A STUDY OF URBAN ENVIRONMENT IN METROPOLITAN CITIES OF INDIA WITH SPECIAL REFERENCE TO DELHI METROPOLITAN CITY.

Dissertation submitted to the Jawaharlal Nehru University
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MASTER OF PHILOSOPHY

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CERTIFICATE

This dissertation entitled " A STUDY OF URBAN ENVIRONMENT IN METROPOLITAN CITIES OF INDIA WITH SPECIAL REFERENCE TO DELHI METROPOLITAN CITY" submitted by BHUWAN KUMAR is in fulfilment of six credits out of a total requirements 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 placed before the Examiners for their consideration.

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DEDICATED TO MY PARENTS

WHO INSPIRED ME FOR

HIGHER STUDIES

C O N T E N T S

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LIST OF FIGURE

CHAPTER - 1

Introduction

Urban environment can be classified into two types : Physical and Cultural. The physical environment is concerned with the quality of natural environment i.e. the quality of air, water, land wilderness areas and other resources. Cultural environment is related to socio-politico ethos of the people residing in the cities. In other words the cultural environment is man-made.

In the quest of attaining self-reliance, a country has to step-up agricultural and industrial production. This tempo also amounts to contributing increasingly larger quantities of dust, smoke, chemicals and other toxic materials including radio active elements to the environment, toxic gases to air, chemicals, detergents and organic wastes to the rivers and seas, pollutants and pesticides to soils, land run-off and organic wastes to public streams. Industrial expansion programmes usually cause movement of the working class population from rural to urban areas leading to disproportionate development of human settlements and slums in the country. These create complicated and uncontrolled municipal problems. There is an enormous strain on fresh water supplies and all the cities are starved of adequate fresh and clean water supplies. People live in unhygienic condition with improper and inadequate sanitation adding prograssively to pollution and disease.

Pollution is generally defined as an undesirable and excessive (beyond the critical limit) addition of foreign substances to water,air and land which adversely alters the natural quality of the environment. The term environment consists of air, water and land. It also consists of biota along with buildings, landscapes, oceans, open spaces, green parks, and other socio-cultural elements. Thus,the environment is complex and comprehensive and is affected by all our activities.

(Environmental pollution is now a serious problem for those living in big, congested and industrialised cities with heavy vehicular traffic. In large urban areas a some major environmental pollution include noxious fumes dust and grit, obnoxious gases, excessive noise, smoke and offensive odours arising mainly from factories processing animal wastes and food residues.)

The magnitude of the hazards now enveloping various industrial centres is at last being realized. Major urban areas and at places even the countrysides are exposed to environmental pollution leading to health hazards as well as extinction of plants and animals. The common pollution parameters in industrial areas and congested place such as Delhi, Bombay and Calcutta are sulpher dioxide (SO_2) niteogen dioxide(NO_2),

hydrogen sulphide (H_2S), oxidents, various suspended particles, carcinogenic hydrocarbons, carbon dioxide (CO_2) and carbon monoxide (CO) into the cities atmosphere.

These are powerful pollutants which are major source of air pollution in big cities and industrially advanced countries is the automobiles (vehicles). Most vehicles burn their fuel rather inefficiently and incompletely thus discharging only partially oxidised combustion products into the atmospher. When exposed to sunlight these products, consisting mostly of hydrocarbons and nitrous oxide, produce ozone and other pollutants. In fact, the automobile is often considered as the greatest polluters of the atmosphere and is responsible for about 75 per cent of noise and about 80 per cent of air pollution in big cities (Central Pollution Control Board, 1987-88).

Industrially clustered cities like Calcutta, Bombay, Delhi and Kanpur are sulpher dioxide (SO_2) oxide of nitrogen (No_x), carbon monoxide, hydrocarbons, metal dust fluorides, pesticides, fly ash, soot and occasionally radioactive substances. Fly ash is particulate and consists of non-inflammable minerals fractions of ordinary coal-soot, on the other hand, is inflammable but becomes released in the unburnt state as soot.

Cotton dust is an important pollutant in Ahmedabad having textile mills. Citizens of Bombay and Delhi are familiar with the thick, black smoke and soot that come out from chimneys of factories and electricity generating plants which burn coal and soot. To some extent these above pollutants are an inevitable consequence of advancing civilization and industrialization, but as living standard rise, man-made atmospheric pollution is felt first to be a major irritent in that it causes loss of amenity and later as a serious threat to health. Some kind of pollution may even render certain areas quite unfit for normal habitation, thereby constituting a major obstacle to Socio-economic progress.

Review of Literature

Our main interest in this thesis is the degradation of physical urban environment because the quality of urban environment has suffered during the exploration, exploitation and disposal of energy and energy products. It is now agreed upon that trash, dirt, disease, noise, strife, poverty and bio-degradation reduce the quality of physical environment The deterioration of physical environment in urban centres is very grave. This is because the qualitative components of the life sustaining forces like air, water, food and space seem to be gradually reduced and polluted our living environment

is one entity and its sustains all life be it an animal, a plant or a microbe. The entire life forces are so related with a set of natural balances that the disturbances to one or the destruction of other, has a definite effect resulting in the upsetting of the balance which many a time is detrimental to the very biology of human beings.

It is true that over the years human beings have envolved into a five sophisticated animals, who, relying on modern technology, seem indifferent to the changes that are takings place right in front of them. These changes are primarily due to the unbridled advancement in technological development of socio-economic factors. Often induced by political consideration and the depletion of natural resources are also creating imbalances in the availability of the resource in urban areas.

In this context the urban environment as perceived by urban geographers has been constantly detoriorating due to over-concentration of population in the cities and their frings areas. (Desai, 1985). Due to the emergence of new industries unplanned growth of sewage, air and water in and around the cities are getting extremely polluted. The river Ganga is the case in point. A religious and cultural heritage of India the river has provided river-front sites for many

important urban centres which have been affected by the water pollutions including industrial waters human, animal and domestic waste, sewage waste. NEERI (National Engineering Environment Research Institute) has warned that the content of sulpher dioxide and other pollutants among the large cities of India have crossed the non-hazardous limit as per the WHO. Different kind of pollutants are generally increasing in the air, water and thus the entire environment is being extremely affected. Therefore, it is call the unhealthy urban environment finding out its existing as well as future problems and brings out the ways and means to eradicate them (Singh et al., 1986).

FInally this degrading urban environment is absolutely man-made phenomena i.e. a product of unprecedented man's intervention in national process. This has resulted in disturbance in urban ecology and has created several problems of health and habitation. The condition of environmental degradation have become alarming not only in big metropolitan cities but also in their settelite cities.

Geographers interested in perception of environment no longer study it only in broad, general and subjective ways or in cultures far away in time or distance, or as an incidental

part or a larger study or by inferance from resources use patterns. Geographers try to understand human being's use of and behaviour in a environment.

There is a body of growing literature on environmental perception indicates as a guide to behaviour. In this sections an attempt has been made to review the available studies from various sources. Although a clearcut classification was not possible, an effort have been made to classify the literature according to the focus of the study i.e.

a] General cum comprehensive;

b] Urbanization and Environment Studies; and

c] Non-Geographers contribution.

a] General cum comprehensive Studies

During the end of the 19th century a very few geographers have attempted to evaluate the environment for the societal well-being. *Humboldt and Ritter* belonging to the same school introduced empirical studies. These inlcluded a assembly of factual data, a search for laws and on investigation. How the physical environment affected the functionings and development of society.

Arvill (1967) has discussed the man and environment system. Three are selected indicators; firstly, the analysis

of human interaction with the physical world through the study of man's tangible footprints on its surface. Secondly, ecology focuses on processes of man-environment interactions rather than on form and content. Thirdly there is environmental perception, i.e. stressing man's 'image' of his surrounding as a key to unravelling the nature of man-land transactions. Each of these frame works provided a coherent working methodology which analyses man and environment system.

Manner et al . (1974) have described the environment in general perspective. They have not a close association betw-en the images of environment that are built in the mind of residents and the present experience, past cognition of events and exposure to information.

Center's (1975) study deals with the environment which is conceived of as containing some specified environmental variables interacting with the bio-system, plus its surroundings. Further supported by *South Wick* (1976). He has discussed corelation between ecology and the quality of environment.

Wilson (1981) is his book, "Geography and the Environment" has given various kind of methodologies and identified the environmental condition in space and time. He has discussed in general the range of systems analytical methods in relation to geography. He found out that it is necessary to

draw a wider range of methods than is customary into the systems framework.

Kayastha (1982) in his paper entitled, 'Perspective on environment and development', has attempted a general discription of envirionmental impact and assessment on human society. *Nag's* (1983) paper entitled "Perception of the Environment : Issues and Challenges" has supported his paper. He has discussed a general discription about the environmental issues and challenges for societal well-being.

The main aim of *Yadav* (1984) study is to explore the interaction of man-society and natural environment. It should be considered as the continuous and ever-deeping process of interchange of matter and energy between the components of this system.

Raza (1982) in his article, "Ecology and Development : A synoptic view" delt with in three folds : Firstly, the relationship betw-en development and its ecological corelates should be studied. Secondly, by examining the relationship itself in the context of the contemporary world; and thirdly by focussing attention on the twin processes of industrialisation and urbanization as they are unfolding themselves on the Indian scene.

Bhat (1982) in his paper on the "Dimension of Environment in the Sixth five year plan" has discussed the integrated view of environment and development process from a spatial perspective to the extent several aspects of the sixth five year plan are related to it.

Garasimob's (1984) paper entitled "Ecogeolraphical problems of Big Cities" has described the goal of constructive ecogeographical investigations which reflects in the definition of "Carrying Capacity" of natural environment and the elaboration of scientifically grounded recommendations for improving local natural capacity of the areas already urbanised or being urbanised.

The geographical value *Desai*'s(1985) study lies in the phenomenological outlook towards the environment. The emphasis is not just on man or environment as such but on the man-environment interface where biophysical and socio-cultural systems interact.

Sachs (1988), has outlined main features of eco-development to create a durable equilibrium between man and nature, while avoiding the errors of lawless growth. The author has laid emphasis on the development of those local resources which are specifically needed for the satisfaction of the basic needs of population keeping in view the future needs technological

b] *Urbanization and Environment Studies*

Under this head, there are number of studies which deal with inter-relationship between urbanization and environmental conditions. In the following pragraphs, several such works are reviewed.

Detwyler (1972), in his book "Environment and Urbanization", he tries to demonstrate how man has changed the natural environment through urbanization, secondly to suggest how physical features and processes influence the growth and function of cities; and thirdly, to reveal some of the feed back between man's actions and environmental processes.

Desai (1985), attempt to analyse residents, sensitivitiy awareness and adaptibility to various environmental problems in the core city of Ahmedabad. She find that their perception is based on environmental quality.

Singh et al. (1988) have identified some salient characteristic features of environmental conditions of India. Urban habitat selecting the Bhopal urban agglomeration as a case study, they conclude that : (a) environmental conditions in Bhopal vis-a-vis other large Indian cities are better; (b) there is urgent need to adopt pollution control measures and well considered environmental options become of rapid population growth; and (c) increasing intra-urban disparties in

qualities of urban life may generate leteral classes of quite significant magnitude which put the entire urban economy and society out of gear.

Singh and Kayastha (1988), argue that special concern for the urban life has been the dangerous problem of urbanisation and environmental pollution is believed to be a reflaction of growth of population, the development of technology, the resulting increase in liginv standards and consumption habits associated with economic growth. The most serious effects of these trends include the increasing spread of air and water pollution, slums and house destruction.

Barr's (1978) major concern has been pertaining to the possible impact of the New Port (Australia) site on the climatic aquatic and aesthatic environment of the surrounding areas. Melbourne already had an air pollution problem. Oxident level exceeded WHO standards on several occasion. The power station at New Port could only exacerbate this problem. When the station was running on natural gas there would be a minimum discharge of 1800 pound per hour of Nitrogen dioxide (NO_2) on oil this would rise to an alarming 2700 pound per hour.

c] *Non-Geographers Contribution*

Takano et al. (1982) have argued that special attention should be paid to the health aspects of urban planning from the view point of environmental conservation as well as from the purely medical point of view. Accordingly to them high energy consumption means not a high quality of life. We must discover how to raise quality of life without imprudently undermining and disrupting the processes of Nature. Health should be an essential factor in the quality of life.

Greenberg (1983) has showed that the association between urbanization and cancer mortality is strongly manifested only for lung, intestive bladder and female brest caners, and that the general indictment against urban pollution is weakened by methodological short coming, including the ecological fallacy, complex intervenning variables like smoking overly broad indicators of risk, and spurious relationship.

Eckbo (1985) has analysed that city have evolved from nature into parasitic anti-nature structures. Growth and constant expansion are their chief characteristics. He has described the alternative area (Ecologically fit for livable) to continue on our current sucidal path or to move toward environmental control.

Crooke (1974) has described how to facilitate the housing systems in urban areas.

One of the major works done by *Rao* (1974) is on how to accommodate housing of squatters in Delhi. He has focused on self-help housing which can be much more economical even with higher standards of amenities provided the housing scheme is more precisely related to the need as the residents see them and that the institution of management assists the residents to get the maximum benefit from the environmental facilities provided. Further supported by the *Payme* (1974), he has described environmental achievements of squatter communities.

Raval (1977) in his paper on "Industries Involvement in Environmental Profies", while agreeing with the contention that industries were not solely responsible for the environmental ills, pointed out that in the absence of coordinated planning from the beginning, the industrial growth had contributed to the worsening of the situation in the social environment. He discussed the role of industries in finding effective solution for environmental problems and suggested that in the preparation of master plans of our cities, the industries should be involved at the initial stage of planning and to have a coordinated approach to the question of our master-

plans and town planning. Another suggestion was to participate industries with local bodies and other authorieties for the solution of air, water, garbage and none pollution by making them contribute both in financial as well as physical terms. According to him the conflict between the 'Environment' and 'Development' was more apparent than real as the primary motivation for economic development. Human welfare and primary motivation for environmental quality was also human welfare.

In India, serious attention is now being given to an integrated/interdisciplinary approach to environmental problem. National Environmental Engineering Research Institute [NEERI] Nagpur; 'Central Board for the prevention and control of water pollution', New Delhi; 'Department of Environment', (Government of India) New Delhi; 'National Physical Laboratory' New Delhi; 'Centre for Study of Environment' (CSE) New Delhi; 'Centre for Urban Studies, Indian Institute of Public Administration', New Delhi; 'School of Planning and Architecture' (SPA) New Delhi; 'Centre for Environmental Planning Technology' (CEPT) Ahmedabad; 'Indian Institute of Technology'; 'All India Institute of Medical Science', New Delhi; 'Sch-ol of Environmental Science' and Centre for the studies of Regional Development School of Social Science, Jawahar Lal Nehru University, New Delhi,

re leading centres of India, where environmental issues are being studied and analysed by Scientist/Social Scientists.

Objectives

The objectives of the present study are two fold;

1] to study the role of man in changing environmental situation in urban areas; and

2] to study the spatio-temporal relationship of urbanization and environmental pollution in metropolitan cities of India, with special reference to Delhi.

Data Base

The study is mostly based upon Secondary sources.

The Secondary Source are :

1] Urbanization data acquired from various census of India Publication : (a) General Population table; (b) Urbanization and Urban standard Area table.

2] Data on Environmental pollution can be acquired from : (a) Air Pollution data from National

Environmental Engineering Research Institute (NEERI) Report.

b. Water pollution data from "Central Board for the prevantion and control of water pollution", New Delhi; and

c. Noise pollution from Acaustic division National Physical Laboratory, New Delhi.

Limitation of Data

The understanding of air pollution trend in India is handicapped not only the scarcity of data but also by differences among several methods and technique of sampling for any pollutant. The restricts comparison amongs and joint interpretation of the result of numerous small scale studies. The need for continuous and concurrent data for at least important pollutants in major urban agglomeration obtained by comparable methods in different cities was recognized by National Environmental Engineering Research Institute (NEERI) as early as 1978.

In India, Noise pollution data is almost about only two cities (Delhi and Bombay) has carried out tests conducted by National Physical Laboratory (NPL) New Delhi in Delhi and Bombay during 1959-61 only Delhi has published report for 1983.

Methodology

Every research schemata is based upon the systematic approach i.e. coherent relationship analysis of the problems raised during the research analysis under the requisite number of term. Here our study is based upon the concept of 'General to particular' approach under this analytical approach, my thesis intends to seek more knowledge about the urban environment by dissecting it into smaller and smaller parts, i.e. to make more and more minute analysis and to be sceptical of general concept.

In this study both the qualitative and quantitative methods have been used. Here, qualitative methods involves the analysis of maps and diagrams while quantitative methods involves some suitable statistical techniques.

Scheme of Chapters

This study consists of five chapters.

1. The first chapter deals with the introduction, a general view of the existing environmental problems in urban areas, statement of the problem, source of data, methodology and Literature review.

2. The second chapter deals with the general scenario

of metropolitan cities of India with special reference to environmental pollution.

3. In the third chapter, the spatio-temporal variation in environmental pollution in Delhi is analysed.

4. The fourth chapter deals with Livability in Delhi. A livable environment is the utmost responsibility of man in his own interest. Yet, the physical environment of air, water, food and land is becoming severe every day. While it appears that these basic amenities are in abundance. Yet the amount of available in a usable form to mankind is becoming lesser. This is certainly not desirable. It is,therefore, important to know to cause and effect of the environment on mankind and vice-versa.

5. The fifth chapter concludes with the findings of the study, and a brief summary of the entire study is also provided.

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CHAPTER - II

Sceanrio in India's Metropolitan Cities
With reference to Environmental Pollution

Environmental pollution is caused by the disposal of domestic and industrial wastes as well. Pollutant as defined, is a substance which adversely affects the environment by changing the growth rate of species, interferes with the food. chain, is toxic in nature and affects health, comfort and prosperity of the people. Environment is defined as the surrounding region or conditions and circumstances of the life of persons or the Society. Pollutants are introduced into the environment is significant qualities as wastes, accidental discharge or as a byproduct of the manufacturing process or other human activities.

Pollutants in the environment originate from a multitude of sources and the identification of these is a necessary prerequisite to the design of a monitoring programme. Pllutant sources may be classified by their spatial distribution as : (a)*Point* and (b) *Line Sources*. Point sources deals industrial chimneys, liquid waste, discharge pipes and localized toxic waste dumps on land. Line sources deals highways airways and runoff from agricultural land while area emissions may arise from extensive industrial/urban complexes (Hewitt et al. 1986).

Role of Urbanization and its Consequences on Changing Physical Environment

The Physical (natural) environment has undergone change of rapid urban-industrial growth which has resulted in vast quantities of potentially harmfull into the atmosphere. Societies have been reluctent to accept or have simply failed to recognize the limitations of the cleansing properties of the atmosphere. The consequence has been that environmental pollution has affected the health and social well-being of people. It has also caused widespread damage to vegetation. Crops, wild life and natural endowment. Finally, it has resulted in depletion of the scarce natural resources needed for long term economic development.

> *Cities are nodes of man's greatest impact on nature. The places where he has most altered the essential resources of land, air, organisms and water. The city is the quintessence of man's capacity to inaugarate and control changes in his habitat. Through urbanization man has created new eco-system within which the interaction of man, has works and nature are complex. This complexity and the importance of our understanding in the modern world [Detwyler et al., 1972].*

History of human development has reflected three great changes in the pattern and organization of settlement, two of them revolutionary. The first great revolution was the transition from hunting and fishing to agriculture and it occurred

in the Neolithic (Revolutionary) age.

The second great change - a transition rather than a revolution was the emergence of what, even by modern standards, be designated as 'cities'. The origin of the city was related to the gradual discovery that as a more organized social body the city could carry progress in material welfare to a distinctly more advanced level.

The change in urban eco-system of which man is a part is inevitable. Since this system is a process and he is inevitably affected by such changes. On the whole, those changes which are natural take place on a scale and at a rate which is not disastrous to him. Urban eco-system deals with the aggregate of external conditions (i.e. pollutate : water air etc.) that influence the life of human beings in the urban settlements. While some of their activities may regulate and utilize these changes to their benefit, more of them serve to accelerate the rate and widen the scope of natural changes in ways that lower the potential of the environment to sustain them. For such effects human beings are responsible and with responsibility enter ethical problems.

Through science and technology human beings now have the means to be aware of change and its effects and the

ways in which their cultural values and behaviour should be modified to insure their own preservation.

Upto the middle of the 19th century, water - power sites.. the seats of earlier industrial improvements continued to attract industries into mill village but with the coming of the rail road industrial complexes developed in cities in order to take advantage of the surplus labour that accumulated there.

These expansion and concentration of industries had marked influence upon the entire urban environment. The new source of power, i.e. coal, the new industrial processes, massed in the new steel works, coke ovens, the new chemical plants for manufacturing chlorine, sulphuric acid and hundreds of other potentially noxious compounds - poured their waste products into the air and water on a scale that made it impossible for the local environment to absorb them as it might have been absorbed by the effluvia of village industry.

Such adultration of urban eco-system warants a closer understanding of environmental problems existing therein so that necessary steps may be taken either to find remedies or to prevent the damages from occurring. In the following paragraphes, an attempt is made to evaluate the environmental problems as they prevail in the metropolitan cities of India.

The Area of Study

The areas have been badly affected by pollution in the Urban centres and out of them the metropolitans are worst affected. In an urban eco-system biological and cultural components of the environment are inter-related and inter-dependent on each other and if any one of them is disturbed through human ill practices, the whole system is significantly deteriorated. This imbalance of urban eco-system is mainly attributed to over-crowding, uncontrolled growth of urban population, lack of resources, lack of employment opportunities, fewer sanitary facilities and foul air. Yet our metropolitan cities continue to expand in size, consequent upon natural rate of increase and an inmigrants from rural areas and small towns and attract more urban and industrial functions, despite the existing level of pollution already being alarming.

The urban environment will continue to deteriorate even beyond the tolerance limit. Therefore, the effective measures are being introduced and legislation are being enforced to improve the situation in this respect. So that a healthy cleaner living situation could be available to all the citizens of the country.

A major phenomenon have happened in metropolitan cities with population growth. As cities grow and expand, the

efficient disposal of billion gallons of noxious wastes produced every day, becomes ever more pressing in many large cities which still lack efficient means of sewage disposal.

