Population, Urban Environment and Health in India

Abstract

The state of human health globally serves as a key indicator for the conditions of the natural environment and the success of sustainable development. Sound development is not possible without a healthy population. Many development activities affect the environment in a way that typically causes or exacerbates health problems. At the same time, a lack of development adversely affects the health of many people. Environmental pollution is one of the serious problems faced by the people in the country. Rapid population growth, industrialization and urbanization accompanied by growing number of vehicles in country are adversely affecting the environment. Though the relationship is complex, population size and growth tend to expand and accelerate these human impacts on the environment. All these in turn lead to an increase in the pollution levels. However, environmental pollution not only leads to deteriorating environmental conditions but also have adverse effects on the health of people. India is one of the most degraded environment countries in the world and it is paying heavy health and economic price for it. The present paper is an attempt to discuss the issues and implications of population on environment and health of the people. The secondary analysis conducted of changes and trends over last fifty years. The analysis reveals that rapid population growth plays an important role in environmental problems of the country, from air and water pollution to the spread of disease. The considerable magnitude of air and water pollution pulls up the number of people suffering from respiratory and water borne diseases and many a times leading to deaths and serious health hazards. The analysis suggests that there is urgent need to control population and environmental pollution in the country for better quality of life and health of present and future generation. The importance of population, urban environment and health has been highlighted. The paper concludes with some policy reflections. The policy aimed at overall development should certainly include efforts to control population and protect urban environment for better quality of life and health of present and future generation.

Population, Environment and Health in India

Introduction

The state of human health globally serves as a key indicator for the conditions of the natural environment and the success of sustainable development. Sound development is not possible without a healthy population. Many development activities affect the environment in a way that typically causes or exacerbates health problems. At the same time, a lack of development adversely affects the health of many people. Environmental pollution is one of the serious problems faced by the people in the country, especially in urban areas, which not only experiences a rapid growth of population due to high fertility, low mortality and increasing rural-urban migration, but also industrialization which is accompanied by growing number of vehicles. In India, the rapid increase of human numbers combines with desperate poverty to deplete and pollute local resource bases on which the livelihood of present and future generations depends. Though the relationship is complex, population size and growth tend to expand and accelerate these human impacts on the environment.

According to the World Development Indicators report in 1997, 1.5 billion people live exposed to dangerous levels of air pollution, 1 billion live without clean water and 2 billion live without sanitation. The increase of population has been tending towards alarming situation. The world's population was estimated to be 6.14 billion in mid 2001 and projected 7.82 billion and 9.04 billion in the year 2025 and 2050 respectively. Contribution of India alone to this population was estimated to be 1033 millions in mid 2001 which has been projected 1363 millions and 1628 millions in 2025 and 2050 respectively. (2001 World Population Data Sheet). According to the provisional results of the Census of India 2001, the population of India on 1st March 2001 is 1027 millions. If the world population continues to multiply, the impact on environment could be devastating.

Population impacts on the environment primarily through the use of natural resources and production of wastes and is associated with environmental stresses like biodiversity, air and water pollution and increased pressure on arable land. India is the world's sixth largest and second fastest growing producer of greenhouse gases. Delhi, Mumbai and Chennai are three of the world's ten most polluted cities. Two-thirds of city dwellers lack sewerage, one-third lack potable water. India grows equivalent of another New York City every year in its urban population. By the year 2000, more than 350 million Indians will live in cities. In 15 years, more than half of Indians will be urban dwellers; 1/3 will be slum dwellers and squatters (downloaded from http:// www.usaid.gov/in/programareas/environm.htm).

India is one of the most degraded environment countries in the world and it is paying heavy health and economic price for it. According to a World Bank sponsored study, estimated environmental damage in the year 1992 amounted to about US $ 10 billion or Rs. 34,000 crores, which is 4.5 % of GDP. Urban air pollution costs India US $ 1.3 billion a year. Water degradation leads to health costs amounting to US $ 5.7 million every year, nearly 60 percent of the total environmental cost. Soil erosion affects 83 to 163 million hectares of land every year. Beside, land degradation leads to

productivity loss equal to US $ 2.4 billion or 4 to 6.3 percent of the agricultural productivity every year (UNDP 1998).

