# URBANIZATION AND URBAN ENVIRONMENT : A CASE STUDY OF FOUR MEGA CITIES OF INDIA

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# CERTIFICATE

This dissertation entitled "**Urbanization and Urban Environment : A Case Study of four Mega Cities of India**" Submitted by **ZAKIR ANSARI**, in fulfilment of six credits of out a total requirement of twenty four credits for the degree of **MASTER OF PHILOSOPHY (M. Phil)** of the University. It is his original work according to the best of my knowledge. It may be place before the examiners for their consideration.

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TO

MY FAMILY

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# CHAPTER I

# INTRODUCTION

## I.1 STATEMENT OF THE PROBLEM

The world's population reached 5.4 billion in mid-1991. Of this 77 percent lived in developing countries. In the 1960's the global population was growing at about 2.1 percent annually and this has now declined to some 1.7 percent per year. The number of people added to the total world population each year now amounts to 92 million which is higher than ever before. "It is projected that world population will reach some 6.3 billion in the year 2000 and 8.5 billion in the year 2025."[1]

"Over 90 percent of the population increase today occurs in developing countries, having risen from 1.7 billion in 1950 to 4.2 billion in 1991 and expected to reach nearly 5 billion in year 2000. At present over 40 percent of the urban population in the developing countries lives in squalor, without access to essential services such as health care civic amenities and public transportation. Coping with these projected population in future poses major challenge to sustainable development and better environmental quality."[2]

Rapidly increasing population leads to increasing demand for natural resources, employment, education and social services. This will make it difficult for mankind to protect natural resources and improve living conditions. Moreover the consumption

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[1] United Nations, "The Global Patnership for Environment and Development, UNCED, Geneva, April 1992, pp.33.

[2] Ibid. p1

pattern in the developing countries is affected by "demonstration effect" leading to more extensive use of natural resources.

Industrialization and urbanization are world-wide phenomena. As the twenty-first century draws to a close urbanization has became a force throughout most of the world and has determined many of the economic, social and environmental changes that have an impact on our daily life. "There is a direct relationship between national development and the growth of large cities".[3]

Population growth in these large agglomeration has been due to natural increase, migration (especially rural to urban and urban to urban migration) and reclassification of population due to areal spread. In large agglomerations population change due to migration plays an important role.

"Large agglomerations are engine of economic growth and development and their share to GNP is increasing."[4] This is the main reason why there is a operation of "pull" and also "push" factor for migrants. Migrants hope to get better prospoects for jobs, access to education, medical treatment. However "push" facts such as poor work incentive and generally harsh living condition also initiate rural to urban migration.

Large urban agglomerations are consumers and producers of higher degree of resources and have became the economic engines for development. In the Process of higher production and consumption they contribute to pollution of natural environment in a large scale not only in urban centres but also in its hinterland and consequently on a

[3] Sivarama Krishnan K.C., 1978, Indian Urban Scene, Indian Institute of Advanced Study, Simla.

[4] Ibid p2

global scale. "Cities require the concentration of food water and fuel on a scale not found in nature. Just as nature cannot concentrate the resources needed to support life, neither can it disperse the waste produced in cities. The waste output of even a small city can quickly overtax the absorptive capacity of local terrestrial and aquatic ecosystem."[5]

Urban environmental degradation has been an inbuilt syndrome of urban growth. Large scale industrialisation, massive rural to urban migration and inadequacy of shelter and related infrastructure of water and sewerage, as well as the efficiency of transport and other public services have created serious social and environmental problems in urban centres of the developing world.

"The urban poor, consisting of 30 to 40 percent of residents in the cities of the developing countries, live in squatter settlements, illegal subdivisions, substandard inner-city housing, custom-built slums and boarding houses. Most housing in those categories lacks essential services and contributes to the spread of epidemic disease and physical disorder."[6]

Environmental pollution has became a serious problem to those who are living in large agglomerations, congested and industrial cities with heavy vehicular traffic. Among other sources power plants and vehicles have been major pollution of urban environment. The quality of air in large urban agglomerations have been below the standard set by the World Health Organizations Exposure to higher Exposure to

[5] Quoted in George Benneh, "Environment Consequences of Different Pattern of Urbanisation", p 159

[6] Hamza Ahmed, "Urban Settlement and the Environment in the Developing World Trends and Challenges."

higher level and duration of noise has been observed, which is mainly due to vehicular and air traffic. The noise pollution created by air traffic is however area specific.

Collection and disposal of solid waste is inadequate in large urban agglomerations. Water supply connection are frequently worn out or inappropriately installed causing enormous wastage and potential cross-pollution.

The existing urban authorities of large urban agglomerations of underdeveloped countries has not been able to cope with the rapid urban growth. They are not able to provide adequate facilities like water, housing sewage, transportation and employment.

"With increasing awareness of the environmental fact that have direct and indirect, adverse and beneficial as well as short-run and long-run impact on development process. The question is no longer generally hinged on the necessity of incorporating environmental consideration in the development process; rather the real issue at present is how to operationally incorporate environmental impact assessment in the planning management and implementation process successfully."[7]

## 1.2 Conceptual Background

The Rio Summit, in Rio de Janario, Brazil (1992) witnessed a controversial debate among developed and underdeveloped countries. The developed countries accused the underdeveloped countries for the environmental degradation. According to these countries the root cause of environmental degradation is large population size. The underdeveloped countries on the other hand accused developed countries and their

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Asit K Biswas and Qu Geping (eds; 1987), "Environmental Impact Assessment for Developing Countries, Published for the United Nations, University by Tycooly International, London, 1987

higher "Consumption level" as the root cause of environmental degradation.

But after the heat and dust raised by this plethora of allegations and counter-allegations settled down, one point was clearly visible-that higher consumption level and large population size coupled with technology level lay at the root cause of environmental degradation.[8]

That is why, I have undertaken this study to know the importance of each factor (population size, level of consumption and technology level) in deteriorating urban environmental of four mega cities of India.

### 1.3 Review of Literature

Our main interest in this dissertation is to analyse the deteriorating physical urban environment. The quality of urban environment has suffered loses due to exploitation of resources and disposal of energy and energy products. The deterioration of physical environment in urban centres is very grave. This is because the qualitative components of life sustaining forces like air, water, food and space seems to be gradually reduced and are polluted.

After the first UN Conferenced on Human Environment at Stockholm, Sweden. (June 1972), there has been a proliferation of literature related to population growth, economic development and their impact on environment. In this section an attempt has been made to review the available studies from various sources. Although a clear-cut classification was not possible, an effort has been made to classify the literature according to the focus of study.

a) Population and Environment;

b) Economic Development and Environment; and

[8] United Nations (1994), "Agenda 21", Report on Rio Summit, New York, 1994

c) Various Issues of Environment.

**a) Population And Environment Studies**

Among the earlier literature, was "population, Resource and Environment: Issues in Human Ecology" by Ehrlich and Ehrlich (1970). The authors have presented a pessimistic view of the crisis posed by the explosive growth of human population. They are of the view that the people of underdeveloped countries will be unable to escape from poverty and misery unless their population is controlled. Since this population growth rate is high it is expected that conditions are going to get steadily and rapidly worse. Today these countries have larger population than they can support given their natural resources. On the other hand developed countries as their struggle to maintain affluence level and grow more food degrade the environment through mass consumption. Stolnitz (1991) has also expressed the above ideas.

Similarly Jolly (1994) has analysed four current theories of the relationship between population change and the environment, particularly land use in developing countries. Population growth plays a different role in each of these theories.

1. For the neoclassical economist, high *population growth is a neutral factor*; it has no intrinsic effect on environment. How population growth affects environment depends on whether free market policies are operative? In an efficient market, population growth can serve to induce innovation and the development of advanced technologies. In an economy full of distortion, high population growth can exacerbate the effects of these distortions.

2. For classical economists, *high population growth is an independent factor* causing environmental degradation. Increasing population puts pressure on

fixed available resources to maintain or increase the population's standard of living. Environmental degradation occurs as resources are depleted.

2. For many dependency theorists, *high population growth is a symptom* of a deeper problem, poverty. Environmental degradation and high population growth are linked, not because one causes the other but because their root cause is same namely, unequal distribution of resources.

3. For analysts that see population as a proximate determinate, *high population growth is an exacerbating factor*. It strengthens the effects of the ultimate cause on environmental degradation. The degree to which these causes, such a distortionary any policies and polluting technologies damage the environment is intensified by the number of people.

**b) Economic Development and Environmental Studies**

Ghosh (1984) has discussed and analysed the current trend in the development of effective policies related to population, resources and environment of Third World Countries- He tried to evaluate the progress made by them during the past decade in attaining long term objectives of a sustained economic growth and improvement in the quality of living for future generations.

Singh (1988) put forth both the positive and negative consequences of industrial development near the urban areas. He also examined the deteriorating quality of urban environment as well as human health due to air, water and noise pollution on the one hand and heavy immigration to cities (e.g. a heavy influx of migrants especially from rural to urban areas) on the other.

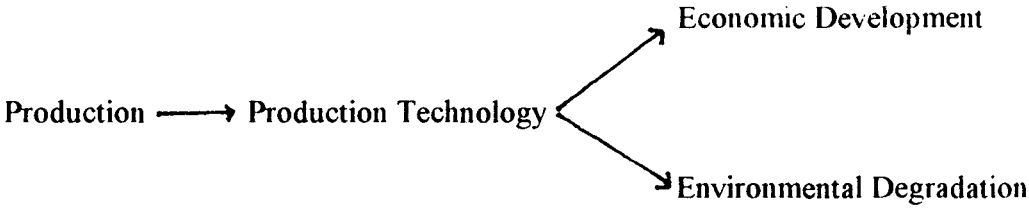
development and environment so much so that a non-concommittant concentration of efforts on one negates the importance of others and results in distortion and disequilibrium. In effect the implication is that environmental problem per se are those that could be overcome by the development process. However, development without goal-oriented objectives will create in the long run environmental problem of resource deterioration-physical and human, chemical and biological pollution.

Muzammil and Srivastava (1991) in their monograph sets out to analyse the inter-relationship among population, resource, environment and development in the Indian Context. The authors hold the view that the major problems encountered in the field of environment in India arise due to poverty and underdevelopment and also the negative effect of development programmes which have been badly planned or badly implemented. Since the whole planning process is aimed at immediate economic development and instantaneous removal of poverty, those concerned with developmental activities loose sight of ecological and environmental imperatives.

Commener (1992) argues that there are important relations linking population. economic development and the environment. There is however difference in opinion about the nature of those linkages and what guidance they can provide for policy options? A common view of the relations among them is that the need of population are met by economic development which in turn causes environmental degradation. Thus

Population ⟶ Economic Development ⟶ Environmental Degradation.

However this approach omits the basic human action that is a necessary precursor to economic development the creation of the means of producing the goods, that generate wealth. It is this intermediary function the technology of production- that leads in parallel to both economic development and environmental degradation. Thus more accurately,




Selden and Song (1992) and Holtz-Eakin and Selden (1992) in their studies tried to correlate gross national product (GNP) with pollution level. According to them environmental degradation and income have inverted U-shaped relationship, with pollution increasing with income at low levels of income and decreasing with income at high level of income. This view was further supported by the World Bank (1992), except for pollutants like carbondioxide.

Bongaarts (1992) accepts that global warming due to emission of various greenhouse gases will have enormous economic and ecological consequences. That is why emissions of various gases should be reduced or stabilized, particularly in the developed countries. But not only the developed countries but also the developing countries should make efforts to curb the emissions of greenhouse gases, because in the recent future they will become major emitters of these gases.

Smith and Lee (1993) put forward the idea of "risk transition". According to them, the cities of currently economically developed countries have gotten "dirty" first.

However after a certain level of prosperity have been achieved, environmental improvement started. According to these writers as a country passes through different stages of development and as their per capita income increases, traditional risk like malnutrition, cooking fire air pollution, food spoilage, etc. decline but modern risks like automobile and industrial air pollution pesticide poisoning, ground-water pollution, radioactivity, etc. increases.

Similarly United Nations (1993) put forth that richer, more industrialised countries will not only find the integration of population, environment and development policies desirable but also easy and even essential for maintaining the quality of life for their people. On the other hand the poorest countries will find that such integration is neither a high priority nor easy, nor even perhaps possible, in view of their primary concern for food, employment and income.

Grossman and Krueger (1995) have studied the relationship between gross national products and pollution level. According to them environmental degradation and income have an invested U-shaped relationship, with pollution increasing with income at low level of income and decreasing with income at high level of income.

### c) Various Issues of Environment

The issues of Social urban environment like crime police activity have been dealt with extensively by Jones (1973). He concluded that a change in police activity have virtually no impact on changes in the incidence of eight-types of crime considered.

Berry (1974) analysed the importance of urban environmental management which was the key factor in abating environmental pollution. Booth, Weich and Johnson (1976) have studied the social urban environment. In their study they have tried to correlate crowding and urban crime rate.

Basavanappa (1976) explored the problems of slums and suggested ways to overcome these problems. Sivaramakrishnan (1978) examined the metro cities of India. Problem like water supply, sewage disposal and sanitation, scarcity of housing and slums and their living conditions have been dealt with extensively. On the same line of discussion Nagpaul (1987) illustrates the problems of India's giant cities and provide avenues to solve them. Poverty, Slums and pavement dwellers, public health and sanitation, lack of infrastructure, air, water and noise pollution are among the main problems. The provision like strategy for environmental improvement; Public and subsidized housing , reducing over urbanization through rural reconstruction. population control though family planning are some of the measures to cope up with the problem.

Faludi (1987) comprehensively evaluates the role of environmental management and planning in controlling pollution in urban areas. Acharya (1988) has dealt with slums and their living conditions. He has done a case study of slums of Bombay. Spain (1988) has dealt with the issue of social urban environment. For his study he has taken a phychological indicator viz. neighbourhood satisfaction. He concluded in his analysis that most of the American neighbour have very less interaction.

Phantumvanit and Liengcharensit (1989) described Bangok's environmental problems and the government's initiative to address them. Aspects like water pollution land subsidence and flooding, domestic and industrial solid wastes, air pollution and noise pollution have been dealt with their study. Chaing (1990) made an attempted in his paper to know the environmental impact and cost of increasing income through economic development in Malaysia.

The environmental problems of urban centres due to different patters of urban centres due to different pattern of urbanization have been discussed by Benneh (1992). He has also considered environmental problems of urban centres at different geographical scale: (a) within the house and its immediate surrounding; (b) within the wider neighbourhood; (c) the city government; (d) the region surrounding the city; and (e) at the global level.

Hamza (1992) discussed the growth and quality of urban settlement and also recommended actions for urban environmental management. According to the author, as the urban settlement of the developing world grows in size, problem arise at two environmental level. The first is the internal living environment and its immediate surroundings. The second is the outer environment that cities provide for their inhabitants.

Jacobi (1992) evaluates both the physical and Social environmental issues and also health and sanitary conditions of metropolitan cities. He had studied the problems of Sao Paulo, Brazil. The delay in solving problems of drainage in Greater Sao Paulo is contributing to the continuing high level of infant mortality. About 90 percent of the

inhabitants of Sao Paulo are served with treated water and 70 percent are connected to the sewerage system. Schelkle (et. al.) (1992) in their study tried to assess how German Development Cooperation may contribute to alleviating the housing problem of the urban poor in Indian Metropolises. This study focused on an analysis of integrated housing project in Delhi and Bombay.

The quality of life and its indicator in the urban area has been widely discussed by Bose (1992) and Swamy (1992). Mathur (1994) explores the link between urbanization and resources in the Indian Context. The author made an attempt to understand the use of resources in India cities, concentrating on two resources-ground water and fuelwood. He also described the under use and inefficient use of land in urban India. He then takes a brief look at the future scenario for India in the light of rapidly growing urban population, its large requirement of energy and other resources as well as the waste it generates. Surprisingly, however the author found no conclusive evidence of the relationship between population growth and resource depletion.

Biswas (1995) evaluate urban environmental management which is the key factor is abating urban pollution. The same discussion has been taken by Savage (1995). He has studies the urban environmental problems of Singapore and Suggested remedial measure to control it. Prasad (1995) explored that the metropolitan centres and large towns dominates the economic activity and people in large number migrate from village with the hope of sharing the 'cake'. Exploding population in all parts of the country resulted in both 'push' and 'pull' factors of rural-to-urban migration on an unprecedented scale. The millions who migrate from rural poverty ended up in urban poverty. Moving from poverty to poverty, a vast majority of migrants hope neither for

a better economic change not for a social change in their live. They end up living in slums and slum like condition without access to health, education, sanitation and development.

Ahmed (1996) described the scarcity of municipal services in Indian cities. The most important municipal service in which inadequacy is found was the supply of safe water. However, inadequacy was also found in sanitation and drainage facilities. In the absence of any major expansion of basic amenities the growing concentration of people in Indian cities like Bombay, Delhi, Hyderabad etc., great pressure exist on municipal services.

Shekhar (1996) in her paper assessed the comparative effectiveness of public services delivered to the urban poor residing in the slums in the five large and medium-sized cities in India. The cities under this study were Ahmedabad, Bangalore, Pune, Calcutta and Madras. The Urban poor in all the cities under study have identified sanitation as the most unsatisfactory public service.

Habitat II (1996) explored a variety of issues faced by urban economy ranging from poverty, housing and urbanization to environmental pollution, and environmental management and planning. The Indian report presents the problems of India. According to this report there had been significant improvement in the coverage of the population to basic human settlement related to amenities and the quality of habitats, with longer durability and increased use of market sourced materials in both urban and rural areas. At the same time, housing cost are rising, floor area per capita is falling and a growing number of people and pushed out to the formal housing market. The impact situation is reflected in proliferation of slums.

From the first section of literature reviewed there is a indication that differential rates of population growth degrade the environmental at different levels. A faster growth of population puts more pressure on the resources and consequently on the environment, than a slower growth of population.

The second section identified economic development as one of the cause of environmental degradation. Not every development process deteriorates the environment. Developmental process without an insight into environmental consideration puts pressure on the environment. Secondly, the authors are of the opinion that it is not development which is actually exerting pressure on the environment rather it is the technology of production which on the one hand leads to economic development and environmental degradation on the other. Thirdly, environmental improvement depends on the income level of an economy. Environmental degradation and income have inverted U-shaped relationship, with pollution increasing with income at low levels of income and decreasing with income at high level of income.

The third section deals with different aspects of urban environment. Issues like housing, sanitation, public health, infrastructure, slum and their environment, environmental management and planning have been dealt in this section. As population concentration takes place in a region, the residents face problems relating to housing, sanitation, public health. Urban environmental management is the key to control pollution and sustainable development of the cities.

Due to the process of urbanization, cities experience concentration of

population. Since urban areas have relatively high level of income their level of consumption is also high. Thus both large population and higher level of consumption exert pressure on the environment. Since cities are the engine of economic growth use certain level of technology for production of goods and commodities, increase the usage of resources, leading to pollution of the environment.. Thus urban environment is degraded due to three factors namely population size, affluence and level of technology. The main aim of this dissertation is to understand and evaluate the relative importance of each of these factors.

## I.4 CHOICE OF STUDY AREA

Since the main objective of the study is to analyse the impact of population growth and urbanization on environment, four mega cities of India has been taken into consideration. These were Greater Bombay Urban Agglomeration, Calcutta Urban Agglomeration, Delhi Urban Agglomeration and Madras Urban Agglomeration. Each of these UA's have a population of more than 5 million in 1991. The main reason for their selection are high absolute population locate in space and high population density.

## I.5 OBJECTIVES

The main objectives of this thesis are :

i) To study the state of physical environment of the four mega cities of India;

ii) To analyse the process and pattern of urbanization in four mega cities of India;

iii) To show the relative importance of population, consumption level and technology in a deteriorating urban environment; and

iv) To analyse the changes in the level of pollution in mega cities of India since

1970's:

v) To suggest possible solutions for the urban crisis with a focus on the management and policy framework.

## I.6 DATABASE

For this study, the data was collected from the following secondary sources:

i) Census of India;

ii) Statistical Abstract of India and various state;

iii) Handbook of statistics – of various states;

iv) Reports of Central Pollution Control Board;

v) Reports of Central Board for the Prevention and Control of Water Pollution; and

vi) Report of National Environmental Engineering Research Institute.

## I.7 DATA LIMITATIONS

The quality of my work would have increased significantly, if there would have been no scarcity of environmental data. Moreover city level data on per capita consumption or per capita GNP is not available. Environmental data namely (petrol, diesel, kerosene etc.) consumption is not available. However CPCB in 1989 published data on consumption of petrol and diesel in metropolitan cities of India. Data related to type and number of units of industries were also not available.

## I.8 METHODOLOGY

The methodology includes tabulation and analysis of data and depiction of information through suitable cartographic techniques. To measure the relative impact

of population of technology in enviornmental degradation, Ehrlich model has been used. Ehrlich and Ehrlich (1991) stated that I= P A T, where

I= environmental impact, i.e., the numercial value of some pollutants;

P=Population size;

A=affluence, usually measured as GNP per capita; and

T= technology usually measured as the amount of pollution per unit of GNP.

The above identity in a modified form, takes the form,

$$\text{Log } \textit{Pollution} = \log \textit{population} + \log \frac{\textit{goods}}{\textit{population}} + \log \frac{\textit{pollution}}{\textit{goods}}$$

has been used to know the relative importance of poulation size, affluence and level of technology in deteriorating the urban environment of four mega cities of India.

## I.9 ORGANISATION OF CHAPTERS

This study consists of five chapters :

i) The first chapter deals with the statement of the problem relating to environmental degradation in urban areas, review of literature, choice of study area, objectives of the study, sources of data, methodology and scheme of chapters.

ii) The second chapter will deal with process of urbanization and population growth in the four mega cities and the growth of population due to various factors.

iii) The third chapter presents the state of environment in four mega cities.

iv) The fourth chapter deals with municipal expenditure in cities, availability of baisc amenities Slum dwellers and their living conditions.

v) Finally in the fifth chapter, we draw conclusion of the study and end with policy imperative for sustainable development of mega cities.

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# CHAPTER II

# POPULATION GROWTH AND URBANIZATION IN THE FOUR MEGA CITIES OF INDIA

## II.1 Population Growth In India

The first comprehensive census of India in 1881 recorded the country's population as 210.9 million which went up to 844.3 million by 1991. India's share in the world population increased to 16 percent in 1991 from 15.2 per cent in 1981. With this every sixth person in the world is now an Indian[1]. Table 2.1 shows the population of India since 1901.

**Table 2.1** : Decadal growth of population of India since 1901

| Year | Total Population (in million) | DECADAL GROWTH Absolute | Percent | Average Annual Exponential growth rate (per cent) |
|---|---|---|---|---|
| 1901 | 238.4 | -- | -- | -- |
| 1911 | 252.1 | 13.7 | 5.7 | 0.56 |
| 1921 | 251.3 | -0.8 | -0.3 | -0.03 |
| 1931 | 279.0 | 27.7 | 11.0 | 1.04 |
| 1941 | 318.7 | 39.7 | 14.2 | 1.33 |
| 1951 | 361.1 | 42.2 | 13.3 | 1.25 |
| 1961 | 439.2 | 78.1 | 21.5 | 1.96 |
| 1971 | 548.2 | 109.0 | 24.8 | 2.20 |
| 1981 | 688.3 | 135.1 | 24.7 | 2.22 |
| 1991 | 844.3 | 161.0 | 23.5 | 2.11 |

***Source*** *: Census of India 1991, Series I, India Provisional Population Totals, Paper 1 of 1991, pp.21.*

[1] Premi, M.K., (1991), "India's Population: Heading Towards A Billion", p.1

Since the annual rate of population growth is not expected to fall below 2 percent before the next census in 2001, a population of over 1000 million or 1 billion by that time appears to be certain. Though the average annual growth rate of population is declining, the net impact remains more or less same as the base population is quite large. The growth rate of population in Indian context can also be expressed through the different stages of demographic transition. Since there is widespread differences among different authors and people about the number of stages of demographic transition, it is left to the readers to decide, on which stage of demographic transition India is passing through.[2] However, according to Premi (1991), "India seems to have entered the third stage of demographic transition since 1971".[3] Table 2.2 shows the rude birth rate and rude death rate for the year 1901-1991.