Every time a toilet is flushed or a bath emptied at home, the waste presents an environmental problem the some is true for chemical wastes, produced in vast quantities by almost every type of factory or industrial plant. If effluents are not rendered harmless, the result is pollution. A major portion of the society in large cities of the developing world live in shanty towns and slums and uncontrolled settlements surrounded by unhealthy atmosphere prone to epidemics. Air, water and noise are most significant elements affecting human health in urban environment. The factors are created by the processes of rapid development such as industries vechicles and like that. This chapter examines Air, Water and Noise pollution in metropolitan cities of India

Urbanization and Pollution

Population has been main factor that affects the urban environment. When population less then technology was so simple. It was most appropriate to rely on the natural ecosystem, to delute, decompose and recycle the waste products. But these days has witnessed a drastic reduction in death rate and increasing birth rate and as a result population has been

rising very explosively. This is not only creating food problems, housing shortages and unemployment problems but also creating environmental hazards. Metropolitan cities having inadequate housing. These inadequacy reflect two most striking features of poor housing are over crowding and lack of basic sanitation, but extremes of temperature, illumination and noise may also exert adverse physiological effects.

Demographic Pattern in Metropolitan Cities of India

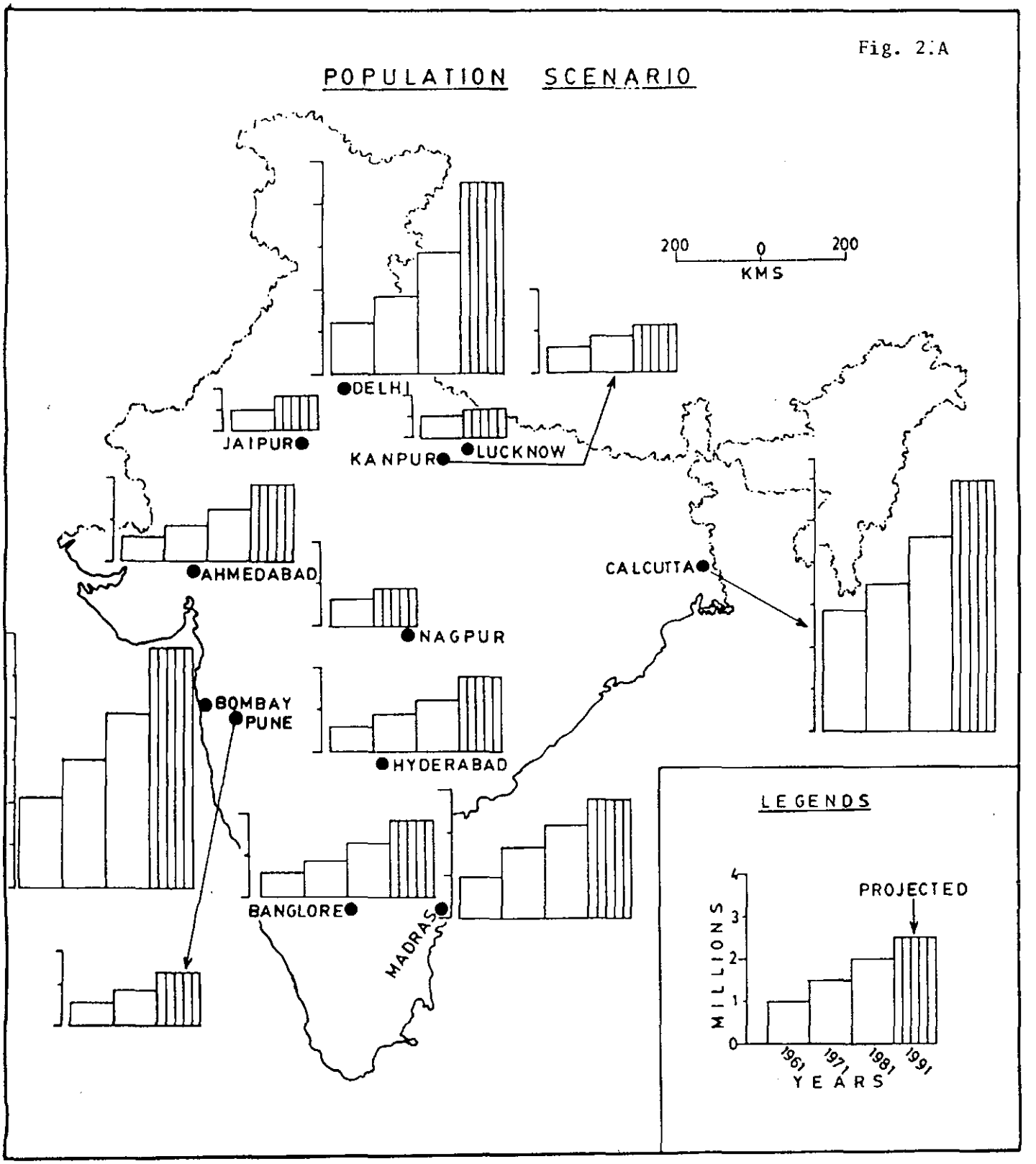
Coming to the present era, it is observed that there were seven metropolitan cities in India, comprising about million which is 4.06 per cent share of the total population in 1961. In the next project data for 1971,1981,1991 it is observed that matropolitan cities have increased at a faster rate (Table - 2.1).

TABLE - 2.1

POPULATION SCENARIO OF METROPOLITAN CITIES

NAME OF CITY	*POPULATION IN MILLIONS*			
	1961	*1971*	*1981*	*1991(Projected)*
CALCUTTA	*5.74*	*7.03*	*9.17*	*11.96*
BOMBAY	*4.15*	*5.97*	*8.23*	*11.27*
DELHI	*2.36*	*3.65*	*5.71*	*8.96*
MADRAS	*1.94*	*3.17*	*4.28*	*5.75*
BANGLORE	*1.20*	*1.65*	*2.91*	*5.12*
HYDRABAD	*1.25*	*1.80*	*2.53*	*3.57*
AHMEDABAD	*1.21*	*1.74*	*2.51*	*3.65*
KANPUR		*1.24*	*1.69*	*2.23*
PUNE		*1.14*	*1.68*	*2.49*
NAGPUR			*1.30*	*1.81*
LUCKNOW			*1.01*	*1.24*
JAIPUR			*1.00*	*1.59*
TOTAL	*17.85*	*27.39*	*42.02*	*59.64*
% of Total Population	*4.06*	*5.00*	*6.15*	*7.66*

Fig. 2.A


POPULATION SCENARIO
200 0 200
KMS
DELHI
JAIPUR
KANPUR
LUCKNOW
AHMEDABAD
NAGPUR
CALCUTTA
BOMBAY
PUNE
HYDERABAD
BANGLORE
MADRAS
LEGENDS
PROJECTED
MILLIONS
0
1
2
3
4
1961
1971
1981
1991
YEARS

During these three decade, the population in metropolitan cities has been continuously increasing. Projected figure for 1991 represent that in this year the percentage of total population in metropolitan city would be increased from 6.15 per cent to 7.66 per cent (Table - 2.1).

Density in Metropolitan Cities

The density of population in metropolitan cities is discussed for four decades only. Due to non-availability of data and area for individual cities anaylsis could not be done for all the decades. Even for the period under review the information is not available for some metropolitan cities. (Table - 2.2)

TABLE - 2.2

POPULATION DENSITY OF METROPOLITAN CITIES OF INDIA - 1951-81

NAME OF THE CITY	PERSONS PER SQUARE KM.			
	1951	1961	1971	1981
CALCUTTA	N.A.	17565	15755	12364
BOMBAY	8130	9486	9901	13671
DELHI	6518	7226	8173	9758
MADRAS	12153	15344	24765	75000
BANGLORE	11568	2406	9466	7991
HYDERABAD	NA	5668	6018	N.A.
AHMEDABAD	7878	9735	N.A.	N.A.
KANPUR	7639	3273	4265	5482
PUNE	3068	2802	3498	4899
NAGPUR	12490	2893	3929	5496
LUCKNOW	6561	4841	6376	7261
JAIPUR	4701	3931	2463	4832

Table 2.2 shows that during these four decades, density of Calcutta's population has been continuously decreasing. The population density in 1961 was 17565 persons per square Km. The next census decade shows 15755 and 10788 persons per square km for 1971 and 1981 respectively. This trend could be a result of saturated growth which was achieved in 1931. What occurred later was a 'spill-over' effect of the excessive population (Sheel, 1986).

Rest elven metropolitan cities show continuously increasing trend. Population density of Bombay was 9486 persons per square Km. in 1961 and 9901 and 13671 persons per square Km. for 1971 and 1981 respectively. A similar trend is observable in Madras, Kanpur, Pune,Lucknow and Jaipur. Bangalore and Nagpur show population density which are fluctuating due to deleneation of city areas. Banglore city area in 1961 was 501.21 square Km. But in 1971 it surprisingly decreased from 501.21 square Km. to 177.30 square Km. and in 1981, it was again increased similarly, Nagpur city shows fluctuating area of the city.

Decadal Growth in Metropolitan Cities

Table (2.1 & 2.2) shows population density and population projection, Madras has the highest density among the all twelve metropolitan cities. With the exception of

TABLE 2.3

POPULATION GROWTH RATE : INDIA'S METROPOLITAN CITIES 1901-1981

NAME OF THE CITY	PERCENTAGE GROWTH RATE OF POPULATION							
	1901-11	1911-21	1921-31	1931-41	1941-51	1951-61	1961-71	1971-81
CALCUTTA	+ 15.46	+ 7.69	+ 13.78	_ 69.90	+ 28.26	+ 25.01	+ 22.57	+ 30.35
BOMBAY	+ 25.28	+ 22.25	+ 1.88	+ 32.94	+ 75.96	+ 39.95	+ 43.80	+ 37.80
DELHI	+ 11.31	+ 27.94	+ 46.98	+ 55.48	+106.58	+ 64.17	+ 54.57	+ 56.66
MADRAS	+ 1.63	+ 3.94	+ 23.36	+ 20.12	+ 65.78	+ 26.07	+ 63.02	+ 34.91
BANGLORE	+ 19.14	+ 25.34	+ 29.04	+ 32.72	+ 91.51	+ 54.04	+ 37.82	+ 76.17
HYDRABAD	+ 11.96	- 19.21	+ 15.10	+ 58.31	+ 52.55	+ 10.77	+ 43.83	+ 40.74
AHMEDABAD	+ 16.62	+ 26.40	+ 14.52	+ 89.68	+ 47.40	+ 37.46	+ 43.40	+ 43.53
KANPUR	- 11.95	+ 21.21	+ 12.62	+ 99.92	+ 44.75	+ 37.68	+ 31.32	+ 32.39
PUNE	+ 5.34	+ 14.84	+ 26.01	+ 29.62	+ 86.72	+ 30.60	+ 43.54	+ 48.48
NAGPUR	- 28.84	+ 39.51	+ 45.99	+ 36.10	+ 47.54	+ 42.26	+ 34.79	+ 39.50
LUCKNOW	- 1.61	- 4.58	+ 14.17	+ 40.97	+ 28.33	+ 31.96	+ 24.14	+ 23.66
JAIPUR	- 14.40	- 9.63	+ 20.06	+ 21.64	+ 68.22	+ 31.82	+ 55.17	+ 57.78

Calcutta and twelve metropolitan cities have shown increasing trend. In terms of absolute growth of population however, Calcutta is reflects increasing trends (Table - 2.3).

Table (2.3) shows that during the decade 1931-41 the Kanpur, which was the highest among other cities, i.e., Bombay with 35.50 per cent, Madras with 80.05 per cent followed by calcutta with 75.80 per cent respectively. The main reason behind this growth is rapid industrializaion, post-second world war and a decline in mortality rate in post-independence period. During 1971-81 decade Banglore experienced highest growth rate followed by Jaipur; 76.17 per cent and 57.78 per cent respectively. The next city is Delhi with 56.66 per cent followed by Bombay with 37.80 per cent. These have been experiencing high increase in population during the last five decades which is estimated to increase more rapidly in future causing serious environmental threat to the urban environment. (Khosla, 1974). This was ultimately resulted in an acute shortage of housing in these cities. According to the census of India, in Bombay 77.6 per cent, Calcutta 64.8 per cent, Kanpur 61.9 per cent, Delhi 58 per cent, Madras 48 per cent respectively, people live in single room dwellings.

POPULATION AND STATUS OF AIR QUALITY

The unchecked population growth in a subsistance economy compelled human being to recover more and more land from forests for agricultural development on steeper and marginal will slopes to meet the increasing demand for food. The barbaric and unscientific commercial expllitation of natural landscape stimulated the degradational activities in the environment.

The seriousness of problems relating to air pollution grows with increasing population density,increase in vehicular traffic and industrialization. Usually, increasing population density is associated with city's green area at a faster rate. This deterioration of urban environment is a fact of life which is accept for generations.Indeed smoke bleaching from a factory chimney is regarded as a sign of economically valuable activity. Smoke come from domestic source through cooking coal and wood. Industrial, domestic and vehicular emissions combine to create pollution of air. In the following paragraphs, an attempt is made to trace the growth of vehicular traffic as well as its impact on air quality.

Vehicular Demography in Metropolitan Cities of India

While an estimated 325 lakh persons made daily trips in the early eighties in the four mega-cities of Calcutta (116 lakh), Bombay (95 lakh), Delhi (62 lakh) and Madras (52 lakh), the annual growth rates of urban travel is these cities were respectively 2.2, 4.6, 9.5 and 6.9 per cent . The travel in these four mega-cities is likely to increase to an estimated 550 to 600 lakh persons perday which is equivalent to a 50,000 bus fleet. (National Commission on Urbanisation 1985 : 261).

The calcultated total vehicle, vehicle per person and vehicular emission (total pollution load) are given in Table 2.4.

Delhi metropolitan city has clearly shown the apex position among all the metropolitan cities of India, during 1981, 1987 and 1991 (projected) respectively Delhi's percentage share of vehicles is 29.40 per cent in 1981 28.47 per cent in 1987 and 30.20 per cent in 1991 (projected). After Delhi is followed Bombay with 17.06, 13.34 and 10.89 per cent for 1981, 1987 and 1991 (Projected) respectively. Data for other metropolitan cities are given in Table 2.4.

TABLE - 2.4

ESTIMATED VEHICULAR EMISSION LOAD IN METROPOLITAN CITY

NAME OF THE CITY	NUMBER OF VEHICLES						VEHICLES PER PERSON			TOTAL POLLLUTON LOAD (Tons per day			
	1981		1987		1991		1981	1987 *	1991*	1987		1991	
DELHI	431123	29.40	1111664	(28.47)	1598000	(30.20)	0.08	0.15	0.18	871.92	(29.09)	1319.96	31.71
BOMBAY	250093	17.06	520838	(13.34)	576400	(10.89)	0.03	0.05	0.05	548.80	(18.31)	460.80	11.07
CALCUTTA	91993	6.27	359918	(9.22)	453400	(8.57)	0.01	0.03	0.04	244.77	(8.17)	357.35	8.59
MADRAS	90000	6.14	275884	(7.06)	415000	(7.84)	0.02	0.05	0.07	188.54	(6.29)	325.06	7.81
BANGALORE	138611	9.45	324140	(8.30)	391500	(7.40)	0.05	0.08	0.08	253.72	(8.46)	305.30	7.34
HYDERABAD	80111	5.46	298039	(7.63)	453133	(8.56)	0.03	0.09	0.13	169.03	(5.64)	357.13	8.58
PUNE	75863	5.17	212167	(5.43)	279500	(5.28)	0.05	0.10	0.11	212.76	(7.10)	211.10	5.07
AHMEDABAD	89897	6.13	303672	(7.78)	415500	(7.85)	0.04	0.09	0.11	243.94	(8.14)	325.48	7.82
KANPUR	51236	3.49	116422	(2.98)	160000	(3.02)	0.03	0.06	0.07	71.80	(2.40)	110.61	2.66
LUCKNOW	40000	2.73	120381	(3.08)	192600	(3.64)	0.04	0.10	0.16	69.58	(2.32)	138.02	3.32
JAIPUR	48763	3.33	162644	(4.16)	214270	(4.05)	0.05	0.12	0.12	74.98	(2.50)	156.52	3.75
NAGPUR	78659	5.36	98301	(2.52)	141500	(2.67)	0.06	0.06	0.08	47.80	(1.59)	95.05	2.28
TOTAL	1466349	100%	3904030	(100%)	5290803	(100%)				2997.65	(100%)	4162.11	100%

* 1987 & 1991 - Projected Population

SOURCE : Central pollution Control Board, Report Assessment of vehicular pollution in Metro cities, Part I - Abrieged Report CUPS/17/1988-89.

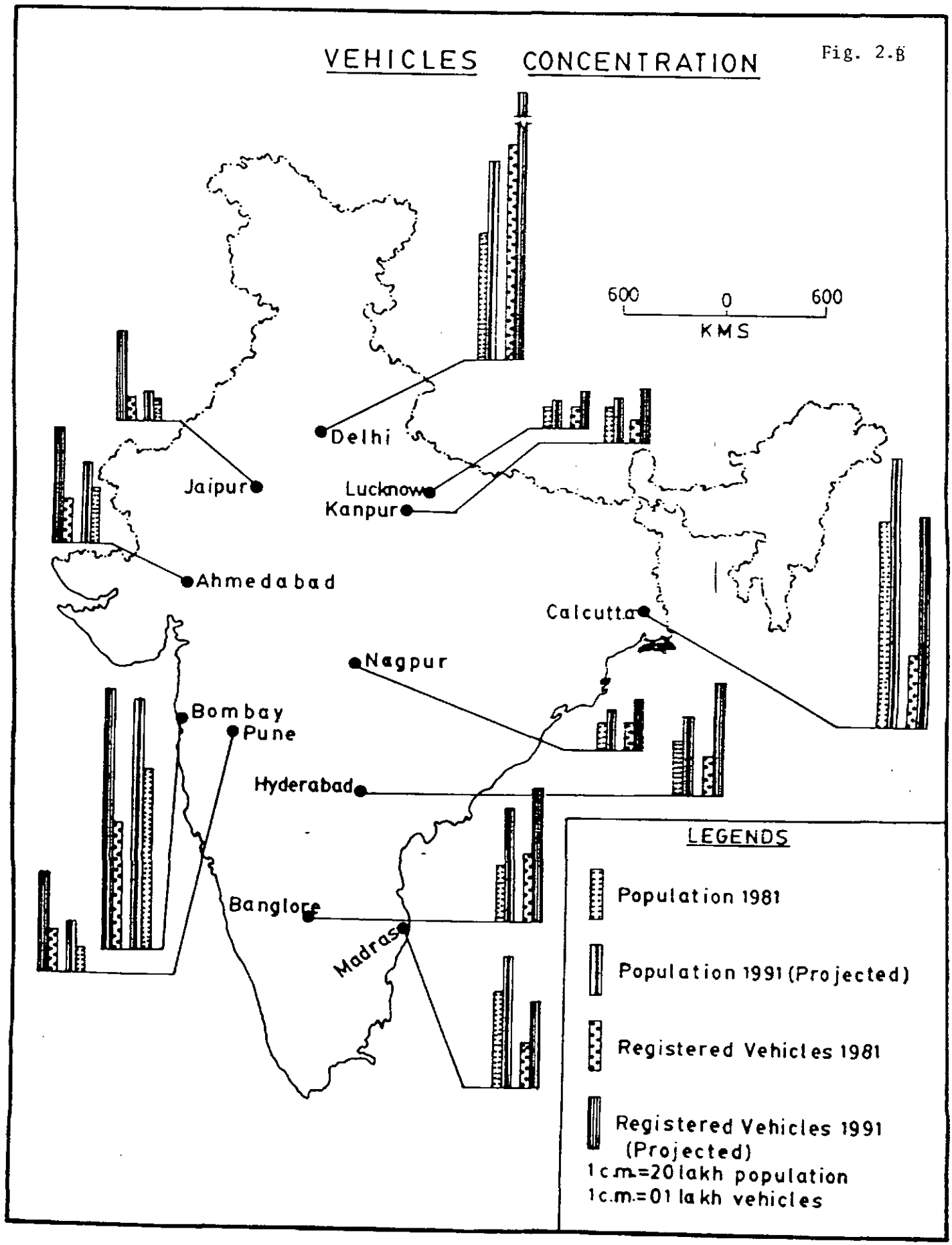
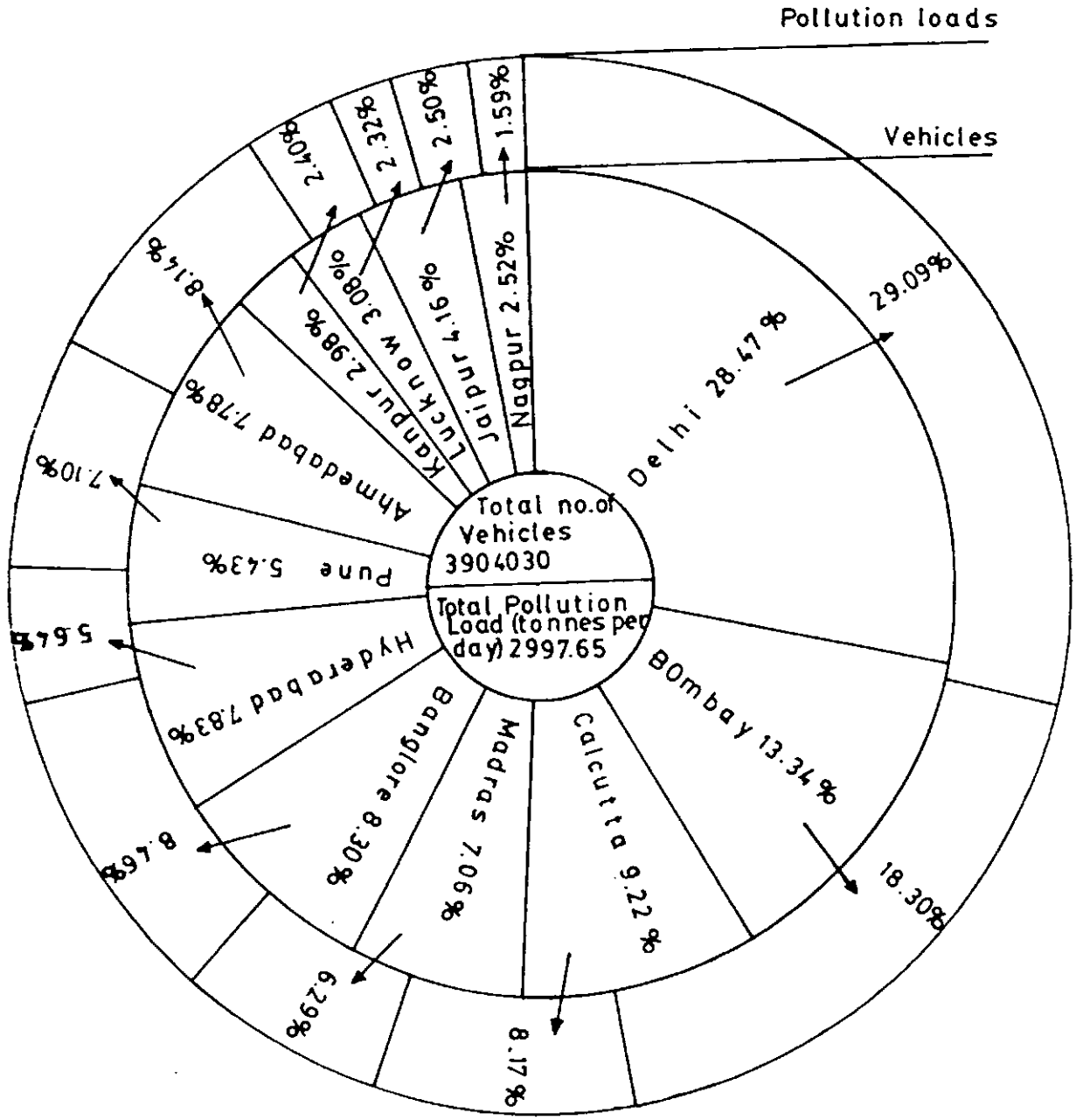

VEHICLES CONCENTRATION
Fig. 2.8
600 0 600
KMS
Delhi
Jaipur
Lucknow
Kanpur
Ahmedabad
Calcutta
Nagpur
Bombay
Pune
Hyderabad
Banglore
Madras
LEGENDS
Population 1981
Population 1991 (Projected)
Registered Vehicles 1981
Registered Vehicles 1991 (Projected)
1 c.m.=20 lakh population
1 c.m.=01 lakh vehicles

Fig. 2.C

DISTRIBUTION OF VEHICULAR EMISSION LOAD In METROPOLITAN CITIES OF INDIA (1987)



A comparative analysis of data for 1981, 1987 and projection year 1991, indicates on interesting phenomenon. Although in absolute terms all cities show increasing trends some cities register percentage shares which are decreasing. Even Delhi has shown decreasing percentage share during the year 1981-1987. As per projected figures for 1991 Delhi will continue to occupy the apex position among all other metropolitan cities of India. Bombay,Calcutta, Banglore and Jaipur are showing decreasing percentage share of vehicles among all the other metropolitan cities for 1991. Consequently, the total pollution loads must decrease. However, for Calcutta and Jaipur the percentage share of vehicles would decrease at lower rate.