The lack of services such as water supply, sanitation, drainage of storm water, treatment and disposal of waste water, management of solid and hazardous wastes, supply of safe food, water and housing are all unable to keep pace with urban growth. All these in turn lead to an increase in the pollution levels. Also the unplanned location of industries in urban and sub-urban areas followed by traffic congestion, poor housing, poor drainage and garbage accumulation causes serious pollution problems. However, all these factors together not only lead to deteriorating environmental conditions but also have adverse effects on the health of people. Pollution related diseases infect the peoples in environment-polluted areas. Due to air pollution the incidence of respiratory diseases lead to increase and water pollution triggers the number of patients suffering from acute water borne diseases. Hence it has been the main areas of concern for demographers, ecologists, planners and policy makers over the recent past. The present paper is an attempt to discuss the issues and implications of population on environment and health of the people.

Demographic Characteristics of the Population of India

India is the second most populous country in the world after China. India supports 16.87 percent of the world's population on its meager 2.4 percent world surface area of 135.79 million square kms. The selected demographic characteristics of the population of India are presented in Table 1. At the time of independence country's population was 342 million. The country's population size had grown from 361 million in 1951 to around 846 million in 1991 and 1027 million in 2001. The population of India almost tripled during the period of 1951-2001. The phenomenal increase in the population during the last fifty years has led to rapid industrialization and high rate of urbanization which have created tremendous pressure on natural resources like land, air and water. The urban population has increased three and half times, from 62.4 million in 1951 to 217.6 million in 1991 and it again increased to 288 million in 2001. The percentage of urban population increased from 17.28 percent in 1951 to 23.33 percent in 1981, 25.71 percent in 1991 and which further increased to 28 percent in 2001. The decadal growth rates of the population are irregular, as it increased from 13.31 percent in 1951 to 24.8 percent in 1971 and afterwards it marginally declined to 24.7 percent in 1981, 23.9 percent in 1991 and 21.34 percent in 2001. The urban growth lead to an increase in the pollution levels and exposes population to serious environmental health hazards. Environmental pollution in urban areas is associated with excessive morbidity and mortality. Overcrowding and inadequate housing contribute to pollution related diseases such as respiratory diseases, acute water borne diseases, tuberculosis, meningitis and various other diseases. Lack of opportunities for gainful employment in villages and the ecological stresses is leading to an ever-increasing movement of poor families to towns. Mega cities are emerging and urban slums are expanding. There has been three and half times increase in urban population over 1951-1991. During the past two decades of 1971-91, India's urban population has doubled from 109 million to 218 million and is estimated to reach 300 million by 2000 AD. Such rapid and unplanned expansion of cities has resulted in degradation of urban environment. It has widened the gap between demand and supply of infrastructure services such as energy, housing, transport, communication, education, water supply and sewerage and recreational activities, thus depleted the precious scarce environmental resource base of the cities. The result is the growing trend in air and water quality, generation of

wastes, and the proliferation of slums and undesirable land use changes, all of which contribute to urban poverty.

Poverty is said to be both cause and effect of environment degradation. The poor people, who rely on natural resources more than the rich, deplete natural resources faster as they have no real prospects of gaining access to other types of resources. Poorer people, who cannot meet their subsistence needs through purchase, are forced to use common property resources such as forests for food and fuel, pastures for fodder, and ponds and rivers for water. Clean drinking water facility through taps is available to only 35 percent of urban households and 18 percent of rural households in India. Other residents use unsafe water sources like wells, ponds and rivers. Population pressure driven overexploitation of the surface and underground water resources by the poor has resulted into contamination and exhaustion of the water resources. Urban population is also using rivers to dispose of untreated sewage and industrial effluent. The result is that health of those dependents on untreated water resources is increasing at risk. In the absence of capital resources, the poor are directly dependent on natural resources. Moreover degraded environment can accelerate the process of impoverishment, again because the poor depend directly on natural assets. Although there has been significant drop in the poverty ratio in the country from 55 percent in 1973 to 36 percent in 1993-94, the absolute number of poor have, however, remained constant at around 320 million over the years. Acceleration in poverty alleviation is imperative to break this link between poverty and the environment. The poverty and rapid population growth are found to coexist and thus seems to reinforcing each other. It also contributes to environmental degradation through over exploitation of natural resources like land, air and water. The deterioration of natural resources and unsafe living conditions affects the environment and health of the poor people.

