REVIEW OF LITERATURE
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This chapter deals with the review of literature related to the topic and issues undertaken for the purpose of study. Indian as well as foreign studies, research journals, official reports, etc have been reviewed to broaden the perspective of understanding issues related to environmental degradation in urbanized areas especially regarding air quality and vehicular exhaust; and different aspects pertaining to management of solid wastes in urban areas.

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 United Nation 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 World Commission on Environment and Development (WCED) opines that “the future is to face ever increasing environmental decay, poverty, hardship and an even more polluted world”.

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.

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.

Pollutants of major public health concern include particulate matter, carbon monoxide, ozone, nitrogen dioxide and sulphur dioxide. Outdoor and indoor air pollution cause respiratory and other diseases, which can be fatal.(WHO, 1990).
National Environmental Engineering Research Institute (NEERI) has pointed out that morbidity and mortality caused by air pollution in major urban centres in the country is of great concern for human health.

According to Sharma and Tiwari (2000), coastal cities like Mumbai are undergoing social, economic and political transition. This is an appropriate time to rejuvenate these cities and protect them from further deterioration; otherwise, they will lose their comparative advantages to newer cities which have been more environmentally oriented. Another factor that coastal cities like Mumbai should worry about is the policy of reclaiming land. This is not only destroying the coastal biodiversity but also threatening the existence of the city due to sea level rise and the consequential submergence and flooding. The reclamation process had had a very damaging impact not only on the mangroves in Mumbai but even on the overall modification of landscape of the coastal city. According to a study, between 1995 and 2000, approximately 40% of Mumbai’s mangroves were destroyed as a result of unchecked dumping and illegal reclamation.

Nagdeve (2007) argues that both population growth and un-sustainable development are a cause for concern in India. Population size and growth tend to expand and accelerate these human impacts on the environment. The biggest concern is that the increasing population will grow to such an extent in future that it will cause overall scarcity of resources.

Landsberg (1970) has highlighted air pollution as one of the major urban environmental issues. He points out that the majority of air pollutants are released in urban areas and it is there that the related climatic modifications are most pronounced. He observed that the release of pollutants into the atmosphere will trigger other changes and hence effects of pollutants cannot be singled out. Climatic modifications may reach far beyond the urban region and result in regional and global changes.

In the words of Wolf (1974) “the quality of city space and air, also called urban ecological ambient, is closely associated with the infrastructure of the city”. The vehicular traffic emits lethal gases into the city air and the land surface is polluted by solid waste.

Murthy and Bhargavi (1983) argued that, though the present technology is not sufficient to completely avoid pollution, if planning were to be re-oriented with due consideration to the atmospheric properties over an area it would definitely reduce pollution.
According to NEERI (2002) the share of PM10 in the metropolitan city of Mumbai is as follows: Transport: 32 percent, 45 percent from industry, 18 percent from area sources, and 5 percent from building and road construction.

MCGM (2000) pointed out that the approximate total consumption of fuel by the auto-sector in Mumbai is Petrol: 33,734 kilo litres/month; and Diesel: 39,959 kilo litres/month. It also stated that on the basis of fuel consumption, air pollution load due to auto-exhaust is 551 M.T.P.D (Metric Tons per Day) comprising of SO$_2$, NO$_2$, CO, SPM and Hydrocarbons. As the pollution is released at the ground level, citizens are exposed to it directly, since there is hardly any opportunity for auto-exhaust pollutants to dilute significantly.

A study carried out by MCGM during a strike period indicates overall 25% reduction in air pollutants levels.

URBAIR study (1991) reported a 50% increase in annual average concentration of Total Suspended Particulate (TSP) from 180µg/m$^3$ to 270 µg/m$^3$ between 1981 and 1990. TSP sources are mainly re-suspension from road caused by vehicles, emissions from diesel and gasoline vehicles, domestic wood and refuse-burning.