**Table 2.2.** : CBR and CDR of India since 1901

| Year | CBR | CDR |
|---|---|---|
| 1901 | 45.8 | 44.4 |
| 1911 | 49.2 | 42.6 |
| 1921 | 48.1 | 47.2 |
| 1931 | 46.2 | 36.3 |
| 1941 | 45.2 | 31.2 |
| 1951 | 40.0 | 27.4 |
| 1961 | 41.7 | 22.8 |
| 1971 | 37.0 | 15.0 |
| 1981 | 34.0 | 12.5 |
| 1991 | 31.0 | 10.0 |

***Source :*** *Census of India, Handbook of population Statistics (1988) and Census of India, 1991.*

[2] United Nations (1973), "The determinants and Consequences of Population trends", Vol I, New York, pp. 58-59.

[3] Ibid, P 23

Both table 2.2 and figure 2.1 shows that the natural increase of population in India has stabilized but its net impact in terms of addition to total population however, remains very large.

## II.2 Urbanization In India

Urbanization is the process by which an increasing proportion of the population of an area becomes concentrated into the towns and cities. Demographically, it is an increase in the proportion of urban population to the total population over a period of time. As long as there is an increase in this proportion, there is urbanization. Usually, it takes place in two ways : the expansion of the size of existing urban units and the appearance of new urban units.

In India, the definition of an urban unit which was adopted in the 1971 census has continued in the 1981 and 1991 census. In all these censuses an urban area is defined as follows.

a) All places with a municipality, corporation, cantonment board or notified town area committee, etc.

b) All other places which satisfy the following criteria :

(i) a minimum population of 5,000;

(ii) at least 75 percent of male working population engaged in non-agricultural pursuits; and

(iii) a density of population of at least 400 persons per sq. km.

Beside, the Director of census operation in States/Union Territories were

Figure 2.1 : Natural Increase in India since 1901

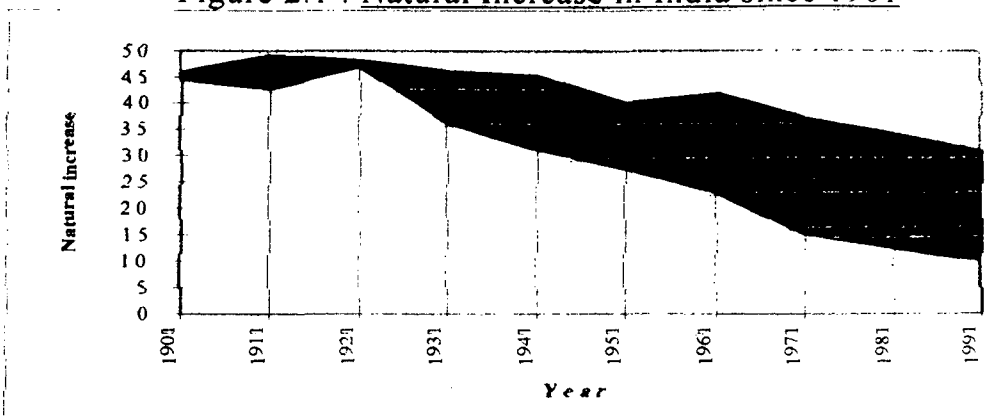



Figure 2.2 : Growth of India's Urban Population since 1951

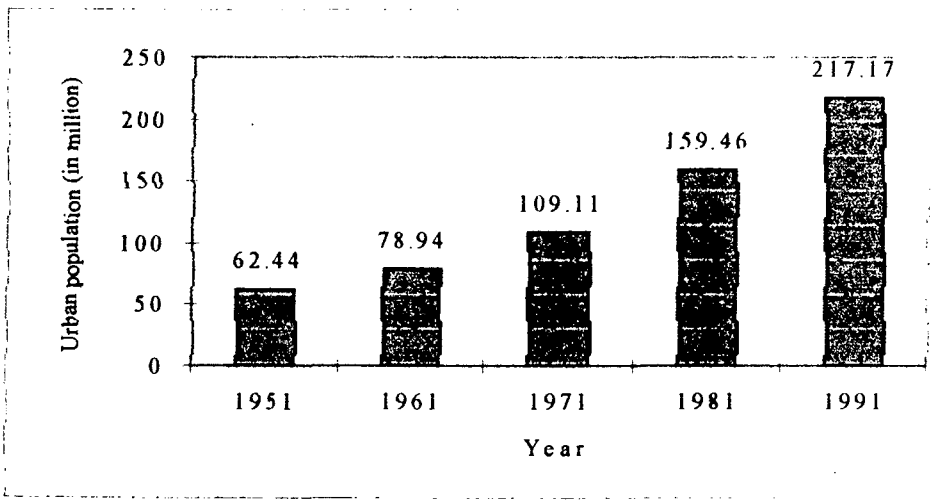
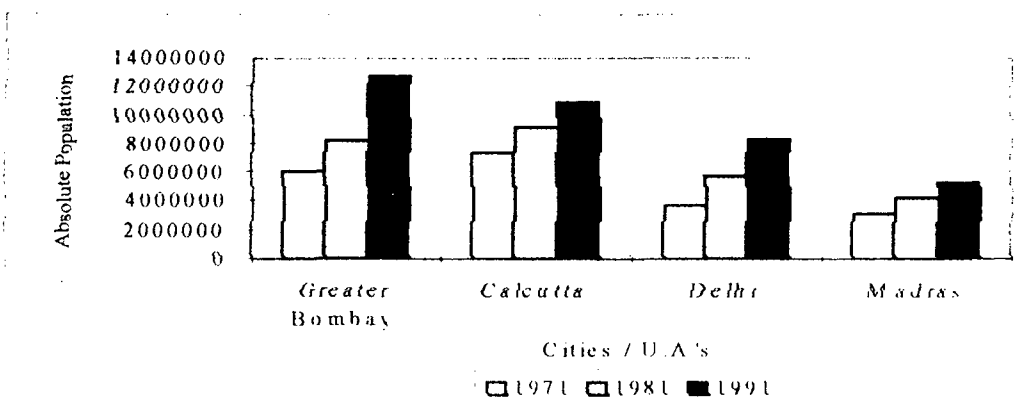



Figure 2.3 : Population Growth in Four Mega Cities (1971-1991)



allowed to include in consultation with the concerned State Government/Union Territory Administration and the Census Commissioner of India, some places having distinct urban characteristics as urban if such places did not strictly satisfy all the criteria mentioned under category (b) above. Such marginal cases include major projects colonies, area of intensive industrial development, railway colonies important tourist centres etc.

### II.2.1 The Concept of Urban Agglomeration

During 1971 census, a new concept called 'Urban Agglomeration' was introduced. It replaced the concept of 'Town Groups' of 1961. In the 'Town Group' concept of 1961 census, it was not always the contiguous urban unit that formed such a group. Even urban units cut off from one another were taken together ignoring the intervening regions. The concept of Urban Agglomeration underlines the fact that it must form a continuous urban spread constituting a town and its adjoining urban outgrowth or two or more physically contiguous towns together with continuous, well recognized urban outgrowth, if any of such towns. Thus these were the condition which an area must satisfy before being treated as Urban Agglomeration.

### II.2.2 Components of Urban Growth

The change in the urban population in a given geographical area over a period of time, is the result of[4]

(1) natural increase;

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[4] Premi M.K. (1991), "India's Urban scene and its future Implication", Demography India, Vol 20, No.1, Jan-June 1991, p. 48.

(2) net rural to urban migration;

(3) population of new towns added during the decade minus the population of the declassified towns, and;

(4) population of area added by the expansion of municipal boundaries.

Table 2.3 shows the breakdown of urban growth into its components for India, for the year 1971-81, and 1981-91.

**Table 2.3** : Break-down of Urban growth into its component, India, 1971-81 and 1981-91

| Components of Urban Growth | Population (in millions) | | Percent Distribution | |
|---|---|---|---|---|
| | 1971-81 | 1981-91 | 1971-81 | 1981-91 |
| 1. Total increase | 49.45 | 56.45 | 100.0 | 100.0 |
| 2. Natural increase | 22.56 | 33.87 | 45.6 | 60.0 |
| 3. Population of new towns | 10.29 | 10.61 | 20.8 | 18.8 |
| 4. Net rural to urban migration | 9.28 | 11.97 | 18.8 | 21.2 |
| 5. Increase due to expansion of municipal boundaries | 7.32 | -- | 14.8 | -- |

***Source*** *: Premi M.K. "India's urban scene and its future implications", in Demography India, Vol.20, No.1, Jan-June 1991, pp. 48.*

The above table (2.3) Clearly shows that share of natural increase in the urban areas had fluctuated substantially from 45.6 percent in 1971-81 to 60.0 percent in 1981-91. In absolute terms also there had been an increase from 22.56 million in 1971-81 to 33.87 million in 1981-91. The share of population of new towns seemed to have remained constant at around 18 to 20 percent during the past two decades. The share

of net rural-to-urban migration during 1971-81 was 18.8 percent which increased, but data for 1981-91 had been clubbed together with the expansion of municipal boundaries.

According to Premi, "Net rural-to-urban migration seems to have declined substantially during 1980's"[5]

It is important to know how urban population growth takes place, before we analyse a particular urban area and the component of its population growth.

### II.2.3 Trend of Urbanization in India

India's urban population was 217.17 million in 1991 constituting 25.72 percent of the total population. Since 1971, the urban population has doubled, increasing at twice the rate of the rural population. Table 2.4 shows the doubling schedule of India's urban population.

**Table 2.4** : The Doubling Schedule of India's Urban population

| Urban Population (million) | Number of years it took to double |
|---|---|
| 25.8 - 51.6 | 43 (1901-1944) |
| 51.6 - 103.2 | 26 (1944-1970) |
| 103.2 - 206.4 | 20 (1970-1990) |
| 206.4 - 412.8 | 17 (1990-2007) |

***Source :*** *Census of India 1991, Population Tables : Paper 2 of 1991.*

[5] Ibid, p 27

From 25.8 million mark in 1901, it took nearly 43 years to reach 51.6 million mark and yet another 26 years for it to increase to 103 million persons. After that it took only 20 years for urban population to double. Given the current rates of growth, urban population is estimated to take no more than 17 years to double itself, and reach a total of over 400 million persons by the year 2007.

**Table 2.5** : Urbanization Trend in India, since 1951

| Census Year | No. of UA's/Town | Urban Population (million) | Urban population as percent of total population | Growth Rate | |
|---|---|---|---|---|---|
| | | | | Decimal | Annual Exponential |
| 1951 | 2,843 | 62.44 | 17.29 | -- | -- |
| 1961 | 2,365 | 78.94 | 17.79 | 26.41 | 2.34 |
| 1971 | 2,590 | 109.11 | 19.91 | 38.23 | 3.21 |
| 1981 | 3,378 | 159.46 | 23.34 | 46.14 | 3.83 |
| 1991 | 3,768 | 217.17 | 25.72 | 36.19 | 3.09 |

***Source*** *: Census of India 1991, Provisional population Tables : Rural-Urban Distribution, paper 2 of 1991, pp.13.*

*Note :* 1. As the 1981 census was not conducted in Assam, the 1981 population figures of India include interpolated figures of Assam.

2. The 1991 census has not been held in Jammu & Kashmir. The 1991 population figures include projected figures for Jammu & Kashmir.

Though the percent increase in the urban population had declined from 3.83 percent in 1971-81 to 3.09 percent in 1981-91, the absolute increase has been higher in 1981-91 (57.71 million) than in 1971-81 (50.35 million). This absolute increase in the

urban population is the main factor which puts pressure on the urban infrastructure.

### II.2.4 Growth of Metropolitan Cities

India's urban scene is no longer one of towns and overgrown villages. Now two third of the urban population lives in genuine cities with population over 1,00,000[6].

Table 2.6 : Urban Agglomeration/Cities having population of over one million

| Census Year | No. of Urban Agglomeration/ Cities | Population (million) | % of population of urban agglomeration to : | |
|---|---|---|---|---|
| | | | Total Population | Urban Population |
| 1951 | 5 | 11.75 | 3.25 | 18.81 |
| 1961 | 7 | 18.10 | 4.12 | 22.93 |
| 1971 | 9 | 27.83 | 5.08 | 25.51 |
| 1981 | 12 | 42.12 | 6.16 | 26.41 |
| 1991 | 23 | 70.66 | 8.37 | 32.54 |

***Source :*** *Census of India 1991, Provisional population Totals : Rural-Urban Distribution, paper 2 of 1991, pp. 38*

One third of urban population lives in cities of a million inhabitants or more, up from one quarter in 1971. "It is estimated that the number of such cities will increase to at least 49 by the turn of the century, representing yet another change in the pattern of habitation in the country".[7]

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[6] Mathur O.P. "The issue of resources in the context of growing urbanization, in Growing Number and Dwindling Resources Teri, 1994, p. 25.

[7] Ibid, p. 30

## II.3 Population Growth And Urbanization In Four Mega Cities

In India there are four mega cities, with a population of more than five million each in 1991. These are Greater Bombay Urban Agglomeration, Calcutta Urban Agglomeration, Delhi Urban Agglomeration and Madras Urban Agglomeration. Almost one fourth of the population living in Class I cities/urban agglomerations in the country lives in these giant metropolises. As per the 1991 census, of the 70.66 million population in the 23 M5 metropolitan cities 37.22 million or 52.68 percent reside in these four large metropolitan centres.

A brief historical account of the growth of population of four mega cities of India is given in the following paragraphs.*

### II.3.1 Bombay

The city of Bombay was founded in 1661 when its population was around 10,000. By 1872, when the first decennial census was held in India, the population in this city was 651,632. The growth of Bombay was not uniform during the last quarter of 19th century due to periodic famines in the hinterland compelling the rural inhabitants to come to the city and periodic epidemic like plague, forcing city dwellers to seek shelter in rural areas in large number. By 1921 the city of Bombay had a population of 1,244,934 and recorded a decadal growth rate of 22.25 percent during 1951-21. Bombay city registered a growth rate of only 1.88 percent, but in the succeeding decade of 1931-41 there was an increase in the rate of population growth to

* This part of the chapter is taken from, census of India 1991, series 1, provisional population totals: Rural-Urban Distribution, paper-2 of 1991.

the time of 32.94 percent by 1951, the population of Greater Bombay increased to 2,966,902. This was mainly due to influx of refugees following the partition of the country and also due to merger of a number of towns with Greater Bombay, increase in trade and spurt of industry in a big way. Thus, during 1941-51 the population growth was 75.96 per cent. During the next decade the population of Greater Bombay becomes 4,152,056 and thus showed a population growth rate of 39.55 per cent during 1951-61. The population of Greater Bombay increased 5,970,575 by 1971 giving an increase of 43.80 per cent during 1961-71. The area, absolute population, growth rate of population for the decades 1971-81 and 1981-91 has been shown in table 2.8. The population of Greater Bombay in 1981 was 8,243,405 and the growth rate during the decade 1971-81 was 38.07 percent. According to 1991 census, the population of Greater Bombay Urban Agglomeration was 12,571,720. This sharp increase in population is mainly due to the addition of five urban areas to Greater Bombay. They are Kalyan Municipal Corporation (1,014,062), Thane Municipal Corporation (796,620), Ulhasnagar Municipal Council (368,822), New Bombay Census Town (307,292) Mira Bayender Municipal Council (175,372).

### II.3.2 Calcutta

The city of Calcutta shot to prominence after it was accepted as the political capital of India by the British Government. Although the city lost its status when the capital was shifted to Delhi in 1911 it continued to grow as an important urban centre as this happened to be a nerve centre having close social and economic interaction with the vast hinterland extending over eastern India.

decennial census was taken in the country. During the succeeding decades the growth in the population of Calcutta fluctuated rather erratically due to natural calamities, epidemics, famine etc. In 1931 the population of Calcutta Urban Agglomeration was 2.14 million. During 1931-41, the growth rate was record as 69.34 percent which came down to 28.94 percent during the decade 1941-51 and the population recorded in 1951 was 4,669,554. Further reduction in the growth rate of the population was recorded during 1951-61 and 1961-71. For these decades the growth rate of population was 28.14 and 24.01 respectively. The area, absolute population, and growth rate of population for years 1971, 1981 and 1991 has been shown in table 2.8.

### II.3.3 Delhi

The British Government developed Delhi as their capital when they decided to shift their seat of administration from Calcutta to this ancient city in 1911. This city has served as the capital to many empires earlier. Delhi has grown as an administrative town through the ages and therefore is distinctly different from other metropolises in the country like Calcutta, Bombay or Madras, which are both industrial as well as port towns.

Delhi is the most rapidly growing metropolitan area in the country. It has consistently shown high growth of the population since Independence. As per 1881 census Delhi had a population of 183,944. The increase in the population of Delhi in the succeeding three decades was rather slow. By 1911 it had a population of 237,944. It was during the same year that Delhi was designated as the capital of the British India.

Beside this the area of the city was also extended from 43 sq. km. to 168 sq. km. Thereafter there had been rapid population growth from 304,402 in 1921 to 447,442 in 1931 with the decadal rate of population growth increasing from 46.98 per cent during 1911-21 to 55.48 per cent during 1931-41. There has been some fluctuation in the population growth during 1941-51 due to large scale population movement which started in the wake of partition of the country. The city during this period recorded a decadal population growth rate of 106.58 per cent and the population was 1,437,134 in 1951. The population growth rate remained high during 1951-61 (61.17 percent), but it came down to 54.57 percent during 1961-71. The table 2.7 shows the area, absolute population and the growth rate of population has been shown in table 2.8. The population growth during 1971-81 was 4.56 and the absolute population in 1981 was 5,729,283. During the decade 1981-91 the annual growth rate of population in this metropolitan city was 46.18 percent. As per the 1991 census the population of Delhi Urban Agglomeration was 8,375,188. Thus the population growth (absolute) has been phenomenal during 1981-91 than in 1971-81.

### II.3.4 Madras

It is one of the ancient cities of Southern India. After Independence Madras has grown as an important town.

This city had a population of 422,325 in 1872, the year of India's first census. Between 1872 and 1931 the population of city almost doubled. The population again doubled between 1931-1951. During the decade 1951-61 the growth rate of population was 26.08 percent. There was an increase of 63.02 percent in the growth rate of

population during 1961-71. The area absolute population and the growth of population for the succeeding years has been shown through table 2.7. The population of the city which become an Urban Agglomeration in 1971 increased to 5,361,468 in 1991.

## II.4 Areal Spread In Four Mega Cities

As one of the main objective of this dissertation is to analyze the changes since 1970's in term of population growth, urbanization and environmental degradation in four mega cities, this part of the chapter will exclusively deal with the population growth and urbanization in four mega cities since 1970's.

Table 2.7 shows the Area, Population Density (per sq.km.), absolute decadal increase and average annual exponential growth rate for four mega cities since 1917. Due to horizontal expansion of the urban area the density has not increased correspondingly. In case of Greater Bombay and Calcutta Urban Agglomeration the density has shown a decline in 1991 in comparison with 1971. However, density of Delhi and Madras urban agglomeration has increased steadily since 1971. In 1993, among the four mega cities Delhi urban agglomeration was the most densely populated mega city followed by Calcutta, Greater Bombay and Madras urban agglomerations.

It is interesting to mention that except for Greater Bombay urban agglomeration the average annual exponential growth rate of other three mega cities has shown a decline in 1981-91. The absolute increase in population in table 2.7 shows that there has been a decline in the absolute growth of population in Calcutta and Madras urban agglomeration whereas, it has increased in case of Delhi and Greater Bombay urban agglomerations. The increase in case of Greater Bombay is attributed

## Table 2.7 : Area, Population and Density in Mega Cities

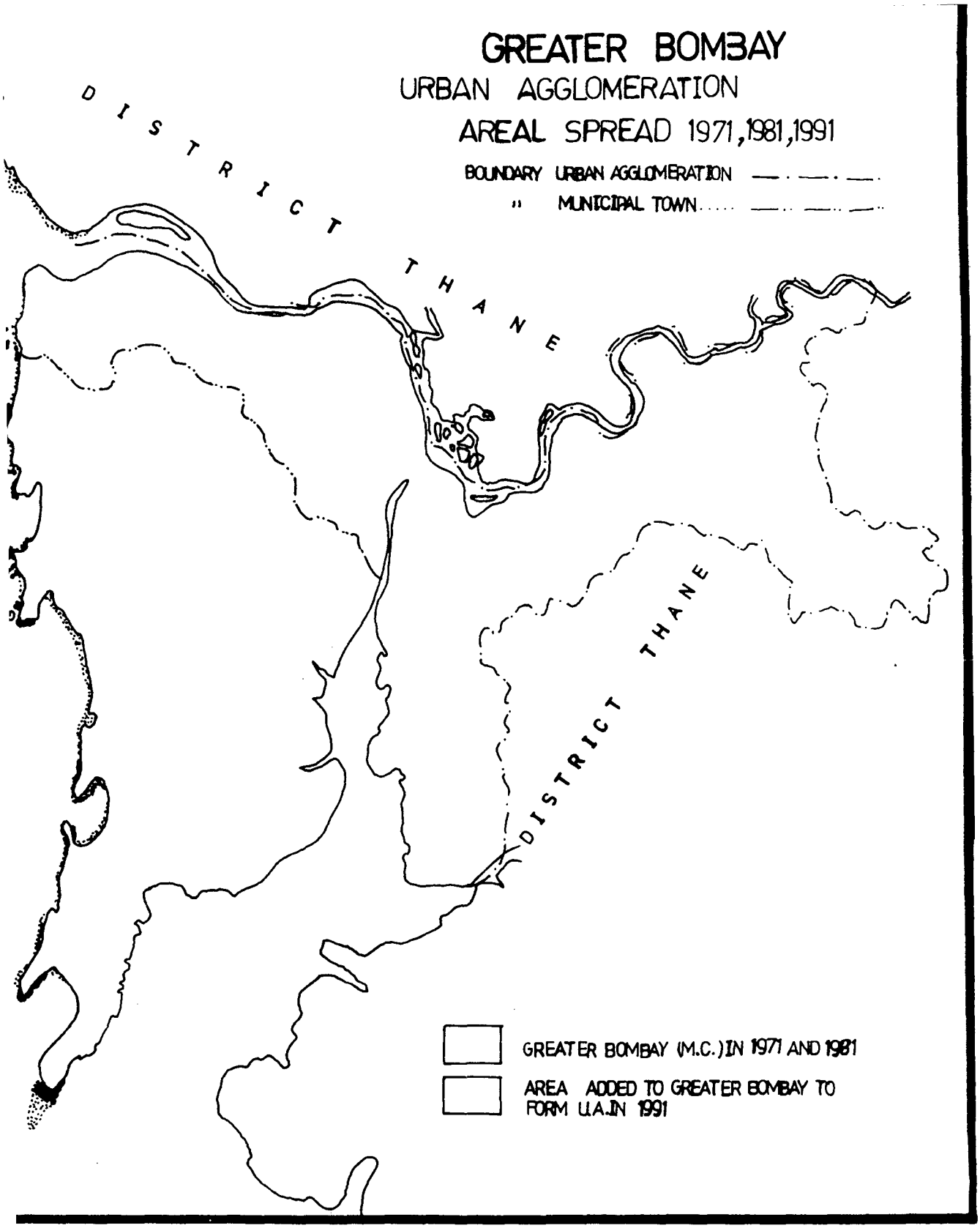
| | Area in Sq. Km | | | Population ( in million) | | | Density (per sq.km.) | | | Decadal Increase (Absolute) | | Average Annual Expotential Growth Rate | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1971 | 1981 | 1991 | 1971 | 1981 | 1991 | 1971 | 1981 | 1991 | 1971-81 | 1981-91 | 1971-81 | 1981-91 |
| Greater Bombay (U.A) | 603.00 | 603.00 | 1177.55 | 5970575 | 8243405 | 12751720 | 9901 | 13670 | 10829 | 2272830 | 4329315 | 3.25 | 4.3 |
| Calcutta (U.A) | 568.79 | 852.23 | 897.41 | 7420300 | 9194018 | 10916272 | 13046 | 10788 | 12164 | 1773718 | 1722254 | 2.16 | 1.7 |
| Delhi (U.A) | 446.26 | 540.78 | 624.28 | 3647023 | 5729283 | 8375188 | 8172 | 10594 | 13415 | 2082260 | 2645905 | 4.56 | 3.8 |
| Madras (U.A) | 530.77 | 571.93 | 612.11 | 3169930 | 4289347 | 5361468 | 5972 | 7500 | 8759 | 1119417 | 1072121 | 3.05 | 2.3 |

Source : 1. Census of India, 1971, Series 1, India, Part VI.A, Town Directory.
2. Census of India, 1981, Series 2, India, Part X A(i), Town Directory.
3. Census of India, 1991, The Million Plus Cities of India : Primary Cenus Abstract.

mainly to massive horizontal expansion 574.55 sq.km. (95.28 per cent). Map 1 shows the areal spread of Greater Bombay urban agglomeration. For the first time it emerged as an urban agglomeration in the 1991 census. Map 2, 3 and 4, shows the areal spread of Calcutta, Delhi and Madras agglomerations respectively. The area of Greater Bombay urban agglomeration has increased 2.7 times approximately since 1971. The areal spread of Delhi, Calcutta and Madras urban agglomerations has not been substantial in comparision to that of Greater Bombay urban agglomerations.