Changing Consumption Patterns

The economic and industrial development is inevitably accompanied by changing patterns of consumption. The number of registered motor vehicles in India provides one useful indicator of expanding consumption and economic growth. The increasing vehicles in country, producing more air pollution, fuel consumption, traffic jams and demands for road construction-often at the cost of agricultural land. Table 2 presents the registered motor vehicles in India during 1950-51 to 1995-96. The total number of registered vehicles in India has increased from 3 million in 1950-51 to more than 33 million in 1995-96, of which about 28 percent are concentrated in the 23 metropolitan cities of India (Transport Statistics of India, 1997). The number of registered two wheelers rose from just 0.27 million in 1950-51 to more than 231 million in 1996. The number of cars, jeeps and taxis also registered an increase from 1.59 million in 1950-51 to 41.89 million in 1996. The number of registered trucks and buses also registered an increase from 0.82 million in 1950-51 to 17.85 million in 1996 and 0.34 million in 1950-51 to more than 4.49 million in 1996 respectively. The major share is contributed by metropolitan cities in all registered vehicles in the country. The population of India in 2000 was just over 1 billion, and there were about 10 motor vehicles for every 1000 people, or a total of roughly 10 million motor vehicles in the country. In 2020, the population of India will be about 1.3 billion, and there will be about 44 motor vehicles for every 1000 people, making a total of 57 million vehicles (Energy Information Administration, 2001). An increase in vehicular pollution is associated with a number of environmental problems like air pollution and global warming. In most urban areas of India, air pollution has worsened due to traffic congestion, poor housing, poor sanitation and drainage and

garbage accumulation. The environmental effects of fuels like oil and petroleum products are of growing concern owing to increasing consumption levels.

As a result of urbanization in India, pressure on urban transport is likely to increase substantially in this new millennium. It has been attempted to evaluate the future transport scenario to forecast the vehicle air pollution levels. Following are some of the points of due consideration:

- India is expected to have 31 metro cities by 2001 and 51 by 2021.
- The number of vehicles on Indian roads is estimated to increase by nine times by the tune of the century out of which 65 % to 70 % shall be two wheelers or three wheelers.
- Urban transport demand is expected to grow by 2.6 times by 2016 at the existing model split in larger medium sized cities.
- At the existing model split, the urban air quality is expected to deteriorate faster in the 21st century, as two-wheeler population would be as high as 86.13 % of the total vehicles used for passenger transportation.
- By the year 2001, CO emission levels are likely to rise seven times and that of hydrocarbons by nine times. The levels of other major pollutants are expected to go up five fold (Luthra, 1999)

Rising Demand for Energy

The environmental effects due to increasing consumption levels of fuels like coal; lignite, oil and nuclear etc. are of growing concern to various researchers. The combustion of these fuels in industries has been a major source of pollution. Coal production through open cast mining; its supply to and consumption in power stations and industrial boilers leads to particulate and gaseous pollution, which can cause pneumoconiosis, bronchitis and respiratory diseases. The energy production/ consumption in India during 1950-51 to 1995-96 is depicted in Table 3. Energy production and consumption has increased steadily in India since 1950 onwards. The production of coal and lignite has increased from 32.2 million tons in 1950-51 to 292.27 million tons in 1995-96, an increase of more than 9 times. The production of petroleum products registered an increase of more than 22 times, from 3.3 million tons in 1950-51 to 74.7 million tons in 1995-96.

The bulk of commercial energy comes from the burning of fossil fuels viz. coal and lignite in solid form, petroleum in liquid form and gas in gaseous form. In addition to emission of greenhouse gases, the burning of fossil fuels has led to several ecological problems and associated with health problems like cancer risk, respiratory diseases and other health problems. Burning of traditional fuel adds a large amount of carbon-di-oxide into atmosphere and increases air pollution.

The production of electricity has increased from 5 billion KWH in 1950-51 to about 380 billion KWH in 1995-96. The shares of thermal power and hydropower changed substantially. The share of thermal power has increased from 51 percent in 1950-51 to about 79 percent in 1995-96 whereas the share of hydropower declined from 49 percent in 1950-51 to 19 percent in 1995-96. The share of nuclear power is nominal. This clearly indicates that burning of fossil fuels,

especially coals, emits lot of carbon di oxide in the atmosphere and leads to global warming. The increasing population numbers and growing affluence have already resulted in rapid growth of energy production and consumption in India, and this trend can only be expected to accelerate in the future. A considerable amount of air pollution results from burning of fossil fuels. Moreover the resources for fossil fuels are also limited thus exploration of alternate energy resources would provide the way out.