The Central Pollution Control Board (CPCB) pointed out in one of its reports that 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. Nonetheless, Mumbai is one of the cities where the main pollutants reported are RSPM and Suspended Particulate Matter; and the predominant factors responsible for the emissions are industries and vehicles.

According to a Report on Environmental Status of Mumbai Region (2007), by the Municipal Corporation of Greater Mumbaion an average 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. (MCGM, 2011)
According to latest studies carried out by the Maharashtra Pollution Control Board (MPCB) in 2010, “air pollution levels in the city are approaching the point of no return”.

The National Environmental Engineering Research Institute (NEERI) monitors RSPM (Respirable Suspended Particulate Matter) levels, which are approximately equivalent to PM$_{10}$. NEERI has observed that annual average RSPM has been declining steadily since 1997, largely as a result of the closing down of textile mills in the city.

The Final Report (2010) by NEERI on Air Quality Assessment Emissions Inventory and Source Apportionment Studies for Mumbai; points out that urban air quality issues have emerged as a major concern impacting quality of life. The high disease burden due to air pollution has started to impact the economy of the urban centres. The common knowledge of air pollution impacts on human health has not yet led to comprehensive plans to combat the rising levels of air pollution level exposure.

An article in The Times of India 11$^{th}$ September 2008, quoted findings from a health survey conducted to find out the incidence of respiratory diseases in Colaba, Parel, Wadala, Versova and Bhandup. It was found that excepting Bhandup all the other four neighbourhoods showed significant incidence of respiratory illnesses that could be linked to air pollution.

A study by NEERI (2010) has shown that Mumbai city ambient air quality has shown improving trends with respect to PM$_{10}$, SO$_2$ and NO$_2$ during the period of 2000-2005. However, in last few years PM decline is not apparent and NO$_2$ levels have shown slow increasing trend.

The Environment Status Report of Brihan-Mumbai (2010-11) specifies that ambient air pollution levels have largely met Central Pollution Control Board (CPCB) standards. However, particulate levels have increased alarmingly at some locations in Mumbai due to massive construction and infrastructural work.

It has been found from various studies that TSP sources are mainly re-suspension from road caused by vehicles, emissions from diesel and gasoline vehicles, domestic wood and refuse-burning. (ESR BMC 1999-2000)

Ostro et al. (1996), in their study found a strong association between PM$_{10}$ and alternative reasons of mortality. It was found that a 10 µg/m$^3$ change in daily PM$_{10}$ value was associated
with a 1% increase in mortality. Moreover the findings of their study were found to be consistent with those of recent studies undertaken in the United States.

Chau L. et al (2010) state that the PM$_{2.5}$ to PM$_{10}$ ratio in the transport modes ranged from 76% to 83%. According to their study, poor vehicle emission controls, poor vehicle maintenance and also the slow moving traffic condition with frequent stops are the major causes of high in-vehicle levels of SPM in some of the public commuting modes.


According to the findings of the Ministry of Urban Development (MoUD) 2008, Census of India 2001; and MoSRTH, 2007, one of the main contributors of emissions in Indian transport is the road transport.

T.V. Ramchandran and Shwetmala of the Energy Research Group, Centre for Ecological Sciences, Bangalore (2008) opined that the introduction of vehicles with stricter emission control may decrease the overall emissions, but the vehicle population growth rate might neutralize that impact in overall emissions.

Vehicular emissions account for about 60% of the Green House Gases (GHGs) from various activities in India (Patankar, 1991).

The urban population of India, which constitutes 28% of the total, is predominantly dependent on road transport. Around 80% of passenger and 60% of freight movement depend on road transport (MoEF, 2000).

According to the Motor Transport Statistics (2010-11), Petrol (76%) is the chief source as a fuel for the rising number of vehicles owned in the study region. 13% of the vehicles use diesel and; 6% and 5% of the vehicles run on CNG and LPG respectively.