Population growth of an urban area depends on three components viz. Natural increase, net migration population of new towns added during the decade minus the population of the declassified town and population added by the expansion of municipal boundaries.[8] The importance of each of these component in expansion of population in an urban area is however difficult to Calcutta due to lack of data (especially total outmigration from an urban area). However the role played by natural increase to increase the population of an urban area can be calculated using the Sample Registration System (SRS) data. Table 2.8, shows the importance of natural increase in growth of population in four mega cities.

[8] Ibid., p6.

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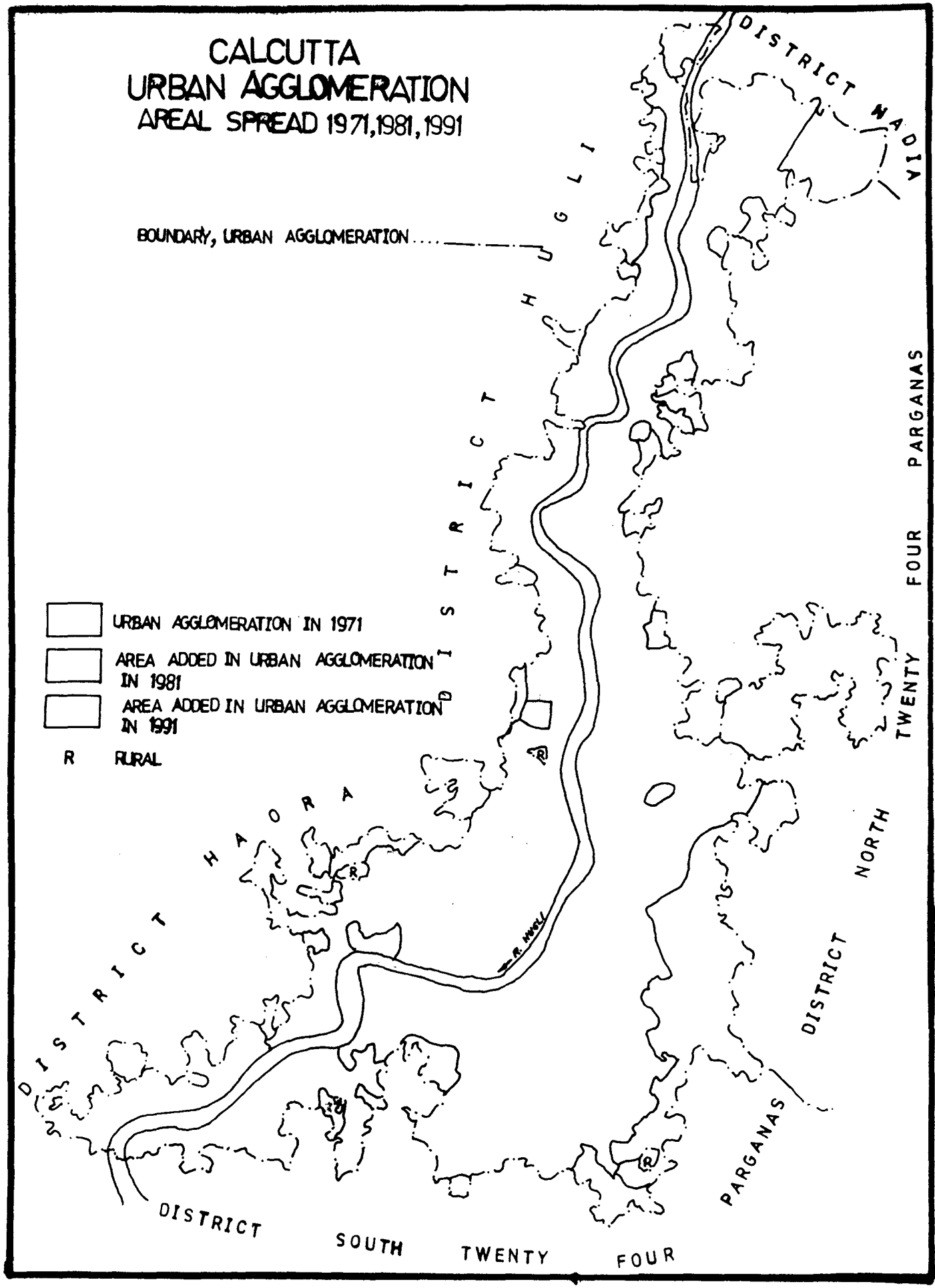
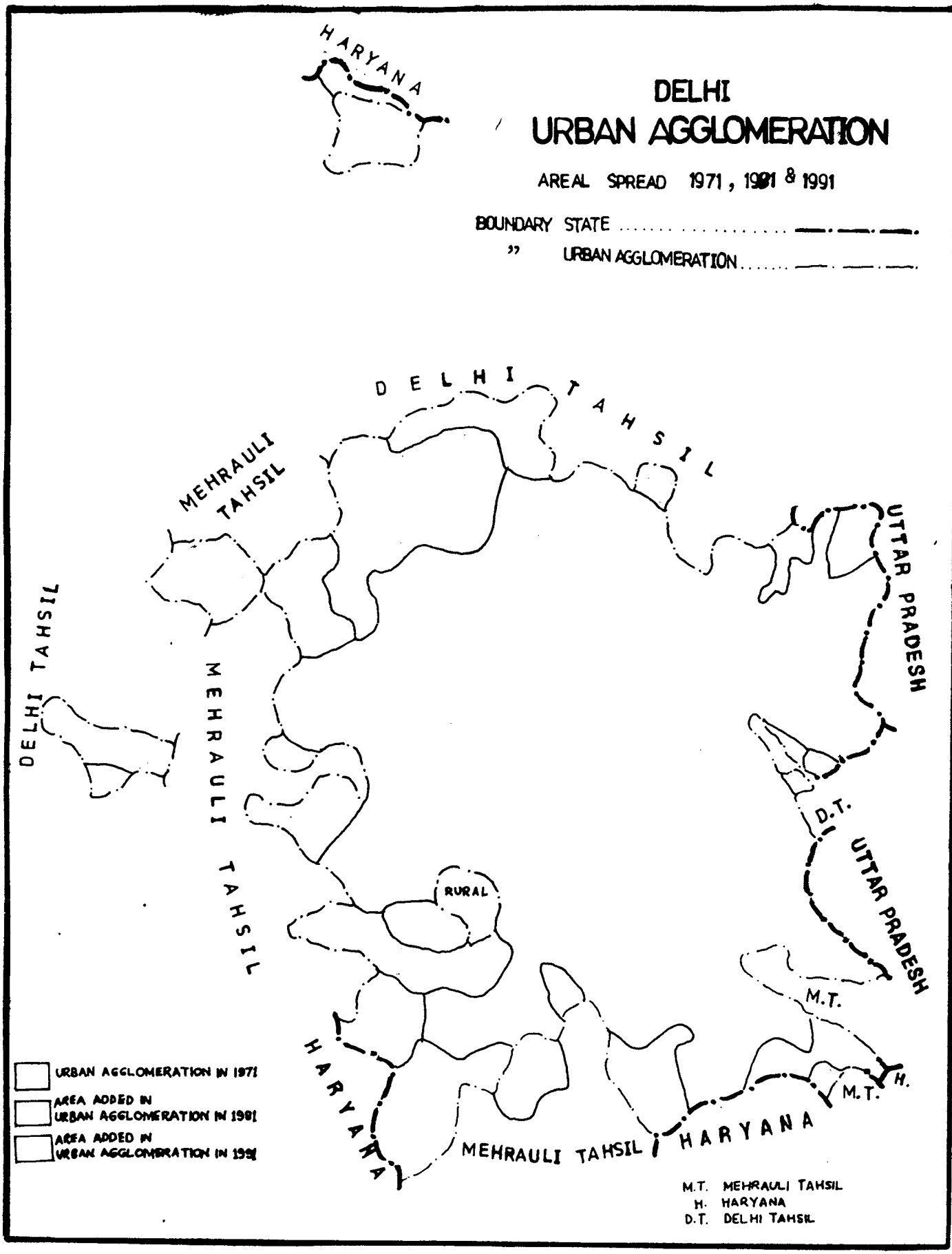


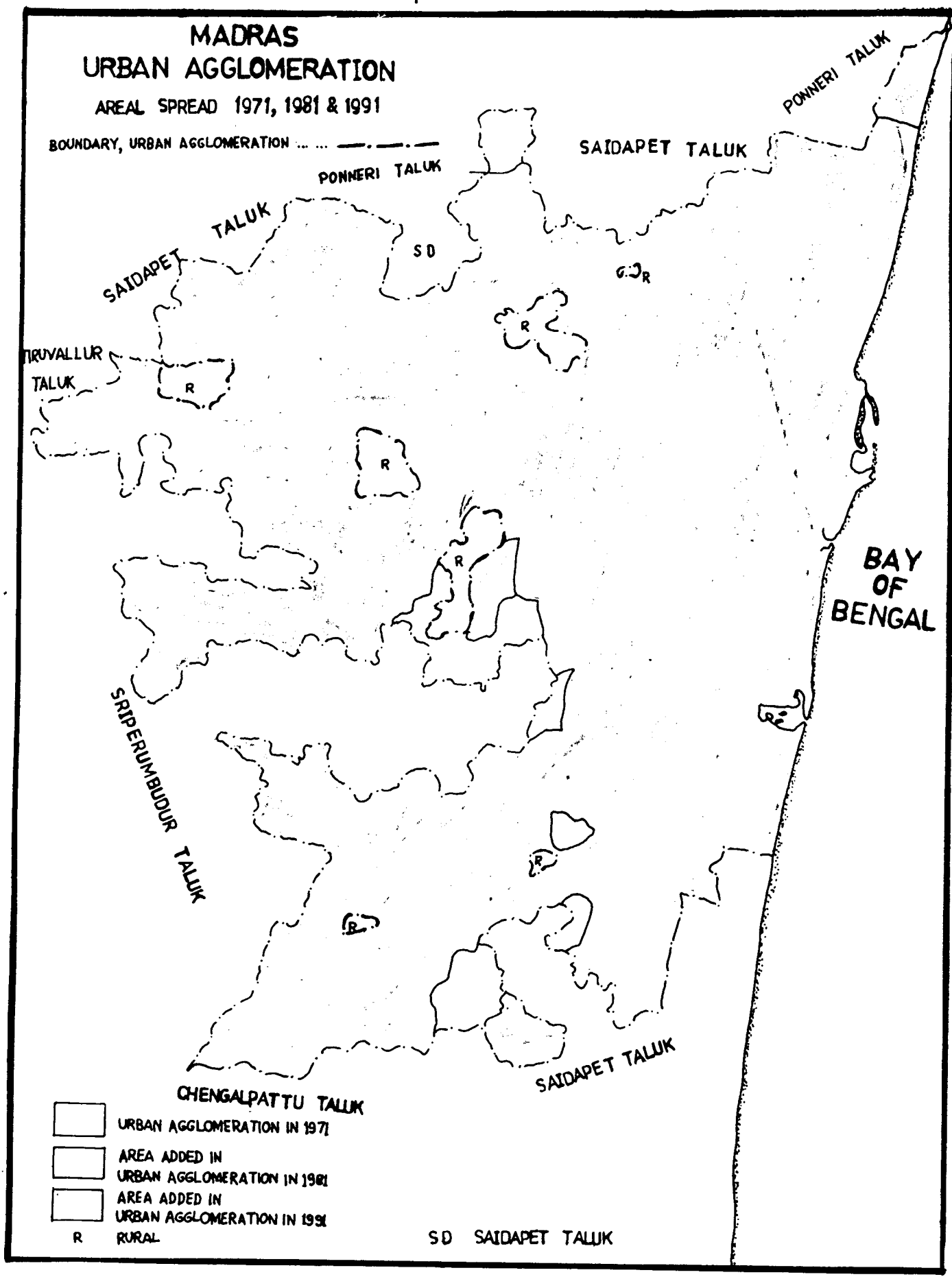

Source : Census of India 1991 , Sevies 1 , Paper 2 of 1992

Map 2·3




Source : Census of India 1991, Series 1, Paper 2 of 1992

Map: 2.4




Source: Census of India 1991, series 1, paper 2 of 1992

**Table 2.8** : Role of natural increase in population growth in four mega cities

| Name of the City | 1971-81 (in %) | 1981-91 (in %) |
|---|---|---|
| Greater Bombay | 53 | 32 |
| Calcutta | 21 | 16 |
| Delhi | 41 | 55 |
| Madras | 57 | 66 |

***Source**: Sample registration system 1971 to 1991.*

Table 2.8 shows that population growth due to natural increase in Greater Bombay and Calcutta urban agglomeration have declined over the years whereas in case of Delhi and Madras urban agglomerations its importance has increased. In case of Greater Bombay the decline has been drastic possibly because of a massive areal spread of 574.55 square kilometer in 1991 which added a population of 2,670,352 of new towns to Greater Bombay urban agglomeration.

However if we consider the population of Greater Bombay without considering the areal spread of 1991, natural increase is responsible for 84 per cent of growth of population. Since Calcutta's population is mainly increasing through net migration and addition of new area, a population policy to restrict population growth in Calcutta must focus on areas other than family planning and birth control. But for the remaining mega cities birth control through family planning methods need to be strengthened.

## II.5 Urbanization Of Four Mega Cities

Since an urban agglomeration consists of 100 per cent urban population, so the indices of urbanization viz. Degree of urbanization and Tempo of urbanization etc. cannot be calculated. However indices of population growth can be calculated taking any year as base year. Table 2.9 shows the indices of population growth in four mega cities taking 1971 as the base year.

**Table 2.9** : Indices of Population Growth in Four Mega Cities

| City/VA / Year | 1971 | 1981 | 1991 |
|---|---|---|---|
| Greater Bombay (U.A.) | 100 | 138 | 210 |
| Calcutta (U.A.) | 100 | 124 | 147 |
| Delhi (U.A.) | 100 | 157 | 230 |
| Madras (U.A.) | 100 | 135 | 169 |

Table 2.9 clearly depicts the pace with which the population of the four mega cities has increased since 1971. The population of Greater Bombay and Delhi has doubled since 1971, Delhi being in the top position. Population growth in Calcutta urban agglomeration has been the lowest among the four mega cities. Though population of Calcutta and Madras urban agglomerations is increasing but at a decreasing rate, the rate being slower in case of Calcutta urban agglomeration.

Population growth in a massive scale, seen in the four cities, is a matter of grave

concern for administrators and policy makers. Rapid population growth in urban areas have not been accompanied by adequate infrastructure in urban areas, particularly those of roads, parking facilities and public transportation. There is acute shortage of low income housing, water supply, public health and sanitation facilities. "The collection and disposal of solid waste is another areaa of concern of city management in India. No city collects and disposes all its solid waste in safe manner and the coverage is often indequate".[9]

Environmental degradation in terms of Air, Water and Noise pollution has increased over the years. It has now become a necessity for these mega cities to quickly responds to the existing problematic situation. Otherwise the sustainability of human life will be in great danger.

**Conclusion**

According to the report published by National Commission on Urbanizations the management of metropolitan and other big cities put a formidable challenge before the planners, administrators and the people of the country. However, the most demanding of the urban challenges, unquestionably, is the challenge posed by urban poverty and housing facility.[10]

The commission felt that:

1. Urbanization should be tackled from a regional level in order to identify and

[9] Habitat II (1996), "Second United Nations Confernce on Human Settlement: India National Report", Government of India.

[10] National Commission on Urbanization (1988) "Report of the National Commission on Urbanization".

establish a hierarchy of urban centres from rural service centres to metropolitan or other major cities serving the region as a whole.

2. That economic planning should be oriented, if we have to achieve anything meaningful in urban development. Such re-orientation should recognise the enormity of urbanization and the consequent problems.
3. Development of medium and small towns should be assigned priority to stem the growth of metropolitan centres and other major cities.
4. The importance of democratically elected local bodies in the management of urbanization should be recognised and they should be assigned adequate powers to enable them to carry out their development and maintenance functions.

Now to conclude this chapter, it can be said that:

1. The rate at which the cities are growing pose a challenge to the urban authorities.
2. Population growth in the mega cities is both due to horizontal and vertical expansion.
3. Population growth in Greater Bombay and Delhi was higher than Madras and Calcutta.
4. The main cause of high population growth in Greater Bombay during 1981-91 was a massive areal spread of 574.55 square kilometer.
5. The main cause of population growth during 1981-91 in Delhi and Madras was natural increase.

In the next chapter we shall discuss the state of environment of four mega cities of India with respect to Air, Water and Noise pollution.

## CHAPTER III

# STATE OF URBAN ENVIRONMENT IN FOUR MEGA CITIES OF INDIA

### III.1 Introduction

This Chapter will comprehensively explain the state of urban environmental in four mega cities of India. The change that have taken place since 1970's in Air, Water and Noise pollution have been dealt with. Why changes if any have taken place? How the pollution levels have changed for the two decades? What are its implications?

### III.2 The Phenomenon of Pollution

Pollution cannot be understood in isolation without the proper understanding of the term environment. Environment may be defined as "the sum of all external and internal factors – Physical, chemical and biological, which affects the structure and function of the living organism, association or a community of the organism, condition of building exposed to it or any visual enjoyment".[1]

Any change in environment which contributes to its deterioration is called pollution of the environment and that which causes the pollution (the agent) is called the pollutant.

Wastes qualify as pollutants because they harm or impair the natural resources in which they are located. Pollution when defined as a process is "the direct or indirect

[1] Odum (1976), "Pollution and its control", Saunders College Publishing, San Francisco

change in one or more components of the environment with actual or potential adverse, harmful, unpleasant or inconvenient effects".

The Phenomenon of pollution is thus embedded in the following prepositions, pollution means :

1. The presence of anything in the environment that is in excess of what is needed.
2. Anything that is in the environment but was not there in its natural state.
3. The direct or indirect change in one or more component or the eco–system which are harmful to the system or at least undesirable to human beings.
4. Intentional or unintentional release of any chemical or geochemical substance into the environment with adverse effect.

On the basis of sources, pollutants can be classified into two broad groups

1) Point source pollutants; and

2) Non–point source pollutants.

While the former are gases and particulate matters such as dust lead, sulphur dioxide ($So_2$) carbon monoxide (Co) etc, the latter are mostly sources which results in run-off, seepages and percolation via diffusion and unidentified routes. However gases and particulate matters emitted from any "moving point source" is also considered as a non–point source pollutants.

Odum (1971), a pioneer in pollutant studies has given another classification from ecosystem point of views, namely

1) Non–degradable pollutants

2) Bio–degradable pollutants.

The non–degradable pollutants are matters like Aluminium, organic phenol compound and pesticides that do not degrade or degrade very slowly. These pollutants not only accumulate but also get magnified with their subsequent movement in "Bio–geo–chemical cycle" along food chain. Bio–degradable pollutants on the other hand get degraded very easily.

Human impacts on the natural environment are ancient and extensive. Even hunters–gatherers were suspected of massive faunal extinction. Agricultural and industrial growth accelerated population growth rate and increased the intensity of impact on environment. The innovation of new products and consumerist life style put even more pressure on natural resources and the environment.

## III.3 AIR POLLUTION

### III.3.1 Definition

According to American Medical Association "Air Pollution is the excessive concentration of foreign matters in the air which adversely affects the well being of the individual or cause damage to property".[2]

Air pollution has been a steadily growing problem since Industrial Revolution began some 300 years ago. The revolution was started by the invention of technology that could use new sources of energy–particularly coal, oil and gas – and that enabled large–scale industry to develop. The combustion of fossil fuels releases a number of

[2] Trivedi P.R. "International Encyclopaedia of Ecology and Environment" Vol. II. Indian Institute of Ecology and Environment, New Delhi, 1995, pp.2-3

pollutants into the atmosphere notably carbon monoxide, nitrogen oxide and smoke, and as the industry expand, so does the pollution. The unprecedented growth in the use of fuel–driven road vehicles, made air pollution more and more difficult to avoid. Emissions of nitrogen oxide, carbon monoxide, hydrocarbons and lead often severely reduces the quality of urban life. "Air pollution has been exacerbated by four particular development that typically occurs as regions/countries become industrialised: growing size of cities; increasing traffic; rapid economic development and higher levels of energy consumption".[3]

According to Stern (1973), "Air quality standards are legal limits placed on levels of air pollutants in the ambient (outdoor) air during a given period of time. As such they characterize the allowable levels of a pollutants or a class of pollutants in the atmosphere and thus define the amount of exposure permitted to the population and/or to ecological system."[4] The author further argues that air quality standards have evolved differently in different countries depending upon the exposure condition, the socioeconomic situation and the importance of health related problems.

### III.3.2 Composition of Normal Dry Air

The typical composition of unpolluted dry air has been given in table 3.1.

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[3] UNEP "Urban Air Pollution", UNEP/GEMS Environment library No. 4, p.7.

[4] Stern, Arthur. C (1977), "Air pollution" third edition. Volume V Air quality management Academic press, New York, pp.460.