Environmental Challenges

The term Environmental Pollution refers to ways by which people pollute their surroundings, air with gases and smoke, poison the water with chemicals and other substances, and damage the soil with too many fertilizers and pesticides. Also pollute the surroundings in various other ways. Environmental degradation is a result of the dynamic interplay of socio-economic, institutional and technological activities. Environmental changes may be driven by many factors including economic growth, population growth, urbanization, intensification of agriculture, rising energy use and transportation. Poverty still remains a problem at the root of several environmental problems. Population growth and economic development are contributing to many serious environmental problems in India. These include air pollution, water pollution and global warming and climate change. Human beings are at the center of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.

Air Pollution and Health

The World Health Organization (WHO) defines air pollution, as "substances put into the air by the activity of mankind into concentrations sufficient to cause harmful effects to health, property, crop yield or to interfere with the enjoyment of property". Air pollution is a major environmental health problem affecting the country. The pollutants consist of gaseous pollutants and suspended particulate matter, such as dust, fumes, mist and smoke (Table 4). Some of the most important air pollutants are suspended particulate matter (SPM), nitrogen oxides (NO_X), carbon monoxide (CO), lead, sulphur dioxide (SO_2) etc. (Table 5). The urban air pollution has grown across India in the last decade is alarming. The main factors accounts to urban air quality deterioration are growing industrialization and increasing vehicular pollution, industrial emissions, automobile exhaust and the burning of fossil fuels kills thousands and lives many more to suffer mainly from respiratory damage, heart and lung diseases. With population growth, increased energy generation, industrialization and increased vehicle use, outdoor air pollution has worsened in most metro cities in India.

According to pollution related studies in the community and patients at the K.E.M. Hospital, Mumbai over the last twenty years have evaluated the full extent of the correlation and damage to human health (Kamat and Mahasur, 1997). It is found that the area around RSP village, Jharia ranks fifth and FCI (Fertilizer Corporation of India) Hospital, Sindri ranks eighth among the top ten locations with highest annual mean concentrations of Nitrogen Oxides (NO_X), having 54 and 46 micro grams per cubic meters respectively. Apart from this, the suspended particulate matter (SPM) level in RSP College, Jharia is the fourth highest in India (Anon 1995). A study conducted by Center for Science and Environment from 1987 to 1998, to understand the trend of

air pollution in Delhi based on three major pollutants: sulphur dioxide, nitrogen oxide and SPM. It shows an increasing trend, though fluctuations are noticed in terms of annual maximum levels. According to the studies conducted by Center for Science and Environment, total SPM levels are not only always above the standard but there are days when they have reached nearly seventeen times the standard. A World Bank study conducted in 1995 revealed that if the air pollution is controlled in Calcutta according to the guidelines of World Health Organization (WHO), lives of 5726 persons may be saved from premature death and of 30 lakhs people may also to be saved to be admitted to hospital.

The World Health Organization (WHO) defines health as a state of complete physical, social and mental well-being and not merely the absence of disease or infirmity. The enjoyment of the highest attainable standard of health is one of the fundamental rights of every citizen in the country. The main factors accounts to urban air quality deterioration and health are growing industrialization and increasing vehicular pollution, industrial emissions, automobile exhaust and the burning of fossil fuels kills thousands and lives many more to suffer mainly from respiratory damage, heart and lung diseases. An automobile exhaust accounts a sizable part of pollution. Their effect on human health is particularly of concern. There is a strong correlation between average blood lead levels and the lead content in gasoline. Hydrocarbons present in the exhaust, particularly, in vehicles with poor combustion cause respiratory problems. Table 6 shows estimated annual episodes of illness and premature deaths due to ambient suspended particulate matter (SPM) in the air in mega cities of Calcutta, Chennai, Delhi and Mumbai have risen significantly in less than five years.