Vehicles Per Persons

Ratio between the vehicle and population is vehicles per persons. In this context Delhi has registered higher ratio among other metropolitancities of India since 1981 to 1987. In 1991, Delhi will again be occupying the top position and Jaipur would be the second city among others (Table - 2.4).

In 1981, Delhi Metropolitan city is followed by Nagpur with its ratio of 0.06 vehicle per person. Delhi's ratio is 0.08 vehicle per person followed by Jaipur (0.05),

Pune (0.05), Banglore (0.05), Ahmedabad (0.04), Lucknow (0.04), Kanpur (0.03), Hyderabad (0.03), Bombay (0.03) Madras (0.02) and Calcutta (0.01) respectively.

The ratio of vehicles per person has shown a very interesting trend. With the exception of Bombay all other metropolitan cities indicate situations during the year 1987-1991.

Decreasing Green Environs

Increasing trends in urban population is always been viewed with concern almost invariably from the point of view of deterioration of city's green environs. The pressure on land have often resulted inan indiscriminate mixture of land uses resulting in a steady deterioration of already strained urban services and envirinmental quality.

TABLE - 2.5

AREA GROWTH RATE PATTERN : METROPOLITAN CITIES OF INDIA

Name of the City	*GROWTH RATE IN PER CENT*	
	1961-71	*1971-81*
CALCUTTA	*12.22*	*28.64*
BOMBAY	*No Change*	*No Change*
DELHI	*36.66*	*21.18*
MADRAS	*134.78*	*7.75*
BANGLORE	*(-) 64.63*	*106.23*
AHMEDABAD	*N.A.*	*N.A.*
HYDERABAD	*35.46*	*N.A.*
PUNE	*15.00*	*6.06*
KANPUR	*No change*	*No change*
NAGPUR	*(-) 0.75*	*0.05*
JAIPUR	*147.67*	*(-) 18.75*
LUCKNOW	*(-) 5.73*	*14.32*

Table 2.5 shows that areas under various cities grew very hapazardly. Calcutta shows on increasing trend during both decades. Bombay and Kanpur have shown no changes for both decades. During 1961-71 decade area of Banglore (-64.63 per cent), Nagpur (-0.75) and Lucknow (-5.73 per cent) were decreasing. During 1971-81, Jaipur (-18.75) city shows a decreasing trend. These flucutating nature could be because of problem of deleneating of boundaries of individual cities.

In general, most of the cities have shown increasing trends in cities area. These upcoming areas converted into market urban centres, transportation institution, commercial institution and industrial factories develop in such a manner that certain characteristics of modern societies integrate and support each other. However, such development pose threat to environmental quality.

Population and Air Pollution

First of all one should know the constituents of air pollution along with the concentrations before any measure to control it. Over 90 per cent of the pollutants exist in gaseous state with their concentration varying between 0.01 to 10 ppm (part per million) for molecules and 0.01 to 10 PPB (part per billion) for metal vapours. Some of the main toxic

and inuurious gases of air pollution sulpher dioxide (SO_2) Hydrogen Sulphide (H_2S), Nitrogen dioxide (NO_2) Hydrogen floride (H_2F) carcinogenic hydrocarbon dust, carbon monoxide and oxidents. The concentration of these pollutants depends mostly on weather conditions, like air, temperature wind direction and to some extent precipitation and Humidity.

A major source of air pollution has been the particulate and gaseous matter which are released by the burning of fossil fuels such as coal and petroleum. The source of air pollution can be divided into two main categories, namely - a] Natural, and [b] Man-made. The pollution due to volcanoes, forest fires and dust belongs to the first categories. Heating and cooking chemical processes nuclear or atomic processes mining and quarrying, tobacco smoke, aerosol sprays, household dust etc. are some of the example to the later categories.

Air pollution generally happen when a pollutant as a constituent is released a wrong amount, in a wrong place or wrong time. For example nitrogen and phosphorus are essential nutrients for living organisms and are extensively used in agriculture to increase crop yield but they can also cause pollution in takes and rivers when found in excess by promoting undue algal growth.

TABLE - 2.6

AIR QUALITY STANDARDS
*Constituted by Central Poylution Control Board (CPCB) New Delhi **

Area	*Concentration Micro gram per cubic metres (ug/m^3) Mean 24 hours time*		
	Suspended Particulate Matter (SPM)	*Sulpher dioxide (SO_2)*	*Nitrogen dioxide (NO_2)*
Commercial	*70*	*20*	*20*
Residential & Rural	*140*	*60*	*60*
Industrial	*360*	*80*	*90*

Table 2.6 shows Air quality standards i.e. permissible limit. If pollutant exceed these permissible limits then it can be clearly said that pollution of air or atmosphere has taken place.

The problems of air pollution are becoming severe in major cities like Calcutta, Bombay and Delhi. A high background dust level during certain times of the year aggrabates the problems. Studies conducted by the National Environmental Engineering Research Institute (NEERI) Confirms that levels of Particulate matter (SPM) sulpher dioxide (SO_2)

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*National Environmental Engineering Research Institute, Nagpur, 1985. pp.287.

and Nitrogen dioxide (NO_2) in certain major metropolitan cities exceed permissible limits. NEERI has studied only nine metropolitan cities of India. They are based upon three sample area such as commercial Industrial and Residential Complexes.

Comparision Between Population and Air Pollution

In this exercise, we have calculated the projected population for 1982, 1983, 1984 and 1985 year respectively. Air pollution data are available in three types of area i.e. Residential, Commercial and Industrial and Air pollutant conists of suspended particulate matter, sulpher dioxide and nitrogen dioxide. We calculated air pollution in cities by summing up all pollutents in all the three sample areas which represent city's air pollution as a whole.

Because of availability of data at different scale, i.e., population in numerical values and pollutions in unit of micro gram per cubic meters the logarithamic graphs are selected to represent the relevant information.

TABLE - 2.7

COMPARISON BETWEEN POPULATION AND AIR POLLUTION

	Projected Population in Million				Air Pllution* in Microgram per cubic Metres			
	1982	1983	1984	1985	1982	1983	1984	1985
CALCUTTA	9.45	9.78	10.00	10.30	511	531	554	547
BOMBAY	8.57	8.84	9.15	9.47	213	313	280	329
DELHI	6.05	6.39	6.70	7.05	395	375	534	512
MADRAS	4.45	4.60	7.76	4.92	167	167	141	138
HYDERABAD	2.60	2.73	2.84	2.96	196	175	219	256
AHMEDABAD	2.58	2.70	2.80	2.90	277	364	361	383
KANPUR	1.75	1.80	1.85	1.90	324	251	332	316
NAGPUR	1.38	1.40	1.45	1.50	178	204	224	250
JAIPUR	1.10	1.13	1.20	1.25	241	256	345	346

**SOURCE : NEERI, 1985*

Fig 2.D shows that major metropolitan cities like Calcutta, Bombay and Delhi are register population and air pollution growing simultaneously at almost identical rates Another metropolitan cities such as Hyderabad, Ahmedabad, Nagpur and Jaipur are no exception. However, Madras and Kanpur are showing uniform rate of growing air pollution and population.

Fig. 2.E shows that which is more polluted city during 1982 to 1985. Calcutta has shown highly polluted city in India and next followed by Delhi and Bombay metropolitan cities. These cities shows pollutants are existing across the permissable limits. Rest nine cities like Madras, Banglore, Nagpur Kanpur, Ahmedabad, Lucknow, Jaipur are moderately polluted cities in India.

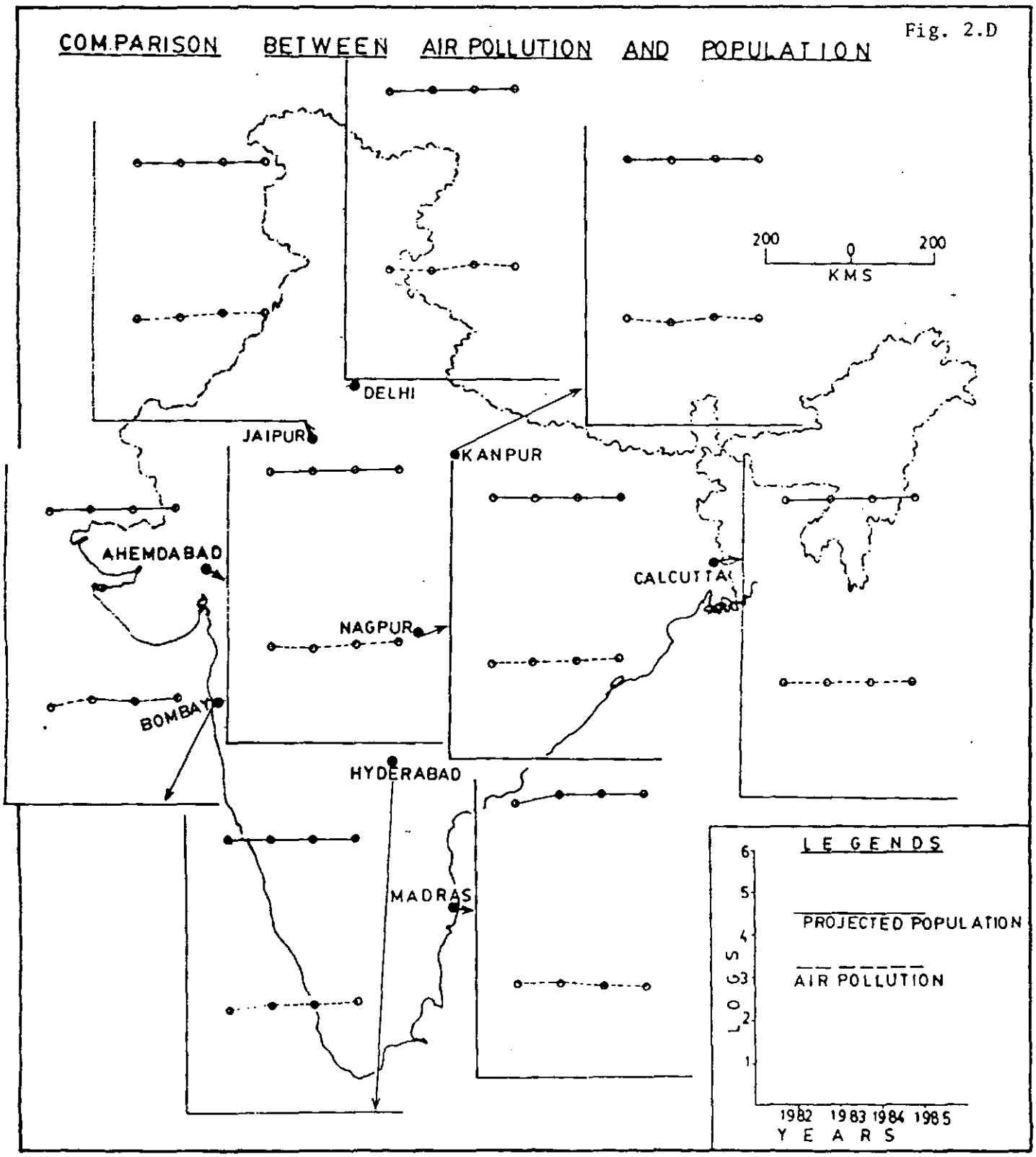
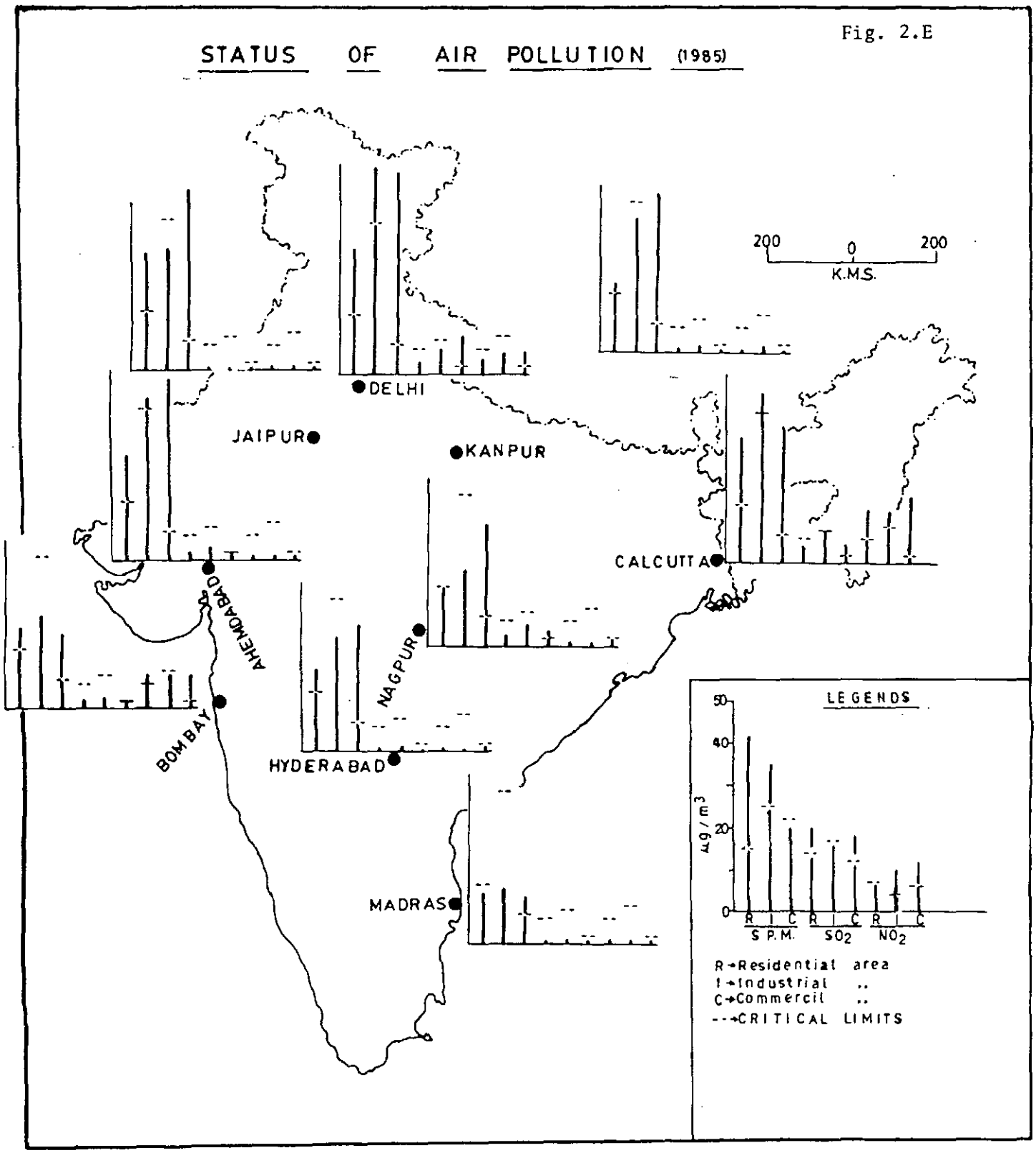

COMPARISON BETWEEN AIR POLLUTION AND POPULATION
Fig. 2.D
200 0 200
KMS
DELHI
JAIPUR
KANPUR
AHEMDABAD
CALCUTTA
NAGPUR
BOMBAY
HYDERABAD
MADRAS
LEGENDS
PROJECTED POPULATION
AIR POLLUTION
LOGS
6
5
4
3
2
1
1982 1983 1984 1985
YEARS

Fig. 2.E


STATUS OF AIR POLLUTION (1985)
200 0 200
K.M.S.
DELHI
JAIPUR
KANPUR
CALCUTTA
AHEMADABAD
NAGPUR
BOMBAY
HYDERABAD
MADRAS
LEGENDS
50
40
20
0
µg/m³
R I C R I C R I C
S P.M. SO2 NO2
R→Residential area
I→Industrial ..
C→Commercil ..
---→CRITICAL LIMITS

Population and Water Pollution

According to central board for the prevention and control of water pollution (New Delhi), Calcutta's environmental sanitation is very poor followed by Kanpur, Madras and Delhi, Ahmedabad and Jaipur. Bombay is the only metropolitan city where environmental sanitation is fairly satisfactory. Table (2.8) shows water supply, discharge waste water collection and treatment situation in metropolitan cities of India.

TABLE - 2.8

WASTE-WATER COLLECTION AND TREATMENT SITUATION IN SELECTED METROPOLITAN CITIES OF INDIA

Name of the City	Population	Unsewared Population	Untreated Population	Water Supply	Waste Water MLD			Per Capita Water Supply
					Generated	Collected	Treated	
	-------(In million)-------							
CALCUTTA	7.03	6.64	7.03	612.90	490.32	26.97	26.97	87.00
BOMBAY	5.97	2.99	4.48	1452.00	1160.24	581.12	635.60	243.22
DELHI	5.65	0.91	1.93	885.30	685.80	708.24	581.18	156.69
MADRAS	3.17	0.79	2.60	218.83	175.06	175.06	45.40	69.00
KANPUR	1.28	0.00	1.28	206.38	165.10	165.10	Nil	161.23

MLD - Million Litre per day

SOURCE : Central Board for the Prevention and Control of Water Pollution CUPS/4/1978-79.

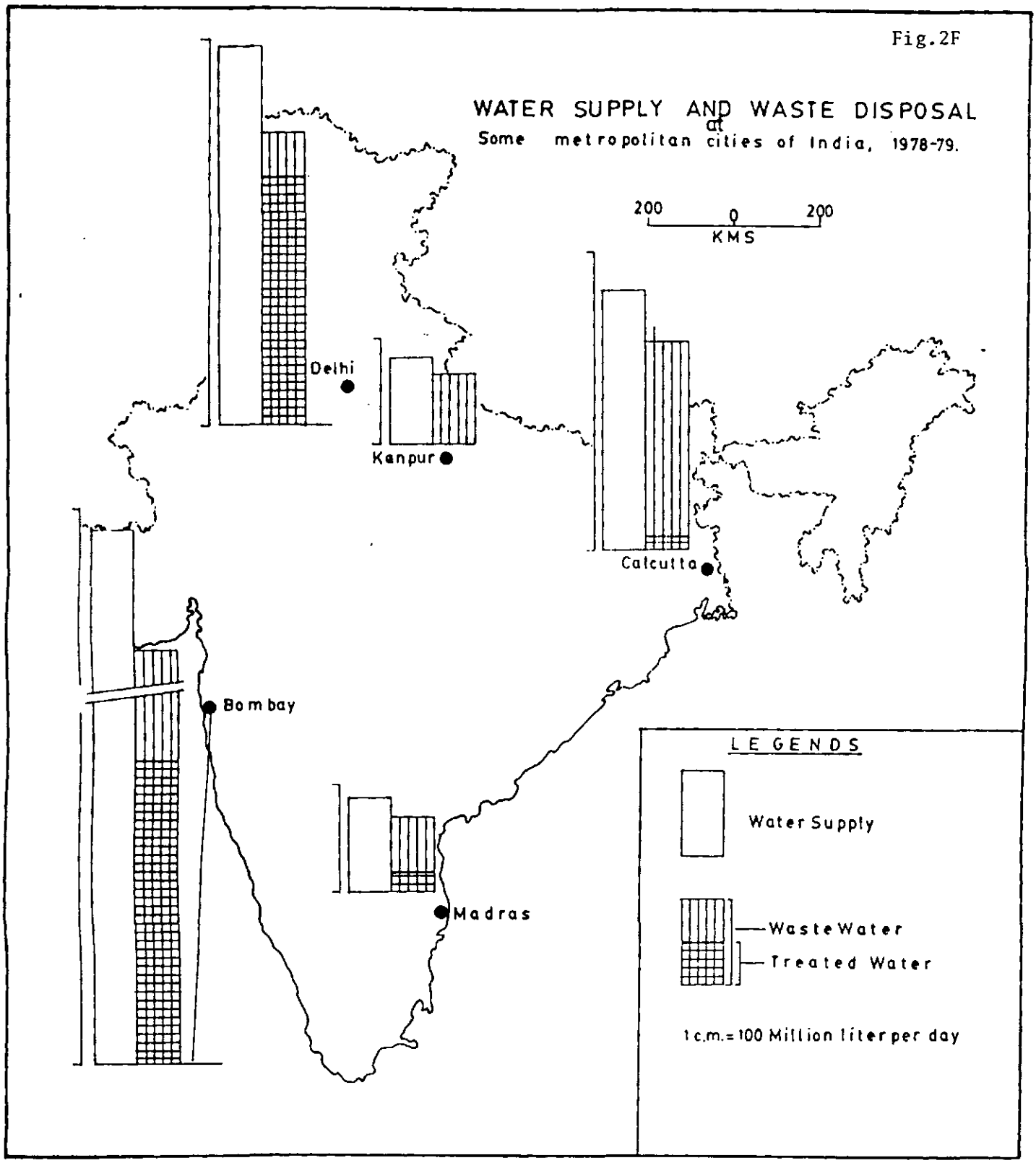


Fig.2F
WATER SUPPLY AND WASTE DISPOSAL
at
Some metropolitan cities of India, 1978-79.
200 0 200
KMS
Delhi
Kanpur
Calcutta
Bombay
Madras
LEGENDS
Water Supply
Waste Water
Treated Water
1 c.m. = 100 Million liter per day

Table - 2.8 reflects that per capita water supply, Bombay has 243 MLD and followed by Delhi, Kanpur, Calcutta and Madras are 157 liter/day, 161.87 and 69 liter/day respectively. National average has 125 liter/day. Thus Bombay Delhi and Kanpur cities has average per capita supply situation above the national average while Calcutta, Madras has below national average level.