**Table 3.1** : Concentration of Gases Comprising Normal Dry Air

| Gases | Concentration (ppm) |
|---|---|
| Nitrogen | 780,900 |
| Oxygen | 209,400 |
| Argon | 9,300 |
| Carbondioxide | 315 |
| Neon | 18 |
| Helium | 5.2 |
| Methane | 1.0-1.2 |
| Krypton | 1 |
| Nitrous oxide | 0.5 |
| Hydrogen | 0.5 |
| Xenon | 0.08 |
| Nitrogen oxide | 0.02 |
| Ozone | 0.01-0.04 |

***Source:*** *Stern, Arthur C.(1968) " Air pollution" Second edition Vol. 1 Air pollution and its effect, Academic press, New York.*

The above table (3.1) shows the typical composition of normal unpolluted Dry Air. Any change in the composition of air reduces its quality. In most cities of the world, the composition of normal dry air has changed. Gases like carbon monoxide, Nitrogen oxide and ozone are found in excess due to various activities of human being. As the composition of air changes, its quality deteriorates and become dangerous for human use.

### III.3.3 Sources of Air Pollution

Sources of air pollution can be both

(i) Natural Sources

(ii) Man–made Sources.

Natural sources which cause pollution in air are volcano, which releases suspended particulate matter, sulphur dioxide, methane, etc. Forest fires and dust storms also cause air pollution. Oceans emit aerosols to the atmosphere in the form of salt particles which are corrosive to metals and paints.

Man–made sources activities of human beings which pollutes the air, are listed in table 3.2. The table clearly shows how various activities of human being release gases which pollutes the environment. An increase in such activities puts more pressure on the environment.

### III.4 Air Pollution In Mega Cities Of India

The main causes of air pollution are the man–made sources which consist mainly of industrial concentration, thermal power plants and fuel driven vehicles. Among these causes, fuel driven vehicles play an important role in polluting the urban atmosphere. Since 1970's there has been a sharp increase in the number of vehicles in all the four mega cities of India. As I shall make it clear at later stage, it has found that Delhi among the four mega cities show a tremendous increase in the number of vehicles, which may be one of the reason why it is the most polluted city of India and the fourth most polluted urban agglomeration of the world.

**Table 3.2** : Man–made sources of air pollution

| No. | Class | Aerosols | Gases and Vapours |
|---|---|---|---|
| 1. | Combustion process (domestic burning thermal power plants, vehicles and also refuse burning) | Dust, fume, smoke | $SO_2$, $NO_2$ Co, organic vapours, odours. |
| 2. | Chemical process (paper mills, cement, fertilizers, etc.) | Dust, fume, mist | Process–dependent ($SO_2$, Co, $NH_3$, $NO_2$, organic vapours, odours. |
| 3. | Petroleum operations | Dust, mist | $SO_2$, $H_2S$, $HN_3$, CO, hydro–carbons. |
| 4. | Metallurgical processes (aluminium refineries, steel plants) | Dust, fume | $SO_2$, $CO_2$, florides, organic vapours. |
| 5. | Mineral processing | Dust, fume | Process – dependent ($SO_2$, CO, fluorides, organic vapours) |
| 6. | Food and Feed | Dust, mist | Odourous materials |
| 7. | Agricultural activities | | |
| | (a) Crop spraying | Dust, mist | Organic phosphate, chlorminated |
| | (b) Field burning | Smoke, fly ash | hydrocarbons<br>Sulphur oxides, organic vapours. |
| 8. | Nuclear Energy Programmes | | |
| | (a) Fuel fabrication | | Florides |
| | (b) Ore preparation | Dust | Iodine–131 and Argon–41 |
| | (c) Bomb explosion | | Radioactive gases (Sr–90, CS–137, C–14, etc.). |

***Source*** : *Trivedi P.R. (1995), Internation Encyclopaedia of ecology and environment, Vol.11, Air Pollution, IIEE, New Delhi.*

### III.4.1 Air quality standard

The Central Pollution Control Board has given minimum standards for the quality of air for the Indian cities. If the quality of air deteriorates beyond the minimum standard it will be called polluted.

The following air quality standards were adopted by Central Pollution Control Board in the 47th meeting on November 11, 1982 in an exercise of its Jurisdiction under section 16(2)(h) of the Air (Prevention and Control of Pollution) Act 1981.

**Table 3.3** : CPCB's Air Quality Standards (24 hour mean)

| Area | Category | Concentration ($ug/m^3$) | | |
|---|---|---|---|---|
| | | SPM | $SO_2$ | $NO_2$ |
| A. | Industrial and Mixed use | 500 | 120 | 120 |
| B. | Residential and rural | 200 | 80 | 80 |
| C. | Sensitive | 100 | 30 | 30 |

*SPM* = Suspended particulate matter, $SO_2$= Sulphur dioxide, $NO_2$= Nitrogen oxide.

***Source:*** NEERI (1994), "Air Quality Status" No. 6., p.220.

According to the procedure specified by CPCB, atleast 95 percent of the time one observes the concentration of the above pollutants exeeding the limit prescribed (Table 3.3). It is applied to any monitoring station, when monitored uniformly over 12 months of an year with a frequency of not less than once a week, with a sampling time of eight hours for any sample.

### III.4.2 Quality of Air in mega cities

Being the engine of economic growth and development, large agglomerations in their process of higher production and consumption exert pressure on the environment. The situation is aggravagated due to the interplay of two factors namely size of population and level of consumption. That is to say if the size of population remains constant and level of consumption increases or vice–versa, the negative impact on the environment is not substantial. But, ceteris paribus, if both the factors show an upward movement the negative impact on the environment is devastating. Such interrelationship between, population size, level of consumption and technology is dealt in the later part of this chapter.

The quality of air in four mega cities of India for the year 1982 and 1992 has been shown in Table 3.4. Bombay the largest industrialised city of India has shown the annual average of SPM as 206, 271 and 325 ug/m3 at industrial, commercial and residential sites, respectively for the year 1992. CPCB standard of 200 ug/m3 (residential and rural zones) has been crossed in 1991 and the same trend has also been observed in 1992. Similarly SPM concentration in Calcutta in 1992 has been 444, 370 and 555 ug/m3 at industrial, commercial and residential sites, respectively. Only residential sites in Calcutta has shown a concentration higher then CPCB standard for the year 1982 as well as 1992.

SPM concentration in Delhi in 1982 has been lower than the CPCB standards. But in 1992 the commercial and residential sites of Delhi have shown SPM concentration at 545 and 542 ug/m3, which is higher than CPCB standards. The

Table: 3.4 Quality of Air in Metropolitan Cities ($ug/m^3$)

| | Suspended Particulate Matter | | | Nitrogen Oxide | | | Sulpher dioxide | | |
|---|---|---|---|---|---|---|---|---|---|
| **Greater Bombay** | Industrial | commercial | Residential | Industrial | Commercial | Residential | Industrial | Commercial | Residential |
| 1982 | 147 | 154 | 209 | 27 | 31 | 32 | 36 | 46 | 26 |
| 1992 | 206 | 271 | 325 | 33 | 27 | 29 | 24 | 14 | 17 |
| | | | | | | | | | |
| **Calcutta** | | | | | | | | | |
| 1982 | 484 | 362 | 376 | 29 | 35 | 21 | 94 | 92 | 41 |
| 1992 | 444 | 370 | 555 | 33 | 35 | 18 | 49 | 43 | 23 |
| | | | | | | | | | |
| **Delhi** | | | | | | | | | |
| 1982 | 376 | 344 | 266 | 31 | 35 | 30 | 41 | 39 | 21 |
| 1992 | 442 | 545 | 542 | 25 | 39 | 24 | 23 | 27 | 14 |
| | | | | | | | | | |
| **Madras** | | | | | | | | | |
| 1982 | 126 | 126 | 188 | 9 | 10 | 15 | 8 | 10 | 9 |
| 1992 | 132 | 100 | 91 | 13 | 16 | 8 | 10 | 7 | 6 |

$ug/m^3$ = Microgram per cubic meters.

Source: (1) NEERI (1985), "Air Quality Status"
(2) NEERI (1994), "Air Quality Status".

concentration of SPM in Madras is well below the CPCB standards for the years 1982 and 1992.

The concentration of nitrogen dioxide in all the four mega cities of India, for all the sites are below the CPCB standard. Similarly the concentration of sulpher dioxide was below the CPCB standard for all cities and all sites except, the commercial site of Delhi where it exceeded the CPCB standard.

### 111.4.2 Air Pollution Load in Four Mega Cities

In the previous section of this chapter we have dealt with the quality of air in the four mega cities. Now we will discuss about the quantity of air pollution in four mega cities of India. Table (3.5) presents a temporal change in the pollution load of various pollutants due to emissions from Transport, Industry and Domestic sources.

#### 111.4.2.1 Pollution Load in Bombay

Emission of Sulphur dioxide from transport has increased marginally from 1300 tonnes per annum in 1970 to 2500 tonnes per annum in 1990. Similarly emission of Sulphur dioxide from domestic sources have shown an increase from 1500 tonnes per annum to 2500 tonnes per increasing at a faster rate than domestic sources. The main emitters of Sulphur dioxide are industries (see table 3.2). Since 1970 emission of Sulphur dioxide from industry has increased at a rate of 1.82 percent per annum. In absolute terms it has increased from 98200 tonnes per annum in 1970 to 151300 tonnes per annum in 1990. The emission of Sulphur dioxide in such rate clearly depicts that "Bombay is the most industrialised urban centre in Inida."[5]

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[5] NEERI (1994), "Air Quality Status", p.27.

Table 3.5 : Estimated anthropogenic pollutant emission by source (000' tonnes per annum)

| | Sulpher Dioxide | SPM | Carbon Monoxide | Oxides of Nitrogen |
|---|---|---|---|---|
| **BOMBAY** | | | | |
| 1970 Transport | 1.3 | 1.3 | 52.3 | 13.3 |
| Industry | 98.2 | 35.3 | 0.5 | 19.4 |
| Domestic | 1.5 | 1.6 | 18 | 0.1 |
| | | | | |
| 1980 Transport | 1.5 | 2.5 | 107.6 | 21 |
| Industry | 151.3 | 38.4 | 0.5 | 27.6 |
| Domestic | 1.6 | 2.5 | 18 | 0.1 |
| | | | | |
| 1990 Transport | 2.5 | 3.5 | 166.6 | 30.3 |
| Industry | 153.1 | 46.1 | 0.5 | 27.6 |
| Domestic | 2.5 | 2.5 | 22.5 | 0.1 |
| **DELHI** | | | | |
| 1970 Transport | 0.8 | 0.8 | 33.3 | 8.3 |
| Industry | 30.8 | 80.8 | 0.1 | 16.7 |
| Domestic | 2.5 | 1.7 | 41.7 | 0.1 |
| | | | | |
| 1980 Transport | 1.7 | 1.7 | 95 | 25 |
| Industry | 30.8 | 86.7 | 0.1 | 16.7 |
| Domestic | 2.5 | 0.8 | 48.3 | 0.1 |
| | | | | |
| 1990 Transport | 5 | 4.3 | 217.7 | 62.5 |
| Industry | 38.3 | 111.7 | 0.1 | 20.8 |
| Domestic | 3.3 | 0.8 | 48.3 | 0.1 |
| **CALCUTTA** | | | | |
| 1970 Transport | 0.4 | 0.1 | 8.4 | 1.7 |
| Industry | 12.5 | 105.8 | 33.3 | 11.7 |
| Domestic | 4.2 | 4.2 | 93.3 | 0.8 |
| | | | | |
| 1980 Transport | 0.8 | 0.1 | 34.2 | 12.5 |
| Industry | 21.3 | 195.8 | 60.4 | 21.1 |
| Domestic | 2.9 | 4.2 | 63.3 | 0.6 |
| | | | | |
| 1990 Transport | 2.1 | 3.1 | 85.8 | 25 |
| Industry | 20.8 | 194.8 | 60.8 | 11.3 |
| Domestic | 1.5 | 2.1 | 32.5 | 0.3 |
| **MADRAS** | | | | |
| 1970 Transport | 0.2 | 0.7 | 4.8 | 1.6 |
| Industry | 16.3 | 28.6 | 0.2 | 12.1 |
| Domestic | 1.8 | 0.8 | 17.3 | 0.1 |
| | | | | |
| 1980 Transport | 0.3. | 1.3 | 31.9 | 11.1 |
| Industry | 18.9 | 29.8 | 0.3 | 15.2 |
| Domestic | 2.1 | 1.4 | 20.5 | 0.1 |
| | | | | |
| 1990 Transport | 1.9 | 2.1 | 132.4 | 37.4 |
| Industry | 22.1 | 35.4 | 0.5 | 17.3 |
| Domestic | 1.6 | 0.9 | 38.9 | 0.1 |

***Source :*** *NEERI (1991), Air Quality Status*

The emission of suspended particulate matters (SPM) has not increased substaintially from any of three (Transport, Industry and Domestic) sources. Increase in SPM from industry has increased from 35300 tonnes per annum in 1970 to 46100 tonnes per annum in 1990.

Emission of carbon monoxide is mainly due to transport. The increase in carbon monoxide load from 52300 tonnes per annum in 1970 to 166600 tonnes per annum due to transport makes it clear that number of vehicles have increased substantially in Greater Bombay.

Emission of oxides of nitrogent (Oxides of Nitrogen) is a function of both transportl and industry. Emission of Oxides of Nitrogen from transport has increased from 13300 tonnes per annum in 1970 to 30300 tonnes per annum in 1990 at a rate of 6.39 percent per annum. Similarly emission of Oxides of Nitrogen from industry has increased from 19400 tonnes per annum in 1970 to 27600 tonnes per annum in 1990, at a rate of 2.4 percent per annum. Here it can be concluded that increase in number of vehicles. The increase of all the pollutants by source in Greater Bombay is depicted in figure (3.1).

### III.4.2.2 Air Pollution Load in Calcutta

Emission of Sulpher dioxide from transport has increased marginally since 1970, i.e. 400 tonnes per annum in 1970 to 2100 tonnes per annum in 1990.

Emission of sulphur dioxide emission from industry has increased during 1970 to 1980 but declined during 1980-1990. It increased from 12500 tonnes per annum in 1970 to 21300 tonnes per annum in 1980 and declined to 20800 tonnes per annum in

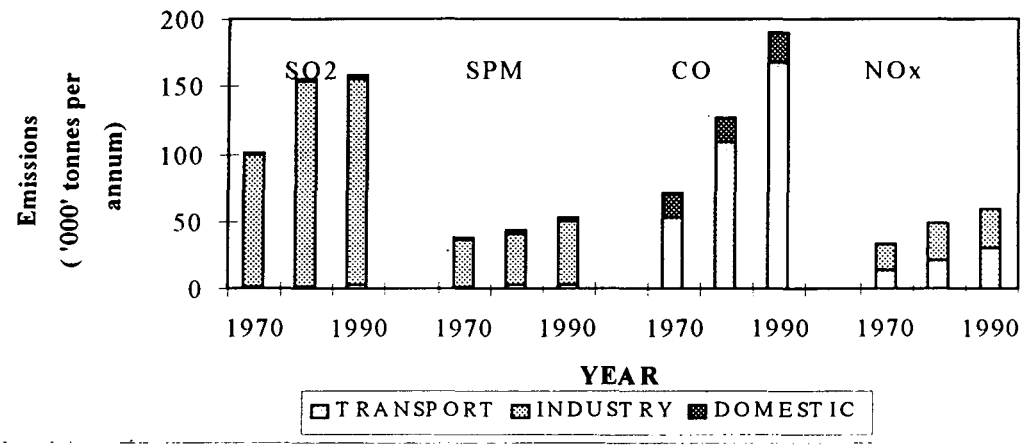
1990. Thus as net increase of 8300 tonnes per annum has been registered in sulphur dioxide emission since 1970. The decline may be due to closing down of sick units or environmental regulation imposed by CPCB. Emission of sulphur dioxide from domestic sources have declined from 4200 tonnes per annum in 1970 to 1500 tonnes per annum in 1990. This decrease may be due to use of non-polluting fuel in cooking.

Emission of suspended participate matter from transport and industry has increase since 1970 in Calcutta. From transport it has increased from 100 tonnes per annum to 3100 tonnes per annum, at a rate of 10 percent per annum. Emission of SPM from industry has increased from 105800 tonnes per annum in 1970 the 194800 tonnes per annum in 1990, at a rate of 4.2 percent per annum. Emission of SPM from domestic sources have however declined from 4200 tonnes per annum in 1970 to 2100 tonnes per annum.

Carbon monoxide emission from transport has increased from 8400 tonnes per annum in 1970 to 85800 tonnes per annum in 1990, at a rate of 46 percent per annum. Similarly CO emission from industry has increased from 33300 tonnes per annum in 1970 to 60800 tonnes per annum in 1990 at a rate of 4.13 percent per annum. However, CO emission from domestic sector has declined drastically from 93300 tonnes per annum in 1970 to 32500 tonnes per annum in 1990 at a rate of 9.3 percent per annum..

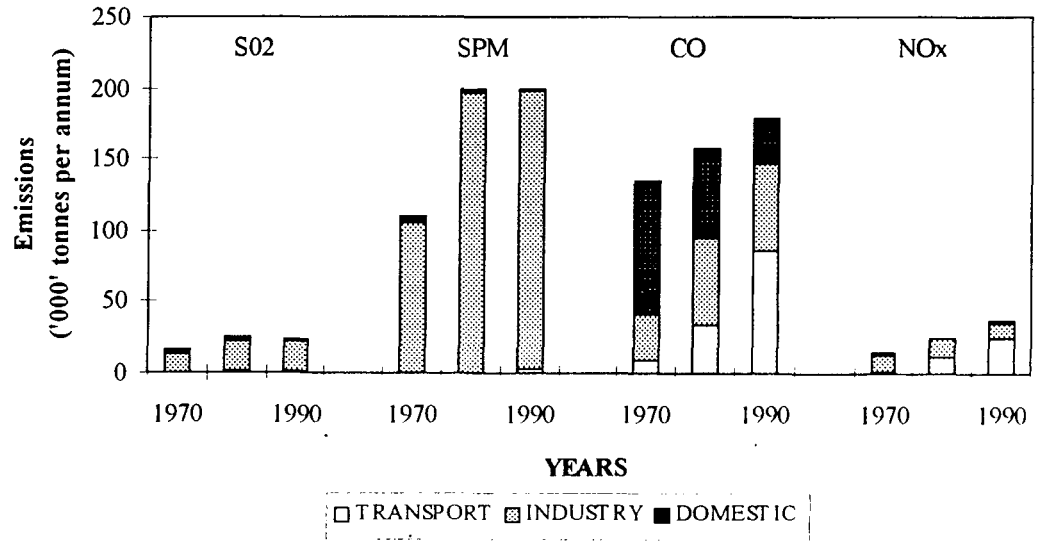
Emission of oxides of nitrogen from transport has increased from a low of 1700 tonnes per annum in 1970 to 25000 tonnes per annum in 1990. This increase is mainly attributed to growth of vehicles in calcutta. Industrial emission of Oxides of Nitrogen has however remained constant over the period of 1970-1990. Oxides of Nitrogen

**Figure 3.1** : Estimated anthropogenic pollutant emission by source (Bombay), 1970-1990.




Source: Table 3.5

**Figure 3.2** : Estimated anthropogenic pollutant emission by source (in Calcutta) 1970-1990




Source: Table 3.5

emission from domestic sector have declined from 800 tonnes per annum in 1970 to 300 tonnes per annum in 1990. The growth of each pollutant since 1970, from different sources in Calcutta is depicted in figure (3.2).

### 111.4.2.3 Air Pollution Load in Delhi

Emission of sulphur dioxide from transport has increased from 800 tonnes per annum in 1970 to 5000 tonnes per annum, at a rate of 26.25 percent per annum. Similarly emission of Sulphur dioxide from industry has increased from 30800 tonnes per annum to 38300 tonnes per annum during 1970-1990. Sulphur dioxide emission from domestic source increased form 2500 tonnes per annum in 1970 to 3300 tonnes per annum in 1990.

Emission of SPM from transport increased from 800 tonnes per annum in 1970 to 4300 tonnes per annum in 1990, at a rate of 21.8 percent per annum. Emission of SPM from industry increased from 80800 tonnes per annum in 1970 to 111700 tonnes per annum in 1990, at a rate of 1.9 percent per annum. 1970-1990 from 1700 tonnes per annum to 800 tonnes per annum.

Emission of CO from transport-increased from 33300 tonnes per annum in 1970 to 217700 tonnes per annum, at a rate of 27.68 percent per annum. It clearly indicate the concentration of vechiles in Delhi (table 3.8). Emission of CO from domestic source increased but is negligible. Similarly CO emission from industry has remained constant over the 20 years.

Emission of COx from transport also increased significantly from 8300 tonnes per annum in 1970 to 62500 tonnes per annum in 1990 owing to a massive increase in

vehicles concentration (table 3.8). No increase in Oxides of Nitrogen emission has been registered from domestic sources. A slight increase in Nox emission has been registered from industry. Emissions of different pollutants by source in Delhi has been show graphically in (figure 3.3).

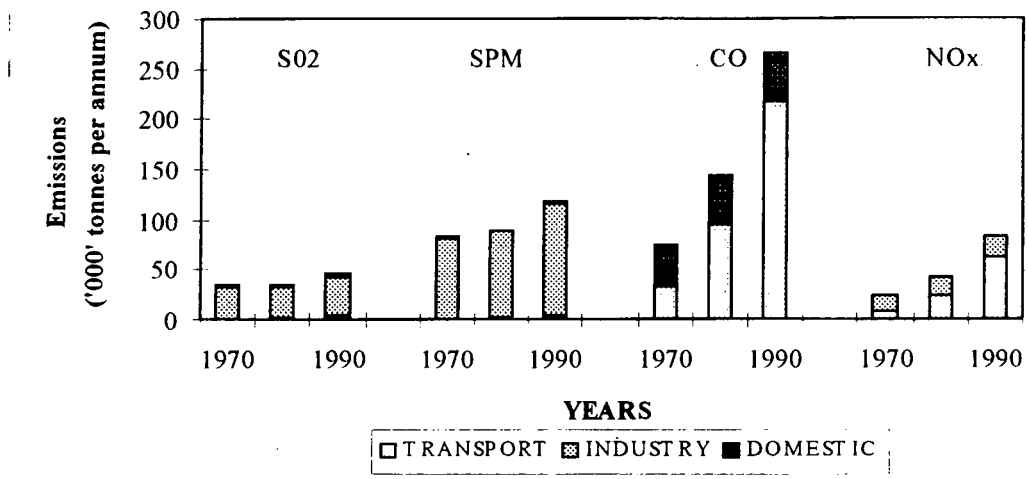
### III.4.2.4 Air Pollution load in Madras

Since 1970 emission of Sulphur dioxide from transport and industry has registered an increase over the 20 years period. Emission of Sulphur dioxide from transport increased from 200 tonnes per annum in 1970 to 1900 tonnes per annum in 1990. Emission of Sulphur dioxide from industry increased from 16300 tonnes per annum in 1970 to 22100 tonnes per annum in 1990. Emission of Sulphur dioxide from domestic sources has however registered a decline of 200 tonnes per annum over the 20 year during 1970-1990.

Emission of SPM from transport increased from 700 tonnes per annum in 1970 to 2100 tonnes per annum in 1990. Emission of SPM from industry increased from 28600 tonnes per annum in 1970 to 35400 tonnes per annum in 1990. Emission of SPM from domestic sources increased from 800 tonnes per annum in 1970- to 1400 tonnes per annum in 1980 but declined to 900 tonnes per annum in 1990.