In a study published in the August 17, 2010 issue of the magazine *Science*, Dr.Kyeongjae "K.J." Cho and others pointed out that in comparison with gasoline engines, diesel vehicles produce more nitric oxide (NO) and nitrogen dioxide (NO$_2$), which are known as NOx pollutants.
All the analysis and modelling results as brought out by NEERI (2010) indicate that many small steps or one big step for a particular sector will not yield results of better air quality. An integrated bunch of steps are likely to achieve improved air quality which will be sustainable. The city of Mumbai will also need integration of its efforts with nearby urban centres and also alignment with overall national goals for better air quality.

Karlsson (2004), specified that vehicle emissions significantly pollute air and require control.

The Environment Status Report of Brihan-Mumbai (2011) stated that Benzo(a)Pyrene, a polynuclear aromatic hydrocarbon (PAH), which is considered to be one of the most potent carcinogenic compounds, is analyzed from SPM but fortunately the annual average level has not surpassed the CPCB limit.

TERI (2003) stated that the situation is particularly bad in India with more than 90 per cent of the national monitoring stations having recorded particulate concentrations exceeding the WHO recommended guidelines. In Mumbai (the island city as well as the eastern and western suburbs), air pollution can be clearly attributed to the heavy concentration of the transport network, construction activities and to a certain extent due to the environmentally hazardous industries that are located in and around Mumbai.

MCGM (2011) has stated that due to infrastructures such as east-west corridors; cement concrete roads, synchronization of signals and use of ultra-modern technologies in new cars and strict implementation of Pollution under Check (PUC) and Bharat II, III and IV stage norms result in reducing Nitrogen Dioxide. Due to cleaner fuels like unleaded petrol and low sulphur diesel, levels of SO2 and Lead are reduced. At the same time, smaller particles (2.5µ and smaller), which are more serious health hazards are generated in a large percentage by vehicles which run on gaseous fuels like CNG and LPG.

Jain (2004) pointed out that high volume of floating population and daily commuters, with almost 65 lakh people travelling daily is a cause for road littering.

In an exhaustive study by Sharma and Patil, (1992) about the aerosols in Mumbai, it has been found that a large percentage of SPM is respirable that causes various types of respiratory
diseases. While sources of gaseous pollutants are well known, the suspended particulate matter (SPM) can be generated from numerous sources.

D’Souza (1997) observed that by 1961, the city had experienced a tremendous growth in population. This had necessitated the incorporation of the suburbs, so that the suburbanization process gained momentum, but subsequently the population growth in the island city started to decline. On the other hand, Mumbai’s position as a major industrial centre got strengthened. There was diversification of the industrial base and chemical, mechanical and other industries gained importance. The economic base of Mumbai changed; services had emerged as a major economic activity in addition to industry and trade. Among the industries, textiles had declined in importance in the 1990s.

MPCB (2005) pointed out that there is no clear distinction between residential, commercial and industrial zones for the city. Industrial areas are further being converted into residential complexes, leading to a boom in construction activity, mainly in the suburbs. For instance, most textile mills have closed down in recent years giving way to residential and commercial complexes.

Manufacturing has given way to finance and services as the major source of formal sector employment while commercial activities retained their importance. The decline in manufacturing is most evident in Central Mumbai, where a number of textile mills have become ‘sick’. As D’Souza (1997) points out, this is an area where at present vast spaces are under-utilized.

Mukhopadhyay (2003) opines that some of the changes in population distribution are due to the Development Control Rules of Mumbai that were originally formulated under the Bombay Town Planning Act of 1955. They have undergone considerable modifications over time. The concept of Floor Space Index (FSI) was introduced in 1964. It enabled some control over density in different areas. Changes in the FSI have affected population distribution. For example, Chembur is an area where a cluster of sensitive installations like oil refineries, the Bhabha Atomic Research Centre (BARC), a fertilizer plant and naval ammunition depot had prompted the government to initially limit FSI to 0.5. This was increased to 0.75 and later in 1998 to 1.00. It led to a sudden spurt in conversion of bungalows into high rise apartments and consequent population growth.
According to Bhagat and Sita (2011), a major cause for concern is the ecological costs of supporting the large urban agglomerations. While cities are no longer dependent on the immediate hinterland for economic sustenance, they depend on it for a variety of eco-services. For example, the quantum of water needed to support the urban agglomerations is on a scale not found in nature. The generation of waste is again such that the immediate neighbourhood cannot disperse it. The “ecosystem appropriation” by large metropolitan centers has given rise to the concept of “ecological foot prints” of cities (Folke, et al 1997).