The total quantity of polluted water generated in Bombay is of 1168 MLD; collected 581 MLD and Treated 636 MLD followed by Delhi is of 708.24 MLD; collected 581.18 MLD and treated by 445 MLD like that Calcutta, Madras and Kanpur respectively. This Table (2.8) metropolitan cities highlights the existence of an artificial environment of congestion of competition and inhibitions, where urban life becomes severely handicapped in the eventof lack of some essential amenities in the urban infrastructure. Basic sanitary measures, like water supply and water disposal from the domain of environmental senitation has wide remification in environmental pollution problems which are extensive in nature. The orony is that whereas the requirement of water for many purposes is increasing at a fast rate, its pollution level is also going up reducing the availability of sufficient potable quality of water. The sewage containing organic wastes,

excessive nutrients like nitrates and phosphates, helps increase in various decomposers like bacteria and fungi. Which are liberated with its discharge into water bodies resulting in pollution. The phosphates nitrates and ammonia compounds also originate from detergents and fertilizers which flow into streams with rain waters and result in excessive growth of algae, a source of deoxygenation of water and emittance of fould smell.

Noise Pollution

After, air and water pollution Noise is also fast emerging as a major pollutant of the environment. Generally Noise defined as unexpected/unwanted sound. The symbol of modern civilization are all contributing to this high level of noise generation. Such a type of noise is not only confined to urban areas, but rural area too are being invaded by modern farm technology, Noise can be measured in terms of landness level, spectra composition and continuous or intermittent nature, both by subjective and objective methods in cases where physical discomfort occurs.

The subjective percaption of loudness of a noise increases linearly with the sound intansity upto a level of eighty decibels. Above this level the human beings suffer a temporary loss of perception with the result that this linearity does not hold good any longer. (Pancholy, et al1960).

Environmental noise levels of more than eighty five decibels should be considered particularly objectionable. For work requiring mental concentration, a noise level below sixty decibels is generally recommended. For restful sleep, noise levels considerably below this limit are necessary.

Noise, however is not merely an intense sound. Noise is defined physically as a complex sound with little or no periodicity and psychologically as a sound undesired by the recipient. (Wilson, 1963). Its effect can come about by short term exposure to intense sound or continuous exposure to less intense noise levels. In mild cases of either type, exposures may result in reduction in output of work, lack of efficiency impairment of hearing or just a vague feating of annoyance. But it is now well-known that noise can also contribute to various serious ailments such as stomach ulcer, caner and disease of the heart.

The noise pollution in the metropolitan cities has been analysed only for two cities : Delhi and Bombay at only one time period, 1960 due to non-availability of data According to Table 2.9 the level of traffic noise in Delhi metropolitan city in localities with medium and heavy vehicle traffic are mostly high, i.e., from seventy five to hundred phons* Generally, the table shows a maximum value of 90 to 95

** a unit of loudness level on a logarithmic (decibel) scale*

TABLE - 2.9

CHARACTERISTICS OF DAYTIME TRAFFIC NOISE IN DELHI

LOCALITY	TYPE OF LOCALITY	AVERAGE NOISE LEVEN PHON	AVERAGE MAXIMUM NOISE LEVEL PHON
Clock Tower, Subzi Mandi	Residences,Shops	79	88
Pul Bangash	- do -	87	94
Fatehpuri	- do -	84	93
Gandhi Market,Sadar Bz.	- do -	80	89
Bara Tooti,Sadar Bz.	- do -	82	92
Sisganj,Chandni Chowk	- do -	88	94
West Patel Nagar	- do -	83	97
Delhi Jn. Station	Railway Station	87	93
Lady Harding Hospital	Hospital	81	93
Safdarjung Airport	Airport,residence	87	95
East Patel Nagar bus stop	Residences	79	94
Police Station,Subzi Mandi,Lahori Gate	Market Residences, market	80	88
Dariba	Residences, Shops	78	88
Police Station,Sadar Bazar	- do -	76	83
Lal Kuan	- do -	83	91
Nai Sarak Chawri Bazar Daryaganj	Residences,Shops,Offices	80	89
Arya Samaj Road, Minto	Residences	82	93
Road,Connaught Circus	Residences,Office,Shops	88	94
Regal Corner,Connaught	- do - Temple Residence	81	90
Circus,Janpath,Birla		83	91
Temple		78	87
Vinay Nagar	Residence	76	83
Subzi Mandi	Market	87	93
Sessions Court, Civil Lines	Courts, Residences	72	74
Ajmal Khan Road	Residences Shops	82	92
East Patel Nagar Mkt.	- do -	66	70
South Avenue	Residences, Bangalows	64	71
Tees January Marg	Bungalors	64	65

TABLE - 2.10

CHARACTERISTICS OF DAYTIME TRAFFIC NOISE IN BOMBAY

LOCALITY	TYPE OF LOCALITY	AVERAGE NOISE LEVEL PHON	AVERAGE MAXIMUM NOISE PHON
Kemp's Corner	Residences	95	101
Bhendi Bazaar	Residences, Shops	98	104
Opera House	- do -	93	96
Thakurdwar	- do-	97	103
Kalbadevi	- do -	94	104
Flora Fountain	Offices	91	96
Crawford Market	Shops	91	95
Queen Road	Residences, Shops	94	101
Shaikh Market Street	- do -	89	95

SOURCE: Pancholy, A.F. et al, (1959) "Noise Survey of India Cities : Part - I, Traffic Noise in Delhi & Bombay - Journal of Scientific & Industrial Research ,1960 Vol. 19A, No.1, pp.19-25.

TABLE - 2.11

MIDNIGHT TRAFFIC NOISE IN DELHI AND BOMBAY

LOCALITY	*AVERAGE NOISE LEVEL PHON*	*AVERAGE MAX. NOISE LEVEL PHON*
DELHI		
Subzi Mandi Clock Tower	*66*	*74*
Subzi Mandi Police Station	*64.*	*70*
Pul Bangash	*69*	*79*
Lahori Gate	*74*	*79*
Fatehpuri	*65*	*70*
Gandhi Market, Sadar Bazar	*59*	*65*
Bara Tooti, Sadar Bazar	*71*	*74*
Sisganj Gurdwara,Chandani Chowk	*68*	*76*
Dariba	*64*	*74*
Sadar Bazar Police Station	*65*	*72*
Lal Kuan	*59*	*66*
Nai Sarak, Chawri Bazar	*63*	*70*
Daryaganj	*62*	*70*
Minto Road, Connaught Circus	*56*	*59*
Regal Corner, Connaught Circus	*56*	*59*
Janpath,Connaught Circus	*61*	*65*
Birla Temple	*54*	*59*
Tees January Marg	*54*	*57*
Safdarjung Airport	*59*	*60*
Vinay Nagar	*55*	*60*
BOMBAY		
Kemp's Corner	*74*	*79*
Frere Road	*77*	*84*
Bhendi Bazar	*92*	*98*
Opera House	*88*	*92*
Thakurdwar	*76*	*84*
Kalbadevi	*79*	*91*
Shaikh Memon Street	*74*	*80*
Crawford Market	*74*	*87*
Queen's Road	*86*	*93*
Hornby Road	*84*	*90*
Sir Pherozeshah Mehta Road	*77*	*84*

SOURCE : Ibid, Table No. 2.10.

phons while the average values lie between seventy to nineteen phons. In Delhi the minimum value does not fall below sixty phons. In Bombay the corresponding maximum levels between a range of 95-105 phons, while average levels are found between whereas the minimum level does not fall below eightyfive phons (Table 2.10)

Table 2.11 shows the noice level at midnight in Delhi and Bombay. In Delhi, it is observed that several places have an average level of seventy phons or more. Which is beyond tolerance level for human beings. These absolute values are still fairly high on account of the continued traffic. In Bombay the total fall in noise level from peak hour to midnight is found to be on an average fifteen phons. It shows that a heavier night-time traffic exists in Bombay as compared to Delhi. It is seen that Bombay has an inordinately high noise level even at mid-night. Themain reason for this heavy traffic is essentially because of heavy traffic density and high-rise buildings which tend to reflect the noices more significantly.

According to a later report conducted in 1983 by National Physical Laboratory day time in Delhi and Bombay noises varied from 60 decibel in quiet localities to 95 decibel in congested busy localities with peaks reaching upto 110 decibel (S.P. Singal 1986; 544-557). Even at

night, the noise levels varied from 50 decibel in quiet localities to 90 decibel in busy localities.

In sum, environmental pollution, in physical sense is a evil normally associated with economic development and progress. It is a problem significant for India as well as for industrially advanced countries.

This is consequent upon increasing amount of population density. The unusually high densities encourage cities to grow beyond their means.

Calcutta, Bombay, Delhi, Kanpur and Ahmedabad are most industrialised cities of India. With such development are associated rapid growth in transportation. Increased use of vehicles which emit large amount of noixious pollutants in the urban atmosphere. Unless a timely cognizance is taken about the ever increasing level of atmospheric pollution the point of no return may be reached. However, as has already been pointed out there exists an increasing awareness about the problems related to atmospheric pollution and a few step have already been taken to improve the contemporary chaos.*

*The newly introduced motor vehicle act is a step in this direction. As per rules new vehicles emitting jumes and toxic gases beyond a set limit would have to be withdrawn from playing on the roads. Besides, there will have to be periodic checks on emission levels.

CHAPTER - III

THE DELHI SCENE : SPATIAL AND TEMPORAL ANALYSIS

Our main concern in this Chapter is to identify Delhi's physical environmental scene along a spatio-temporal dimension. The present study growth of urbanisation and its impact on physical environment in Delhi Metropolitan area.

In general, an explosive urbanisation is leading to competition for the use of space. In the process of adjusting to it the inhabitants violently disturb the environment by building structures of concrete and other building materials in an unplanned way. Various types of transport and communications are also developed. As a result of bodily wastes, detergents, chemicals, pesticides, gases and most of man-made synthetic substances released in the atmosphere intrude in the natural environment and throw major segments of the ecosystem out of balance. The new science and technology and economic growth have had an adverse impact on the environment. Hence it is important to give due recognition to an environmental balance in an urban planning.

Delhi metropolitan city with a geographical extent of 28°24'17"N to 28°53'N latitude and 77°5'E to 77°20'E[1] is situated on the banks of the river Yamuna. Its largest geographical landmass is the 'Northern Ridge' which runs

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1. Source: The Atlas of World Geography (London, 1977)P.16.

from South to North-East on the West side of river Yamuna. This ridge divides this part of the city roughly into two equal parts. The Ridge is the remaining part of the oldest hill range of India 'the Aravallis', which run further South-west into the state of Rajasthan.

The weather condition of the Delhi city is influenced by the inland position with the great desert of Rajasthan to the west and South-west and Gangatic plain of Uttar Pradesh to the east. Extreme dryness with an intensely hot summer and cold winter are the characteristic feature of the weather. The cold season starts in late November and extends to about the beginning of March. This is followed by the hot season which lasts till about the end of June when the monsoon arrives. The monsoon contrinues into the last week of September. The two post monsoon months October and November constitute a transition period from the monsoon to winter conditions.

Physical features and Pattern of Urbanisation.

The 'Delhi Ridge' is often rightly called the 'Lung of Delhi' because of its abundant trees and plant life. This ridge has borne the main impact of unplanned urbanization

of Delhi metropolitan city. Historically in the early 1912, the process of urbanisation in Delhi metropolitan city was restricted to a triangular area between the ridge in the west and the river Yamuna in the east. Even then it was felt that any encroachment or expansion beyond these areas would have far reaching consequences. Eventua-ly, however, due to rapid urbanisation and population influx into the capital, urban growth spilled beyond the ridge and the river on both sides. To add to the woes of the city, after 1920, a large part of the ridge was blasted out to connect the west Delhi with the rest of the city. This large part of the blasted ridge area is now known as Jhandewalan. The Lung of the city also suffers from unauthorised encroachment and reckless destruction of the green areas often by none other than the army.

Since independence, the population of Delhi metropolitan city has exploded from less than million to over a staggering eight million. According to census of India, one third of Delhi's green environs have been destroyed since and agricultural land around Delhi has decreased by 32 percent (India 1987).

Delhi metropolitan city has become an epicentre of trades Commercially and Industrially in the northern region

besides housing; official complexes, prime medical and educational institutions. Consequently there had been a massive influx of migrants from rest of the country and thereby precipitating flattering population growth in the Delhi metropolis during last few decades.

Census claims that there has been approximately fourfold rise in urban population in Delhi metropolitan city during 1941-1981 which has necessitated the increase in total area of Delhi metropolitan city to accommodate the burgeoning population. Due to availability of copious land, there has been about thirty seven percent increase into total area of Delhi metropolitan city from 327 square km. to 446 square km. during 1961-1971 which again increased to 592 sq. km. by 1981. Still there has been increase in density of population in Delhi metropolitan city from 8171 to 9745 persons per square km. during 1971-81 (table 3.1)

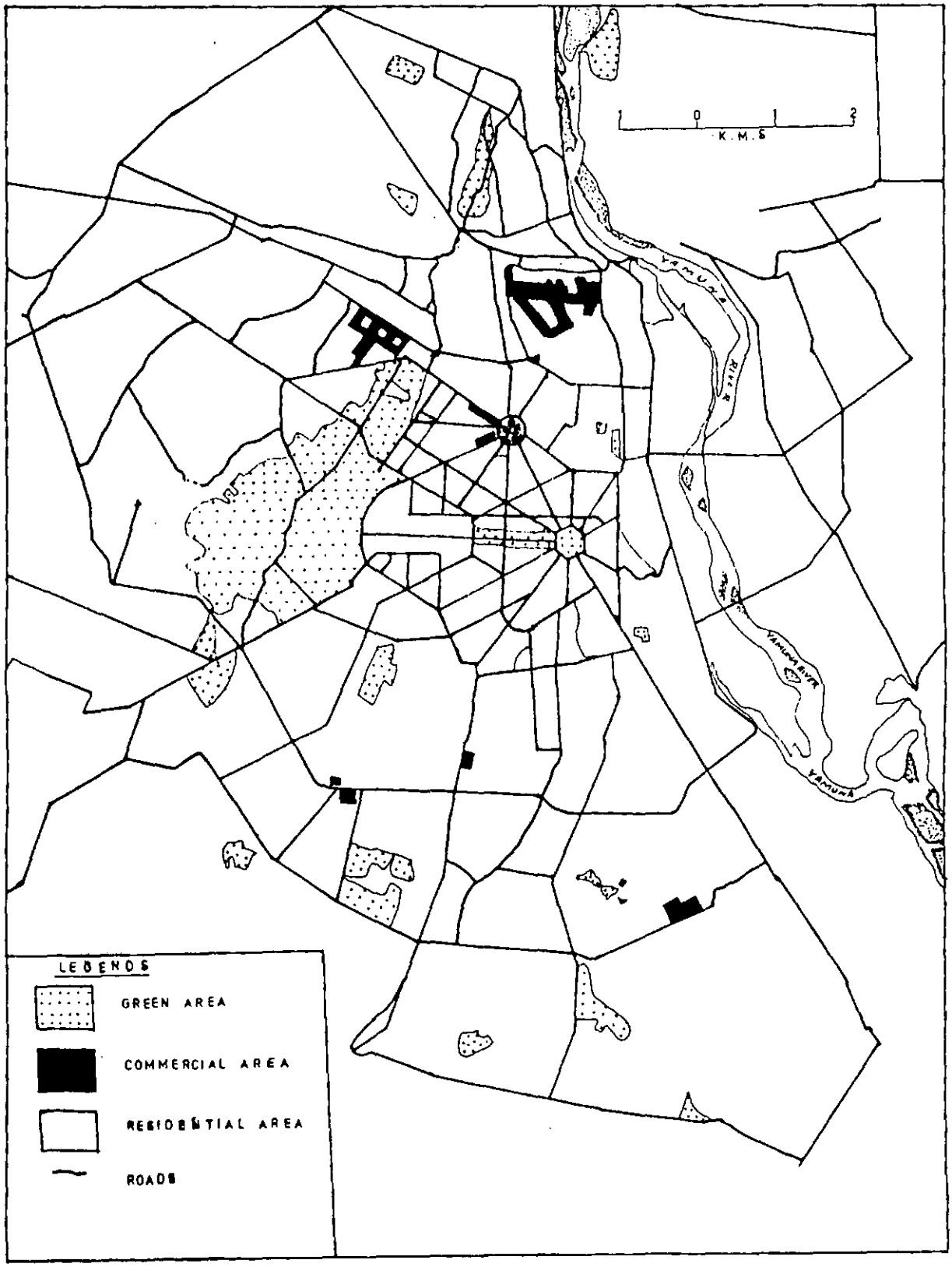
TABLE (3.1)

Growth of Delhi Metropolitan City

Years	*Population (in million)*	*Area (square km.)*	*Density (Persons per square km.)*
1961	*2.36*	*326.55*	*7227*
1971	*3.65*	*446.26*	*8179*
1981	*5.71*	*591.90*	*9647*

ECOLOGY OF DELHI CITY

Fig. 3.A



The development of Delhi's morphology has followed a radical pattern where the centre business district areas, namely part of walled city and connaught place remained in the heart of city whereas residential areas developed in the peripheriphery encircling the Central Business District areas (Fig. 3-A).

Demographic Trend

Population analysis reflect fundamental base for the study of spatial organisation of socio-economic provision in any region whose ultimate aim is to provide maximum facilities to the people. The total population of Delhi metropolitan city according to census, was 5.71 million in 1981 while the population in 1961 and 1971 were 2.36 and 3.65 million respectively, thus decennial percentage growth of 54.57 and 56.66 percent respectively. Table 3.2a and Table 3.2b are show the trend of population growth since 1901.

Table 3.2a

Trend in Growth rate of population since 1901 - 81

Years	*1901*	*1911*	*1921*	*1931*	*1941*	*1951*	*1961*	*1971*	*1981*
Growth Rate (in percent)	*100*	*111*	*143*	*209*	*325*	*671*	*1102*	*1703*	*2668*

DELHI

Fig. 3.B

GROWTH OF POPULATION IN PERCENTAGE

BASE YEAR 1901

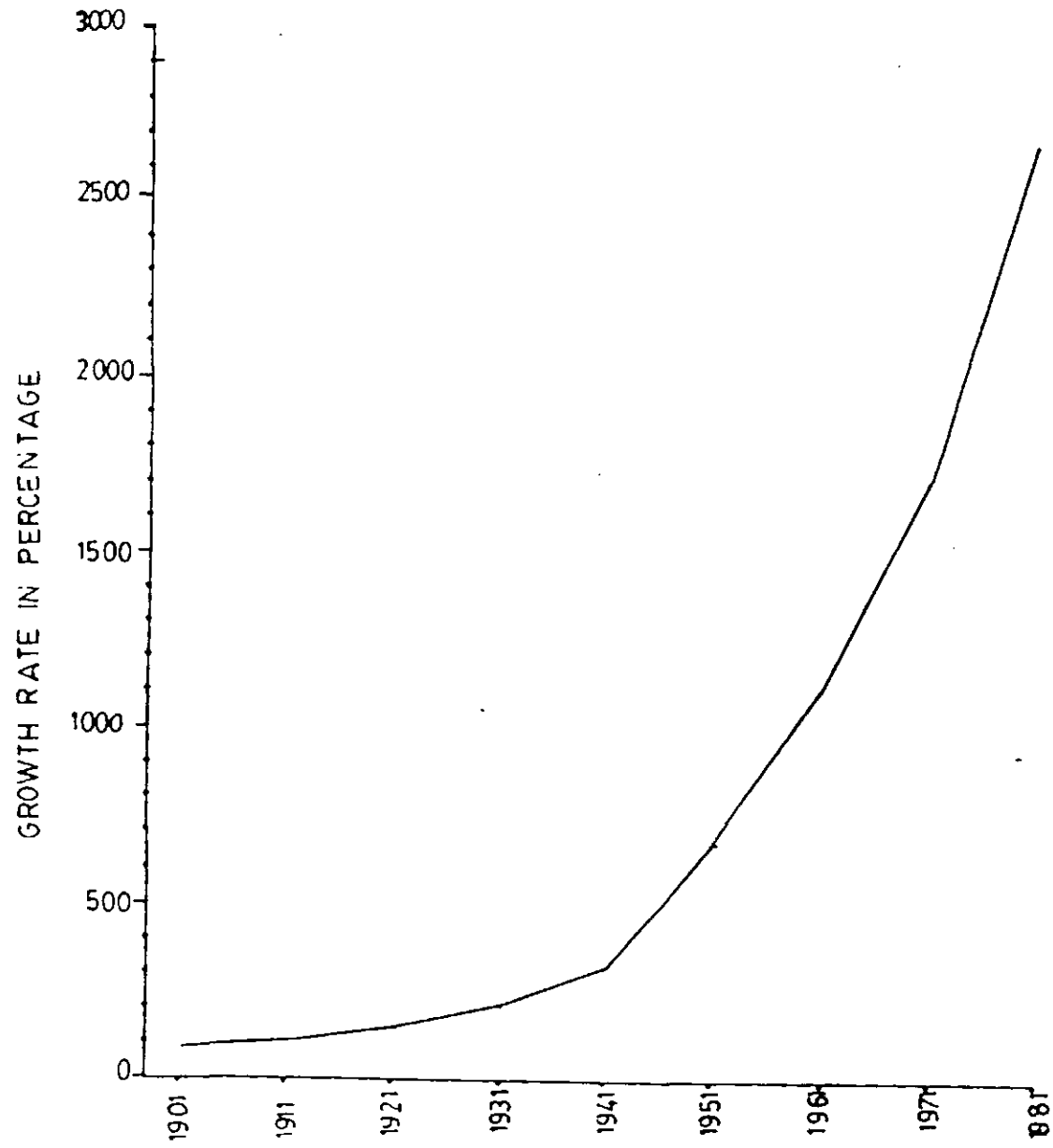


Table 3.2b

Trend of Decadal Growth Rate, 1901 - 1981

Decadal years	*1901-11*	*1911-21*	*1921-31*	*1931-41*	*1941-51*	*1951-61*	*1961-71*	*1971-81*
Growth rate (in percent)	*+11.31*	*+27.94*	*+46.98*	*+55.48*	*+106.58*	*+64.17*	*+54.57*	*+56.66*

