INTRODUCTION

Introduction

The environmental problems that countries face differ considerably; among the factors affecting them are the stage of development, the structure of the economies and environmental policies (World Development Report, 1992).

The United Nations International Strategy for Disaster Reduction defines environmental degradation as “The reduction of the capacity of the environment to meet social and ecological objectives, and needs”.

1.1. Concept of Urbanization

The concept of urbanization specifically means a process involving an increase in the proportion of the population that is urban in relation to the increase of the total population as in relation the proportion of the non-urban population of a region. The U.N. defines as ‘urban’ any settlement with at least 2,000 residents; however, some countries use threshold populations of 5,000, 10,000 or 20,000.

The city environment is a composite effect of its geographical aspects such as terrain, drainage including water bodies, modes of transport and movement within the city as well as from-and-to the city. Various institutions providing services to the residents of a city such as centres of production that provide some of the essential services, concerning health, education, marketing in consumers’ products as well as facilities for residence, electricity, water and movement from one place to another within the city. Use and misuse of organs of environment affect directly on the day-to-day working and life of urban dwellers. With the increase of urban population working capacity of positive organs become weak, inefficient and even polluted, thus resulting into discomfort to their users. Recently, due to tremendous increase in city population, both due to immigration and industrialization, city environment has become polluted to the extent that the very life of city dwellers is at stake (L.N. Verma, 2008).
Unfortunately, in doing so, the functioning of the natural environment has been greatly disrupted. The World Commission on Environment and Development opines that “the future is to face ever increasing environmental decay, poverty, hardship and an even more polluted world”.

Verma (2008) also points out that with the exponential increase in global population across the globe along with the consequential increase in urbanization and urban centres, the natural landscape of a richly vegetated countryside is being transformed into cities and towns characterized by concretionary structures which greatly modify the pre-existing climate conditions. Previously, towns and cities were considered to be the centres of higher standard of life, but now most of the urban centres of the developed world in general and developing world in particular have become unsuitable for human beings because of congestion, pollution, etc.

Increasing urbanization means increase in the concentration of people in limited space, industrial establishments, vehicles, urban wastes, etc. All these factors have led to pollution of land, water, air and noise; apart from the migration of rural people to cities.

The ecological issues in urban areas are the consequence of the concentration of population and of human activities in them which results in modification of the original environment. In developing countries, they are also the result of the widespread poverty that characterizes the cities, and the absence of strict zoning regulations that have led to an admixture of land-use. This has further complicated the scene with respect to management of various urban administrative processes as well as maintenance of ecological balance.

Aziz (1992) observes that urban environmental issues are tending to assume an important dimension especially in developing countries since there is a rapid increase both in the number of cities and in the urban population.

Urban planners, too, have pointed out that lack of adequate urban infrastructure and urban environmental management are contributing in a big manner towards environmental problems in urbanized areas.

Rapid urbanization has aggravated problems like sanitation especially in towns and cities that are not served by proper solid waste collection and disposal facility, drainage, solid waste management, degradation of land and soil, emissions from the domestic and industrial activities,
street and slum congestions, and improper disposal of hazardous waste. All these factors have consequently resulted in poor health and well-being of people.

1.2. Trends in Urbanization

Presently the global population is almost touching the seven billion mark. Out of this tremendous increase in global population, cities contain nearly 50% people. Urbanization and its negative consequences are a global phenomenon impacting almost half the world population that lives in cities.

The phenomenal increase by the 19th century and also during the 20th century is generally said to be associated with the migration factor coupled with the widely spreading phenomenon of industrialization. The large scale influx of migrant labourers has given rise to lame settlements known as ‘shanty’ in almost all metropolises, in which people live with the barest possible civic amenities around heaps of garbage to make ‘slums’ of unhygienic unhealthy environment.

In the more developed regions, where the proportion of urban population is already high, the increase will not be as spectacular as in the less developed regions. Over a period of only 65 years, the urban population of the developing countries has increased ten-fold (WCED 1987). Hence, urban ecological issues are likely to gain importance in Third World countries.