In the countryside, nitrates from animal waste and chemical fertilizers pollute the soil and water, and in the cities, the air is contaminated with lead from vehicle exhaust. In India's largest cities-Mumbai and Delhi-about one-half of children under age 3 show signs of harmful exposure to lead, defined as to or more micrograms of lead per deciliter of blood (IIPS and ORC Macro, 2000) The indoor air pollution may pose an even greater hazard for human health. Cooking and heating with wood, crop residues, animal dung, and low-quality coal produce smoke that contains dangerous particles and gases. When fuels such as these are burned indoors, using inefficient stoves and poor ventilation, they can cause tuberculosis, other serious respiratory diseases, and blindness (Mishra, Retherford and Smith, 1999). About 15 to 18 million children in developing countries are affected by high levels of lead in their blood, which could be the result of emissions from vehicle exhaust and are likely to suffer from related illness (Kapoor, 1997). The WHO estimates that 84.000 deaths were directly attributable to outdoor air pollution in Indian cities (WHO, 1996). At the same time, indoor air pollution accounted for 496,000 deaths in villages and 93,000 deaths in cities (WHO, 1997). The health links to air pollution are considerable. In fact, indoor air pollution from cooking and heating with unsafe fuels has been designated by the World Bank as one of the four most critical environmental problems in developing countries. Central Statistical Organization shows that the urban air pollution has grown across India in the last decade is alarming.

Water pollution and Health

Water is among the most essential requisites that nature has provided to sustain life on earth. About 80% of earth's surface is covered by water. The deteriorating quality of water is creating various problems for the mankind. The growth in population, about 90 percent of which will occur in urban areas, will also increase the demand for water for domestic and industrial use and treatment of wastes. Water pollution from domestic and human wastewater is the main cause for much severe water borne diseases. The industrial water pollution is due to inadequate measures adopted in the industry for the abatement of pollution. Inadequate disposal of urban waste and open dumping of garbage contaminates surface and ground water.

Water and sanitation services are basic necessities of a community and are most essential conditions for development, as they play an important role in improving health and quality of life. Inadequate water and sanitation coverage is one of the most serious environmental problems (Sumeet, p 123). It has been estimated that 80 percent of the diseases in the world are associated with water usage or poor environmental hygiene (Sumeet P. xvii). In India, water pollution comes from three main sources: domestic sewage, industrial effluents and run-off from activities such as agriculture. The large-scale use of pesticides may have revolutionized food production, but these chemicals are responsible for more than 2 million human poisonings every year with a resultant 20,000 deaths (WHO, 1986).

Polluting a river is dangerous because generally, rivers are the primary source of drinking water for towns and cities downstream of the point of pollution. Broadly, the causes of water pollution can be attributed to:

- Urbanization
- Industrialization
- Withdrawal of wastes
- Agricultural run-off and improper agricultural practices
- Religious and social practices

According to the scientists at the National Environmental Engineering and Research Institute, a staggering 70% of the available water in India is polluted. Only five states, Maharashtra, Gujrat, Delhi, Uttar Pradesh and West Bengal, generate more than 63% of the total wastewater in India as they lack treatment facilities (Down to Earth, July 15, p.19). Sewage generated from 25 heavy polluting cities and towns account for about 75 percent of the pollution load in the river. The Yamuna with 200 million litres of untreated muck being dumped in it everyday by Delhi's Sewerage System has become one of the most polluted rivers in the world (Down to Earth, June 30, 2000, p.55).

The increasing river water pollution is the biggest threat to public health. The diseases commonly caused due to polluted water are cholera, diarrhoea, hepatitis, typhoid amoebic and bacillary, dysentery, guineaworm, whereas scabies, leprosy, trachoma and conjucvitis are some of the diseases associated with water scarcity. All these could be attributed to the rapidly increasing population and lack of water resources. Inadequate access to safe drinking water and sanitation

facilities leads to higher infant mortality and intestinal diseases. More than one million children died due to diarrhoea and other gastrointestinal disorders in 1990s. In addition, around 90 lakh cases of acute diarrhoeal diseases have been reported in India, Uttar Pradesh reporting the highest number of cases (Central Bureau of Health Investigation, 1996). It is estimated that 73 million workdays are lost every year due to water related diseases. The cost of treating them and the loss in production amount to Rs. 600 crores a year (Citizen's Report, 1982).