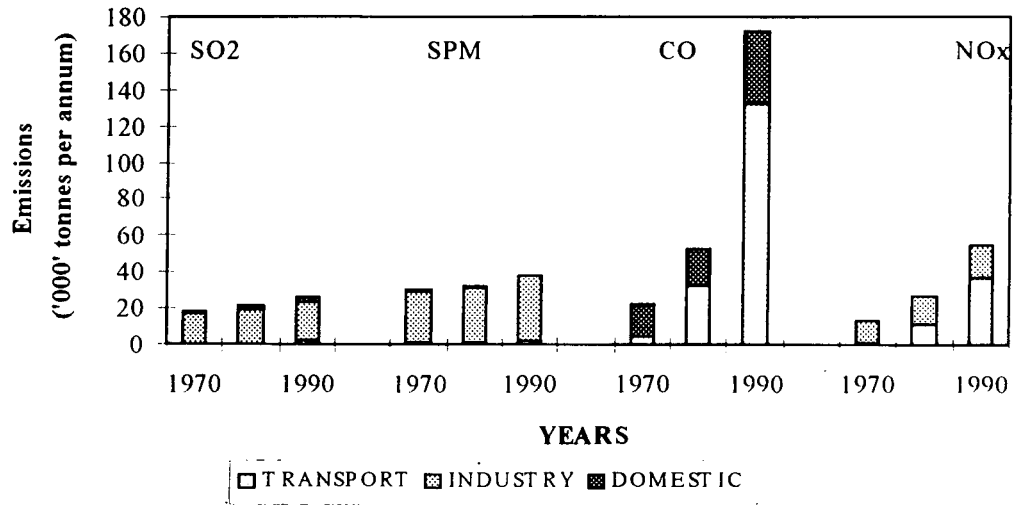
Emission of CO from transport increased from 4800 tonnes per annum in 1970 to 132400 tonnes per annum in 1990, at a rate of 132.9 percent per annum. This may be mainly due to massive increase in vehicles table (3.8). Emission of CO from domestic sources also increased tremendously from 17300 tonnes per annum 28900 tonnes per annum in 1990. Emission of CO from industry has increased only slightly over the year.

**Figure 3.3** : Estimated anthropogenic pollutant emission by source (in Delhi), 1970-1990




Source : Table 3.5

**Figure 3.4** : Estimated anthropogenic pollutant emission by source (Madras), 1970-1990




Source : Table 3.5

Emission of Oxides of Nitrogen from transport increased from 1600 tonnes per annum in 1970 to 37400 tonnes per annum in 1990. This may be mainly due to increase in the number of vehicles in a large scale (table 3.8). Emission of Oxides of Nitrogen has increased but not significantly. Emission of Oxides of Nitrogen from domestic sources has remained over the 20 year period. Emission of different pollutant from various sources in Madras has been shown graphically in figure (3.4).

From the above discussion (III.4.2) and table 3.5 some important results can be highlighted. Emission of $CO_2$ is highest in Delhi among the four mega cities which is mainly attributed to a massive increase in vehicle fleet. Emissions from industry shows that Bombay and Madras have same type of industries and Delhi and Calcutta have same type of industries. CO emission from domestic source was highest in Calcutta.

Since from the above discussion it may be concluded that an increase in vehicle population is the main cause of air pollution in mega cities, a thorough discussion of air pollution due to transport is necessary.

### III.5 Air Pollution due to Transport

One of the most serious pressures on the environment comes from motor transport. Its danger to the environment as air pollution is most severe in urban areas. The automobile proliferation illustrates how the free market principle, in this case the principal of freedom to select one's method of transportation, may conflict with the aim of maintaining an environment congenial for the masses. Having a private automobiles is regarded as an indication of prosperity and a good standard of living. The expansion in private transport has led to more pressure on the environment.

Since 1970 the total number of vehicles in all the mega cities have increased sharply. In 1991 Delhi ranked first with a vehicle population of (19,22,787) followed by Madras (6,05, 801), Bombay (5,88,158) and Calcutta (4,41,958). The highest growth rate per annum during the period 1970 to 1990 was observed in Madras (54.84 percent), followed by Delhi (42.13 percent), Calcutta (21.12 percent ) and Bombay (18.48 percent) (table 3.8) fig (3.5).

Since there is a positive correlation between number of vehicles and pollution load of carbon monoxide it is important to know the composition of vehicles among the four mega cities. In 1971 42.35 percent of total vehicles of our mega cities was concentrate in Delhi, followed by Bombay (28.22 percent), Calcutta (19.10 percent) and Madras (10.33 percent) fig. (3.7). But in 1991 there was slight change n their position with Delhi ranking first with (54 percent) vehicles followed by madras (17.02 percent), Bombay (16.52 percent) and Calcutta (12 percent). fig (3.8).

"Among all types of vehicles, two wheelers are responsible for most of pollution[6]". And that is why it is important to analyse the population of two-wheelers. In 1991 Delhi ranked first in two-wheeler population (12,94,006) which constitute 67.26 percent of the total vehicular population. Madras ranked second (4,33,046) followed by Bombay (2,21,531) and Calcutta (1,67,813) Fig 3.6. The proportion of two-wheeler to total vehicles in 1991 in Madras was 71.48 percent , the highest among the four mega cities, with Calcutta and Bombay ranking third and fourth respectively (table 3.8) fig (3.5)

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[6] Financial Express (20.02.91) "Fuel Emission: Case of Two Wheelers".

Two wheelers have very poor fuel efficiency. With 25-40 percent of the fuel supplied being exhausted without being burnt. Among the two-wheelers two-stroke engines add more to air pollution than four-stroke engines (Table 3.6).

**Table 3.6** : Typical Concentration of Exhaust Emission for 2–Stroke and 4–Stroke Gasoline Engines

| Pollutants | 2–Stroke Engine | 4–Stroke Engine |
|---|---|---|
| Carbon monoxide, % | 3.3 | 3.4 |
| Hydrocarbons, ppm | 5500 | 850 |
| Nitrogen Oxides, ppm | 150 | 1000 |

**Source** : *Financial Express (20.02.91) "Fuel Emission : Case of Two Wheelers".*

Why is there excessive emission of unburut hydrocarbons in 2–stroke engine? It is because in 2–stroke engines the intake and compression constitute one stroke, and the power and exhaust are combined in the second stroke. In a 4–stroke engine, on the other hand, there are four distinct stages, namely intake, compression, combustion and exhuast.

Diesel powered vehicles create relatively minor pollution problems compared to gasoline powered ones. The diesel engine exhausts only about a tenth of the amount of carbon monoxide as exhausted by a gasoline engine, although its hydrocarbon emission may approach those of gasoline engine.

Emission from a typical Indian car at different condition is shown in table 3.7

**Table 3.7** : Emission from a typical Indian Car

| Speed (Km ph) | Hydrocarbon (ppm) | Carbon monoxide % | Oxides of nitrogen (ppm) |
|---|---|---|---|
| Idle | 8200 | 3.50 | 75 |
| 32 | 2825 | 1.39 | 475 |
| 48 | 2475 | 0.28 | 1375 |
| 64 | 2175 | 0.18 | 1600 |
| 80 | 2000 | 0.18 | 1945 |

***Source*** *: Trivedi P.R.(1995) "International Encyclopaedia of Ecology and Enviornment", Vol.11, Air Pollution, p.27.*

The main pollutant from transport is carbon monoxide. That is why it is necessary to study changes in total pollution load of Carbon monoxide.

**Table 3.9** : Estimated Carbon monoxide emission from transport

| Name of the City | Carbon monoxide Emission ($10^3$ $ta^{-1}$) | | |
|---|---|---|---|
| | 1970 | 1980 | 1990 |
| Bombay | 52.3 | 107.6 | 166.6 |
| Calcutta | 8.4 | 34.2 | 85.8 |
| Delhi | 33.3 | 95.0 | 217.7 |
| Madras | 4.8 | 31.9 | 132.4 |

$10^3$ $ta^{-1}$ ='000' tonnes per annum

***Source :*** *NEERI (1991) "Air Quality Status".*

Emission of carbon monoxide from vehicles have increased significantly in Delhi i.e. 33.3 tonnes per annum in 1970 to 217.7 tonnes per annum in 1990. During the same period emission of carbon monoxide from vehicles in Bombay increase from 52.3 tonnes per annum in 1970 to 166.6 tonnes per annum in 1990. In 1980 Bombay ranked first in carbon monoxide emission followed by Delhi, Calcutta and Madras. But in 1980 Delhi become the major emitter of carbon monoxide from vehicles followed by

## Table 3.8: NUMBER OF VEHICLES IN OPERATION IN FOUR MEGA CITIES

| | Two Wheelers | Three Wheelers | Four Wheelers | Six Wheelers | Others | Total |
|---|---|---|---|---|---|---|
| **Bombay** | | | | | | |
| 1970 | 20,293 | 7 | 90,699 | 23,109 | 1,858 | 1,35,966 |
| 1980 | 75,847 | 3,300 | 1,80,845 | 38,492 | 3,140 | 3,01,622 |
| 1989 | 2,21,531 | 36580 | 3,18,594 | 7,127 | 4,326 | 5,88,158 |
| **Delhi** | | | | | | |
| 1971 | 1,09,112 | 19,812 | 65,626 | 14,712 | 3,815 | 2,04,078 |
| 1981 | 3,64,010 | 20,920 | 1,30,238 | 37,082 | 9,518 | 5,61,768 |
| 1991 | 12,94,006 | 65,829 | 4,38,169 | 99,210 | 26,513 | 19,23,787 |
| **Calcutta** | | | | | | |
| 1971 | -- | -- | -- | -- | -- | 92,043 |
| 1981 | 44,479 | -- | 85,289 | 28,880 | 13,675 | 1,72,323 |
| 1989 | 1,67,813 | 3082 | 169,537 | 50,763 | 33,177 | 4,41,958 |
| **Madras** | | | | | | |
| 1971 | 15,185 | 493 | 28,421 | 4,067 | 1,622 | 49,788 |
| 1981 | 89,029 | 5,640 | 50,445 | 9,007 | 1,991 | 1,56,112 |
| 1991 | 4,33,046 | 18,544 | 1,33,360 | 18,643 | 2,208 | 6,05,801 |

*Source* : 1. Statistical Abstract of Maharastra.
2. Statistical Abstract of Tamil Nadu.
3. Handbook of Statistics, Delhi.
4. A Handbook on Transport 1989. Department of Transport, Govt. of West Bengal.
5. Handbook of Statistics, West Bengal.

**Figure 3.5** : Total registered vehicles in four mega cities 1970-1990

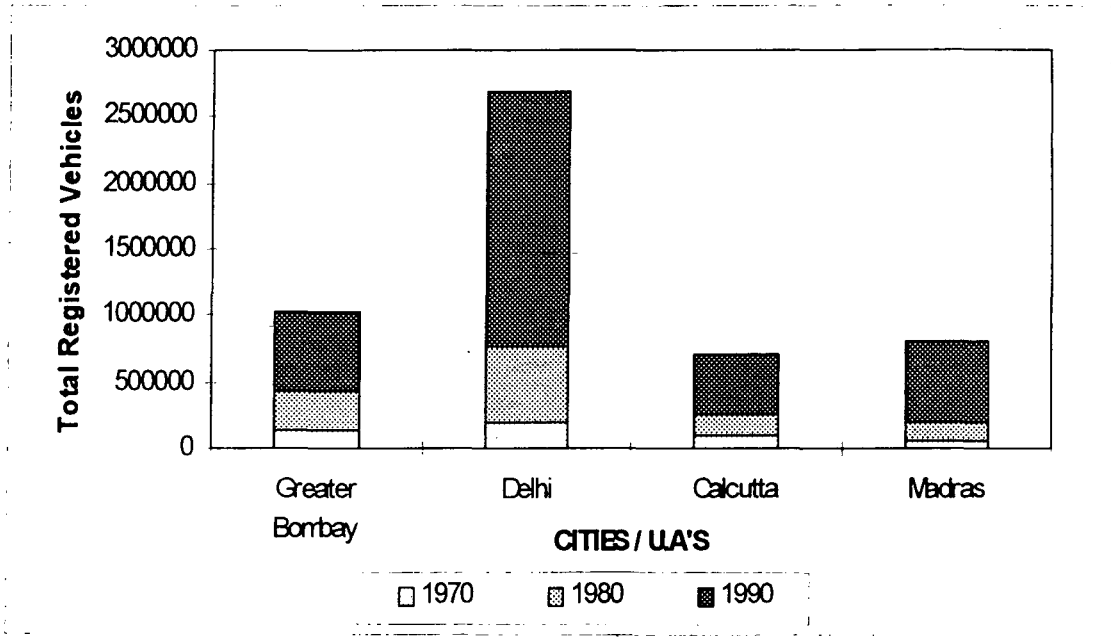



**Figure 3.6** : Registered Two wheelers in four mega cities, 1970-1990

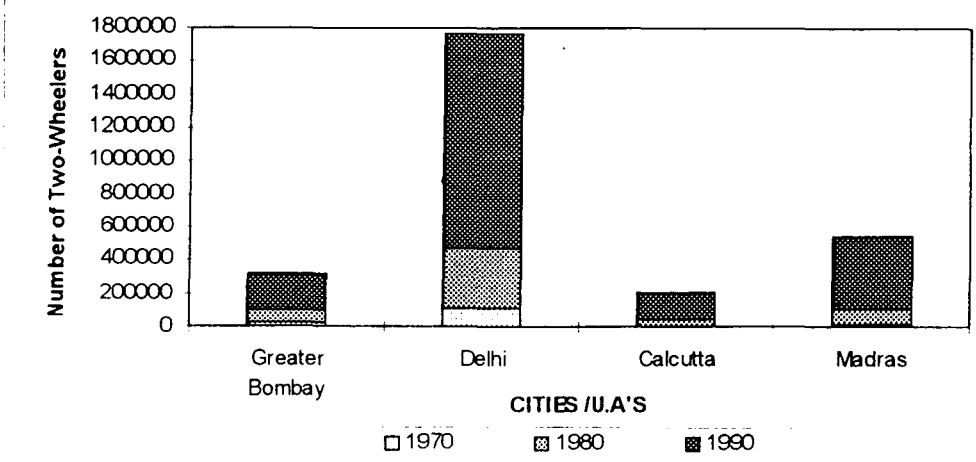


**Figure 3.7** : Percentage composition of vehicles in four mega cities, 1980

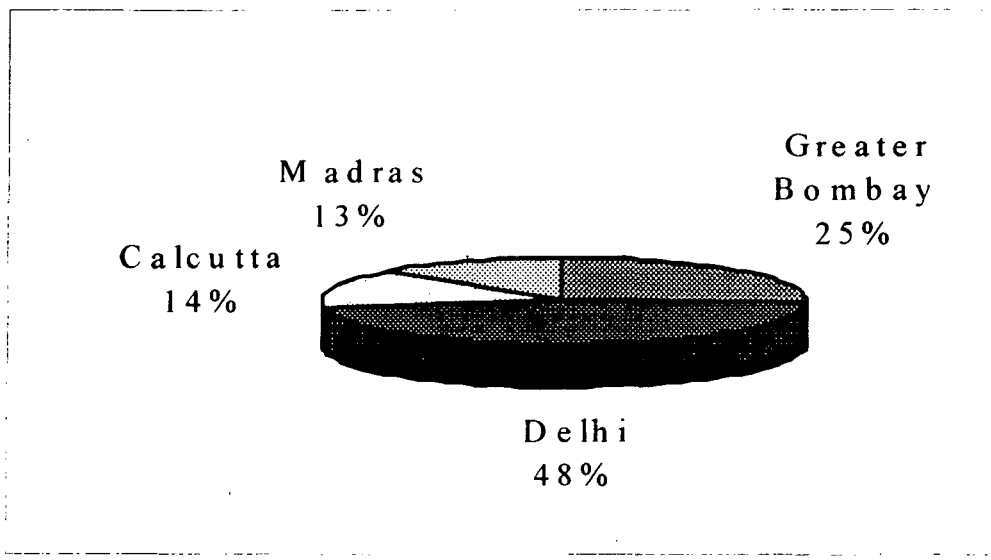
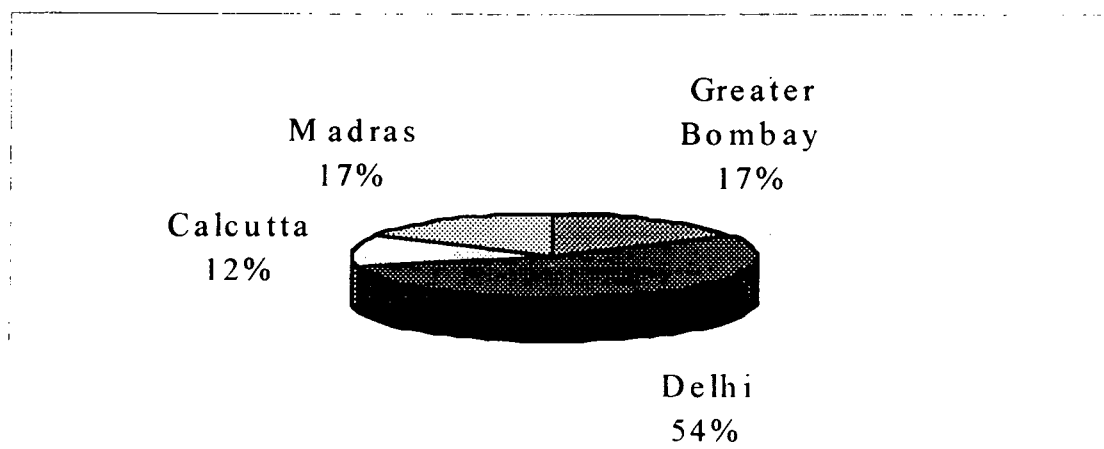



**Figure 3.8** : Percentage composition of vehicles in four mega cities, 1990



Bombay, Madras and Calcutta. It shows that vehicular population has increased significantly in Delhi during 1980-1990.

**Figure 3.9** : Carbon monoxide emissions due to Automobiles 1970-1990

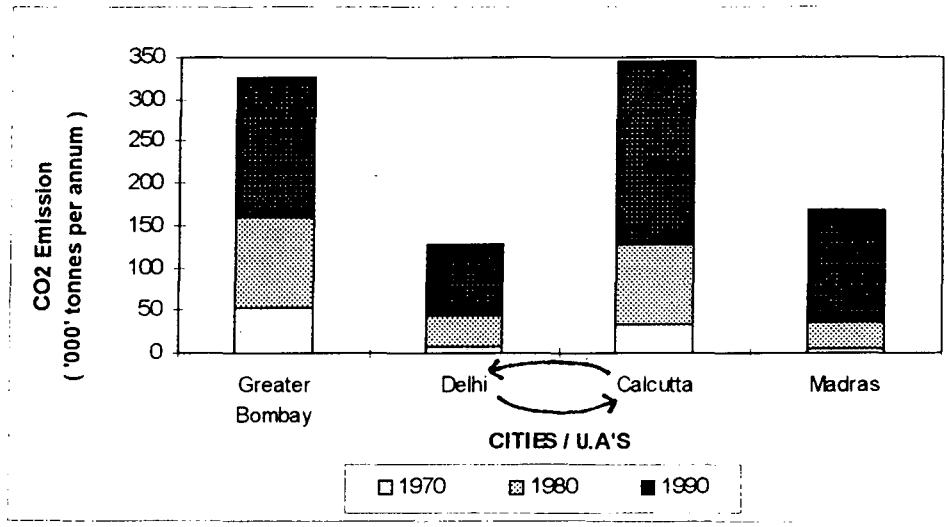



Table 3.9 and figure 3.9 shows that all the mega cities have shown an increase in the total pollution load of carbon monoxide. Delhi ranks first with a load of 217700 tonnes per annum followed by Bombay, Madras and Calcutta. Bombay and Delhi have exchanged their ranks in 1990 with respect to 1980 rank, Bombay slumping to 2nd position and Delhi gaining the first position.

The major reason why Delhi is the most polluted city with respect to carbon monoxide is kthat the total number of vehicles in Delhi has increased around 10 times since 1970 (2,04,078 in 1971 to 19,23,787 in 1991). The second reason is that, it consists of 54 percent of the total number of vehicles of all mega cities taken together for the year 1990 (table 3.8 & figure 3.8).

At this stage it is obvious to compare the increase in number of vechilces in Delhi and the other three mega cities.

Reason 1 : During 1972–73, according to the 27th round survey results of NSS. the proportion of very "affluent household" with monthly per capita consumption expenditure of more than Rs.200/– was found to be highest in Greater Bombay (12.91 per cent), followed by Delhi (10.60 per cent), Madras (6.36 per cent and Calcutta (6.03 per cent) respectively (Table 3.10).

**Table 3.10** : Number of very "Affluent Household" in Mega Cities

| Name of the City | Very Affluent Household (per cent) | |
|---|---|---|
| | 1972–73 | 1987–88 |
| Greater Bombay | 12.91 | 10.5 |
| Delhi | 10.60 | 13.2 |
| Calcutta | 6.03 | 7.2 |
| Madras | 6.36 | 6.8 |

***Source :*** (1) NSSO, 27th Round
(2) NSSO, 43rd Round

As table (3.10) showed that during 1987-88, the proportion of very "affluent household" with monthly per capital consumption expenditure more than Rs 700/- was found to be more in Delhi (13.2 percent) followed by Bombay (10.5 percent) Calcutta (7.2 percent) and Madras (6.8 percent) respectively.

The implication of such an increase in the number of very "affluent household" will be higher expenditure and high mass consumption.

Reason 2: An increase in the consumerist attitude due to "demonstration effect" poured in by the mass media and satellite channels, leads to constant demands of new products. There was also the increased rate of obsolescence of consumer goods and goods of mass consumption.

Reason 3: It has been a established fact that the Marginal Propensity to Consume (MPC) of a poor is higher than the rich. If a poor gets any additional income it is diverted more towards consumption and less towards savings. An increase in the average income of middle and lower class people will resulting higher consumption. Thus an increase in consumption level of a city result from well-do-section of the society as well as poor sections of the society.

### III.6 Water Pollution

Water pollution is a phenomenon that is characterised by the deterioration of the quality of land, water (river, lakes, marshes and ground water) or sea water. Water pollution is defined as "Changes that occur in the quality of our surface and subsoil water to such a degree that its suitability either for human consumption or for the support of man's natural life processes decreases or cease".[7] Before analysing the situation of water pollution in the four mega cities, at the outset it may be made clear that this part of the chapter only deals with quantity of polluted water rather than the quality of polluted water.

According to the National Environmental Engineering Research Institute, a staggering 70 percent of all available water in the country is polluted. While another study by Centre for Science and Environment found that out of 29 Indian rivers, water course other than Ganga at Garmukteshwar in Uttar Pradesh and the Teesta at Jalpaiguri, West Bengal are unfit for human use. The main cause of river pollution

[7] Trivedi PR (1995) "International Encyclopaedia of Ecology and environment, Vol.12, Indian Institute of Ecology and Environmental, New Delhi, p.2.