Indian Scenario

India’s population has grown very rapidly since the demographic watershed of 1921. With the improvement in medical treatment and medical facilities, sanitary improvement, etc., mortality rate reduced drastically and led to a spectacular increase in population. The population is growing at the rate of about 17 million annually. One of the most important reasons for population explosion in the cities of India is the large scale rural to urban migration and rapid urbanization.
Due to the rapid growth of population and uncontrolled and unplanned urbanization in India, environmental degradation has been occurring very rapidly in urbanized areas and is causing shortages of housing, proliferation of slums, declining water quality, excessive air pollution, noise, dust and heat, and the problems of disposal of solid wastes and hazardous wastes. The metropolitan cities like Mumbai, Kolkata, Chennai, Delhi, Bangalore, Kanpur, Hyderabad etc. present a particularly depressing picture today.

1.3. Current urban population in India

According to the provisional data released by Census Department of India, for the first time since Independence, the absolute increase in population is more in urban areas than in rural areas. It also points out that the current urban population stands at 31.16% and that of rural is 68.84%. Level of urbanization increased from 27.81% in 2001 to 31.16% in 2011 whereas, the proportion of rural population declined from 72.19% to 68.84%.

During 2001 – 2011 the population of the country increased by 181.4 million. The increase in rural areas stands at 90.4 million. While that of urban areas stands at 91.0 million. (Census of India 2011)

During the first half of the 20th century, city environment in India was simple and manageable wherein one could go about one’s normal activities with the least amount of strains and stress. By the end of the century, urban life and city’s physical environment became un-adjustable because of growth of urban population, unlimited demands and ambitions of urban dwellers, congestion and crowd in residential buildings, transport hazards and unsafe movement within the city. Above all, unhygienic conditions, poor drainage, heaps of garbage, pollution of air, water, food and erosion of social values made the city life in India intolerable and miserable (L.N. Verma; Urban Geography, 2008, 4).

Environmental pollution in India can broadly be attributed to rapid industrialization, urbanization, commercialization, and an increase in the number of ownership of private vehicles (Maitra, 1993). Vehicles are a major source of pollutants in cities and towns and the concentration of ambient air pollutants in most cities of India are high enough to cause increased mortality. The rate of generation of solid waste in urban centres too has outpaced population
growth in recent years with the wastes normally disposed off in an unscientific manner (India: State of the Environment 2001).

1.4. Introduction to the Area under Study

Mumbai (formerly known as Bombay) is the largest metropolitan city of India. It is located on the western sea-coast of peninsular India along the Arabian Sea at 18°53' N to 19°16' N latitude and 72° E to 72°59' E longitude. Greater Mumbai Region consists of 7 islands in the city region and 4 islands in the suburbs. The present day city is divided into two revenue districts, Mumbai City District, i.e., the island city in the South and Mumbai Suburban District comprising the Western and Eastern suburbs. The island city and the suburbs together form the Greater Mumbai or Brihan-Mumbai with an area of 437.71 sq.km.

In the 16th century, Mumbai was a cluster of seven fishing islands which have now become a single landmass, in the form of a narrow peninsula. In 1840, Mumbai islands covered an area of 18 sq. miles with a population of about half a million. The colonial powers recognized the importance of protected harbours offered by these islands and developed it as a major harbour. The transformation of a group of seven small islands, off the shore of coastal Maharashtra into one of the most crowded metropolitan city of India went through a lot of major and minor changes. Mumbai’s transformation from a trading town into an industrial and manufacturing centre began in 1854. Since then Mumbai is growing, expanding, urbanizing, as well as commercializing and today it has become the major financial and business capital of India.

Today, in terms of population, Mumbai is one of the largest mega cities in the world and is currently ranked fourth after Tokyo, Mexico City and New York. The city is the financial capital of India with a large commercial and trading base. It plays host to a number of industries, multinational companies and important financial institutions. With a per-capita income thrice that of the national average, Mumbai makes huge contribution to the total tax revenues of the country.
The city is an important international sea port and strategic from the defence point of view. On a flip side the city is also vulnerable to climate risks due to its flood prone location and the landmass composed largely of reclaimed land. The most vulnerable sections are the slum dwellers and squatter communities in the city that comprise more than half of the total population.

1.5. **Climatic Aspects of Mumbai**

Mumbai experiences a tropical climate, with a southwest monsoon rainfall of more than 2100 millimetres a year. Mumbai experiences summer from March to May, monsoon between June and September and winter during October to February. The relative humidity is quite high during this monsoon season.

In the City District, daily average temperatures range from the minimum of 23.7°C to the maximum of 31.2°C. In the Suburban District, the temperatures vary from the minimum of 16.3°C to the maximum of 33.3°C.
Figure 1.1 Map of Greater Mumbai Region

Source: www.mcgm.gov.in
1.6. Physical Vulnerability of Mumbai city

Mumbai is separated from the mainland of Konkan region of Maharashtra by a narrow creek known as Thane Creek and a Harbour Bay. The city is surrounded on three sides by the sea: Arabian Sea to the West, Harbour Bay in the West and Thane Creek in the East.