Table (3.2a) represents the change in population since 1901. Simple growth has been computed, assuming 1901 as base year with content 100 population.*. Here, it is observed that Delhi's growth rate has increased since 1901. The table 3.2b reflects that from 1901 - 11 to 1941 - 51 the population growth rate is on an increase. While in 1941-51 decadal growth rate was 106.58 percent, for later decades it was 64.17 percent in 1951-61 followed by 54.57 percent in 1961-71 and 56.66 percent in 1971-81 respectively. Thus, 1941-51 decadal growth was highest. The main reason behind this growth was the influx of refugees after partition when Delhi city witnessed one of the

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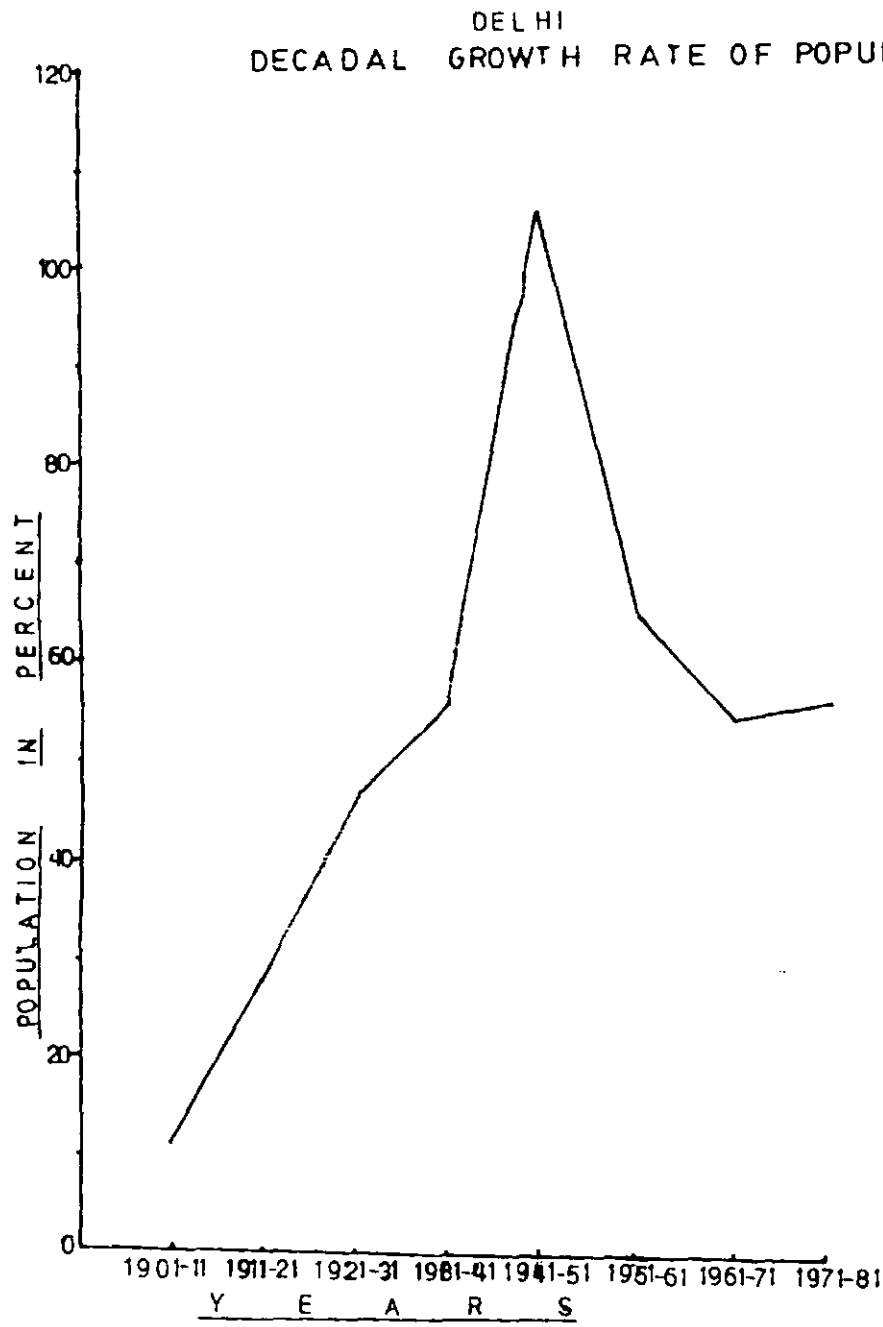
* *The growth has been computed with the help of the formula°*

$$G = \frac{X_i \ldots\ldots X_n}{X} \times 100$$

where $X_i \ldots\ldots X_n$ = *1911, 1921 ..... 1981*

X = 1901 and G = Growth since 1901.

Fig.3.C


DELHI
DECADAL GROWTH RATE OF POPULATION
POPULATION IN PERCENT
120
100
80
60
40
20
0
1901-11
1911-21
1921-31
1931-41
1941-51
1951-61
1961-71
1971-81
YEARS

largest immigration in the human history. Although the decadal growth rate during 1961-71 has been lower than the growth during 1951-61, it is still faster than anticipated. In 1971-81, it has resulted in rapid growth.

Density Pattern

The density of population of the Delhi metropolitan cities is analysed for four decades only 1951, 1961, 1971 and 1981. Due to non availability of data earlier decades could not be included. It is evident from the preceding analysis that the growth of population has been confirming. Here the most obvious reflection of the phenomena is through the density of population since 1951.

Table 3.3

Density of Population, 1951-81.

Year	*1951*	*1961*	*1971*	*1981*
Density (in persons per square km.)	*6518*	*7226*	*8173*	*9745*

Above discussion about the population scenario of

Delhi metropolitan city reflects that it is growing at a rapid pace because of unprecedented migration from all the corners of the country and natural increase. The population had increased four-fold during the past decade.

It is evident from table (3.4) that from 1961 onward, the congestion of people in a housing unit went on increasing. (table 3.4). It can be thus inferred from the above analysis, that with the increasing population, residential units have been overspilling making the housing problem acute still. It would not be wrong to say that many a times, the solution is and has been sought in the slum and squatter settlements. (Sheel, 1986). The old residential places like, Shahdara, Chandini Chowk, Town Hall had turned into semi factory areas. The gardens and reserved monuments-were heavily squatted upon. Most of the schools were in tents. The shopping area were over crowded. The wholesale trade centres were nothing better than fish market (Sadar Bazar, Azadpur Mandi). The whole of old Delhi was dotted with clusters/pockets of slushy slums. Such congestion eventually leads to increasing pollution. One such pollution is of an quality.

Table 3.4

Ratio between Households and Houses.

Years	*Total No. of Census Household per census houses.*
1961	*0.20*
1971	*0.85*
1981	*1.11*

Air Pollution

The continued increase in population and its consequences upon socio-economic development have contributed to the degradation of air quality in many of parts of Delhi metropolis areas. The atmosphere has a certain capacity to absorb pollutants without adversely affecting human health or terrestrial or aquatic ecosystems. However, this capacity is often exceeded by increased air emission from vehicles, power plants, industrial facilities and domestic sources.

Transport is the prime source of mobility in urban society. It not only provides a fast, convenient and economical mode of carier to meet multifarious activities of citizens but also caters to the needs of transportation of goods of commercial and industrial importance from stock centres to user agencies. However, it vitiates the environment in the process by emanating obnoxious and toxic pollutants in the surrounding atmosphere and thereby poses serious health hazards to biotic community.

Vehicular Pattern and Pollution Load

The Delhi metropolitan city has experienced one of the most significant rises in vehicles in 1981-86 when the city witnessed approximately eight-fold increase. The decadal growth rate for vehicles during 1971-81 was recorded to be about 142 percent, while the decadal population rate was about fifty eight percent during the same decadal year. The statistics show that the Delhi metropolitan city accounts for about ten percent of total registered vehicles in the country, and about twenty percent of total registered vehicles in metropolitan cities in 1987 (Table 3.5A) (Fig.3). The

TABLE - 3.5A

GROWTH PATTERN REGISTER VEHICLES IN DELHI

CATEGORY OF VEHICLE	1971		1981		1987	
	ALL INDIA	DELHI	ALL INDIA	DLEHI	ALL INDIA	DELHI
BUSES	94000	3038	154000	8044	230000	14037
GOOD VEHICLE	343000	13620	527000	36599	848000	61672
CARS JEEPS TAXIS ETC	862000	60292	1117000	125860	1626000	188323
TWO WHEELER	576000	93523	3375000	345109	7178000	665096
GRAND TOTAL	1865000	180424	5173000	536011	9882000	960997

TABLE - 3.5B

DISTRIBUTION OF REGISTERED VEHICLES IN DELHI

		1971	1981	1987
1. BUSES	A	3038	8044	14037
	B	3.36	5.21	6.10
	C	1.70	1.50	1.46
2. GOODS VEHICLES	A	13620	36599	61672
	B	4.00	6.90	7.30
	C	7.50	6.80	6.90
3. CARS JEEPS TAXIS ETC	A	60292	125860	188323
	B	8.80	11.30	11.60
	C	33.40	23.50	19.60
4.TWO WHEELERS	A	93253	345109	665096
	B	16.20	13.60	11.50
	C	51.71	64.40	69.20

A - Total number of vehicles
B - Percentage of total vehicles in India
C - Percentage of Total vehicles in Delhi

SOURCE : Motor Transport Statistics 1983-84, 1984-85 and Ministry of Surface Transport.

TABLE - 3.5 C

VEHICLES AND POLLUTION LOAD

CATEGORY OF VEHICLES	No. OF REGISTERED VEHICLES IN DELHI	POLLUTION LOAD (TONNES/DAY) PARTICLES MATTER (SPM)	SULPHER DIOXIDE (SO_2)	OXIDE OF NITROGEN (NO_x)	CARBON MONOXIDE (CO)	HYDRO CARBON (HC)
A. PATROL DRIVEN						
1. CARS, JEEPS & STAIN WAGONS	211774	1.49	0.36	14.47	180.95	27.10
2. TAXIS	8808	0.09	0.021	0.86	10.70	1.61
3. TWO WHEELER	770110	3.02	0.302	1.05	256.76	151.00
4. THREE WHEELER	45151	0.311	0.031	0.11	33.10	15.57
B. DIESEL DRIVEN						
1. BUSES	16266	1.40	2.80	38.90	23.50	3.90
2. GOODS VEHICLE	64555	2.27	3.96	59.00	39.90	8.80
GRAND TOTAL	1111664	8.58	7.47	105.388	535.900	207.98

SOUECE : TABLE (8) central Pollution Control Board Report, Assessment of Vehiclar Pollution in Matropolition Cities Part - II, Delhi CUPS/18/1989-89.

distributional pattern of different types of vehicles for Delhi metropolitan city clearly depicts that two and three wheelers are dominating. Constituting about seventy percent share of the total vehicles whereas share of four wheelers are twenty percent, that of goods vehicles six percent and buses 1.5 percent in 1987 (Table 3.5B) (Fig.3). It is also evident that about one and half lakh more vehicles are being included in Delhi per year. (Table 3.5C).

The total vehicular pollution load (calculated by Central Pollution Control Board) for Delhi metropolitan city clearly shows an increasing trend. There is an increase from 424 tonnes per day to 865 tonnes per day during 1980-81 to 1986-87. Table (3.5c). Table (3.5C) shows that the petrol-driven vehicles contributed about ninety percent carbon monoxide and hydrocarbons while the diesel-driven vehicles emitted about eight four percent of oxide of Nitrogen in 1986-87. Out of total pollution load among the petrol driven vehicles, two and three wheelers contributed about fifty four percent. The corresponding figures for hydrocarbons matter was eightypercent. The four wheelers emitted about forty three percent total carbon monoxide discharged and its share has been thirtythree percent for 1986-87 year.

Fig. 3.D

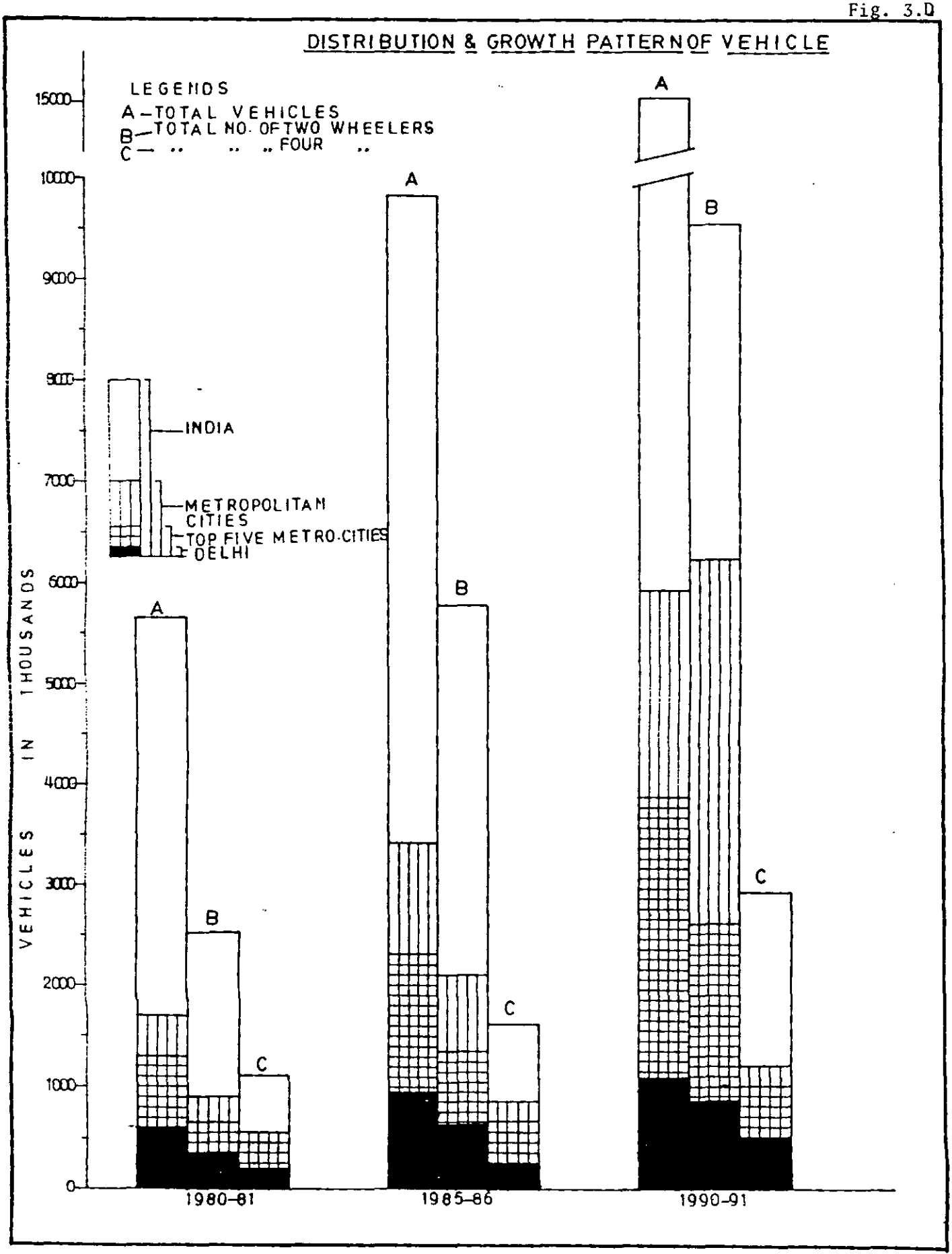
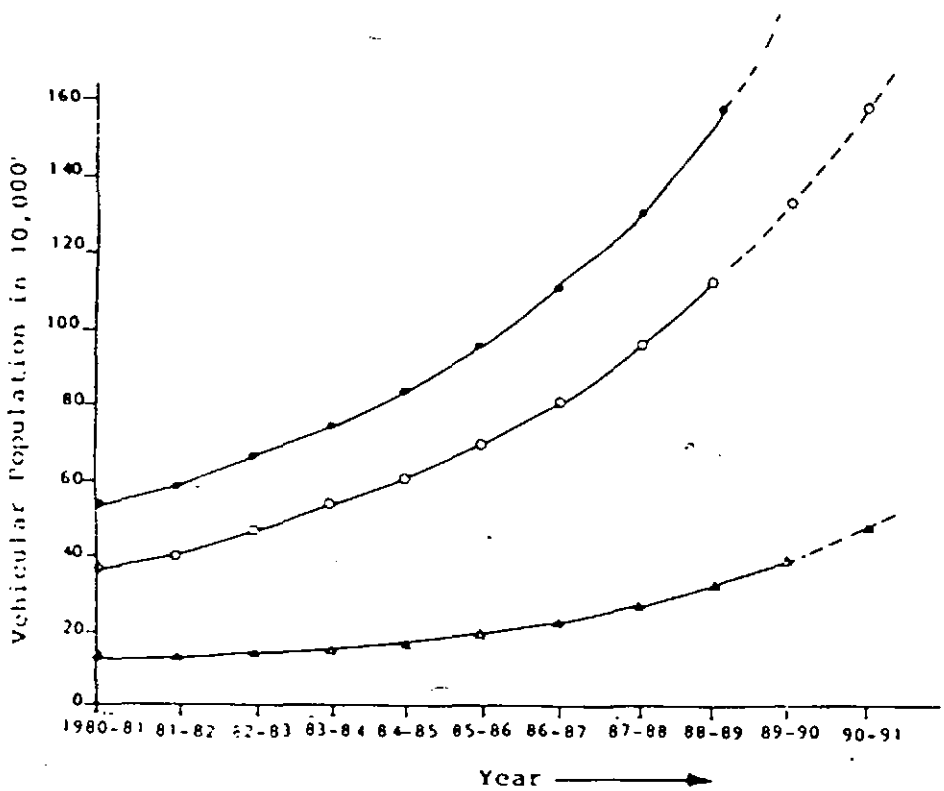

DISTRIBUTION & GROWTH PATTERN OF VEHICLE
LEGENDS
A—TOTAL VEHICLES
B—TOTAL NO. OF TWO WHEELERS
C— .. .. .. FOUR ..
VEHICLES IN THOUSANDS
15000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
INDIA
METROPOLITAN CITIES
TOP FIVE METRO-CITIES
DELHI
A
B
C
1980-81
1985-86
1990-91

Fig. 3.E

GROWTH PATTERN OF DIFFERENT CATEGORIES OF VEHICLES IN DELHI



• Total Registered Vehicles
o 2 and 3 Wheelers
Δ 4 Wheelers and Taxis
·····Projection by Graphic Pattern

Source of Pollutant emission

Recent data i.e. for 1987 by Central Pollution Control Board indicate that the motor vehicles and industries of all classes combined emit 1173 metric tonnes noxious gases into the Delhi city's atmosphere every day. Vehicles emit 671 tonnes of noxious gases into atmosphere every day. This constitutes fifty seven percent of the air pollution in the atmosphere. Central Pollution Control Board has estimated that during the peak traffic hour emmissions from vehicles amounts to 1400 kg. of carbon monoxide, 600 k.g. of hydrocarbons and 100 k.g. of nitrogen oxides.

After vehicles second major source of air pollution in Delhi metropolitan is industrial concentration in the city. According to Central Pollution Control Board Survey conducted in 1987, industries emit forty three percent of noxious gases in the Delhi's atmosphere every day. Power Plant are main contributors to emit the pollutants in the atmosphere. Power Plant emits 24.32 percent out of the total pollutant emission in the atmosphere every day (Appendix table1.). In Delhi, the Indraprastha and Badarpur thermal power stations which supply electricity to the city are estimated to emit 149 metric tonnes of fly ash, ninety metric tonnes sulpher dioxide (SO_2) and forty one metric tonnes oxides of nitrogen

per day. Wind carry these pollutants over a large area of the city. Other industrial areas, i.e. Nazafgarh, Okhla and Zakhira are sources of pollution that spreads over large areas in the Delhi's atmosphere.

In Walled City (Delhi), there are 653 small and heavy industries. Among different types of industries located in and around the city there are 266 sound polluting industrial units which include saw mills, engineering goods stone crusher, wooden-boxes, plastic goods and grinding of earth units.

There are 271 air polluting industrial units which includes Engineering goods, rubber and tyres, reclamation of mobile oil, grease and lead, soap, food products, plaster of paris, pottery, sheep carcassing and ice factory etc. Other 116 water polluting industrial units are polishing and elctro-plating and dyeing chemicals industries. All these industries are annually consuming huge amount of energy coal and gasoline causing environmental pollution in the city. (Table 3.6)

The river Yamuna is the main source of water for the city for high consumption of water for domestic and industrial purposes. This river receives huge amounts of waste water every day, which is toxic in many respects.

TABLE - 3.6

DISTRIBUTION OF INDUSTRIAL UNITS IN WALLED CITY [DELHI] ACCORDING TO TYPES OF INDUSTRIES (1979)

Zones	Sound Polluting Units	Pollution (Smoke)	Pollution (Water)	Bad and abnoxious smell producing units	Grand Total
Shahdara	54	49	37	-	160
Karol Bagh	19	80	16	-	115
New Delhi	54	39	10	-	103
Sadar Bazar	44	08	25	16	096
Paharganj	39	19	08	02	068
West Cities	47	16	11	-	074
Civil Lines	09	42	60	-	057
Total	266	253	116	18	653

In addition to this, huge amount of garbage is disposed off every day in the streets of the city which not only create nuisance but also causes severe health problems. In the following paragraphs an attempt has been made to evaluate some of the issues related to environmental degradation in detail.