## Table 3.11 : Water Supply, Waste Water Generation, Collection and Treatment in Four Mega Cities, 1978-1988

| Name of the City/ Year | Projected Population | WATER SUPPLY | | | WASTE WATER (MLD) | | SEWERAGE SYSTEM | | Mode of Disposal | Untreated Waste Water (MLD) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Total Population (MLD) | Per Capita (Lit/Day) | Covered (%) | Genrated | Colleted | Population Treatment Covered (%) | Capacity (MLD) | | |
| Greater Bombay | | | | | | | | | | |
| 1978 | 5,970,575 | 1542.8 | 243.38 | N.A. | 1168.24 | 581.12 | 50 | 63.56 | Creek, Sea | 1104.68 |
| 1988 | 10,331,657 | 2143 | 207.8 | 99 | 1714.4 | N.A. | 80 | 82 | | 1632.4 |
| Delhi | | | | | | | | | | |
| 1978 | 6,647,023 | 885.3 | 243.89 | N.A. | 708.24 | 581.18 | 75 | 444.92 | River Yamuna | 263.32 |
| 1988 | 7,464,000 | 1848 | 258 | 96 | 1480 | 745 | 75 | 745 | Agri. Land | 735 |
| Calcutta | | | | | | | | | | |
| 1978 | 7,031,383 | 612.9 | 87.46 | N.A. | 490.32 | 26.97 | 5.5 | N.A. | River Multi | 429.03 |
| 1988 | 10,380,542 | 976.1 | 226.7 | 95 | 780.9 | N.A. | N.A. | N.A. | Hooghly | 683.27 |
| Madras | | | | | | | | | | |
| 1978 | 3,169,930 | 218.83 | 88.75 | N.A. | 175.06 | 175.06 | 75 | 45.4 | Sea, | 129.66 |
| 1988 | 3,880,796 | 250 | 75.8 | 85 | 200 | N.A. | 77 | N.A. | Irrigation | 175 |

*Source* : (1) Stuatus of water supply and waste water collection, treatment and disposal in Class-I cities : CUPS/4/1978-79.
(2) Statis pf water supply and waste water collection, treatment and disposal in Class-I cities : CUPS/30/1989-90.

are biological and industrial effluent which drained into them in order to flush the wastes of cities and town. Although there are laws to protect the rivers from defilement, yet very little control is exercised by the pollution control authorities on the industrial units.

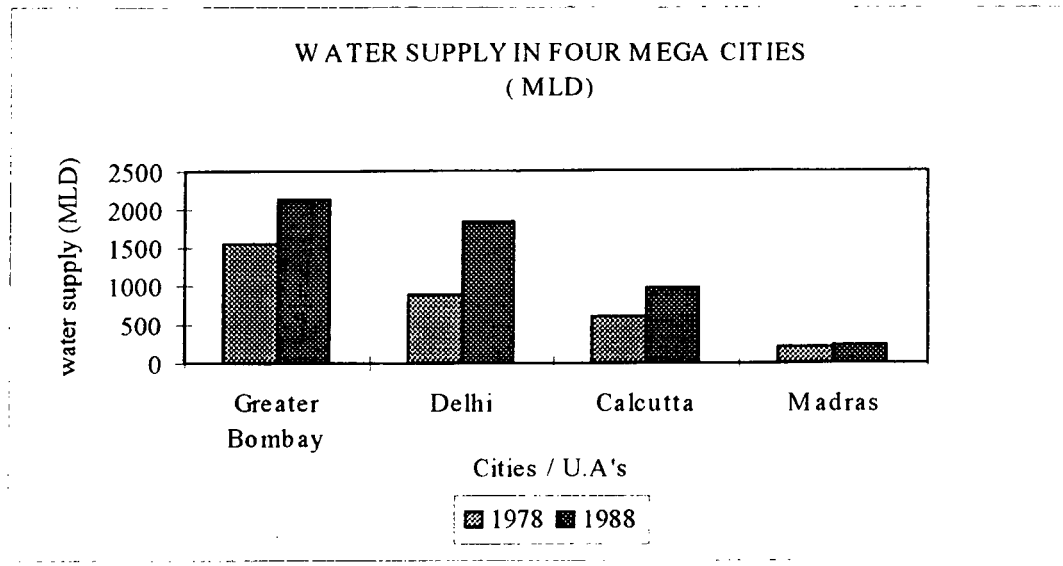
Mega cities with mega population and ever increasing number requreie more water for their substance. Supply of more water results in an increase in waste water. And since the sewerage treatment capacity has not been able to cope with the ever increasing quantity waste water, water sources near the mega cities are getting polluted in a much faster way.

Table 3.11 shows the temporal change in water supply, waste water generation, collection and treatment for four mega cities of India.

The water supply increased in all the four mega cities during 1978 and 1988. The water supply in Delhi has more than doubled from 885.3 MLD in 1978 to 1848 MLD in 1988. Bombay during the same period has increased its water consumption by 600.2 MLD, followed by Calcutta 363 MLD and Madras 31.17 MLD. Water consumption in Bombay was highest among the other cities i.e. 2143 MLD in 1988, followed by Delhi (1848 MLD), Calcutta (976.1 MLD) and Madras (250.MLD).

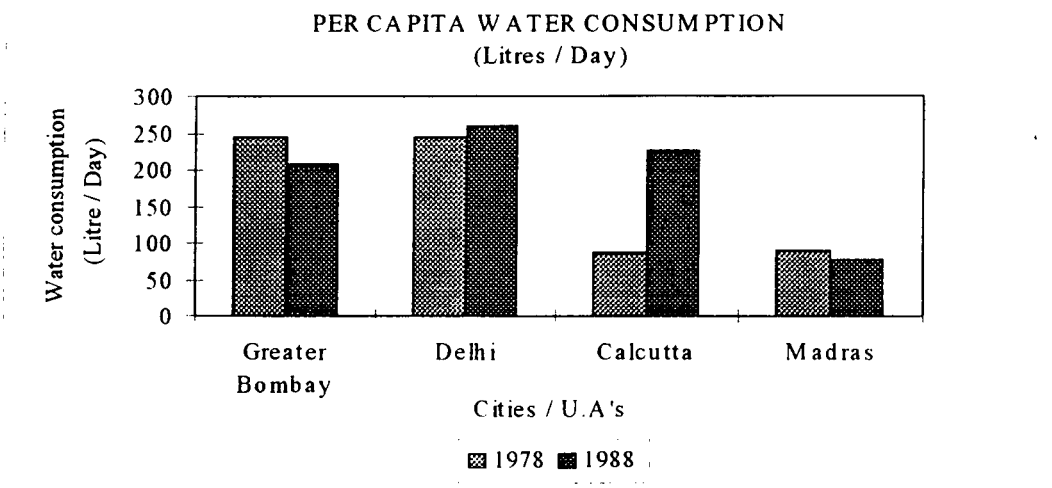
However, the per capita consumption of water in Bombay had decreased from 243.38 liters per day to 207 liters per day. Similarly Madras had shown a decline in per capita water consumption from 88.75 liters per day. On the other hand, Calcutta and Delhi have shown an increase in per capita water consumption. While in Delhi per capita water consumption had increased from 243.89 liters per day to 258 liters per day, it has increased from 87.46 liters per day to 226.7 liters per day in case of

**Figure 3.10** : Water supply in four mega cities (MLD), 1978-1988




Source : Table 3.11

**Figure 3.11** : Per capita water consumption in four mega cities 1978-1988

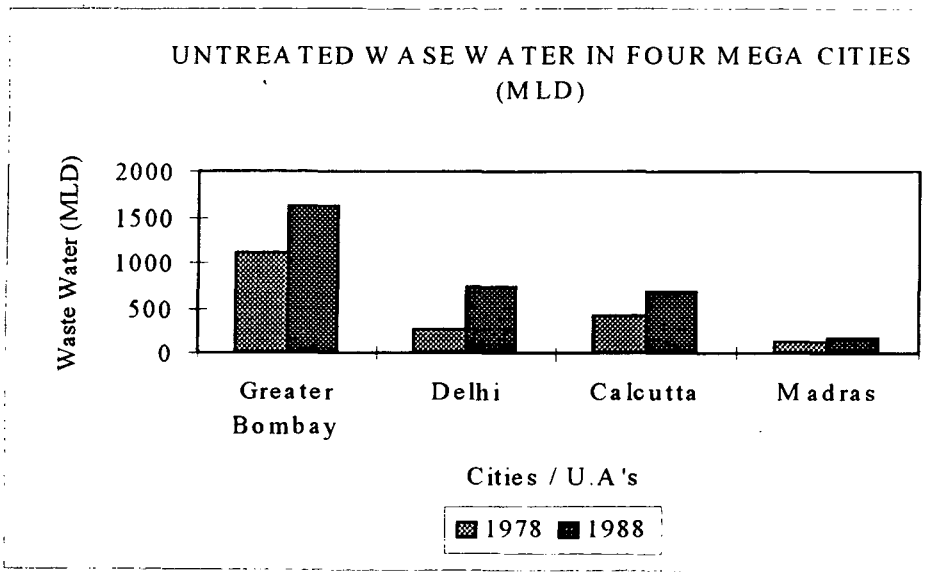



Source: Table 3.11

Calcutta. The implication of such an increase in water consumption is that more generation of waste water takes place.

The four mega cities of India do not have adequate sewerage treatment capacity which can cope with the ever increasing generation of waste water (table 3.11). Even the treatment capacity presently available to them are not fully utilized. And the net result is that large volume of untreated waste water are discharged outside the city to water courses.

**Figure 3.12** : Volume of untreated waste water by four mega cities 1978-1988




Source : Table 3.11

The total untreated waste water discharged by Greater Bombay increased from 1104.68 MLD in 1978 to 1632.4 in 1988. Similarly the volume of untreated waste water generated by Delhi increased from 263.32 MLD in 1978 to 735 MLD in 1988, in Calcutta from 429.03 MLD in 1978 to 683.27 MLD in 1988 and in Madras it increased from 129.66 MLD in 1978 to 175 MLD in 1988. This is also shown graphically in figure 3.12.

Such an increase in the volume of untreated waste water put pressure on the water courses near the city. An article "Yamuna may turn into sewage" published in Anand Bazar Patrika (20.2.89), describes the condition of Yamuna water. According to the article, a swelling population coupled with mushrooming unauthorised satellite colonies in and around Delhi, is threatening to run the Yamuna into a sewage. Before the Yamuna enters the capital 100 milliliters of its water contains more than 7500 disease causing bacteria, but after receiving Delhi share of sewage, carries 29 million bacteria according to pollution control experts. Then the condition of Arabian sea near the coast of Greater Bombay can be well understood. The condition of water courses

near Calcutta and madras are also not encouraging. The time has come when the urban authorities must think seriously about water pollution in cities.

### III.7 Noise Pollution

Since sound is regarded as a pollutant after a certain limit, any device to measure the intensity of sound is complicated by the difficulty of trying to reproduce on an electronic instrument, a metre reading that bears some relationship between sound and its effect on human beings. Therefore a number of devices with different measuring units were invented. The Decible has been the basic unit of sound. It can be and is applied to noise assessment, but given that its principal purpose is scientific rather than social, so it must be used with care when applied to social sciences. What level of noise should be the permissible level for human exposure. Depending upon one's attitude. even music which may be a factor of noise pollution, can give pleasure to some or can be extremely irritating for others.

The Central Pollution Control Board has recommended noise standards for ambient air quality.

**Table 3.12** : Ambient Air Quality standards in Respect of Noise
(in Decible)

| Area Code | Category of Area. | Limits in dB(A), Leq | |
|---|---|---|---|
| | | Day time | Night time |
| A | Industrial area. | 75 | 70 |
| B | Commercial area | 65 | 55 |
| C | Residential area. | 55 | 45 |
| D | Silence Zone. | 50 | 40 |

*Source: CPCB, "Parivesh: The news letter", Vol. 3 (iv) December 1996.*

**Note :** 1. Day time is reckoned in between 6 am to 9 p.m.

2. Night time is reckoned in between 9 p.m. to 6 a.m.

3. Silence zone is defined as areas upto 100 meters around such premises as hospitals, education institution and courts. The silence zones are to be declared by the competent authority.

Now let us see whether our four mega cities are facing the problem of noise pollution or not.

**Table 3.13** : Noise level in four mega cities of India (1991)
(in Decible)

| | Residential | | Commercial | | Industrial | | Silence | |
|---|---|---|---|---|---|---|---|---|
| | Day | Night | Day | Night | Day | Night | Day | Night |
| Greater Bombay | 45.81 | 45.68 | 63.81 | 60.75 | 78.79 | 56.72 | 58.77 | 46.66 |
| Calcutta | 76.86 | 58.76 | 70.90 | 57.78 | 75.82 | 58.70 | 69.89 | 65.70 |
| Delhi | 53.71 | _ | 63.75 | _ | 65.81 | _ | 62.68 | _ |
| Madras | 57.87 | 45.50 | 74.80 | 69.71 | 69.76 | 63.69 | 46.70 | 47.50 |

*Source : CPCB (1996), "Parivesh: The Newsletter", Vol 3 (iv) December 1996.*

Greater Bombay was having a problem of noise pollution for all the categories of area for day time as well as night time except for the night time in Industrial areas. Where the noise level is below the permissible limit. This may be due to non-functioning of various industries during night time. Similarly in case of Calcutta during night time in industrial area the noise level was below the standards set by CPCB. For other categories the noise level was above the minimum standard set by CPCB. Delhi was also suffering from noise pollution. The day time noise level was higher than the CPCB standards except for industrial areas. The data for night time noise level was however not available. In case of Madras, the noise level for industrial

areas were below the CPCB standards for day time as well as night time. For other categories and time it shows that noise pollution is prevalent.

On the basis of data discussed so far, it is evident that th emost noisy Indian city is Calcutta which is followed by Bombay and Madras. Since data for Delhi is adequate its position cannot be ascertained. The residential and commercial areas and silence zones of Calcutta, industrial areas of Bombay are most Vulnerable to noise pollution. The residential areas and silence zones of Madras, and commercial areas and industrial areas of Delhi are least polluted by noise. Thus the most noisy Indian mega city is Calcutta followed by Bombay, Madras and Delhi.

### III.8 Growth of Polluting Industries in four mega cities

City level data on number of industrial units are not available. Therefore we have made an attempt to use proxy data on workers in those industries which pollutes to environmental. These industries are

| NIC Group Number | Type of Industry |
|---|---|
| 10 | Coal mining |
| 11 | Crude Petroleum and Natural Gas |
| 12 | metal Ore Mining |
| 19 | Other Mining |
| 24 | Manufacture of Wool, Silk and Synthetic Fibre Textile (Textile Industry) |
| 28 | Manufacture of paper and products, and Printing, Publishing and allied industries (Paper Industry) |
| 29 | Manufacture of leather and leather and four products (leather industry) |
| 30 | Manufacture of rubber, plastic, petroleum and coal products |

**Table 3.14 :** Number of Main Workers in Polluting Industries

| Industries Group No. | Greater Bombay | | | Calcutta | | | Delhi | | | Madras | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1971 | 1981 | Percentage Change | 1971 | 1981 | Percentage Change | 1971 | 1981 | Percentage Change | 1971 | 1981 | Percentage Change |
| 10 | - | 31 | - | 339 | 171 | -98.25 | 8 | 25 | 68 | 36 | 31 | -16.13 |
| 11 | - | 1383 | - | 5 | 65 | 92.33 | 6 | 13 | 53.85 | - | 31 | - |
| 12 | - | 56 | - | 55 | 30 | -83.33 | 21 | 15 | -40.00 | - | 10 | - |
| 19 | - | 1235 | - | 95 | 110 | 13.64 | 67 | 4694 | 98.57 | 187 | 62 | -201.61 |
| 24 | - | 20136 | - | 2650 | 185 | -1322.43 | 543 | 1150 | 52.78 | 25 | 235 | 89.36 |
| 18 | - | 47366 | - | 29543 | 29390 | 0.52 | 26632 | 45067 | 40.91 | 17945 | 22898 | 21.63 |
| 19 | - | 18338 | - | 21565 | 24543 | 12.13 | 9876 | 11792 | 16.25 | 2860 | 4404 | 35.06 |
| 30 | - | 10422 | - | 16215 | 17849 | 9.15 | 8802 | 30187 | 70.84 | 5740 | 9013 | 36.31 |
| 31 | - | 84047 | - | 19005 | 22750 | 16.46 | 7080 | 13876 | 48.98 | 8385 | 13343 | 37.16 |
| 23 | - | 66043 | - | 24290 | 21574 | -12.59 | 20233 | 39288 | 48.50 | 12925 | 24012 | 47.17 |
| 40 | - | 8202 | - | 6460 | 9093 | 28.96 | 14375 | 24792 | 42.02 | 7025 | 5551 | -26.55 |
| Total | | 2,57,259 | | 120222 | 125760 | 4.60 | 87643 | 170899 | 94.99 | 55128 | 79590 | 44.37 |

**Note:** These are district level data. Data for Bombay (1971) is not avaiable.

**Source:** Census of India, 1971, General Economic Table.

Census of India, 1981, General Economic Table.

| | |
|---|---|
| 31 | Manufacture of Chemical and Chemical products |
| 34 | Manufacture of metal products and part except machinery and product |
| 40 | Electricity |

For our analysis it is assumed that an increase in number of workers in an industry adds more to pollution. At the outset it must be made clear that since data relates to district level, it would not represent the actual trend of pollution through these industries in cities. However, since most mega-cities are presented by district urban having 100 present urban population, it was decided to take district urban.

### III.6.1 Greater Bombay

Since trendwise data of workers for different industries are not available nothing can be said about the growth of the pollution through the polluting industries. But we will later compare the 1981 data with other districts to get some idea of pollution level in the mega cities.

### 11.6.2 Calcutta

In Calcutta workers engaged in the industrial groups 10, 12, 28 and 34 have declined. Workers have increased in industrial groups 11, 19, 29, 30, 31 and 40. From this it may be concluded that pollution from coal mining, metal are mining, manufacture of wool, silk and synthetic fibre textile manufacture of paper and paper products industry and manufacture of metal products and part have declined while pollution would have increased from crude petroleum and natural gap industry, manufacture of leather and leather products, chemical industry and electricity generation has increase. Since the number of workers have increased from 1,20,222 in 1971 to 1,25,760 in

1981, it can be assumed that pollution through the industries (under the study) have increased.

### III.6.3 Delhi

During 1971-81 workers in industrial groups 12 whereas in groups 10, 11, 19, 28, 29, 30, 31, 34 and 40 industry have increased. From this it may be concluded that pollution has declined from et. al. one mining but has increased from all other industry (under the study. Since the number of workers have increased from 87643 in 1971 to 170899 in 1981, it can be assumed that pollution through these industries (under the study) has increased.

### III.6.4 Madras

During 1971-81 worker under three industries (group 10, 19 and 40) declined while it increased in other industries except for group 10 and 12 for which trendwise data is not available. Since the number of workers have increased from 55128 in 1971 to 79590 in 1981, it can be assumed that pollution through the industries (under the study) have increased.

The group of workers in polluting industries was the highest in Delhi (9.50 percent per annum) followed by Madras (4.44 percent per annum) and Calcutta (0.46 percent per annum). The growth of workers for Bombay was not calculated because of inadequacy of data. However Greater Bombay had the largest working population in polluting industries in 1981 (2,57,259), followed by Delhi (170899), Calcutta (125,700) and Madras (79590). Thus we may conclude that industrial pollution was highest in Greater Bombay in 1981 followed by Delhi Calcutta and Madras.

In this analysis show change or growth through percentage points. Also add it in the table.

**Conclusion**

From the above discussion it can be concluded that :

1) Since 1970, air pollution had increased in all the mega cities of India.

2) The main cause of air pollution in mega cities was automobiles.

3) Among the four mega cities, Delhi had the largest share of automobile fleet.

4) Per annum growth rate of vehicels was highest in Madras (55.84 per cent per annum).

5) Emission from two-wheelers were higher than other type of vehicles.

6) Diesel-powered vehicles pollute more than gasoline powered vehicles.

7) The share of very "affluent household" were highest in Delhi in 1987-88, followed by Greater Bombay, Calcutta and Madras.

8) Greater Bombay consumed more water than any other mega city of India.

9) Per capita water consumption had increased in Delhi and Calcutta, but declined in Madras and Greater Bombay during 1978-1988.

10) The volume of untreated waste water was the highest in Greater Bombay folowed by Calcutta, Delhi and Madras.

11) The most noisy mega city was Calcutta followed by bombay and Madras. Since data for Delhi is inadequate its position cannot be ascertained.

From all these conclusion one can conclude that the state of urban environment in four mega cities of India has deteriorated since 1970.

The next chapter deals with the Housing facilities in urban areas and its relationship with enviornment, municipal finance and cleanliness of cities and slums and their living condition.

## CHAPTER-IV

# HOUSING, HOUSEHOLD AMENITIES, MUNICIPAL FINANCE AND SLUMS IN FOUR MEGA CITIES

### IV. 1. Introduction

This chapter deals with various urban issues like housing and environment; availability of household amenities in Mega Cities; municipal expenditure and Cleanliness of cities and slum and environment. The last part of this chapter would introduce critical linkages between population size, level of consumption and level of technology in the four mega cities.

### IV. 2 Housing and Environment

The single most important change in human settlement in the twentieth century is manifested in the growing proportion of the population living in urban centres and cities as compared to those in rural areas. Construction technology and land constraints have changed the housing typology in urban areas from single-unit plotted development to vertical structure and multi-household complexes. This changing pattern is seen in mega-and metro cities as well as in large towns.

The access of quantity housing and urban basic services directly influence the quality of life of people, their productivity levels and growth potential. "As urban settlement of the developing world grow in size, problem arise at two environmental level. The first is the internal living environment and its immediate surrounding. The second is the outer environment that cities provide for their inhabitants. Although the

deteriorated environmental condition and inefficient-services of substandard housing may be cause of high incidence of disease, it is low income and inadequate diet in poorer communities that are the main cause of poor health and inability to attain better living condition".[1]

**Table 4.1 :** Types of Census Houses Occupied.

| Name of the city | Total No. of Household | Pucca | Semi-Pucca | Kutcha | Servicable Kutcha | Non-serviceable Kutcha |
|---|---|---|---|---|---|---|
| Greater Bombay | | | | | | |
| 1971 | 1,203,233 | 86.93 | 3.58 | 4.63 | 1.14 | 3.72 |
| 1981 | 1,590,575 | 90.06 | 4.08 | 2.25 | 0.86 | 2.75 |
| 1991 | 2,616,286 | 89.29 | 8.53 | 2.21 | 0.81 | 2.74 |
| Calcutta | | | | | | |
| 1971 | 5,56,478 | 76.21 | 17.16 | 2.12 | 0.55 | 3.96 |
| 1981 | 1,721,143 | 80.10 | 13.42 | 2.46 | 2.56 | 1.46 |
| 1991 | 2,134,201 | 83.18 | 14.26 | 2.57 | 1.81 | .75 |
| Delhi | | | | | | |
| 1971 | 5,99,358 | 82.64 | 3016 | 6.12 | 5.09 | 2.99 |
| 1981 | 1,017,754 | 84.96 | 4.03 | 3.02 | 5.29 | 2.70 |
| 1991 | 1,619,467 | 85.48 | 4.47 | 1.05 | 7.50 | 2.55 |
| Madras | | | | | | |
| 1971 | 3,38,414 | 60.58 | 18.51 | 9.93 | 4.68 | 6.31 |
| 1981 | 8,22,216 | 65.43 | 13.26 | 8.51 | 6.73 | 6.07 |
| 1991 | 1,130,455 | 72.73 | 10.12 | 7.16 | 7.67 | 4.49 |

*Source :*

1. Census of India 1971, series-1, India, Housing Table Part IVB.
2. Census of India 1981, Series 1, Household Tables Part VIII A & (i).
3. Census of India 1991, Occasional Paper No.5 of 1994, Housing & Amenities, A database on Housing and Amenities for Distric, Cities and Town.