Global warming and climate change

The country's large population and rapidly increasing energy use plays an important and growing role in global warming. Global warming can have major physical, environmental and socio-economic consequences, which can be both positive and negative. The estimation of these impacts is complex and marked with uncertainties. Climate change would cause changes in precipitation patterns, ocean circulation and marine systems, soil moisture, water availability, and sea level rise. These would make an impact on agriculture, forestry and natural eco-systems like wetlands and fisheries. Also with rising temperatures, and subsequent increasing heat stress and alternation in patterns of vector-borne diseases, the global population would be more vulnerable to health problems, causing disruptions in settlement patterns and large-scale migration. All these would have significant socio-economic consequences (Compendium of environment statistics, 2000).

Policy implications

From the various effects of population growth on urban environment and health of the human beings, discussed in this paper, it appears that if human beings want to exist on earth, there is now high time to give top priority to protect urban environment. The creation of employment opportunities is essential in areas with high poverty and unemployment. Poverty also affects the demographic characteristics of the population and hinders the transition to slower population growth. Unless significant measures are taken to incorporate environmental concerns into development, urban planning, technological innovations, industrial growth, and resource management, the situation is likely to worsen in the future. Efforts to protect the environment requires a range of actions, including conservation of resources, introducing new technology, and taking economic and legal measures to prevent and clean up pollution. In addition, the slowing population growth can reduce the stress on the environment and in the country; there is an urgent need to reduce fertility. Further, measures to control air pollution should be intensified throughout the country. Wastewater treatment plants be established in accordance with the need of time and its usage should be encouraged. The heavy penalty should be imposed on industries disposing off the wastes into the river. Moreover, the landfills are to be properly managed to prevent ground water contamination. Since slums are one of the major sources of water pollution proper measures should be taken to facilitate the slums with water and sanitation facilities. Special efforts should be made for informing and educating the people and local leaders about the adverse effects of large population through specially designed Information, Education and Communication (IEC) activities. There is a need for preventive and curative measures to control air pollution. More emphasis should be laid on compulsory environmental education at the school level in order to make people aware of the environment protection. The environment protection should not be a responsibility of government alone but local people and leaders should

be encouraged to make dedicated efforts to eradicate the environmental problems.

Summary and conclusions

Rapid population growth continues to be a matter of concern for the country as it has manifold effects, one of the most important being environment degradation. The outcomes of excessive population are industrialization and urbanization accompanied by increasing number of vehicles. The study reveals that the considerable magnitude of air pollution in the country pulls up the number of people suffering from respiratory diseases and many a times leading to deaths and serious health hazards. The situation is also similar for water pollution, as both ground water and surface water contamination leads to various water borne diseases. From the various effects of environmental degradation on health of human beings, discussed in this paper, it appears that if human beings wants to exist on earth, there is now high time to give top priority to control pollution of all types for a healthy living. It can be said that even after fifty years of independence, India is unable to achieve the desirable standards of health for its population as consequences of environment degradation.

To sum up, it may be emphasized that the environment is neither a free gift of environmental goods and services, nor it can be thought of as just a sink for depositing of waste products from houses, industries and other sources. It is the need of time to protect environment for quality of life and health of present and future generation.

Table 1: Selected demographic characteristics of the population of India, 1951-2001

Year	Population (in millions)*	Decadal Growth Rate (%)*	Urban Population (in million)*	% of Urban Population to total population*	Density (Per Sq. Kms.)*	% of Population below poverty line**
1951	361.1	13.31	62.4	17.28	117	54.88[1]
1961	439.2	21.64	78.9	17.96	142	51.32[2]
1971	548.2	24.80	109.1	19.90	177	44.48[3]
1981	683.3	24.66	159.4	23.33	210	38.86[4]
1991	846.3	23.86	217.6	25.71	267	35.97[5]
2001	1027	21.34	287.6	28	324	

Source: * Census of India, Provisional Population Totals, 2001.
** Planning Commission Estimates refers to following periods:

[1] 1973-74,
[2] 1977-78,
[3] 1983,
[4] 1987-88,
[5] 1993-94

Table 2: Registered motor vehicles in India. (in thousands)

Year	Two Wheelers	Cars, Jeeps And Taxis	Trucks	Buses	All Vehicles
1950-51	27	159	82	34	306
1955-56	41	203	119	47	426
1960-61	88	310	168	57	665
1965-66	226	456	259	73	1099
1970-71	576	682	343	94	1865
1975-76	1045	779	351	115	2669
1980-81	2599	1147	542	159	5336
1985-86	6207	1758	848	223	10490
1990-91	14047	3013	1411	333	21310
1991-92	15026	3130	1425	341	22583
1992-93	15241	3194	1538	354	19973
1993-94	18338	3617	1650	419	23605
1994-95	20831	3840	1793	423	30294
1995-96	23111	4189	1785	449	33557

Source: India Development Report, 1999-2000.