Status of Air Pollution

It is true that meterological factors play an important role in pollution transport irrespective of its entry into the environment. Generally, most of the pollutants find their way,directly or indirectly, into the atmosphere. Wind is the first and most obvious meteorological factor responsible for the dispersion of pollutants. The plume of effluent from the chimney is carried down-wind. The wind flow is never smooth or laminar. The stronger the wind the greater will be the turfulance and therefore the mixing and dillution. Following table (3.7) traces the rend in pollution for 1978-85.

Fig. 3.F

DELHI

ANNUAL GROWTH RATE OF POLLUTION

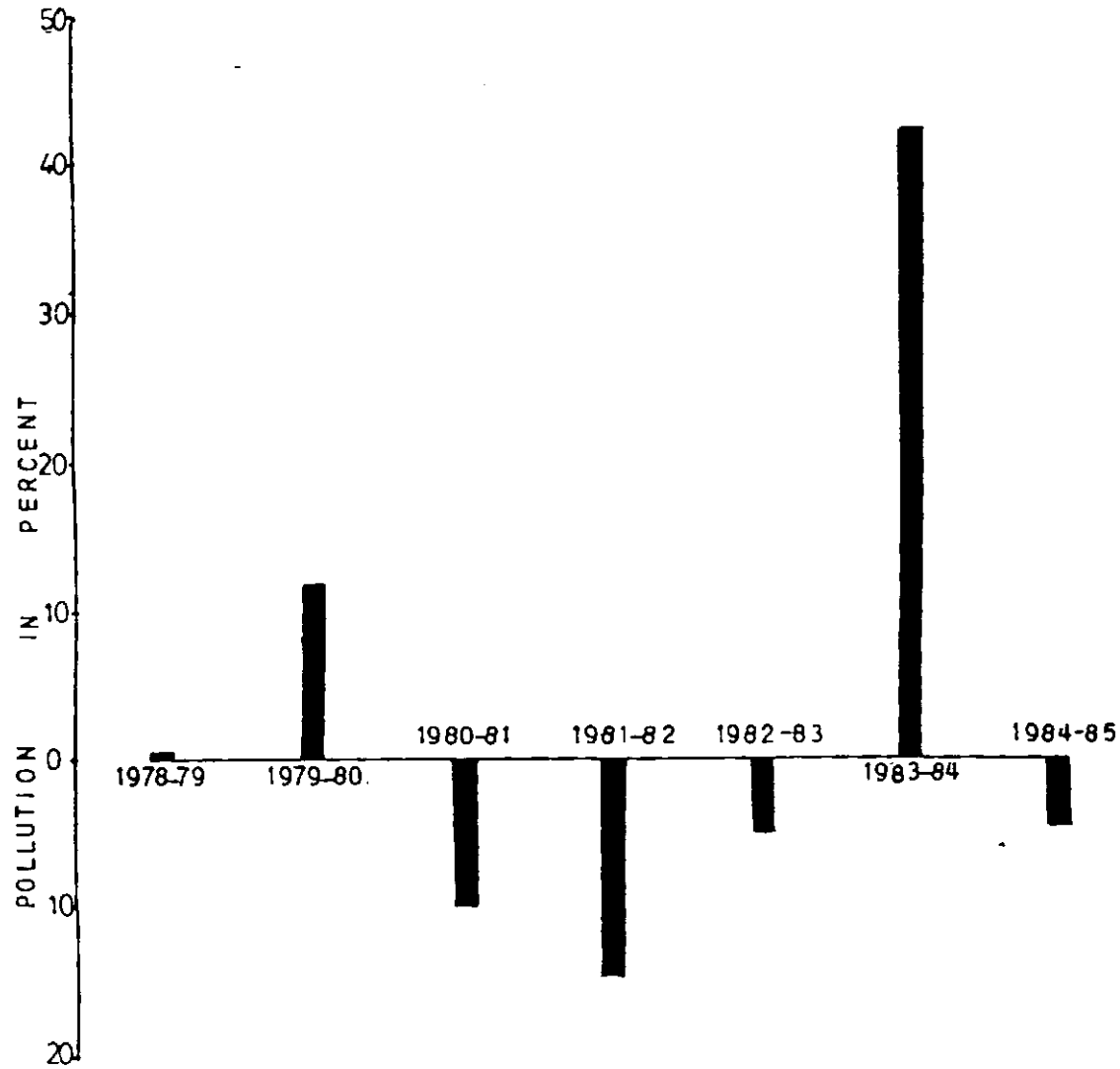


Table 3.7

Annual Growth rate of total pollution in Delhi from 1978 - 1985.

Annual Year	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85
Growth rate (percent)	+0.44	+10.76	-9.98	-14.13	-5.06	+42.40	-4.12

Total pollutants constitute suspended particles matter, sulpher dioxide (SO_2) and oxide of nitrogen (NO_x). This table (3.8) and line graph (Fig.3) based on the table indicate an interesting feature and that is a great fluctuation over year from 1978 to 1985. (Fig.3) It may perhaps be conjectured that wind speed has a bearing upon this variation.

Spatial and Temporal analysis

In Delhi metropolitan city dust strom is a common. They are pre monsoon westerly winds from the desert resulting in high air-borne dust suspension. As dust remains visibility goes down and dirty stain is very high. Except in rainly season (due to wash-out), through-out the year suspended

particle matter pollutant levels are considerably high. Table (3.8) the data is based on report by the National Environment Engineering Research Institute. In the report there is a survey regarding the air quality of Delhi on the basis of sampling method. They have selected three sampling station. These sampling sites are located at the following places : Netaje Nagar, (Residential area) Town Hall, (Commercial area) and Najafgarh (Industrial area). Table 3.8 shows Netaji Nagar to be more polluted than other two places, i.e. Town hall and Najafgarh. Annual average SPM levels are found to fluctuate at slow rate. In 1985 annual average SPM level was 407 ug/m^3 while Netaji Nagar, Town Hall and Najafgarh had 488 - 439 and 294 ug/m^3 respectively.

The level of suplher dioxide (SO_2) varies from residential to commercial to industrial areas. In general, Najafgarh industrial areas have high values as compared to other places. The annual average sulpher dioxide in Delhi metropolitan city works out to be 34 ug/m^3 in 1978; 26 ug/m^3, 30,28,34,39 ug/m^3 in 1979, 1980, 1981, 1982 and 1983 respectively. In 1984 and 1985 the sulpher dioxide content has increased to a strikingly high level, i.e. 62 ug/m^3, 61 ug/m^3 respectively. Of all the three stations, Najafgarh industrial area had the highest level of sulpher dioxide followed by

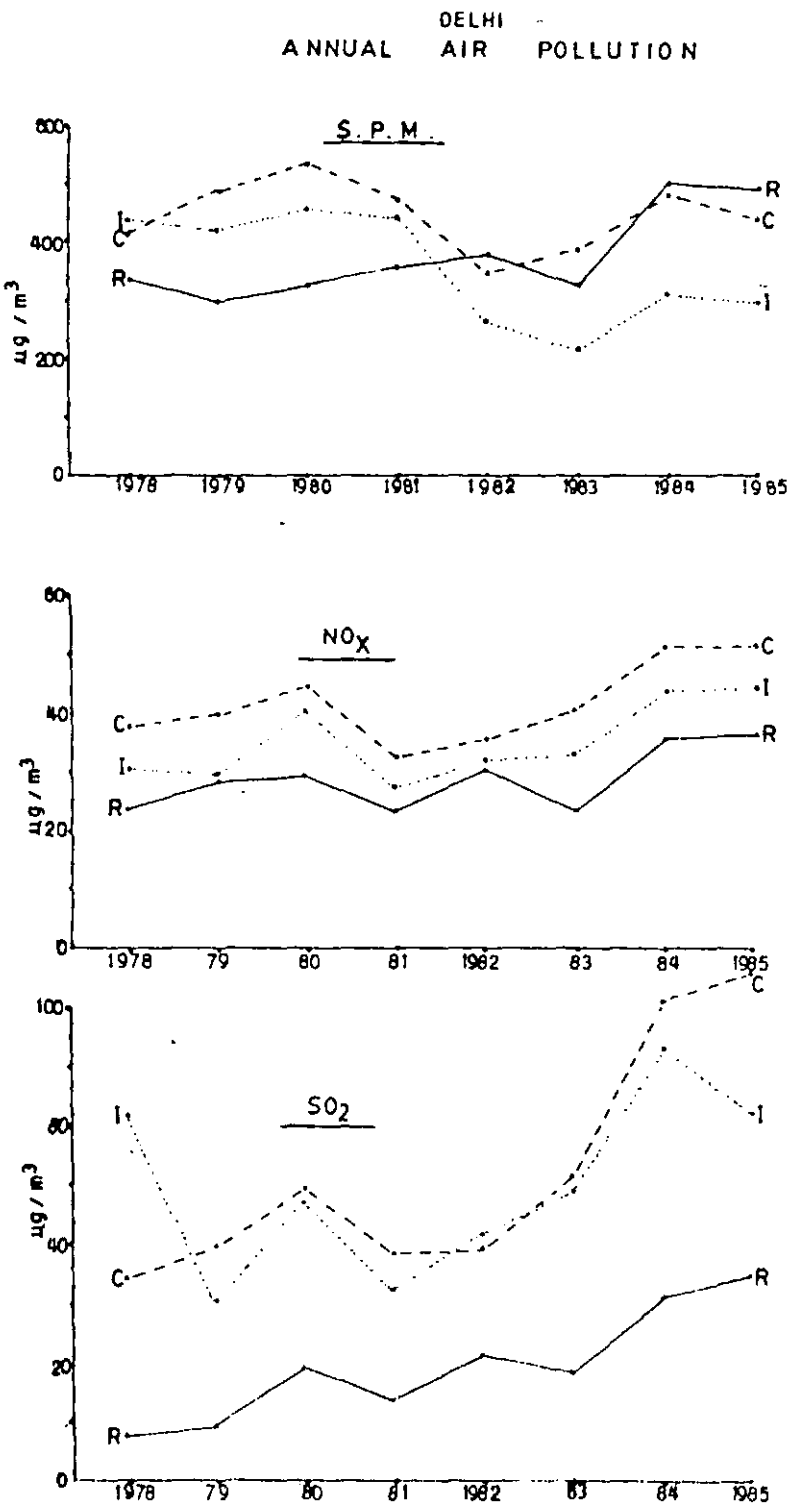
TABLE - 3.8

AIR POLLUTION (DELHI)

YEARS	Netaji Nagar	Town Hall	Najafgarh	Average Annual
	S.P.M. IN ug/m^3 ANNUAL			
1978	331	404	431	390
1979	296	481	417	398
1980	320	535	451	435
1981	354	419	441	405
1982	376	344	266	329
1983	322	374	215	304
1984	498	482	308	429
1985	488	439	294	407
	SO_2 IN ug/m^3 ANNUAL			
1978	7	34	61	34
1979	9	39	30	26
1980	19	49	47	38
1981	13	38	32	28
1982	21	39	41	34
1983	18	51	49	39
1984	31	81	73	62
1985	34	86	62	61
	NO_x IN ug/m^3 ANNUAL			
1978	23	37	30	30
1979	28	39	29	32
1980	29	44	40	38
1981	23	32	27	27
1982	30	35	31	32
1983	23	40	33	32
1984	35	51	43	43
1985	36	51	44	44

SPM - Suspended Particles Mater
SO_2 - Sulpher Dioxide
NO_x - Oxide of Nitrogen
ug/m^3 - Microgram per Cubic Meters

Fig. 3.G


DELHI
ANNUAL AIR POLLUTION
S.P.M.
μg / m³
800
400
200
0
C
I
R
1978
1979
1980
1981
1982
1983
1984
1985
NOx
60
40
20
SO2
100
80
60

Town Hall (Residential area). Sulpher dioxide level was lowest among all the three stations at Netaji Nagar throughout the year.

The Nitrogen dioxide (NO_2) level shows highest value in Town hall followed by Najafgarh and Netaji Nagar. These pollutant gas generally emit from motor vehicles. (Fig.4.A).

Water Pollution

The water is affected by sewage and industrial effluents and by unplanned urbanisation. There pollutants are in the form of suspended solid (S.S.), Cromium (Cr), Nikel (Ni), Copper (Cu), Zinc (Zn), Lead (Pb), Cadmium (Cd) total dissolved solids (TDS) and oxygen demands etc.

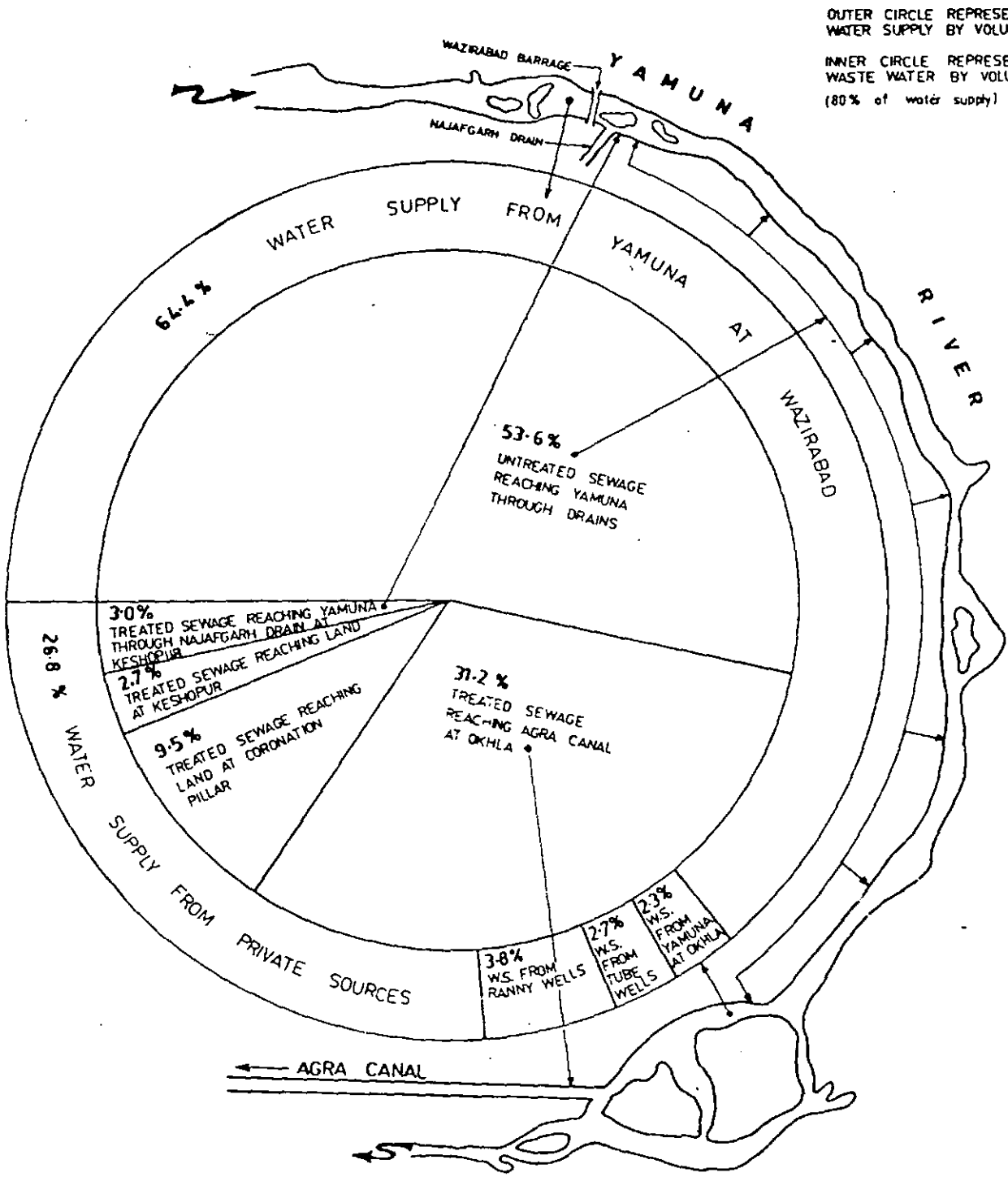
Water is a prime requirement for every living organism. With the rapid increase in population and of industries, the water requirement is increasing on one hand, it is being increasingly polluted on the other hand. In Delhi metropolitan city alone the per capita per day consumption of water is 157 liters. This huge quantity of water is consumed by the city's population and by the industries. The contaminated water from sewers along with

various amount of toxic substances create pollution in river water.

River Yamuna has an extents of 48 kms. from Wazirabad to Okhla. When the river enters the Delhi city at Wazirabad, the water is much cleaner. When it leaves the city at Okhla, after the 48 kms. stretch it is most polluted segment of the river. These days the Yamuna water near the city is not useful for irrigation. This is because at the entry point Wazirabad - Colifarm count (an effective measure of bacterial contamination) in 75 MPN/100 ml. (MPN/100 ml - Most probable Number near hundred mili litres). When it leaves the city at Okhla this value becomes 240,000 MPN/100 ml. (control Pollution Control Board year) in 1987-88. This figure suggests that at the exit point Yamuna converts into an almost open sewer.

According to Central Pollution Control Board, the daily flow of untreated toxic waste water into Yamuna the rough the Seventeen drains of Delhi metropolis area is 515000 kilo litres per day carrying about 150 tons organic matter, 300 tonnes of disolved solids and 150 tonnes of suspended solids. Najafgarh being the city's largest contributor. It is dumping more than fifty four percent of the untreated waste water.

Fig. 3.H



WATER SUPPLY AND WASTE DISPOSAL AT DELHI

TABLE - 3.9

SOURCE OF WATER SUPPLY IN DELHI CITY

Name of Water-Supply Source	*Quantity in Percent*
R. Yamuna at Wazirabad	*64.4*
Private Sources	*26.8*
Ranny Wells	*3.8*
Tube Wells	*2.7*
R Yamuna at Okhla	*2.3*
Delhi	*100.00*

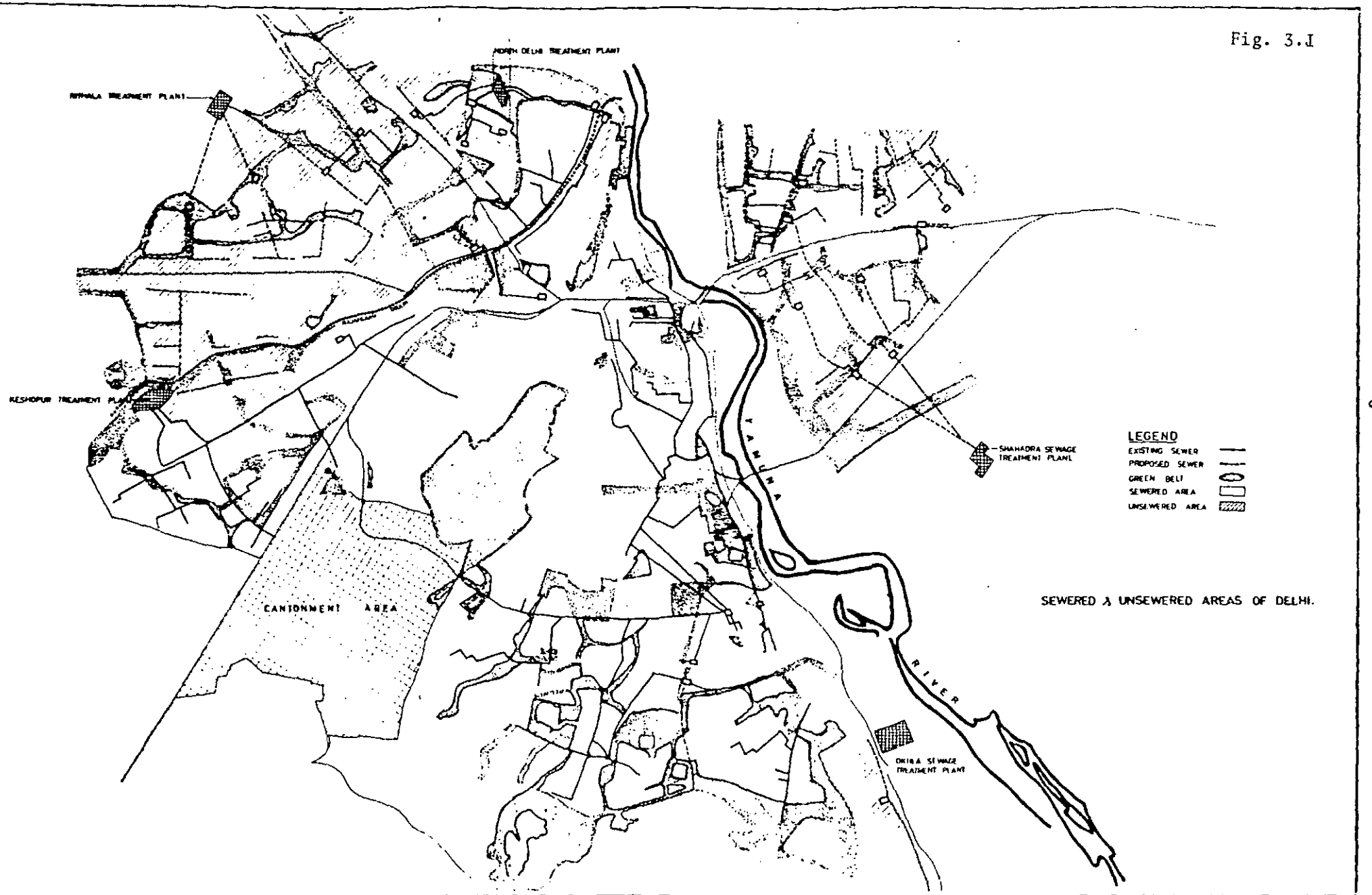
SOURCE : *Central Pollution Control Board (1978-79)*

Spatial Analysis

The Table 3.9 shows that the main source of water-supply Delhi in drawn from river Yamuna at Wazirabad and Okhla. A small fraction of the water for supply in Delhi is also obtained from tubewell and ranney wells. (Fig. 3.H).

It is clear from the table that 46.4 per cent of the total waste water is treated at the three sewage treatment plants at okhla, Coronation Pillar and Keshopur. The rest of the waste water find their way into the open drains

Fig. 3.I



SEWERED & UNSEWERED AREAS OF DELHI.

of the city due to inadequacies in Sewage treatment facilities in Delhi City (Fig. 3 . I).

TABLE - 3.10

WASTE WATER DISPOSAL AT DELHI

Types of Disposal Treated/Untreated	*Place of Disposal*	*Quantity of Disposal in per cent*
Untreated Sewage	*R. Yamuna*	*53.6*
Treated Sewage	*Agra Canal at Okhla*	*31.2*
Treated Sewage	*Coronation Pillar*	*9.5*
Treated Sewage	*Keshopur*	*2.7*
Treated Sewage	*R. Yamuna at Keshopur*	*3.0*

SOURCE: Central Pollution Control Board, 1978-79.