[1] Hardoy, J. and D. Satterthwaite (1984) "Third world Cities and the Environmental of Poverty". In Robert Repetto (eds) The Gobal possible : Resource, Development and the New Century, Yale University Press, Connecticut,

Now let us discuss the quality of housing in four mega cities of India. Table 4.1 shows a temporal change in the availability of quality housing for the residents of four mega cities. The share of pucca houses to total houses in Greater Bombay had increased from 1971-81. Pucca census houses in Greater Bombay was 86.93 percent, 90.06 percent and 89.29 percent in the year 1971, 1981 and 1991, respectively. In Greater Bombay the share of semi-pucca houses also increased to 3.58 percent in 1971 to 4.08 in 1991 and to 8.53 percent in 1991. The share of pucca houses in Calcutta had increased since 1971. In 1971 it was 76.21 percent which increased to 83.18 percentin 1991. The share of semi-pucca houses had declined from 17.16 percent in 1971 to 14.26 percent in 1991. Share of pucca house in Delhi increased from 82.64 percent in 1971 to 85.48 percent in 1991. During the same period semi- pucca houses increased from 3.16 percent to 4.47 percent. Share of pucca houses in Madras increased from 60.58 percent in 1971 to 72.73 percent in 1991. During the same period semi-pucca houses declined from 18.57 percent to 10.12 percent.

Greater Bombay had the highest share of pucca and semi-pucca houses, followed by Delhi, Calcutta and Madras. Pucca and semi-pucca houses are more environmental friendly than Kutcha houses. Thus it can be concluded that any pressure of environment due to housing is least in Greater Bombay followed by Delhi, Calcutta and Madras. In other words increased prevalence of Kutcha houses implies greater dependence on nature for building materials. The added pressure of population leads to a higher rate of gleanings from the environment to provide for the shelter. Thus these Kutcha houses become environmentally unsustainable.

## IV.3 Availability of Household Amenities in Mega Cities.

Since 1981, data on household amenities were available related to electricity, toilet and safe drinking water. The provision of such facilities improves the living condition of households. It has been observed that there has been an increase in the income of local bodies of the municipal corporation. And since the income of municipal corporation also are directed towards these ends, the living condition of the cities are expected to be better off than before.

The provision of electricity for households, in 1981 for Greater Bombay was 77.56 percent followed by Delhi (75.05 percent), Madras (65.38 percent ) and Calcutta (62.93 percent) respectively. As far as provision of toilet facilities were concerned the ranking are Calcutta (85.98 percent) followed by Greater Bombay (73.41 percent), Madras (69.71 percent) and Delhi (68.19 percent) respectively (table 4.2).

The distribution of household by source of drinking water show that mainly tap water was made available for the households in the mega cities. In Grater Bombay 92.11 percent of the Household get water from Tap which was followed by Delhi (68.26 percent), Calcutta (55.96 percent) and Madras (52.56 percent) respectively (table 4.3).

The household amenities in 1991 with respect to electricity has shown an increase over 1981 for all the mega cities. For Greater Bombay the increase was from 77.56 percent to 89.90 percent, for Calcutta it was 62.93 to 77.17 percent, for Delhi it was 75.05 to 81.37 percent and for madras it was 65.38 to 80.84 percent. (table 4.3)

**Table 4.2 :** Household by availability of Electricity, Toilet facilities in mega cities, 1981 (in percent)

| Name of the city | Electricity | Toilet facility |
|---|---|---|
| Greater Bombay | 77.56 | 73.41 |
| Calcutta | 62.93 | 85.98 |
| Delhi | 75.05 | 68.19 |
| Madras | 65.38 | 69.71 |

***Source:*** *Census of India, 1981, series 1, part VIII A and B (V) Household tables.*

**Table 4.3 :** Proportion of households having electricity, safe drinking water and toilet facilities (1991)

| Name of the city | Electricity | Safe drinking water | Toilet | Electricity Plus S.D.W | Toilet Plus S.D.W | Electricity Plus Toilet | All the three facilities | None of the three facilities |
|---|---|---|---|---|---|---|---|---|
| Greater Bombay | 89.90 | 94.74 | 71.85 | 86.37 | 69.49 | 70.30 | 68.11 | 1.47 |
| Calcutta | 77.17 | 92.24 | 89.19 | 71.16 | 82.27 | 74.58 | 68.60 | 0.62 |
| Delhi | 81.37 | 96.27 | 66.81 | 78.93 | 64.93 | 63.96 | 62.17 | 1.19 |
| Madras | 80.84 | 52.16 | 73.75 | 41.42 | 38.67 | 71.34 | 37.10 | 7.58 |

***Source:*** *Census of India, 1991, occansional paper No.5 of 1994, Housing and Amenities: A data base on Housing and Amenities for districts, cities and town.*

Toilet facilities in Greater Bombay and Delhi has shown a decline while it has shown an increase for Calcutta and Madras (table 4.2 and table 4.3). While the decline in Greater Bombay was 1.56 percent, it was 1.38 percent for Delhi. The increase in toilet facility for Calcutta is 3.21 percent and for Madras it was 4.04 percent.

From the above discussion on availability of civic amenities in mega cities, it can be concluded that during the period of 1981-1991, electricity facility in all the mega cities have increased, but the toilet facilities have declined for Greater Bombay and Delhi urban agglomeration. Toilet facilities have however increased in Calcutta and Madras urban agglomerations.

## IV.4 Municipal Expenditure and Cleanliness of Cities

Now lets, see the role of local bodies in making cities clean and a better place for living. It all depends on the type of expenditure and the amount sanctioned in each sector of expenditure, whether cities are better off than before in terms of providing better facilities to the people of the cities.

Since 1970 Municipal income and expenditure has increased (table 4.4) in monetary terms. However, the matter of concern is whether they have increased in real term or not. Moreover the per capita municipal expenditure in real terms also tells the story of city's cleanliness and provision of better facilities in terms of. Public works, safety and convenience, sanitation and public health.

Taking the wholesale price index (base 1970-71=100) the indices of growth of per capita municipal expenditure on different head were calculated (table4.5). The table clearly showed that changes incurred in the per capita municipal expenditure in real

(at Current Prices)

| | Income | Expenditure | | | |
|---|---|---|---|---|---|
| | | Public Health | Safety and Convenience | Public Works | Total |
| **Greater Bombay** | | | | | |
| 1970-71 | 521,128 | 168,511 | 42,247 | 51,733 | 535,244 |
| 1980-81 | 2,090,227 | 509,870 | 273,838 | 272,838 | 1,872,877 |
| 1991-92 | 10,036,570 | 2,205,872 | 459,355 | 1,200,179 | 8,833,428 |
| **Madras** | | | | | |
| 1970-71 | 123,753 | 22,331 | 28,711 | 23,899 | 127,322 |
| 1980-81 | 417,052 | -- | -- | -- | 420,320 |
| 1990-91 | 824,564 | 299,764 | -- | 91,312 | 727,968 |
| **Calcutta** | | | | | |
| 1970-71 | 154,336 | 48,727 | 11,192 | 43,389 | 147,846 |
| 1980-81 | 347,749 | 84,176 | 23,330 | 122,058 | 349,687 |
| 1987-88 | 1,391,649 | 82,783 | -- | 730,340 | 1502,968 |
| 1990-91 | 2,087,673 | -- | -- | -- | -- |
| **Delhi** | | | | | |
| 1970-71 | 271,136 | 60,022 | 447 | 47,648 | 265,619 |
| 1980-81 | 746,228 | 221,699 | 594 | 95,975 | 719,725 |
| 1990-91 | 3,048,001 | 1,163,119 | 4,303 | 147,565 | 3,056,511 |

*Source* : Statistical Abstract of India, 1992, Central Statistical Organisation. Department of Statistics, Ministry of Planning and Programme Implementation. GOI, New Delhi, Table No.538-539, pp.535-564.

**Table 4.5** Comparison between WPI and muncipal expenditure on different sectors.

| | Index No- (1970-71=100) | | | |
|---|---|---|---|---|
| | Public Health | Safety and Convenience | Public works | WPI (Base 1970-71=100) |
| Greater Bombay | | | | |
| 1970-71 | 100 | 100 | 100 | 100 |
| 1980-81 | 221 | 471 | 367 | 248 |
| 1990-91 | 689 | 571 | 1167 | 454 |
| Madras | | | | |
| 1970-71 | 100 | 100 | 100 | 100 |
| 1980-81 | _ | _ | _ | 248 |
| 1990-91 | 786 | _ | 213 | 454 |
| Calcutta | | | | |
| 1970-71 | 100 | 100 | 100 | 100 |
| 1980-81 | 129 | 200 | 217 | 248 |
| 1988-89 | 114 | _ | 1450 | 356 |
| Delhi | | | | |
| 1970-71 | 100 | 100 | 100 | 100 |
| 1980-81 | 244 | 100 | 131 | 248 |
| 1990-91 | 869 | 500 | 138 | 454 |

From the above discussion it can be concluded that per capita municpal expenditure except for Greater Bombay, has not increased over the years in real terms. Per capita municipal expenditure had increased in some sectors and declined in some sectors. Thus, these cities are better off in providing those services where per capita municipal expenditure have increased. Bombay is better off in providing all the facilities like Public health, safety and convenience and public works. Delhi is better off in

terms. Since 1970, for Greater Bombay urban agglomeration Municipal expenditure on public health became worse off from 1970-71 to 1980-81, but it became better off during 1990-91. Expenditure on safety and convenience has been better off than before for 1980-81 and also 1990-91. Public works expenditure per capita has increased but was lower in real terms for 1980-81. But thereafter it increased sharply, and the situation become better off for the year 1990-91 (see table 4.5 and fig. 4.1).

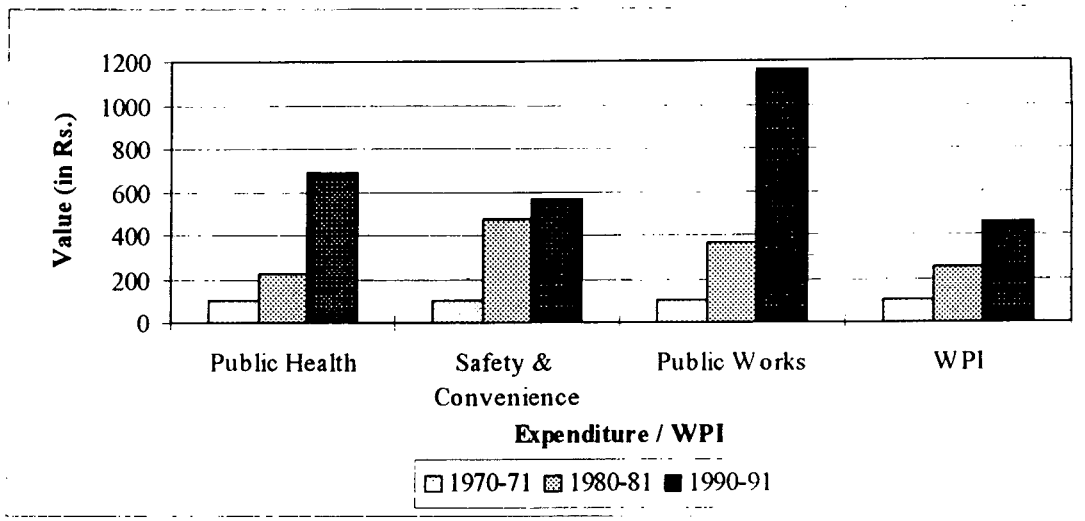
In Calcutta urban agglomeration, the situation is worse in terms of municipal expenditure. Only public works in 1990-91 showed a respectable situation. Expenditure on public health, safety and convenience and public works increased in monetary terms but in real terms it declined sharply for 1980-81 and 1990-91 (table 4.5 and figure 4.2).

Delhi's per capital municipal expenditure in safety and convenience has been the lowest among the four mega cities. Except for public health in 1990-91 all other areas have not shown any increase in per capital municipal expenditure (see table 4.5and figure 4.3).

Madras urban agglomeration showed a better situation in public health during 1990-91, but pubic works have shown a decline in same time period. Due to lack of data other informations are not calculated (table 4.4 and fig. 4.4).

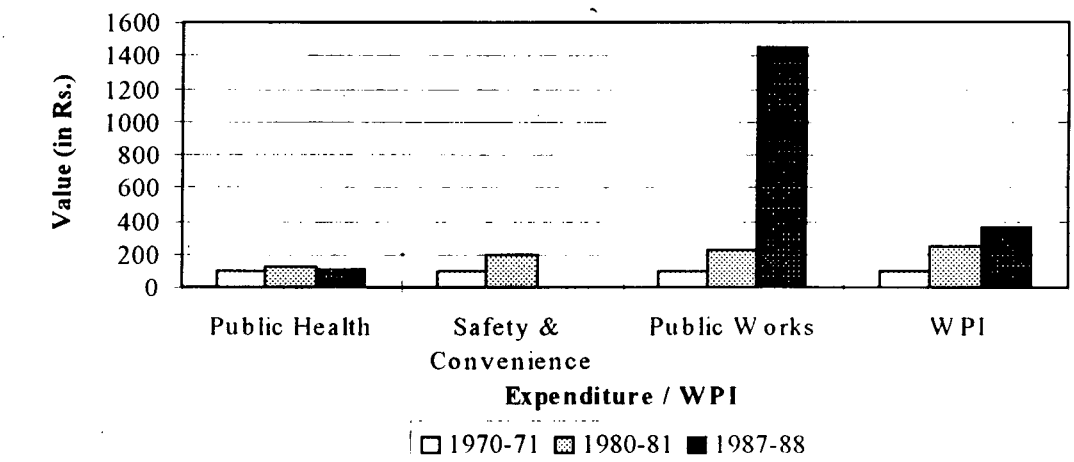
As a whole Greater Bombay urban agglomeration ranks first among the four mega cities in terms of per capita municipal expenditure.

**Figure 4.1** : Growth of municipal expenditure in different sectors (in Greater Bombay) 1970-1990.



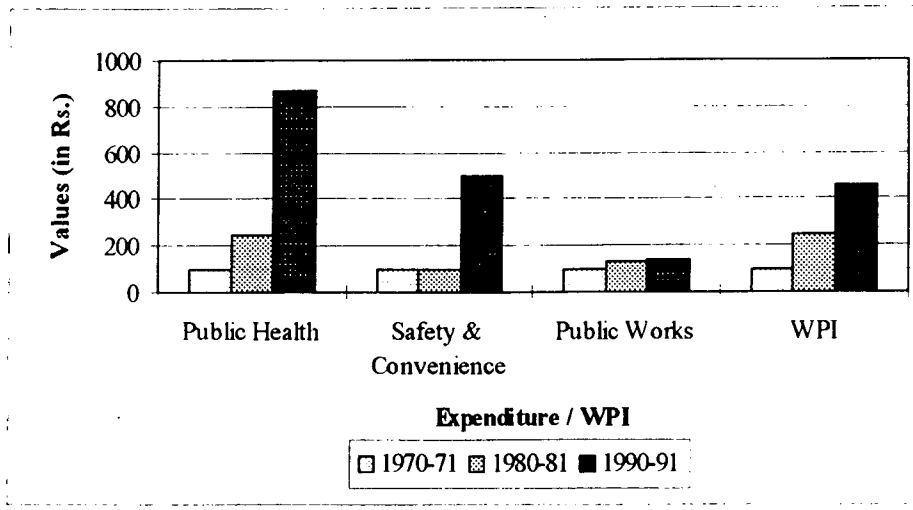

Source: Table 4·5

**Figure 4.2 :** Growth of municipal expenditure in different sectors (in Calcutta) 1970-1990.



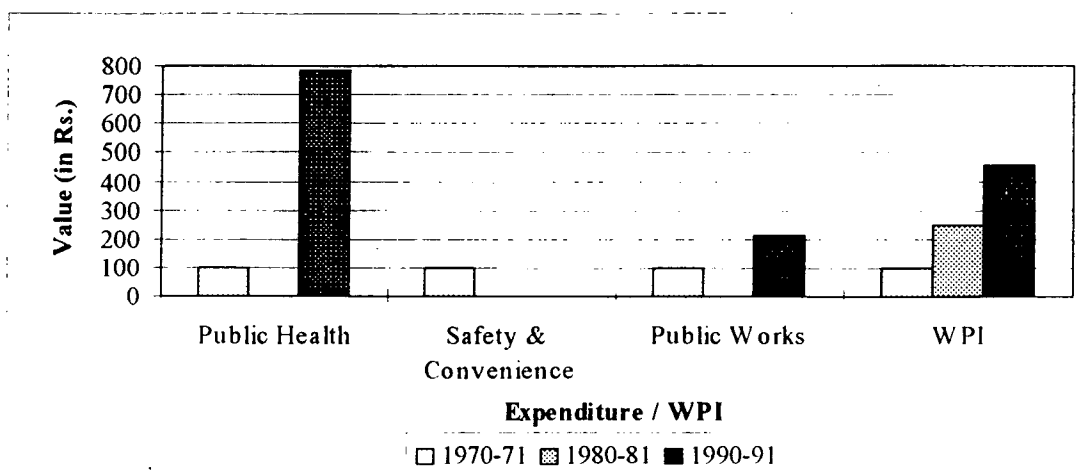

Source : Table 4·5

**Figure 4.3** : Growth of municipal expenditure in different sectors (in Delhi) 1970-1990.




Source : Table 4.5

**Figure: 4.4** : Growth of municipal expenditure in different sectors (in Madras) 1970-1990.




Source : Table 4.5

providing facilities like public health and safety and convenience. Calcutta is better off only in public works and Madras is better off only in public health sector.

Here it can said that Bombay is in a better off situation, but other mega cities have to increase their expenditure on various sectors of public importance to provide better facilities to its residents. In all one may add that despite the national increase in per capita municipal expenditures, what emerges as significant is the whole generation of governance, the role of public and private partnership. Such a partnership would facilitate service delivery such as waste water treatment, solid waste management and other environmental services to mega cities. This would ensure the enviornmental improvement around urban slums.

### IV.5 Slums And Their Environment

Most of the large agglomerations of the underdeveloped as well as developed nations encounter a gap between demand and supply of quality housing for their residents. The urban poor who are most affected by this problem, have provided and continued to provide their own housing by constructing clusters of substandard dwellings, commonly referred to as slums and marginal settlements.

A number of definitions are given for slums by various authorities. A definition of the slums as offered in the report on urban land policies of the United Nations refers to it as "....a building or group of buildings, or area characterised by overcrowding, deterioration, unsanitary conditions or absence of facilities or amenities which because

of these conditions or any of them, endanger the health safety or morals of its inhabitants or the community."[2]

The Government of India Slum Area (Improvement and Clearance) Act of 1954 defines a slum "as any predominantly residential area where the dwellings by reasons of dilapidation, overcrowding, faulty management, lack of ventilation, light or sanitary facilities of any combination of these factors are detrimental to safety, health or morals."[3]

### IV.5.1 Growth of slums in mega cities

Though housing facilities are increasing in the mega cities yet it had failed to keep pace with the rising demand. Slums are increasing because of two reasons.

1. There is gap existing between demand and supply of housing. That is to say demand is quite higher than the supply.
2. The price of land and housing are beyond the reach of poor people. So they resort to self-financed housing in the marginal lands of the city, lacking in all sorts of amenities.

There are not many studies which deal with the physical and social aspects of slum-dwellers and pavement dwellers in the Indian context. Moreover there is very limited data available on slums and the availability of basic amenities. In 1979, a survey on slums was done in the metropolitan cities of India.

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[2] United Nations, "Urban Land Policies", United Nations Secretariat Document ST/SCA/9, April 1952, New York, p.200.

[3] Socio-Economic Survey of Madras Slums (1975), Tamilnadu Slum Clearance Board, Madras.

Unchecked growth of population, industrialization and urbanization leads to heavy influx of rural and urban labour class families to the cities. Being from lower income strata, these families cannot afford costly settlements and higher rents, and are forced to live in marginal land, in slum and squatter settlements. Slums generally present the most unhygenic, ugliest, nauseating scene. During rainy seasons the whole area gets flooded, the pathways become swampy and the entire colony becomes a fertile breeding place for mosquitoes, exposing the slum dwellers living in the area to all sorts of diseases. During summer, the thatched huts are prone to fire accidents. Thus the slum dwellers life is the most miserable one, devoid of all basic amenities.

The sprawling slums have become common in cities not only in large metropolitan towns but also in medium-sized towns[4]. Slums are lacking in sanitary arrangement and inadequate amenities that are necessary for the maintenance of physical and social health of the community.

Table 4.6 shows the temporal change in Dwelling units, Pavement Dwellers and slum population for years 1971, 1981, and 1991. Number of dwelling units have increased in all the mega cities. Greater Bombay had the largest number of dwelling units as per 1991 census, 2,616,286, followed by Calcutta (2,134,210), Delhi (1,619,467) and Madras (1,130,455). Growth rate of dwelling unites had been the highest in Calcutta i.e., 14.17 percent per annum followed by Madras (11.70 percent per annum), Delhi (8.51 percent per annum)

[4] Ibid., p.14.

Table 4.6 : Temporal Change in Dwelling Units, Houseless Population and Slum Population

| Name of the City/U.A. | Dwelling Units 1971 | 1981 | 1991 | Houseless Population 1971 | 1981 | Slum Population (in lakhs) 1981 | 1991 |
|---|---|---|---|---|---|---|---|
| Greater Bombay | 1,203,233 | 1,590,575 | 2,616,286 | 59,169 | 44,289 | 28·31 | 41·26 |
| Calcutta | 556,478 | 1,721,143 | 2,134,201 | 48,802 | 37,642 | 30·28 | 43·86 |
| Delhi | 599,358 | 1,017,754 | 1,619,467 | 7,049 | 22,516 | 18·00 | 32·08 |
| Madras | 338,414 | 822,216 | 1,130,455 | 15,136 | 6,841 | 13·63 | 21·08 |

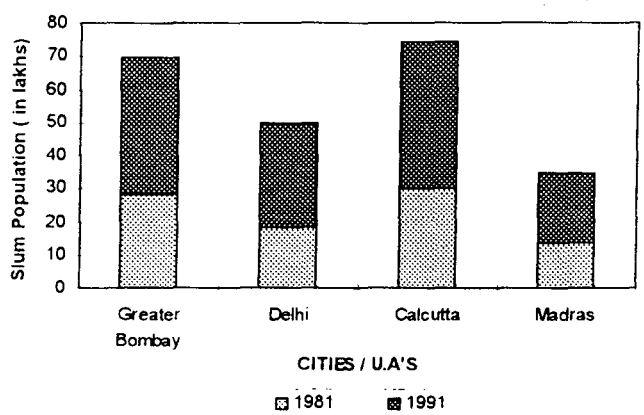
**Source :** (1) Census of India 1971, Series I, General Population Tables Part II A(i).

(2) Census of India 1981, Series I, General Population Tables Part II A(i).

(3) Census of India 1991, Series I, Primary Census Abstract : General Population.

(4) A compendium on Indian Slums, TCPO, September 1985.

Fig. 4.5 Growth of Slum Population in Four Mega Cities (In Lakhs)




Slum population has increased in all mega cities. Calcutta has highest slum population of 43.86 lakhs in 1990, followed by Greater Bombay (41.26 lakhs), Delhi (32.08 lakhs) and Madras (21.08 lakhs). The making of these cities based on slum population was same in 1981, with Calcutta having the highest Slum population of

30.28 lakhs followed by Greater Bombay (28.31 lakhs), Delhi (18.00 lakhs) and Madras (13.63 lakh) respectively.