Table 3: Energy production/consumption in India, 1950-51 to 1995-96.

Year	Coal & Lignite (Mn Tons)	Petroleum Products (Mn Tons)	Natural Gas	Electricity (Billion KWH)			
				Total	Thermal	Hydro	Nuclear
1950-51	32.2	3.3	NA	5.1	2.6	2.5	
1960-61	55.23	7.7	NA	16.9	9.1	7.8	
1970-71	76.34	17.9	0.65	55.8	28.2	25.2	2.4
1980-81	119.02	30.9	1.52	110.8	61.3	46.5	3
1990-91	225.5	55	12.77	264.3	186.5	71.7	6.1
1995-96	292.27	74.7	20.82	379.9	299.3	72.6	8

Source: CMIE, Energy, September, 1999. Economic Survey, 1998-99, GOI.

Table 4: Some major pollutants, their sources and their related health hazards

Pollutant	Source	Effect on human health
Carbon Monoxide	Incomplete fuel combustion (e.g. two-stroke engine)	Fatal in large does: aggravates heart disorders; effects central nervous system; impairs oxygen carrying capacity of blood
Sulphur dioxide	Burning of sulphur containing fuel like coal in power plants and oil by vehicles	Affects the functions of lungs
Suspended particulate matter	Smoke from domestic, industrial and vehicular sources	Small particles are poisonous. They are carriers of carcinogenic tracer elements
Nitrogen oxides	Fuel combustion in motor vehicles, power stations and furnaces	Affects the respiratory system, Irritation of respiratory tract
Volatile hydrocarbons	Partial combustion of carbonaceous fuels (two stroke engines, industrial processes, disposal of solid wastes)	Drowsiness, eye irritation, coughing
Oxidants and ozone	Emissions from motor vehicles, photochemical reactions of nitrogen oxides and reactive hydrocarbons	Causes increased sensitivity to infections, lung diseases, irritation in eyes, nose and throat, risk asthmatics, children and those involved in heavy exercise
Lead		Nervous system slow down and brain development is retarded
Aldehydes	Emissions from motor vehicles	Irritation of eyes, nose, throat, sneezing, coughing, nausea, breathing difficulties, carcinogenic in animals
	Chemicals	

Source: Compendium of Environment Statastics, 1998 and 1999.

Table 5: State of ambient air quality in 10 metro cities of India during 1991

City	SO_2	NO_2	NH_3	H_2S	SPM	RSPM
Ahemadabad	16	7	17	1	285	122
Mumbai	27	26	51	2	226	91
Calcutta	62	39	93	4	394	180
Delhi	33	46	176	1	543	204
Hyderabad	10	19	10	2	156	56
Jaipur	8	14	29	2	338	108
Cochin	11	10	74	1	115	58
Kanpur	7	13	65	1	380	135
Chennai	8	13	33	2	101	67
Nagpur	9	9	70	1	173	82

Source: Compendium of Environment Statistics, 2000.
Note: Units are in 10^{-6} grammes per cubic meter

Table 6: Estimates of annual episodes of illness and pre-mature deaths due to ambient suspended particulate matter (SPM) in the air by metro cities of India

Metro cities	Annual episodes of illness		Annual pre-mature deaths		
	1991-92		1991-92	1995	Increase
Calcutta	3022786	5446225	5726	10647	4921
Chennai	462966	680241	863	1291	428
Delhi	3990012	5197018	7491	9859	2368
Mumbai	2579210	4005538	4477	7023	2546

Source :1. Carter Brandon & Kirsten Hommann, 1991-92, Valuing Environmental Costs in India: The Economy Wide Impact of Environment Degradation, World Bank, mimeo.

2. Anon, Tiny Killers, Down to Earth, Society for Environment Communications, New Delhi, November 15, 1997.

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