikssona (2005) Emery (2007), Hema and Rajkumar(2009), Chudhari et.al (2011), Akil and Ho (2014). Since the earlier studies examined either one phase of SWM or any related aspects of SWM, a concrete solution to the exciting the situation is not found. Hence a study is taken by the investigator covering all aspects of SWM mainly generation, collection and transportation and disposal of solid waste.

Objectives of the Study

- ❖ To examine the solid waste management practice by the selected households
- ❖ To analyze the profile and working conditions and health status of sanitary workers
- ❖ To understand the working of waste recycling unit in Coimbatore and to identify the major health issues of those working in this unit.
- ❖ To suggest suitable measures to reduce the solid waste problem.

Hypothesis

- ❖ Income is the major determinant of willingness to pay for solid waste management by the households.
- ❖ Education is the basic factor to improve the condition of sanitary workers.
- ❖ Unemployment is the predominant reason for selecting job in the recycling unit.

The present study attempt to explore the major problems in solid waste generation by the households and condition of sanitary workers and working of recycling unit. It will of immense help to government and policy makers to ensure the solid waste management in a sustainable manner.