A number of studies (Sita and Phadke, 1984; Gupta and Prasad, 1996) had shown that the spatial distribution of population in Greater Mumbai had undergone significant changes, particularly since 1961. The decrease in the relative share of the population of the island city continued. The trend towards suburbanization was apparent with the share of the suburbs increasing from 60% in 1981 to 75% in 2011.

Pendharkar S., (2003), Chief Planning Division (MMRDA), in his Report on Population and Employment Profile of MMR has pointed out that about half of the population in Greater Mumbai lives in slums and more than one third population of Urban MMR lives in slums.

The municipal Solid Waste Management (SWM) is only in slums that are notified and not ones considered illegal by the Brihan-Mumbai Corporation (BMC). Thus, the coverage of slums in the Solid Waste Management (SWM) system of the Brihan-Mumbai Corporation is quite low and as per an estimate by YUVA (Youth for Unity & Voluntary Action).

According to the Solid Waste Management Department of the Metropolitan City of Greater Mumbai, (2010) 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.

Tinmaz and Demir (2005) in their study have pointed out that the most important problem faced due to uncontrolled population growth and rapid urbanization is the problem of Solid waste management in Turkey, due to inadequate management practices.
Jain (2004) specified that the problem of solid wastes is aggravated due to high density and large population in slums. According to him very high volume of floating population and daily commuters with almost 65 lakh people travelling daily is a cause for road littering.

Sarika, (2004), pointed out that Municipal Solid Waste management is one of those very serious problems that Mumbai is facing at the moment and which is an indicator of increased consumption patterns and wealthy lifestyle that Mumbai enjoys.

Timmerman (2000) has pointed out that environmental and socio-economic problems of coastal ecosystems in developing country like India encompass a large number of anthropogenic activities. Three of the four megacities in India viz. Mumbai, Calcutta and Chennai are on coasts. In addition, there are several coastal towns playing crucial role in the economic development of the country. Some of the major problems of all these urban and coastal town ecosystems include discharge of domestic and industrial effluents, agricultural wastes, radioactive and thermal wastes; tourism and shipping; oil spills and over exploitation of the living coastal resources, etc. Human activities create stress on the ecosystem beyond its tolerance limit that can pose hazards to the coastal and marine environment, and to the health and safety of the population living in the coastal areas. A city like Mumbai is a living example of both the problems and the immense opportunities provided by this global phenomenon.

Environmental pollution in India can broadly be attributed to rapid industrialization, urbanization, commercialization, and an increase in the number of motorized vehicles (Maitra, 1993).

Vehicles are a major source of pollutants in cities and towns. The concentration of ambient air pollutants in the metropolitan cities of India; as well as many of the Indian cities, is high enough to cause increased mortality. The rate of generation of solid waste in urban centres has outpaced population growth in recent years with the wastes normally disposed in low-lying areas of the city’s outskirts (India: State of the Environment 2001).

Lewis Mumford (1938) opined that industrial pollution has vitiated beyond imagination the civilization and culture of the Orient.
Six to seven million people are added annually to urban India. At the beginning of this millennium, 285 million Indians lived in its nearly 4400 towns and cities (Census 2001). It is estimated to rise to 550 million by the year 2021 and 800 million by 2041 when it will surpass China. At that point urban India will be larger than the total population of Europe (NIUA 2000)

Sarkar (1994) opined that the public transportation systems in Mumbai are fully saturated. The congestion on roads is largely due to the unchecked rise in the number of private vehicles.