The new industrial, commercial and residential settlements such as Bandra-Kurla Complex, Wadala and major residential areas of Worli have developed along the reclaimed coastal areas which are low-lying and flood prone. Most parts of the present day city are built on reclaimed land. The city is barely a few metres above sea level in many places. The airport area is hardly about 7.5 metres above sea level.

Coastal erosion, landslides, flash-floods associated with heavy precipitation and the unprecedented floods of June 2005 are some of the incidents that reflect the vulnerability of the city to coastal climate hazards.

Mumbai has around 900 and more industries that are involved in manufacturing or processing or storage of hazardous goods. Many of these are in close proximity to residential and commercial areas, thereby increasing the risk of fires and explosions.

The most troubling aspect of the evolution of the Mumbai region into the country’s most important economic centre of the country is the present set of irreversible modifications it has undergone due to human intervention. The ever-increasing population due to in-migration of skilled as well as unskilled manpower from within and outside the state of Maharashtra has added to the problems of the city with respect to space for residing, provision of civic amenities, spread of vector-borne and water-borne diseases, solid waste management, pollution of all kinds, rampant reduction of vegetation cover etc.

1.7. Administrative set-up of Mumbai City
For administrative purposes, Mumbai Metropolitan region (MMR) has been designated to combine Greater Mumbai Region (GMR) and the surrounding areas of Thane, Navi Mumbai, Ulhasnagar, Mira Road, Vasai, Virar, Bhayandar, Bhiwandi, Karjat, Alibaug, etc.

The city is divided into different administrative zones known as ‘wards’ to ease the day-to-day functioning of the civic authority.

The map of Mumbai city, including the location of different administrative wards is shown in Figure1.2 below.
Fig: 1.2 Ward Map of Greater Mumbai

Source: MCGM
Administrative divisions of Greater Mumbai

The 24 wards of Greater Mumbai are administratively grouped under three zones, the City Zone covering wards A, B, C, D, E, F (South), F (North), G (South) and G (North);

The Eastern Suburban Zone covering wards L, M, (East), M (West), N, S, and T and;

The Western Suburban Zone includes the following wards H (East) and H (West), K (East), K (West), P (South) and P (North), R (South), R (Central) and R (North).

Mumbai being an important metropolitan city, attracting more and more migrants from within and outside the state of Maharashtra, to work as skilled as well as unskilled workers has undoubtedly put tremendous strain on its natural resources as well as on its capacity to provide basic civic amenities to its residents. Therefore, some of the issues which are considered to be requiring urgent attention and also requiring remedial measures for maintenance of an ecological balance in the region are undertaken for the purpose of study.

Issues related to quality of air in parts of Mumbai are studied to explore if auto-emissions are contributing to the increasing pollutant load in the city and suburbs. At the same time, population growth and the problem of solid waste in the city is also being studied to deduce if a correlation exists. The various solid waste management techniques adopted in the city are also analyzed briefly.

1.8. Air Pollution in Mumbai

Apart from being India’s financial and commercial centre, Mumbai is also one of the most industrialized Indian cities. There are approximately 40,000 small and big industries in the city, of which 32 have been classified as hazardous. Industries in the air-polluting category include textile mills, chemical, pharmaceutical, and engineering and foundry units.

Data generated over the years reveal that Suspended Particulate Matter (SPM) and Respirable Suspended Particulate Matter (RSPM/PM10) exceed permissible levels at many locations, particularly in urban areas. Air pollution problem becomes complex due to the multiplicity and
complexity of air polluting source mix (e.g. industries, automobiles, generator sets, domestic fuel burning, road side dusts, construction activities, etc.)

Since 1991, Mumbai has seen a negative growth in industrial development. The city has more concentration of commercial and other tertiary activities. This indicates that apart from other area sources such as hotels, bakeries, open eateries, crematoria, etc that are responsible, the transport network, plays a major role in the decline in quality of air in Mumbai, with an ever-increasing number of commuters who travel from the suburbs to the island city. Incidentally, Kalbadevi, the old Central Business District (CBD) lies in South Mumbai, that is in the island city. The historical CBD, the Fort Region as well as the modern corporate CBD, Nariman Point too, lies in southern part of the island city. Though, the new Bandra-Kurla Complex is an upcoming focal point in Mumbai, the commuters travelling to south Mumbai and back is much higher as compared to the other destinations. This has grossly increased the traffic congestion on this route. Consequently the vehicular traffic and pollution both, on this sector are very high during peak hours.