Table 3.11 represents waste water flow and pollutant loads in Drain in years 1982-83. Here, it is observed that the daily flow of untreated waste water measuring about fifty four per cent of the total share of waste water generated. It is pouring 190 tonnes Biological oxygen demand, 300 tonnes of dissolved solids, and another 150 tonnes of suspended solids in Yamuna every day. Out of the seventeen drain draining the Delhi metropolis area, seven contribute in terms of volume as also in quantities of pollutants which are significantly high. These seven drains

TABLE - 3.11

WASTE WATER FLOW & POLLUTANT LOADS IN DRAINS (1982-83)

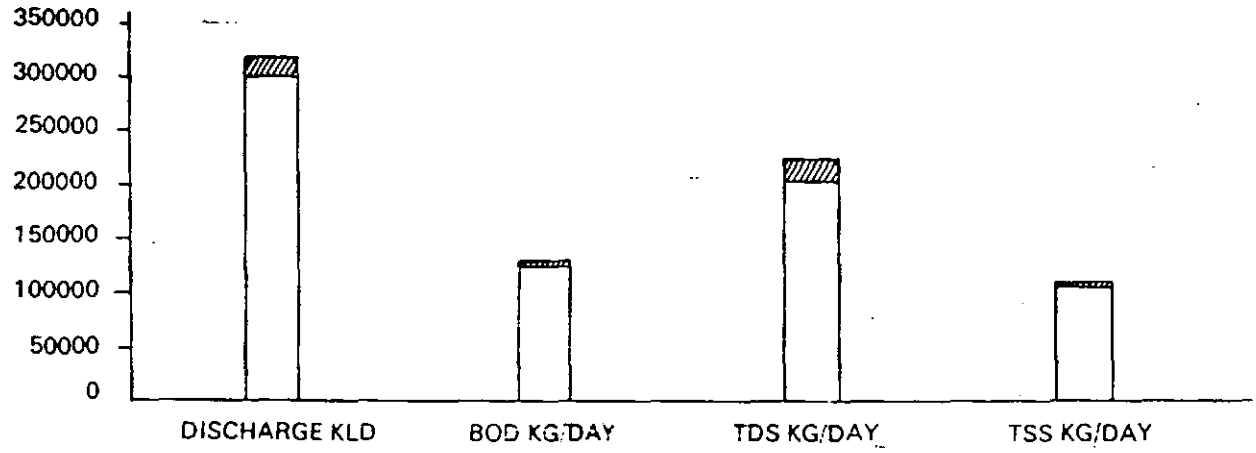
	Average flow (KLD)	SS mg/l	BOD mg/l	COD mg/l	Cr mg/l	Ni mg/l	Cu mg/l	Zu mg/l	Pb mg/l	Cd mg/l	TDS mg/l
Najafgarh	1254690	523	79	244	0.14	0.15	0.12	0.59	0.12	0.008	1127
Magazine Road	2946	361	259	555	0.02	0.03	0.16	0.36	0.09	0.002	1096
Sweeper Colony	858	77	46	119	0.01	0.01	0.05	0.24	0.04	0.001	390
Khyber Pass	4358	167	16	93	0.04	0.03	0.03	0.12	0.07	0.010	803
Metcalf House	8067	272	83	272	0.02	0.02	0.06	0.31	0.07	0.002	1214
Kudsia Bagh	10201	178	74	243	0.03	0.02	0.07	0.30	0.15	0.002	826
Trans-Yamuna MCD	7775	623	78	415	0.09	0.12	0.20	0.73	0.09	0.004	2364
Mori Gate	773	210	42	154	0.02	0.03	0.06	0.30	0.07	0.001	775
Civil Mil	76972	297	135	316	0.05	0.06	0.19	0.65	0.09	0.002	748
Power Home	76521	792	116	351	0.05	0.15	0.23	0.75	0.06	0.001	1846
Sen Nursing Home	61483	323	94	252	0.10	0.05	0.12	0.42	0.09	0.003	879
Drain No.14	12817	105	4	23	0.01	0.02	0.01	0.15	0.08	0.005	547
Maharani Bagh	9664	442	118	292	0.01	0.02	0.03	0.15	0.03	0.001	816
Kalkaji	2029	113	17	88	0.01	0.02	0.01	0.19	0.05	0.002	1257
Tughlakabad	2706	1126	66	170	0.49	0.21	0.51	0.32	0.23	0.007	3831
Okhla Primary	237177	334	124	314	0.04	0.04	-.10	0.35	0.07	0.001	880
Okhla Secondary	33289	113	66	182	0.01	0.03	0.04	0.30	0.04	0.002	612

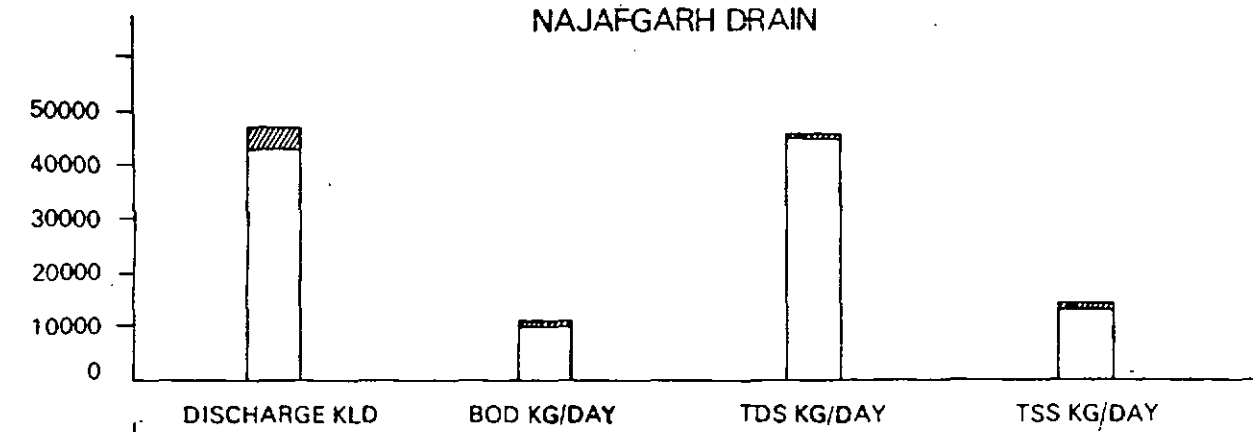
SOURCE: CPCB,

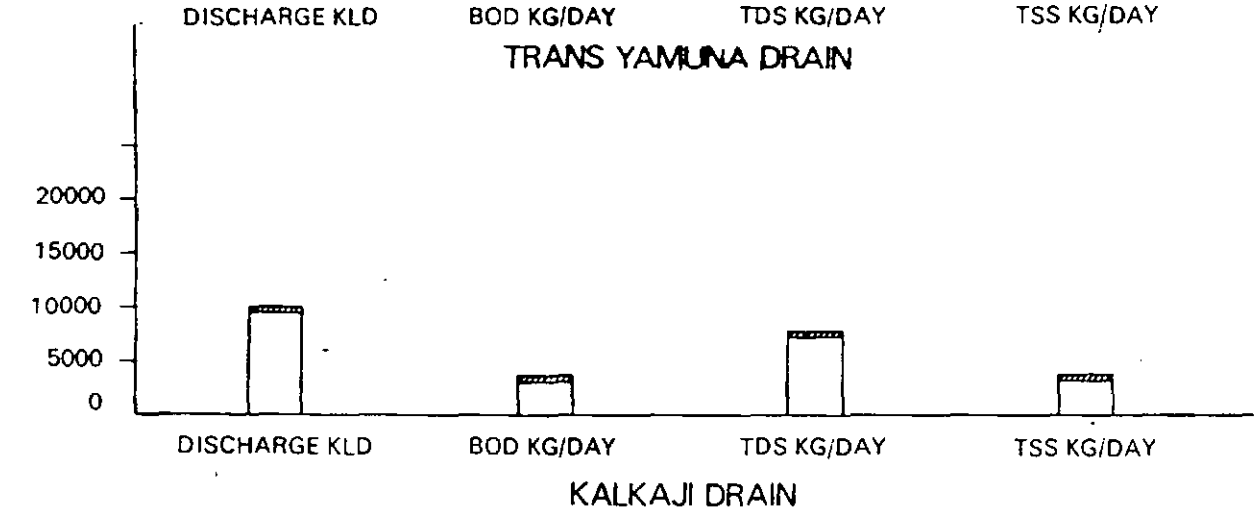
TABLE : 3.12

Drain	Item	Discharge KLD	Parameters Of Pollution		
			BOD Kg/day	TDS Kg/day	TSSKg/day
NAJAFGARH	Domestic Wastewater	2,70,000	72,500	1,45,000	72,500
	Industrial Wastewater	18,100	5,500	19,800	6,800
	Total	2,88,100	78,000	1,64,800	79,300
	Industry : % Total	6.3	7.1	12.0	8.6
TRANS-YAMUNA MCD	Domestic Wastewater	32,000	5,225	10,450	5,225
	Industrial wastewater	4,300	1,500	1,000	1,500
	Total	36,300	6,725	11,450	6,725
	Industry : % total	11.8	22.3	8.7	22.3
KALKAJI	Domestic Wastewater	9,000	2,800	5,600	2,800
	Industrial Wastewater	400	400	300	400
	TOTAL	9,400	3,200	5,900	3,200
	Industry : % total	4.2	4.8	6.7	5.6
ALL DRAINS COMBINED	Domestic Wastewater	5,14,560	1,47,300	2,94,600	1,47,300
	Industrial Wastewater	22,800	7,400	21,100	8,700
	Total	5,37,360	1,54,700	3,15,700	1,56,000
	Industry : % total	4.2	4.8	6.7	5.6

Fig. 3.I







INDUSTRIAL V/s DOMESTIC WASTE WATER GENERATED IN THE UNION TERRITORY OF DELHI.

are : Najafgarh,Tughlakabad, Trans-Yamuna Municipal Corporation of Delhi, Sen Nursing Home, Maharani Bagh, Kalkaji and Okhla drains. All these discharge directly into Yamuna, except Kalkaji, Tughlakabad and Okhla which discharge into the Agra canal (Fig. 3.J).

These seven drains together discharge some 1802326 kilo literes day of waste water and thereby contribute ninety five per cent of the total untreated water reaching Yamuna. Along with waste water flows through these seven drains 147 tonnes of Biological oxygen Demand which is agin ninetyfive per cent of the total untreated Biological oxygen Demand reaching the river every day. The Najafgarh drain along contributes 53.6 per cent of the total share of drain flow and 50.4 per cent of the total untreated Biological oxygen Demand Load.

Next table 3.13 indicates that three drains i.e. Najafgarh, Trans-Yamuna municipal corporation of Delhi and Kalkaji drains are located at industrial sites. These drains discharge 23,000 kilo liters day; it is carrying a total Biological oxygen demand load of 7.4 tonnes a day. These drains are carring 4.2 per cent industrial waste water and 4.8 per cent of Biological oxygen demand load to the total share of the all seventeens drains.

These three drainages have significant number of industries situated along their courses. Their percentage contribution to industrial waste waters as compared to the total waste water is 6.3 per cent, 11.8 per cent and 4.3 per cent every day respectively for Najafgarh, Trans-Yamuna municipal corporation of Delhi and Kalkajee drains flows. The corresponding Biological oxygen demand percentage are 7.1, 22.3 and 12.5 respectively for Najafgarh, Trans-Yamuna Municipal Corporation of Delhi and Kalkajee drains.

Noise Pollution

Road traffic is one of the major causes of noise in a city. The roar of Jet planes honking of buses, taxis and cars, the screeching of rushing vehicles wailing of emergency vehicles sirens, whistlish of railways engines, back fire from motor vehicles, the din of factories, the thunder of construction machinery all are symbols of modern civilization contributing to the high level of noise.

An idea of noise pollution can be had by any one passing through any of the radial roads leading to connaught place during the long peak flows of morning and evening or walking along any one route. On Sansad Marg, Barakhamba Road, Baba Kharak Singh Marg a constant cacophony assails (unpleasent

discordant sound attack violently) human ears.

The situation is worse in areas in old Delhi i.e., in Chandani-Chowk, Sadar Bazar where peak or off-peak hours make no difference. Kashmere Gate, Pusa Road, Patel Road and Mo-lchand Chowk in South Delhi are among other areas where noise prevails for most part of the day (National) Physical Laboratory Year.

Road traffic is one of the major causes of noise in a city. Therefore, some idea of the degree of noise pollution can be had from the manner, the traffic has grown over the year (Table 3.5).

Another important cause of noise in the city is high-rise building which contribute to a lot of noise pollution. In 1951 the NPL's (National Physical Laboratory) conducted a a survey in Delhi metropolis areas which coincided with another survey in Bombay. It was found that Bombay was much noiser because of its high-rise buildings. In areas of high-rise buildings sound cannot travel freely and get reflect from one building to another. Consequently, these reflections create more sound.

Even today Delhi's noise level is not as high as Bombay. This is because Delhi continues to have vast open

spaces and plenty of trees and shurbs. The situation will change when high structures multiply all over the city.

TABLE - 3.13

NOISE POLLUTION DATA 1983

LOCALITY	*AVERAGE NOISE (1959) (in Decibel)*	*AVERAGE NOISE (1983) (in Decibel)*
1. Arya Samaj Road (in front of Mandir)	*82*	*76*
2. Connaught Circus (Near Scindia House)	*81*	*87*
3. Darya Ganj (Golcha Cinema)	*89*	*88*
4. Jama Masjid	*80*	*74*
5. Subji Mandi (Opp. Ice factory)	*87*	*89*
6. Chandani Chowk (Opp. Red Fort)	*88*	*82*
7. Sarojini Nagar (Main Market)	*76*	*74*
8. Patel Nagar	*79*	*79*
9. Shahadara	*83*	*83*

SOURCE: National Physical Laboratory (Piolot Noise Survey, Delhi - 1983).

National Physical Laboratory conducted survey in 1983 twenty five selected points which include residential, commercial industrial and semi-rural areas as well as heavy, medium, and light vehicular traffic, padestrain traffic, areas near railway lines and under oil flight paths, etc. (Appendix-II).

From table 3.14 it can be s-en that noise level varieş from sixty decibel to ninety decibels. These noise levels are directly corelated with the density of vehicles which contribute a major portion to the prevailing noise. Connaught circus has on an average noise of eighty seven decibels, DAryaganj has eighty-eight decibel and subji Mandi has eighty nine decibel. Chandani Chowk Registers eighty two decibels whereas Shahadara has eighty five decibels respectively. These areas have more traffic congestion from morning peak hour to night peak. Thus, there exists possibility of adverse effect on hearing in these areas of city over a preolonged period of noise exposure.

Another very interesting feature is that over a period of 25 years starting 1959 the range of noise levels due to traffic remains approximately the same in Delhi.

Distruction of Green Environs

In Delhi Migrant workers, urban slum and unauthorized colonies have multiplied over time. Thereby increasing the chaos Table - 3.[illegible] and 2.2 . According to this table Delhi city has some 30.19 per cent slum population.

In Delhi congestion in housing has increased. Households per house shows an increasing trend, figure being 0.20, 0.85 and 1.11 in 1961, 1971 and 1981 respectively.

Such congestion indirectly reflects the growing population pressure on land which is limited inevitably, the green areas get encroached upon and show a declining trend over a period of time.

Table - 3.15

GROWTH OF DELHI CITY'S AREA SINCE 1951

Year	*1951*	*1961*	*1971*	*1981*
Growth rate in Per cent	*100*	*162.85*	*222.55*	*269.69*

From the table (3.15), it may be intended that the increase in city's area is at the expense of agricultural areas and green belt that sourround the city.

According to a report by the Institute of Medical Sciences, sixty-eight per cent of the worksites in the capital had noise level of ninety to hundred decibele which is twice the internationally permissiable limit.

To Sum up :

1] Delhi Metropoliten city occupies the apex position in terms of growth of vehicle. Consequently, Delhi records the highest pollution load created by traffic among those metropoliten cities of India which are analysed.

2] Pollution Loads created by vehicular traffic are very high as compared to pollution loads resulting from industrial pollution.

3] As far as water pollution is concerned, the major source of contamination appear to be various industries which are located along main drains. These industries dump their industrial waste including numerous toxic elements into water without treating them for polluting agents.

4] The congestion in Delhi has an impact on the

the agricultural land around Delhi consequently, the green environs show depletion.

CHAPTER - IV

LIVABILITY IN DELHI

Creation of livable environment is the utmost responsibility of human beings in their own interest.[1] Yet, the quality of physical environment consisting of air, water and land is becoming severe day by day. While it appears hat these basic amenities are in abundance, the amount available in a usable form to mankind is becoming lesser. This certainly is not desirable. It is therefore, important to know the cause and effect of the environment on human being and vice-versa. This will help in promoting ways and means of favourable interaction between human beings and their environment.

Livable environment refers to the whole gamut of influences which impringe on human beings and affect their well being. It includes physical surroundings of law, sea and air, the viruses, bacteria and other organisams of the biological environment together with the socio-economic complexities of the human environment. Disease or ailment is a sign or maladjustment between individual human being and the stresses, stains, and other adverse factors of

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1.The concise Oxford Dictionary of Current English-explains livability as climate fit to live in. Livability is variously explained as house, room, environment fit or pleasant to live in, endurable or habitable. It may be admitted, however, that the concept has an element of subjectivity. In the present analysis, the concept is quite loosely applied to mean the physical quality of atmosphere in Delhi. The broad generalisations are contingent upon the availability of relevant data in published form which does not allow in-depth analysis however desirable it may be.

his/her surroundings, the response being conditioned by the genetic make-up (i.e. internal environment or inborn constituion) of the individual (Howe, 1976).

Human beings the dominent specicies in the ecosystem, with highly developed brain have evolved languages for communication. They can think, plan and make use of toolsto create new environmental situation. In this process, they modify natural eco-systems considerable depending on their own social and economic needs. Agriculture, Industrialisation and urbanisation are three of the obvious examples of their ability to create new ecosystems and environments.

Human beings are also responsible for a wide range of changes which occur in the ecosystem. Some of these changes are more or less stable, while other are transient in nature. Human beings have more recently brought about changes in the chemical composition of soil, of the water of the streams lakes and even of the sea. Changes have been brought-in the air that collectively contribute to a massive modification of the natural environment for living organism of all kinds.

Human beings livable environment is the combination of those physical circumstances in which they lives. Which are

essential for their health, enjoyment of life and the opportunity to develop their individuality and purpose of life. The air which they breathe about 25 times per minute is essential for existence. The freedom from toxic or noxious materials will help to avoid respiratory and other illness which shorten their lives. Freedom from offensive odours will allow them to enjoy the air rather than create apprehension about polluted air. On the other hand water is not required every few seconds to sustain life. But about half a gallon of water in consumed every day in our life.

The average human being moves approximately 8000 liters fo air in order to provide for the exchange of gases like oxygen and carbon dioxide necessary to sustain life. Much of the particulate and droplet material, together with minute quantities of gases absorbed on to it or dissolved in. It may be deposited in the respiratory tract. The amount so deposited will depend upon the particle size of the aerosols. Particles below one micron usually penetrate the deep lung regions. In this way toxic materials dissolved in or absorbed by the arerosols may reach the deep portion of the lung where they may exert deleterious affecting over a protentially vast lung surface area. (devilliers 1970)

The close relationship between environment and health has been increasingly stressed in recent years, especially in economically developed countries, where the environmental pollution mainly caused by chemical and physical contamination water, air and soil presents acute problems. In most of the developing countries biological contamination have remained the problem of environmental pollution. However, other types of pollution are rapidly increasing and there is a need to control them before they get out of hand.

'Livability' - The comfortable and peaceful life of human beings is conditioned by many natural and man-made factors. The resistance and immunity of human body is limited and also varies over space in terms of existing global climatic pattern. These are certain permissible limits within which human beings can cope with both physical and cultural environment. Physical environment is the most important one for the survival of human being because it has direct pathological consequences. Air, water, noise, food, shelter etc. are the chief components of physical environment. On the other hand problems related to human relationship comprises cultural environment. Lack of needed quantity and quality of the

components of both physical and cultural environments affect health and minds of the human beings.

Rapid rate of industrialisation and urbanisation have caused disturbances in the ideal permissible requirement of better physical environment all over the world. Urban areas in particular face the severe crisis in attaining the livable conditions of life. The 'greed' and 'need' of the people, in the matropolitan cities do not match with the supply of the needed goods and civic amenities which in turn has created the problems of physical and cultural environment.

In this chapter, the livability for human beings in Delhi metropolitan city has been explained in relation to environmental pollution in the form of air and noise pollution only. Both air and noise pollution are the result of unplanned and unchecked industrialisation and urbanisation process.

Air Pollution and Liability

Table 4.1 and 4.2 show spatial and temporal scenario of different pollutants which are existing in the Delhi city's atmosphere. Temporal analysis deals with year-wise data from 1982 to 1985. Spatially consisting of three different zones, Najafgarh industrial area, Town hall Commercial area and Netaji

TABLE - 4.1.

"Percentage of Pollutant beyond the Air Quality Standard in Delhi City's atmosphere"(SPM)*

Year	Categories	Present value	ug/m^3 (24 hours Mean) AQS CPCB	AQS WHO	Percent beyond the AQS CPCB	WHO
1982	Industrial area	376	360	190	4.45	97.89
	Commercial area	344	70	190	391.43	81.05
	Residential area	266	140	190	90.00	40.00
1983	I.A.	322	360	190	(-)10.56	69.47
	C.A.	374	70	190	434.29	96.84
	R.A.	215	140	190	53.57	13.16
1984	I.A.	498	360	190	38.34	62.11
	C.A.	482	70	190	588.57	153.68
	R.A.	308	140	190	120.00	62.11
1985	I.A.	488	360	190	35.56	156.84
	C.A.	439	70	190	527.14	131.05
	R.A.	294	140	190	110.00	54.74

Source: NEERI, 1985, Nagpur.

SPM - Suspended particle matter.
ug/m^3 - Micro gram per cubic metre.
CPCM - Central Pollution Control Board.
AQS - Air Quality Standard.