In 1981, Greater Bombay was having 34.3 percent population living in slums, followed by Calcutta (32.9 per cent), Madras 31.8 per cent) and Delhi (31.4 per cent). But the situation changed drastically in 1991, with Madras having 40.3 percent population living in slums, followed by Calcutta (40.2 per cent), Delhi (38.3 per cent) and Greater Bombay (32.8 per cent) respectively (see table 4.6 and fig. 4.5).

The number of Houseless population or pavement dwellers declined for Greater Bombay, Calcutta and Madras but increased for Delhi. Each of these city is having less than 1 percent of its population living without housing facility.

### IV.5.2 Civic and other amenities in Slums

As mentioned slums have peculiar characteristics like, overcrowding faulty management of design in building, narrow and unplanned streets. Houses in slums lack ventilation, light or sanitation facilities, facilities like provision of safe drinking water, sewerage system and paved roads etc.

**Table 4.7 : Civic and other amenities in notified slums 1981**

| Name of the city | Number of notified slums | Latrine Facility | | Water supply through public tab | Electrification | |
|---|---|---|---|---|---|---|
| | | Private | Community | | Domestic | Road Lighting |
| Greater Bombay | 619 | 0 | 418 | 390 | 1 | 58 |
| Calcutta | - | - | - | - | - | - |
| Delhi | - | - | - | - | - | - |
| Madras | 802 | 145 | 188 | 432 | 70 | 435 |

**Source :** 1. Census of India, 1981, District Census Handbook, Greater Bombay, Part XIII (A&B).

2. Census of India, 1981, Series 20, Tamilnadu, Town Directory, Part X(A).

**Note :** 1. Date for Class 3 cities of West Bengal are available and not separately for Calcutta.

2. Date for Delhi are not available.

The civic and other amenities in mega cities in 1981 has been shown in table 4.7.

Out of 619 notified slums in Greater Bombay, none of the household had private latrines. Only 418 slums have community latrine facility. Water supply through public tap is available to 309 slums. And only 10 slum households had proper domestic electrification. No proper electrification was available for 561 slums. The situation of Madras is somewhat better in terms of electrification of both households and roads. Out of 802 slums, 70 have facilities of domestic lighting and road lighting exists in 435 slums. Small share of households (145) slums have private latrines, and only 188 slums have the provision of community latrines. Water supply through public tap was available only to 432 slums.

Table 4.8 Drainage Arrangement in slums of four mega cities (in percentage)

| Name of the City | Drainage Arrangement | | | |
|---|---|---|---|---|
| | (a) | (b) | (c) | (d) |
| Greater Bombay | 61.3 | 30.25 | 8.39 | 100 |
| Calcutta | 85.17 | 12.64 | 2.18 | 100 |
| Delhi | 61.57 | 29.42 | 9.00 | 100 |
| Madras | 24.21 | 9.16 | 66.62 | 100 |

Drainage Arrangement Code :

(a) no. drainage; (b) open *Kutcha* or *Pucca* drainage; (c) covered or underground drainage; (d) all.

***Source :*** *Sarvekshana, Vol.XV, No.3, 44th Round NSS, 1988-89.*

The above table (4.8) clearly shows that Calcutta has the poorest drainage system among the four mega cities followed by Delhi, Bombay and Madras respectively.

From the above discussion it can be clearly concluded that slums are still devoid of basic civic amenities. And, therefore there is a need that urban authorities should try to improve their living condition through provision of various facilities which are minimum necessity for good living.

Since the slum dwellers and pavement dwellers lack even the basic necessities for their livelihood, their health conditions are not robust enough to fight against disease. And that is why, the negative impact of environmental pollution is more on them then the well-to-do section of the society.

### IV.5.3 Measures for Improving Slum Condition

The governmental efforts for Slum Clearance started as early as 1956. The idea was to rehabilitate slum dwellers in a better social environment. But the Programme encountered resentment from Slum dwellers. Most of them refused to stay away from the settlements which were close to their place of work.

In 1972, the emphasis of Government Policy therefore changed from Slum Clearance to environmental improvement of Slums. The Environmental Improvement of Urban Slums (EIUS) Programme provided minimum amenities like Sanitary Latrines, drainage, potable water supply, good approach roads and paved streets with proper lighting . The EIUS with an emphasis on Social Justice aimed at improving the living conditions of the urban poor. Initially this programme was extended to 20 cities and later on, to all the cities having 3 lakhs population or more. The EIUS programmes was taken up as part of the Minimum Need Programme in the state. The Programme was extended to all urban centres in the year 1978. In the fifth plan, the outlay of EIUS programme was Rs. 50 crores which increased to 151.45 crores in the sixth plan and further to Rs. 269. 65 crores in the Seventh Plan during which 9 million Slum dwellers were expected to benefit from the scheme.

**Sites and Service Scheme**

The site and service scheme came up as an alternate housing option for low income families. The basic objective of this scheme was to provide low income families with land and public utilities. One of the components of this scheme include provision of residential plots, toilets and bath units. Loans were granted to the weaker sections for construction of low cost housing units. The eligibility criterion for the economically weaker section to get HUDCO loans under this scheme is that a household income should not exceed Rs.700 per month.

## Urban Community Development (UCD) Programme

The urban community development programme had strategies to combat urban problem in general and of the depressed areas in particular. The UCD programme emphasised self-help, community organization and support from the government for self help activities. The components of UCD programmes are :

a) Child-welfare activities; pre-school classes, immunization, mid-day centres, medical check-up and creche.

b) Youth welfare activities; Typewriting classes, youth rallies, auto-rickshaw driving, civil defence.

c) Women's welfare activities; Mahila Mandal income generation activities.

d) Other activities; dispensaries, exhibition, basti committees, cooperatives, film shows, anti mosquito drive.

In 1985 the UCD merged into a new programme called the Urban Basic Service (UBS) Programme.

## Urban Basic Service (UBS) Programme

In 1985 the UBS Programme was launched in the country with effect from the Seventh Five year plan as a scheme sponsored by the central government.

The programme of Urban basic Services was multi-dimensional and community-oriented programme involving the integration of services of the central government, the state government, local bodies and the UNICEF. The cost of the programme was shared by the central government, the state government and UNICEF to the extent of 40 percent, 40 percent and 20 percent respectively.

The main component of the UBS programme are as under:

) Primary Health Care; the emphasis here is on preventive health care, immunization, improved infant feeding practice, child-growth monitoring home-based diarrhoea

management, drinking water supply, environmental sanitation, family planning and birth spacing.

b) early childhood learning facilities which include establishment of pre-school and creches.

c) Women's economic upgrading by providing skill training for women;

d) Water supply; extension for community taps and the installation of hand pumps as well as rehabilitation of closed wells.

e) Sanitation, which covers construction of low cost poor flush latrines and providing environmental sanitation facilities.

"The UBS programmes has been taken up in all the urban centres of 25 union territories in the country"[5].

**Self Employment Programme for Urban Poor (SEPUP)**

The government of India implemented the SEPUP programme in 1986. The aim of the programme was to assist the urban poor to take up self employment in ventures by ear-marking a sum of Rs.200 crores. The programme was implemented by selected branches of public sector banks in all the urban centres with a population exceeding 10,000 as per 1981 census.

Under SEPUP the urban poor households each with an income of less than Rs. 600 per month are eligible for loans upto Rs. 5000. The amount of loan to be sanctioned depended on the type of work undertaken from among thirty three categories of self employment venture, such as rickshaw pulling, weaving, shoe-mending, tailoring, carpentry, book binding etc. loans under the programme carry on interest of 10 percent per annum. The loan amount is to be repaid in 33 equal monthly installments, after a grace period of 3 months.

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[5] Cousins W.J. (1985) " Improving Basic Services of Urban Poor", UNICEF, New Delhi, pp. 24.

## Nehru Rozgar Yojna

The Nehru Rozgar Yojna has been designed to provide employment to the under employed and unemployed among the urban poor. The cost of the programme is shared by the central government and the state government on 60 percent and 40 percent basis. The Nehru Rozgar Yojna consists of three components:

i) Scheme of Urban Micro-Enterprises (SUME)

ii) Scheme of Urban Wage Employment (SUWE), and

iii) Scheme of Housing and Shelter Upgradation (SHASU)

### Scheme of Urban Micro-Enterprises (SUME)

Scheme of Urban Micro-Enterprises (SUME) assists eligible beneficiaries to secure technical/vocational training and to set up micro level enterprises. The urban poor, household each with an annual income of less than Rs. 11850/- are eligible for assistance under the scheme. This scheme is applicable to all urban settlements excluding areas falling under cantonment board.

### Scheme of Urban Wage Employment (SUWE)

Scheme of Urban Wage Employment (SUWE) seeks to provide wage employment opportunities to the urban poor though the creation of socially and economically useful and productive assets. Any poor person residing in urban areas willing to take up manual work on a casual basis on payment of the statutory minimum wages is eligible for assistance under this scheme. Within this scheme, special attention will be paid to low lost sanitation and drainage works. This scheme is applicable only to urban settlements with a population below one lakhs.

### Scheme of Housing and Shelter Upgradation (SHASU)

Scheme of Housing and Shelter Upgradation (SHASU) provides technical training in construction activities and assists beneficiaries belonging to economically

weaker sections. Housing and Urban Development Corporation (HUDCO) assisted government in providing loan and subsidies to the beneficiaries. All families belonging to Economically Weaker Sections having a household income of less than Rs. 1250/- per month are eligible for assistance under this scheme. This scheme is applicable to all towns, cities with a population between 1 and 20 lakhs.

The failure or success of these programme cannot be assessed, since we do not have enough data for the recent years on the availability of civic amenities to the slum dwellers.

### IV.6 - Critical Linkages

There are several linkages at work between environment and population. There is no doubt about the fact that population growth put pressure on the resources and consequently on the environment. But at the same time, technologies of production differ considerably in their relative impact on economic development and environmental quality. For example, while a nuclear power plant and a hydroelectric dam may contribute equivalent amount of electricity, the nuclear power plant is likely to have much greater environmental impact. A third factor viz., affluence measured as per capita consumption exerts an effect on environmental degradation. If the consumption good happens to be automobile with obsolete technology its impact on environmental degradation is massive.

Ehrlich and Ehrlich (1991) has stated the problem as follows: "The role of overpopulation and population growth in causing environmental deterioration is summarized in the equation: I=P x A x T. The impact (I) of any group or nation on the environment can be viewed as the product of its population size (P) multiplied by per capita affluence (A) as measured by consumption, in turn multiplied by a measure of

damage done by the technologies (T) employed in supplying each unit of that consumption"[6].

When this relation is expressed in the appropriate dimension it takes the form of a mathematical identity:

$$\text{Pollution} = \text{population} \times \frac{\text{goods}}{\text{Population}} \times \frac{\text{pollution}}{\text{goods}}$$

Here affluence is expressed as the per capita consumption (or production) of a particular goods, and the technology factor is expressed as the amount of pollution imposed upon the environment per unit of production of that good. In this form the relation should be capable of evaluating the relative impact of the three factors that affects environmental pollution.

In order to assess the relative impact of changes in the three factors that determine the changes in emissions- population, affluence and technology- it is useful to convert their values to logarithms. The basic equation then takes the additive rather than multiplicative form:

$$\log pollution = \log population + \log \frac{goods}{population} + \log \frac{Pollution}{goods}$$

For the four mega cities, we have taken net environmental change of carbonmonoxide emission and nitrogen oxide emission from transport into consideration. The following tables 4.9 and 4.10 show the relative change in four factors - I, P, A and T.

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[6] Ehrlich, P.R., and A.H. Ehrlich (1991) "Healing the planet: strategies for Resolving the Environmental Crisis". Reading, Massachusetts: Addison Wesley

Table 4.9 Factors in the relative change in carbon monoxide emissions from mobile sources, four mega cities 1970-1990 (in percentage)

| City/U.A | Carbon monoxide emission relative change 1970-1990 | Environmental Impact factors relative change, 1970-1990 | | |
|---|---|---|---|---|
| | | Population | Vehicles / Population | Carbon Monoxide emission / Vehicles |
| Greater Bombay | 3.1855 | 1.9062 | 2.2675 | 1.5223 |
| Calcutta | 10.2143 | 1.4711 | 3.2661 | 2.1260 |
| Delhi | 6.6375 | 2.2964 | 4.1018 | 0.6936 |
| Madras | 27.5833 | 1.6914 | 7.1975 | 2.2676 |

Table 4.10 Factor in the relative change in nitrogen oxide emissions from mobile sources, four mega cities 1970-1990

| City/U.A | Nitrogen Oxide emission relative change 1970-1990 | Environmental Impact factors relative change, 1970-1990 | | |
|---|---|---|---|---|
| | | Population | Vehicles / Population | Nitrogen Oxide emission / Vehicles |
| Greater Bombay | 2.2782 | 1.9062 | 2.2675 | 0.5266 |
| Calcutta | 14.7057 | 1.4711 | 3.2661 | 3.0596 |
| Delhi | 7.5301 | 2.2964 | 4.1018 | 0.7985 |
| Madras | 23.3750 | 1.6914 | 7.1975 | 1.9221 |

Now, if the data from table4.9 and 4.10 are applied in the equation with log function the following results can be obtained which is expressed in table 4.11

Table 4.11 : Percentage Contribution of Population Affluence and technology in Environmental Degradation

| Releative Increase in Pollution (Log Value) | Percentage Share of each factor | | |
|---|---|---|---|
| | Population | Affluence | Technology |
| Carbon monoxide (1.1) | 27.3 (0.3) | 54.5 (0.6) | 18.2 (0.2) |
| Nitrogen Oxide (1.1) | 27.3 (0.3) | 54.5 (0.6) | 18.2 (0.2) |

**Note :** Figures in bracket in Col. 1, 2, 3 & 4 shows the log values.

From the above table (4.11) it can be clearly observed that in case of both Carbon monoxide and Nitrogen Oxide emission, the main responsible factor is Affluence ie. due to higher level of consumption.

From the above table (4.11) it can be seen that carbon monoxide emission was occuring mainly due to Affluence, followed by population and technology. In other words Affluence was responsible for 54.5 percent of carbon monoxide emission, while population and technology was responsible for 27.3 percent and 18.3 percent of carbon monoxide emission respectively. Similar is the case with nitrogen oxide emission.

Thus it becomes clear that environmental degradation in four mega cities of India was mainly due to high per capita consumption followed by population growth and then by use of technology. Any attempt to check enviornmental pollution in these cities must deal with "affluence" factors, the control of which seems to be difficult to contain in the forseeable future.

**Conclusion**

The following conclusions can be drawn from the above discussion:

1. Number of Slums and Slum population have increased since 1970 in the four mega cities of Calcutta, Bombay, Madras and Delhi.
2. Calcutta shelters the highest number of slum population among the four mega cities.
3. the condition of the slums in terms of availability of civic amenity like drainage arrangement.
4. Per Capita Municipal expenditure has increased since 1970, for Public health, safety and convenience, and public works.
5. Per Capita municipal expenditure on public health was the lowest in Calcutta among the four mega-cities.
6. Provision of household amenities (electricity, safe drinking water and toilet facilities) were best in Calcutta followed by Greater Bombay, Delhi and Madras.
7. Housing condition have improved since 1970's in all the mega cities.
8. Among the three factors namely, population size, affluence and technology, affluence emerged as the main factor which deteriorates the urban environment of the four mega cities.

The main aim of this dissertation was to study the state of urban environment of the four mega cities of India and their correlates. Conclusions 1 to 7 clearly depicts the state of urban environment in terms of the availability of basic amenities to the residents

of the city. The last conclusion shows that affluence is the main factor which deteriorates the urban environment followed by population size and level of technology.

According to Habitat II (1996) report " Development of housing infrastructure and services have not kept in tune with the growth of housing. The nagging problem of upgradation and renewal of basic services like potable water and sanitation is serious in Indian cities". This situation is being confirmed by conclusions (number 1,2,3,4,5,6). The municipal services are still not enough to cope with need of the city (Ahmed 1994). We have yet to come through a study which have dealt with what factors were responsible for the environmental degradation of urban areas. Commoner (1992) however had made a study of developed countries in which he conclude that 'Affluence' is the main factor of environmental degradation in these countries.

# CHAPTER V

## CONCLUSION AND SUGGESTION

This study made an attempt to know the environmental quality and their correlates in the four mega cities of India. There are mainly three factors viz. population size, level of consumption and technology level, which deteriorates the quality of natural environment. Due to interplay and inter linkages between these three factors, urban areas are creating more pollution in air, water and Noise. Air, Water and Noise pollution are concentrated mainly in urban areas and originate from transportation, fuel consumption, industrial processes and domestic solid waste generation and disposal. These pollutants crossing certain limits puts the sustainability of human life in danger.

Due to rapid growth of population, migration and associated urbanization, large areas becoming urban. Urbanization leads to concentration of population in any given region. The four mega cities showed the largest concentration of population in the Indian subcontinent. One of the reasons for such a large concentration of population is that rural to urban migration are generally directed towards big cities/towns rather than smaller towns. Due to large size of the population total consumption of food and water, use of vehicles etc. are also high.

Not only that these mega cities have large population but also their level of consumption is higher than smaller towns and rural areas. Thus both large population size and higher level of consumption results in massive consumption of natural and

physical resources. Since nature cannot produce large quantity of resources in a small region, there is the difficulty of disposing large quantity of waste in a small region. And the end result is pollution in the region and the hinterland.

In cities like Greater Bombay, Calcutta, Delhi and Madras, Air pollution caused by emission from automobiles have taken serious proportions. Industrial pollution is also increasing at a faster rate. Though action has been taken to reduce the problem of pollution, but they are not enough to reduce the pollution to a manageable size.

More and more cities are becoming urban. Though the rate of urbanization has fallen during 1981-91, the actual growth of urban population growth has been massive. Though the population growth rate in Delhi, Calcutta and Madras, declined during 1981-91, it has no impact on the absolute size of the population growth. They have added more population during 1981-91 than in 1971-81. The case of Greater Bombay is different. It has shown a high growth rate of population in 1981-91 than in 1971-81. This is mainly because of massive areas spread of 574.55 square kilometre, and inclusion of five new towns.

In a nutshell it can be said that pollution level of Air, Water and Noise has increased over time in these mega cities. The main cause of air pollution in these cities is attributed to increasing number of vehicles especially two-wheelers. Delhi has got the largest number of registered motor vehicles among the four mega cities. This is mainly due to the fact that it has highest percentage of household under "very affluent Household" category. Water pollution in/by the cities is increasing. The per day water consumption is highest in Greater Bombay followed by Delhi, Calcutta and Madras.

Similarly the waste water generated in these cities is highest in Greater Bombay, followed by Delhi, Calcutta and Madras. All these mega cities have megre waste water treatment capacity and as a result most of the waste water generated is disposed off untreated. The volume of untreated waste water is highest in Greater Bombay followed by Calcutta, Delhi and Madras. The noise level in the cities are showing different levels. Noise pollution in Greater Bombay is not observed in Industrial areas during night time. Noise levels are higher in Calcutta than in Greater Bombay. In case of Madras noise levels for industrial areas are below the CPCB standards.

Slum dwellers of four mega cities are still devoid of basic amenities necessary for living. However safe water supply, have increased during 1981-91. But still the provisions are quite low. This is due to the fact that slums are increasing at a faster rate in all the four mega cities of India.

Per capita municipal expenditure has increased in the four mega cities though not in all the sectors viz., Public health, safety and convenience, and public works. Greater Bombay is better off in terms of per capita municipal expenditure on all the three sectors in 1991. But in the real terms per capita municipal expenditure public health has been lower n 1981, than what it was in 1971. Per capita municipal expenditure in public works in Calcutta has shown an improvement over the years. However other sectors have not shown impressive results. The per capita expenditure on real terms in Delhi was better for public health and safety and convenience for the year 1990-91. For other years and other sector the per capita expenditure was not impressive. Housing condition in the four mega cities of India has increased since 1970. Greater Bombay provide highest percentage of pucca and semi pucca houses for its

residents followed by Delhi, Calcutta and Madras. The provision of civic amenities is the best in Calcutta followed by Greater Bombay Delhi and Madras. since there is scarcity of time series data on civic amenities, any thing about the improvement in their living condition cannot be concluded. The main factor of environmental pollution, using I=PAT equation, is affluence in the four mega cities of India. The second important factor of environmental is population size and the third one is technology level.

To sum up, the following findings can be highlighted.

1. Per capital consumption level is the main factor which deteriorates the urban environment of the four mega cities. Population size and technology level comes in second and third place respectively.

2. The main cause of air pollution in these mega cities is increasing number of vehicles.

3. Delhi urban agglomeration emerged as an urban centre with highest level of air pollution.

4. Greater Bombay urban agglomeration emerged as an urban centre with largest volume of untreated waste water.

5. Calcutta urban agglomeration had a relatively higher intensity of noise pollution.

6. All the mega cities have very low waste water treatment capacity.

7. Since 1971, Housing conditions have increased in all the four mega cities.

8. Yet, these mega cities are still not able to provide all the basic amenities, namely Electricity, Toilet and Safe drinking water to their residents.

9. Per Capita Municipal expenditure had increased since 1970. However, it has not been able to keep pace with the inflationary trends in most of the sectors and years.

10. Slum population is increasing in all the mega cities of India.

11. In 1991, Slum population was highest in Calcutta followed by Greater Bombay, Delhi and Madras.

12. Industrial pollution is highest in Greater Bombay followed by Delhi, Calcutta and Madras.

**Policy Implications**

In order to combat environmental pollution various legislations has been passed, but they have never proved successful because of policy implementation disorder. Urban authorities must take the things seriously otherwise, these cities will not be a safe place to live. The following suggestions are made, which if used may solve the urban environmental problem to some extent.

**1. An extension of "polluters-pay principle"**

The polluter-pay principle means that the polluter should bear the expense of carrying out the pollution, to ensure that the environment is in an acceptable state. Following this principle, the individual owning vehicle or vehicles should be taxed accordingly for the pollution it emits in the environment.

**2. Municipal tax**

Similarly a certain amount of tax is to be levied to household, generating more solid waste, which must be based on some sort of income consideration.

**3. Control of Pollution at point source**

It Should be made necessary for the industries or hotels which generate more waste water, to have a treatment plant. So that treated waste water should be released by them. This will reduce the burden of treatment of plant of municipality. Similarly air polluting industries should have necessary arrangement for combating pollution at the point source.

**Where the thesis stands?**

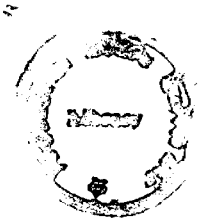
Various studies have been undertaken by independent aurthors relating to urban environment. Studies done by Jolly (1994), Gross man and Krueger (1995), Hamza (1992), Mathur (1994), Sivaramakirshnan (1978), Nagpaul (1987), Bose (1997), Savage (1995), Biswas (1995), have mainly focused on the qualitative aspects of environmental pollution. Any change in the pollution level was expressed through terms like more, enormous, tremendous, higher etc. commoner (1992), however had dealt with the quantitative aspect of environmental pollution of developed countries.

Since, this study dealt with quantitative analysis of environmental pollution i.e., how much each factor of pollutant, (population size, level of consumption and level of technology) pollute the environment, it cannot be compared with studies done by the authors mentioned above. It also cannot be compared with the study done by Commoner (1992), because he has taken problems of specific countries rather than cities.

**A Vital Question ?**

The real issue at present in these mega cities is how to operationalise and incorporate environmental impact assessment in the planning, management and implementation process successfully. the relative importance of each of the three factors population size, affluence and technology level can be evaluated using I=PAT equation. A vital question however remains unanswered i.e., what minimum income level should be reached by these mega cities to minimise their environmental degradation ?





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