Taking into consideration the ill-effects of the various emissions that are responsible for air quality decline the CPCB has laid down specifications with respect to ambient air quality standards (both short term, i.e., 24 hourly, and long-term, i.e., annual) for industrial, residential/rural/other, and sensitive areas with respect to pollutants such as SO2, NOX, SPM, RPM, Lead (Pb), and CO. Ambient air quality standards for NH3 have also been notified.

The following table gives the NAAQS for the some of the parameters as per the exposure period in various areas.
## Table 1.1

National Ambient Air Quality Standards

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Exposure Period</th>
<th>Industrial Area</th>
<th>Residential Area and other area</th>
<th>Sensitive Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO2</td>
<td>Annual Average</td>
<td>80</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>24 Hrs Average II</td>
<td>120</td>
<td>80</td>
<td>30</td>
</tr>
<tr>
<td>NO2</td>
<td>Annual Average</td>
<td>80</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>24 Hrs Average II</td>
<td>120</td>
<td>80</td>
<td>30</td>
</tr>
<tr>
<td>NH3</td>
<td>Annual Average</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>24 Hrs Average II</td>
<td>400</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>SPM</td>
<td>Annual Average</td>
<td>360</td>
<td>140</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>24 Hrs Average II</td>
<td>500</td>
<td>200</td>
<td>100</td>
</tr>
<tr>
<td>RSPM</td>
<td>Annual Average</td>
<td>120</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>24 Hrs Average II</td>
<td>150</td>
<td>100</td>
<td>75</td>
</tr>
<tr>
<td>Lead</td>
<td>Annual Average</td>
<td>1.0</td>
<td>0.75</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>24 Hrs Average II</td>
<td>1.5</td>
<td>1.0</td>
<td>0.75</td>
</tr>
<tr>
<td>CO</td>
<td>8 Hrs</td>
<td>5.0 mg/m³</td>
<td>2.0 mg/m³</td>
<td>1.0 mg/m³</td>
</tr>
<tr>
<td></td>
<td>1 Hr</td>
<td>10.0 mg/m³</td>
<td>4.0 mg/m³</td>
<td>2.0 mg/m³</td>
</tr>
</tbody>
</table>

(Above values are in µg/m³)
Municipal Corporation of Greater Mumbai (MCGM) checks air quality for criteria air pollutants namely SO2, NO2 NH3 and SPM regularly. Municipal Corporation of Greater Mumbai’s ambient air quality monitoring network comprises of 18 receptor oriented monitoring sites spread at different locations over Mumbai.

1.9. Transport sector

Transportation is an important component of the economy causing an impact on development and welfare of population. The basic infrastructures required for the region’s economic growth are roads, railways, and water and air connectivity. It is a well-established fact that with the increase in economic activities, the dependence of fossil fuel based energy sources and consequent greenhouse gas (GHG) emissions have increased rapidly in recent times.

Thus the overall development of the transport network and more so, the ownership of an increasing number of private vehicles is adding to the pollutant load in the atmosphere. Excessive over-crowding of public places and congested roads are a common feature in Mumbai.

Motor vehicles are leading to increasing air pollution levels in urban areas of the world. The UNEP and World Health Organization (1992) have stated that besides substantial CO2 emissions, significant quantities of CO, HC, NOx, SPM and other air toxins are emitted from these motor vehicles in the atmosphere and cause serious impacts on the local environment and health of the residents. Air pollution from motor vehicles is one of the most serious and rapidly growing problems in urban centres of India, too.

Vehicular Pollution

Automotive vehicles emit several pollutants depending upon the type of quality of the fuel consumed by them. While the predominant pollutants in petrol/gasoline driven vehicles are hydrocarbons and carbon monoxide, the predominant pollutants from the diesel based vehicles are Oxides of nitrogen and particulates. (Central Pollution Control Board)
1.10. Vehicular emissions load in India

In India, the number of motor vehicles has grown from 0.3 million in 1951 to approximately 50 million in 2000, of which two wheelers account for 70% of the total vehicular population. Two wheelers and cars belong to the category of privately owned vehicles that account for approximately four-fifth of the total vehicular population. (Sharma 2001); and larger concentration of vehicles in these urban cities specially in four major metros namely, Delhi, Mumbai, Chennai and Kolkata which account for more than 15% of the total vehicular population of the whole country, whereas more than 40 other metropolitan cities accounted for 35% of the vehicular population of the country.