Air pollution in urban areas has assumed alarming proportions. More than 90 per cent of the national monitoring stations have recorded particulate concentrations exceeding the World Health Organization (WHO) recommended guidelines (TERI 2003).

The Energy and Resources Institute (TERI 1998) estimated the incidence of mortality and morbidity in different groups in India due to exposure to PM10 and translated these impacts into economic values. The results indicated 2.5 million premature deaths and total morbidity and mortality costs of Rs 88,500 crore to Rs 4,25,000 crore annually.

A Report on the Environmental Status of Mumbai Region (2006) put forth by the Maharashtra Pollution Control Board (MPCB) has estimated that on an average 60% of air pollution in Mumbai is caused by auto-emission. Therefore vehicular pollution is a major contributing factor in causing air pollution in the city environment.

NEERI (2010) in their study of Mumbai City pointed out that though winter does not lead to large-scale burning of wood, as is common in Delhi, the measured concentrations of Particulate Matter are higher in Mumbai. Visibility reduction due to fine particles has started its impact in Mumbai as well, which are mainly due to the presence of fine particles in the atmosphere.

Parikh et al (1995) has pointed out in his study that rapid industrialization took place with most of the industrial clusters with exceeding high concentrations of air pollution located in the vicinity of Chembur,.

It has also been pointed out by the Report on the Environmental Status of Mumbai Region (2006) put forth by the Maharashtra Pollution Control Board (MPCB) that MSW disposal sites
are in the thickly populated areas of the city. There is no mechanical facility provided for segregation of MSW. The sites have been fully utilized and exhausted; and there is an urgent need to select new sites and adopt scientific methods for treatment and disposal of Municipal Solid Waste.

Berry (1977) in his study of Chicago city has stated that “Study of solid wastes is beset by problems”. The three problems associated with it, according to him, are waste generation, collection and disposal. He observed that waste generation varies from area to area depending upon the land-use type.

In the words of Chakraborty (1987) “all kinds of human industry dealing with material goods produce wastes”. Depending on the nature of human activities the volumes of discharged wastes vary. Technologies available for disposal of domestic wastes should be cost effective and at the same time socially acceptable. He has suggested that each municipal government has to design its own style of operation. He emphasized the management and legal aspects with the help of a study of coal using thermal power station to bring out the basic principles of waste disposal with the active involvement of waste generators.

Attarwala (1986) has elaborately discussed the disposal techniques or systems involved in solid waste disposal in Bombay while Kotkar and others (1991) have also highlighted the problems of solid waste in Bombay and indicated remedial measures. They have suggested that Refuse Derived Fuel (R.D.F) is one of the techniques to convert wastes into a resource.

According to a study undertaken by Mahadevia and Pharate (2005), the per capita generation of wastes in Mumbai is about 630 gm. per person per day (MCGM 2004). The quantity of municipal solid waste generated within Greater Mumbai is 7,800 MT per day. Of this, the waste generation in the island city itself is 48 per cent. There is higher share of the island city in the total garbage generated than its proportionate share in total population because, the island city, being major employment centre, gets a large proportion of floating population, in the day time.

Mahadevia (2005) has pointed out that there is much higher generation of construction site debris in the eastern suburbs, followed by the western suburbs and then in the island city.
There is a need to combine different methods and stakeholders in such a way so as to minimize environmental and social costs associated with waste management (Gerlagh et al, 2004).

Verma L.N. (2008), in his book on urban planning states that “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”. He also stated that by the end of this century, urban life and city’s physical environment has become 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 have made city life in India intolerable and miserable.

Fenger J. (1999) in his paper on Urban Air Quality has specified that in recent decades in industrialized western countries the levels of SO$_2$ and soot has reduced. However, the increasing traffic has switched the focus onto NOx, organic compounds and fine particles.