TABLE - 4.2

PERCENTAGE OF POLLUTANT BEYOND THE AIR QUALITY STANDARD IN DELHI CITY"S ATMOSPHERE" (SULPHER DIOXIDE AND NITROGEN OXIDE)

Year	Category	ug/m³ (24 hours means) Present Value		AQS CPCB		AQS WHO	Percent Beyond the AQS CPCB		WHO
		SO_2	NO_2	SO_2	NO_2	SO_2	SO_2	NO_2	
1982	IA	41	31	80	90	50	-	-	-
	CA	39	35	20	20	50	95	75	-
	RA	21	30	60	60	50	-	-	-
1983	IA	49	33	80	90	50	-	-	-
	CA	51	40	20	20	50	155	100	2
	RA	18	23	60	60	50	-	-	-
1984	IA	73	43	80	90	50	-	-	-
	CA	81	51	20	20	50	305	155	-
	RA	31	35	60	60	40	-	-	-
1985	IA	62	44	80	90	50	-	-	-
	CA	86	51	20	20	50	330	155	-
	RA	34	36	60	60	50	-	-	-

SOURCE : NEERI, 1985, Nagpur.

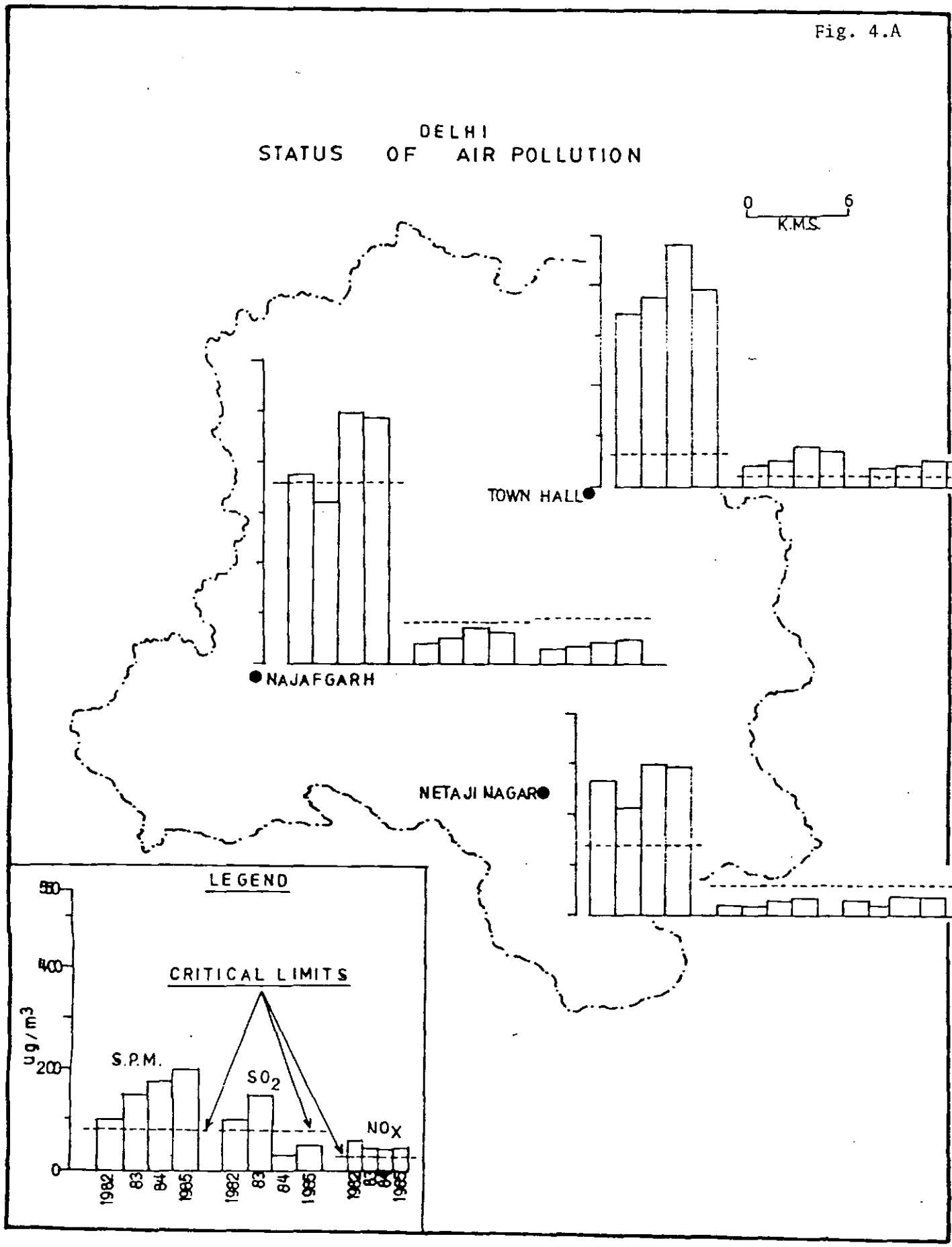
- Indicates Pollutants has below AQS

AQS, WHO Values indicate mid value between from upper limit to lower limits.

SO_2 - Sulpher dioxide

NO_2 - Nitrogen diozide

Fig. 4.A


DELHI
STATUS OF AIR POLLUTION
0
6
K.M.S.
TOWN HALL
NAJAFGARH
NETAJI NAGAR
LEGEND
CRITICAL LIMITS
S.P.M.
SO2
NOX
ug/m3
400
200
0
1982
83
84
1985

Nagar residential area. Here pollutants are consist of three main pollutants such as SPM; sulpher dioxide (SO_2) and Nitro gen-dioxide (NO_2).

The Geographical analysis of air pollution becomes enential to know the spatial distribution of various pollutants in the city. Table 4.1 and 4.2 show the average annual 24 hours mean. Concentration of atmospheric pollutant in certain parts of the city. It has been observed that in Najafgarh industrial area, the SPM concentration is relatively higher than the other commecial and residential areas. And the concentration of SO_2 and NO_x are relatively higher in commercial area rather than industrial and residential areas. (Fig.4.A).

Percentage Share of excess air pollutant in Delhi City's atmosphere.

Town hall commercial area has accounted for very high percent of excess pollutant in all the years. This area is followed by Najafgarh industrial area and Netaji Nagar residential area respectively. (Fig. 4.A).

Environmental pollution is not confined to any particular part of our earth. It is a global phenomenon. The recent U.N. Conference held in June 1972 at Stockholm,

on Human environment has focussed the attention of all nations on the growing world-wide menace of environmental contamination arising out of air, water, land and noise pollution.

Attention of the world today is focussed on environmental pollution and its deleterious effects on all living things. Countries like USA, U.K., Japan and other developed European countries are already taking precaution to prevent or lessen the pollution. With urbanisation and industrialisation, with increasing mechanical means of transport, with the craze for speed, with mechines moving faster than the speed of sound creating noise nuisance, with the use of atoms for war or peace,air, water and food are all getting polluted. Developing and progressive countries like India should be more concerned with this and should take steps in time so that they may not suffer from what other developed countries have suffered from.

In the light of foregoing discussion, India has selected apart from criteria adopted by Central Pollution Control Board (CPCB), Standards followed by World Health Organisation (WHO). CPCB standards are for India whereas WHO has well known universal standards applicable all over the globe.

TABLE - 4.3

CPCB's Air Quality Standards (24 hours mean), New Delhi.

Area	Category	Concentration (ug/m^3) SPM	SO_2	NO_2
A	Industrial Mixed use	360	80	90
B	Residential Rural	140	60	60
C	Sensitive area	70	20	20

TABLE - 4.4

WHO's Air Quality Standards (24 hour mean)

SPM	-	100 - 150 ug/m^3
SO_2	-	150 - 230 ug/m^3.

ug/m^3 - Microgram per cubic metres.

WHO Air Quality Standard provides a range (Table 4.4) we have taken mid value between the lower value and the upper value. This mid value is considered as a reference point. With this reference point as air quality the standard value the existing pollutant values are converted into percentages to access excess pollutants which are there in the atmosphere.

Table 4.1 and 4.2.show nature of excess pollutants. Table 4.1 represents SPM pollutants and Table 4.2 shows SO_2 and NO_2 pollutants. Table 4.1 indicates a very interesting point. SPM values are very high in Najafgarh industrial area in all years with the exception of 1983. But percentage share of excess foreign pollutants is very low.

The concentration of excess SPM pollutant is very high in Town area in all years i.e. 391 percent in 1982; 434 percent in 1983, 589 percent in 1984 and 527 percent in 1985 respectively. These percentage are in reference with the standard set by CPCB. However, W.H.O. gives a range and the mid point taken as a standard in the present analysis is higher than that set by CPCB. Accordingly, when excess SPM for Town Hall is calculated against the WHO standard the resulting figure are lower i.e. 81 percent in 1982, 97 percent in 1983, 154 percent in 1984 and 131 percent in 1985.

In sum, the different zones have registered fluctuating contents. This is consequent upon wind which is the first and most obvious metrological factor reponsible for the dispersion of pollutants. The plume of effluent from the chimney is carried down-wind. The wind flow is never smooth. Within the wind stream we always find eddy motion or turbulence

which leads to mixing. The stronger the wind greater will be the turbulence and therefore the mixing and dillution.

Table 4.2 shows, the concentration of excess SO_2 and NO_2 pollutant are existing in the atmosphere in commercial area.- Town hall. Rest of the areas have showed concentration below the air quality standards.

Percentage share of excess noise pollution in Delhi city.

Noise is also an important aspect of urban environment problem. It is the most subjective pollutant in Delhi city while its level is very high in urban areas in the region. A survey was conducted in certain important localities of city, i.e. Industrial area, Commercial and Residential areas. This survey was conducted by the national physical laboratory in 1983.

Table 4.5 shows the pattern of noise pollution in Delhi city. Average noise level varies from 63dB at Pusa Campus residential area to 89dB at Subji Mandi industrial cum commercial area.

TABLE - 4.5

PERCENTAGE SHARE OF EXCESS NOISE POLLUTION

Name of Area	In decibel		Excess Noise percentage
	Present Average Noise	Acceptable noise level (Upper Unit)	
1. Pusa Road	63	45	40
2. Arya Samaj Road	76	50	52
3. Baber Lane	68	45	51.11
4. Connaught Place	87	55	58.18
5. Pahar Ganj	81	50	62
6. Daryaganj	88	50	62
7. Jama Masjid	74	50	48
8. Subji Mandi	89	60	48.34
9. Chandani Chowk	82	50	64
10.New Rohtak Road	81	60	35
11.Laurrance Road	70	45	55.56
12.Inderpuri	63	45	40
13.Chanakyapuri	82	45	82.23
14.Sarojani Nagar	74	50	48
15.Lodi Road	81	50	62
16.Tilak Nagar	82	45	82.23
17. Delhi Gate	76	50	52
18.Shahdara	85	60	42
19. I I T	64	45	42.23
20.Nizamuddin	70	45	55.56
21.Patelnagar	79	45	75.56

SOURCE: National Physical Laboratory, Delhi.

The methodology which was adopted in preceding section (for calculation of excess air pollution) is also followed through to determine the areas with excess noise pollution. The excess is calculated with the help of Indian Standard Institution's (IS : 4954 - 1986) acceptable noise level and present noise condition.

It may be observed that all 21 points have excess noise pollution. Chanakyapuri and Tilak Nagar show very high percent of excess noise pollution. Rohtak Road industrial area is shwoing very low level of excess noise pollution. Rest of the locations have noise pollution which varies from 40 percent to 76 percent. Rohtak Road industrial area experiences very low level of excess noise pollution because the area located away from the city. Another reason is its location among open spaces which does not allow sound to reflect. The sound spreads over the space and this spreading checks the noise intensity.

Livability Condition

As per discussion so far we may sum up the livability conditions in Delhi in the following section.*

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* Admittedly, the analysis is based on very few observations. As pointed out earlier, this is due to non-availability of relevant data for more observation points.

Sulpher dioxide and oxide of Nitrogen pollutants exist excessively in Town hall (Commercial area). Rest of the areas such as Najafgarh (Industrial area) and Netaji Nagar (Residential area) have these components below the permissible limits. In Town Hall all three pollutants (SPM, Sulpher dioxide, oxide of Nitrogen) are existing upto the critical limit. The noxious gas sulpher dioxide has pathological effect on human being causing chest constriction and death from respitratory ailments. Oxide of nitrogen causes inhibitcilia action, so that soot and dust penetrate far into the lungs.

It may be said that Town Hall area along with its surrounding is not fit for livable purposes. Because pollutants emitting zone spread over an area of say twenty five square km. (Dhurandhar, 1986). Rest two area (Najafgarh and Netaji Nagar)are moderate as far as livable conditions are concerned.

According to the table 4.5 all twenty one points have reflected excess level of noise pollution in Delhi city. These excess noise indicate that the noise levels are crossing the tolarence limits. The noxious noise has been known to cause narvous disorder headache, irritation, high blood pressure and short memory.

CHAPTER - V

SUMMARY & CONCLUSION

This study has made an attempt to approach the problem of environmental quality in metropolitan cities of India from the view point of sustainability of human life. The more serious of the types of pollution are air and water pollutions which are concentrated mainly in urban areas and orginate from transportation, fuel production, industrial processes and domestic solid disposal etc. These excessively increasing pollutants into the environment are the most important elements to control for the sustainability of human life.

The concept of environmental quality is a recent phenomenon in geography. Here, Geographers are concerned with the study of earth's surface and the way human beings here interacted with their environment. i.e. the subject matter is essentially about the relationship that exists between human beings and their environment over the global surface. Geography is therefore, a very broad science which deals with interaction in space that changes through time. As such, its boundries of ten blur and overlap with other sciences.

The present discussion starts with a review of literature which is done in order to access the existing status of environmental concern in Geography. Geography

In cities like Calcutta, Bombay, Ahmedabad and Kanpur, industrial pollution caused by emission of gaseous substances has assumed serious propotions because of bad location of industries which tend to cluster together amidst sprawling residential colonies. Delhi metropolitan city on the other hand has taken to automobile civilization in a big way; the exhaust fumes only help radiate pollution even further. It is surprising that with all these massive pollution and health hazards, little tangible action has been taken to reduce the problems to a manageable size.

This is not to suggest that state governments are impervious to public protests and representations. Pollution as a social menace and health hazard has been recognised both by Delhi Administration and by some other state governments. However, the authorities tend to regard the problem largely as one limited to air pollution. Efforts are being made to instal pollution control equipments wherever necessary to control air pollution. How speedily the scheme would be implemented is a vital question because progress will depend upon the co-operation of the public and private sectors. Pollution, however, includes much wider dimensions and deserve greater attention than it receives.

City's environmental problems, particularly those of resource utilization and waste disposal, generally become explicit only after long time after the actual actions and activities causing them take place. It is unfortunate that either

equipped with integrative techniques and enriched with physical and social contents is relevant to understanding of environmental problems. It can be of great help in gathering and processing requisite information and subsequently offering solutions for multi dimentional issues (sing et al.1988). In India's ecology and environment of urban areas and sustainability of human life are outstanding goals of scientist, social scientist planners and those who give leadership to the society.

India has witnessed rapid industrial development in thelast two decades. India's metropolitan cities recognised by the census claim about sixteen percent of the total population of India. In terms of industrial workers the metropolitan cities claim about twelve percent of the total workers of India as per 1981 census.

The first step in this study was to place India's metropolitan cities in a proper perspective. An attempt has thus been made to analyse the environmental situation within the metropolitan cities at the national level. This involved findings out the position of Delhi metropolitan city among the other metropolitan cities.

because of ignorance concerning these effects or because of necessity or sometimes because of the desire to fulfil short-term individual objectives at the expense of wider social goals, we so often postpone steps to take care of natural ecosystem. In order to obtain fuel or timber now, we cut down green areas in such a manner so as to create deserts in their place for all time to come.

It is true that environmental quality is based upon the availability of resources. The way in which these resources are distributed and one used will also determine to a large extent the quality of life for different living organism. The disposal of wastes into a river affects the life of those using the water down streams. The impoverished immigrants live in the unhealthy surroundings of a squatter settlement because socity has not made adequate provision for work in this home, community. Although the society provides economic incentives sufficient to draw them into the metropolitan city it does not provide enough to give them a reasonable livelihood.

Delhi metropolitan city which is the polynodel point of trade and commerce in the northern region is also the capital of India. It has developed in radial pattern to accommodate the burgeoning population. To meet the travel

requirements of residents transport there has been tremendous growth in private and public. Thus, the vehicular population has recorded about 142 percent growth while the population growth was about fifty eight percent during 1971-1981. Presently, Delhi accounts for twenty seven percent and ten percent and ten percent of total registered vehicles in metropolitan and the country respectively. These increasing pollutants into the city's atmosphere such as carcenogenic hydrocarbon, carbon monoxide (co) and oxide of nitrogen (No_x), Sulphur dioxides (SO_2) carbon dioxide (CO_2) and particles matters (SPM).

To sum up, the following findings may be highlighted.

1. This study brings out a great deal of dissimilarity in metropolitan cities of India in regard with extent and intensity of environmental pollution.

2. Older metropolitan cities like Calcutta, Bombay, Delhi, Madras and Ahmedabad are more problematic than newly becoming metropolitan cities i.e. Kanpur, Nagpur, Jaipur etc. It may perhaps be because of older metropolitan cities are highly resource-based apart from being key cities for concentration of all types of facilities.

3. Calcutta metropolitan city emerges as an urban centre with highest level of environmental problem among all other metropolitan cities of India.

4. Bombay metropolitan city has relatively higher intensity of noise pollution.

5. All the metropolitan cities are required to control the excessively increasing pollution.

6. Delhi metropolitan city has fast emerging as possessing maximum numbers of vehicles and decreasing green environs. If proper care is not taken immediately, situation may go out of hands.

7. As far as air pollution in Delhi is concerned, the major sources of pollutants appear to be from the vehicle traffics.

8. For water pollution the major sources of contamination are from various industries which are located along the main drains. These industries dump their industrial effluents into the river Yamuna without treating them for polluting agents.

9. The twenty one points for which the data for noise pollution are available register ever increasing levels of noise invariably beyond the permissible limit.

Appendices

Appendix 1

TOTAL POLLUTANT EMITTED BY MOBILE & STATIONARY SOURCES IN DELHI AREA (1987)

Sources of Pollutant Discharge	In M.T.P.D.							Total	%
	SPM	HC	SO_2	NO_x	CO	Others/ oldehyde Ketone/ Fluorida	Organic acids/ lead		
Domestic & Commercial	20.594	12.902	34.568	12.532	27.632	-	-	108.228	
Transport	146.722	135.311	21.245	82.321	284.969	0.323	0.037	670.928	57%
Power Plant	149.061	1.881	89.733	40.509	0.215	3.839	-	285.288	
Textile	0.168	1.870	3.665	0.485	-	0.438	-	6.626	
Glass Ceramics	63.457	2.456	4.505	1.290	-	0.430	-	72.138	
Chemical	8.564	2.626	5.101	0.305	-	1.720	-	18.316	43%
Engineering	1.623	0.433	0.780	0.217	0.78	-	-	3.833	
Rubber	0.582	0.838	0.879	0.114	0.003	-	-	2.416	
Misc.	2.124	0.740	1.143	0.288	1.097	-	-	5.392	
Total	392.895	159.057	161.619	138.061	314.696	6.750	0.037	1173.115	

M.T.P.D. - Metric Tonne Per day.

Source : Sectional Office, A-1, Dr. Mukherjee Nagar Delhi-110009
"Central Board for the Prevention and Control of WAter Pollution" New Delhi.

Appendix - 2

NOISE SURVEY 1983 DATA

S. No.	Locality	Time of Measurement	Field Condition	Maximum	Average	Ambient	1959 values
1.	Pusa Campus (Near Bangalow Type Qrs)	1030 hrs.	Light traffic	70	63	51	
2.	Arya Samaj Road (in front of Mandir)	1115 hrs.	Medium traffic Mostly shopping noise	80	76	68	82
3.	Babar Lane (near fly over)	1200 hrs.	Medium traffic Rail Noise (occasional)	73	68	56	
4.	Babar Lane	1230 hrs.	During train transit	80 (engine transit) 65 (Bogies transit)	-	56	
5.	Connaught Circus (Near Scindia House)	1015 hrs	Heavy traffic	90	87	77	81
6.	Pahar Ganj/Khanna Talkies	1115 hrs.	Open Market Congested area light traffic	82	81	59	
7.	Darya Ganj/(Golcha Cinema)	1045 hrs.	Congested area, Heavy traffic, (dual carriage way)	91	88	83	89
8.	Jama Masjid (Back)	1130 hrs	Congested area light traffic Open Market	78	74	67	80
9.	Subji Mandi (opp. Ice Factory)	1245 hrs.	Congested area heavy heavy traffic on dual carriage way	92	89	82	87
10.	Sadar Bazar(Bara Tooti)		Measurements were not possible due to crowd of onlookers making noise				
11.	Chandani Chowk (Opp. Red Fort)	1130 hrs.	Slow, medium traffic mainly of two, three and four wheelers	85	82	74	88
12.	New Rohtak Road (Near Kamal Resturant)	1045 hrs	Dual carriage way medium traffic	85	81	73	
13.	Lawrence Road(Chowk)	1140 hrs	Residential area with light traffic	74	70	59	
14.	Inderpuri (JJ Colony)	1240 hrs	Residential	68	63	56	
15.	Chanakya Puri (Australian H.C.)	1020 hrs	Light to medium traffic	86	82	68	
16.	Sarojini Nagar (Main Market)	1100 hrs	Light traffic	79	74	63	76
17.	Lodhi Road Flyover (Top of F.O.)	1145 hrs	Heavy traffic	85	81	72	
18.	Tilak Nagar (Water tank)	1045 hrs	Medium traffic	85	82	75	
19.	Palam Village(Bus Tr.)	1145 hrs	Rural area, light traffic, tractors	76	71	61	
20.	Delhi Cantt (Sadar Bazar)	1230 hrs	Light Traffic Shopping area	81	76	66	
21.	Shahdara	1045 hrs	Crowded bus terminus Medium traffic	90	85	77	
22.	I.I.T. Campus (near Library)	1100 hrs	Moderate Traffic	69	64	49	
23.	IIT Campus (near residential Quarters)	1815 hrs	During flyover of airoplanes	85	-	59	
24.	Nizamuddin (Near Rly Station)	1015 hrs	Light traffic	75	70	55	
25.	Nizammudin (near Rly Stn)	1100 hrs	During train transit	80 (engine transit) 60 (Bogies transit)	-	-	-
26.	N.P.L. Colony	24 hrs	Day-time(0800-2000)	-	60	-	
			Early night time (2000-2300)	-	58	-	-
			Late-night(2300-0800)	-	55	-	-
27.	Patel Nagar	24 hrs.	Day-time(0800-2000)	-	79	-	79
			Early-Night (2000-2300)	-	76	-	-
			Late Night time (2300-0800)	-	67	-	-

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