1.11. Health and environmental effects of vehicular pollutants

The vehicular emissions have damaging effects on both human beings as well as on ecology. The effects may be direct as well as in-direct. These pollutants are believed to directly affect the respiratory and cardio-vascular systems. High levels of Suspended Particulate Matter are found to be associated with increased mortality, morbidity and impaired pulmonary function. (Ackerman et al 2002; Gibbs et al 1995; Glen et al 1996; Johnson et al 2000).

According to a Report on Environmental Status of Mumbai Region (2007), by the Maharashtra Pollution Control Board, on an average it is estimated that 60% of air pollution is caused by Auto-emission.

Air pollutants do not only restrict their impact to causing impaired health conditions, but they greatly influence the global problem of climate change caused due to the release of the Green House Gases (GHGs).

Mumbai being a coastal city and most of its population living in the low-lying areas, people will be greatly affected by climate change. According to earlier estimate of a study conducted 10 years ago, the economic damage to Mumbai, as a result of climate change could amount to over Rs. 2 lakh crores. Climate change will mainly impact tourism, human health, loss of man hours, loss of property and lead to spread of diseases such as typhoid, malaria, diarrhoea, leptospirosis, etc. (MCGM, 2011).
Another latest study by the Organization for Economic Co-operation and Development (OECD), has estimated that by 2070, 11.4 million people and assets worth $1.6 trillion would be at peril in Mumbai due to climatic extremes such as severe storm-surge flooding, stormy winds and rising seas. (Article in Times of India, 12th November 2012)

1.12. Solid Wastes

Solid wastes are all wastes arising from human and animal activities that are normally solid and are discarded as useless or unwanted. If not managed properly, these wastes can have an adverse impact on the environment and public health arising from contamination of soil, water and pollution of air and through spread of diseases. (National Solid Waste Authority of India, Environmental Information System, 2003)

Main sources of Municipal Solid Waste are: residential premises, business establishments and street sweepings; and is a mixture of vegetable and organic matter; inert matter like glass, stones, ashes, cinders, textiles, wood, etc.

**Significance of solid waste management in urban areas**

Solid waste management has in recent years become the focus of attention and study. The issue acquires more significance in urban centres which generate immense quantities of waste due to concentration of population and economic activities. Moreover, there is increasing concern as to ‘where’ to dispose of the waste as many urban centres are running out of space in reasonably close proximity for disposal of waste (Berry, 1977). The problems are particularly acute in large metropolitan centres such as Mumbai.
1.13. Solid Waste Scenario in Mumbai City

Mumbai, the largest metropolitan city in India, presents one of the most critical Solid Waste Management (SWM) systems. According to the Solid Waste Management Department of the Metropolitan City of Greater Mumbai, (2010-11) the amount of waste generated in the city is approximately 9200 Metric Tons per Day (MTPD). It is broadly classified as 3500 MTPD of biodegradable waste, 1900 MTPD of recyclable waste, 1100 MTPD of inert material and 2700 MTPD of construction waste and silt.

A citizen of Mumbai on an average generates 475 gms or garbage per day. The composition of garbage is 54% wet organic matter, 15% dry organic matter, 12% sand and earth and 10% paper and recyclables. Plastics compose only 9%, but it causes maximum nuisance such as clogging of drains, choking the gutters and its combustion poses health hazards due to the release of toxic gases and moreover it is not biodegradable.

In order to handle this huge amount of garbage (MSW) there were three dumping grounds for disposal of wastes, viz. Deonar, Mulund and Gorai. Presently only two dumping grounds at Deonar and Mulund are in operation and Gorai Dumping Ground had to be closed and instead Kanjur, situated along the Thane Creek in the Eastern suburbs is a proposed site of MSW Processing and Disposal for future. Though it is not fully operational, partial dumping of waste at Kanjur has already begun since May 2012. One Refuse Transfer Station is also located at Mahalaxmi which handles 600-700 MT of garbage load per day from A to G/South ward.