NEERI (2010) has also pointed out that it is important to note that high load contribution does not necessarily lead to high ambient contribution of a particular source at the receptor site. This is due to the fact that emission distribution in atmosphere depends upon multiple factors such as local meteorology, location, height of release, atmospheric removal processes and diurnal variation. Further, it is equally important that fine particles which constitute higher fractions of toxics are mostly released at ground level sources such as vehicles, refuse burning, bakeries-crematoria, road side eateries, airport and railways ground operations etc.

Studies carried out over the past decade indicate that Mumbai is likely to be highly vulnerable to climate change.

Deshmukh (1997) argues that the rapid rate of disappearance of mangroves, especially on account of changes in landuse, requires urgent attention and efforts have to be directed to protect representative areas for long-term studies and research. Vast stretches of mangroves were
destroyed by dumping heaps of garbage on them and by converting the mangrove areas into dumping grounds.

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.

Goenka (1992) observed that liquid sewage continues to be discharged into the Arabian Sea without being treated.

The growth of Municipal Solid Waste (MSW) has outpaced population growth in recent years as a result of changing lifestyles, food habits, and rising living standards (GOI 2002). About 48 million tonnes of solid waste are generated in the urban areas every day, an eight-fold increase since independence (CPCB 2000). Of this not more than 72 per cent is collected daily, which leads to accumulation and decomposition of the waste in public places with adverse effects on public health.

Seventy per cent of Indian cities have inadequate waste transportation facilities resulting in littering during collection and transportation. The landfill sites too are seldom managed in an environmentally acceptable manner and are prone to groundwater contamination because of leachate production according to TERI (2003).

Pachauri (1993) considers that in the future, international relations will be dominated by ecological concerns and issues; negotiations would pertain to safeguarding the earth’s environment. Developing countries must accept this as otherwise they are the greatest losers. India must take the lead since the country has the basic skills and infrastructure for meaningful research and since it is a major developing country it can play a key role in global negotiations.

The World Development Report (1992) has rightly observed that many cities generate more solid wastes than they can collect or dispose off. However, increase in volume of solid waste is correlated to income levels.

Garg (1991) has pointed out a possible solution to the problem of solid waste and its disposal.
Idris et al., (2004) has pointed out that the annual waste generation has been observed to increase in proportion to the rise in population and urbanization, and issues related to disposal have become challenging as more land is needed for the ultimate disposal of these solid wastes.

According to a NEERI Report (2005), 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.

A number of studies (Sita&Phadke, 1984; Gupta & Prasad, 1996) had shown that the spatial distribution of population in Mumbai had undergone significant changes, particularly since 1961. The decrease in the relative share of population of the Island city continued. The trend towards suburbanization was very apparent, with the share of the suburbs increasing from 60% in 1981 to 75% in 2011.

The population density of 39,446 persons per sq.km (excluding no development area) makes Mumbai the most densely populated city in India (Environment Status of Brihan-Mumbai, 2010-11).

A very visible aspect regarding population distribution is the high proportion living in the slums. These are fairly widespread and account for over 50% of the population with the main concentration in the suburban zone. Various efforts have been made to tackle the slum issue (Sharma 1996).

According to a Report of the Ministry of Environment and Forests (2000), the challenge of managing municipal solid waste (MSW) in an environmentally and economically sustainable manner is bound to be an uphill task with India’s urban population slated to increase to about 600 million by 2030. 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 quadruple by 2047.

As per the findings of a study on Sustainable Solid Waste Management in India (2012) it has been pointed out that open burning of solid wastes and landfill fires emit nearly 22,000 tons per year of pollutants into the air in the city of Mumbai alone. These pollutants include Carbon
Monoxide (CO), Hydrocarbons (HC), Particulate Matter (PM), Nitrogen Oxides (NOx) and Sulphur Dioxide (SO2) as well as a large amount of dioxins/furans. Open burning was found to be the largest polluter in Mumbai, among the activities that do not contribute any economic value to the city. Since open burning happens at ground level, the resultant emissions enter the lower level breathing zone of the atmosphere, increasing direct exposure to its residents.