Deonar dumping ground is the largest one receiving 75% of the total garbage. It has a processing capacity of 2000 tons/day of waste and uses composting technology. Mulund dumping ground processes market/hotel/restaurant waste of 500 tons/day using bio-methanation process. Mulund dumping ground has nearly exhausted its capacity to receive more garbage. The new site Kanjur is supposed to be the first Sanitary Landfill site in MCGM, with a composting facility for processing 1000 MTPD MSW and Bio reactor plant of capacity 3000 MTPD MSW. Till the time Kanjur does not become fully operational, Mulund dumping ground receives about 1500 to 2000 MTPD of garbage. (MCGM, 2011)

The following map (Fig. 1.3) depicts the location of the Dumping Grounds and Refuse Transfer Stations located in the study region.
Fig: 1.3 Location of Solid Waste Dumping Grounds of Greater Mumbai

Municipal Solid Waste Dumping Grounds

1. Deonar Disposal Site
2. Mulund Disposal Site
3. Malad Disposal Site
4. Gorai Disposal Site
5. Mahalaxmi Refuse Transfer Station
6. Kurla Refuse Transfer Station
Collection of Waste in Greater Mumbai

Collection of refuse or waste is the first stage in solid waste management. The collection system would depend on the method generally used for storing the waste. As per the Environment Status Report, MCGM 2010-11, there are 3751 community collection points and 48% of the total garbage is collected from these community collection points and the remaining 52% is collected from house to house. The daily municipal solid waste (MSW) is collected and transported by deploying various types of vehicles such as compactors, skip vehicles, dumpers, tempos, JCB machines, stationary compactors, etc.

The table below sheds light on the quantity of waste and the number of trips made by vehicles meant for collecting waste.

### Table 1.2

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Classification of Waste</th>
<th>Tonnes/Day</th>
<th>Vehicle Trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Biodegradable</td>
<td>3500</td>
<td>1590</td>
</tr>
<tr>
<td>2</td>
<td>Recyclable</td>
<td>1900</td>
<td>236</td>
</tr>
<tr>
<td>3</td>
<td>Construction waste &amp; silt</td>
<td>2700</td>
<td>275</td>
</tr>
<tr>
<td>4</td>
<td>Inert Matter</td>
<td>1100</td>
<td>140</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>9200</td>
<td>2241</td>
</tr>
</tbody>
</table>
1.14. Major issues in Solid Waste Management in Mumbai:

Major problems in executing safe and hygienic collection, eco-friendly and efficient transportation and nuisance free disposal are unauthorized open refuse spots, absence of adequate numbers of modern refuse transfer stations; and location of disposal sites in the middle of thickly populated areas and the consequent complaints of environmental pollution due to burning of garbage, foul odour, etc. With increasing urbanization, land available for dumping and creation of landfill sites is becoming unavailable. Only four landfill sites are located in the MCGM area whose lifespan has expired. The problem is further aggravated due to high density and a large slum population.

The various methods adopted for disposal of Municipal Solid Wastes in Mumbai are:

1. Composting
2. Bio-methanation of wet garbage
3. Vermi-composting
4. Incineration
5. Recycling of dry waste (done by rag-pickers)

These methods are now being adopted by a number of decentralized units working under various organizations working in coordination with MCGM, thus forming an effective public-private ownership.

In the backdrop of all such issues which are invariably leading to degradation of the environment in Mumbai city, the following objectives have been taken into consideration for the purpose of conducting a study.
1.15. OBJECTIVES

The objective of this study is to analyze the relationship between environmental issues and the various human activities responsible for the same.

The following objectives will be addressed:

- To bring out the major issues of environmental degradation existing in Mumbai (Island City as well as the suburban area), such as ever-increasing population, air quality decline and the problem of solid waste management.

- To gauge if decline in air quality caused due increase in the levels of Nitrogen Oxides, Respirable Suspended Particulate Matter (RSPM) as well as Suspended Particulate Matter (SPM); and to find out if increasing vehicular population in Mumbai is a major contributor.

- To explore the spatial and temporal variation of solid wastes in the city at a ward level.

- To suggest some corrective measures, if possible, to curb the process of environmental degradation, that is happening due to various human activities and the unchecked process of urbanization in the city.

1.16. HYPOTHESIS

With the above-mentioned objectives in view the following hypotheses have been framed:-

- Air pollution is mainly due to increase in the growing number of vehicles in the city.

- The increasing amount of solid wastes is mainly due to increase in population and unplanned process of urbanization.
In the following chapters the following hypotheses will be tested with the help of secondary data collected from various sources.