State of Environment Chandigarh - 2004

Punjab State Council for Science & Technology
In collaboration with
The Energy & Resources Institute, New Delhi
Department of Environment, Chandigarh &
Chandigarh Pollution Control Committee

Sponsored by
Ministry of Environment & Forests, Govt. of India

State of Environment Chandigarh 2004

By
Punjab State Council for Science & Technology, Chandigarh
(State Host Institution)
in collaboration with
The Energy & Resources Institute (TERI), New Delhi
(National Host Institution)
The Department of Environment, Union Territory of Chandigarh
Chandigarh Pollution Control Committee

Sponsored by

Ministry of Environment & Forests, Govt. of India

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Photo courtesy

Charan Kamal Singh & Dinesh Gupta, PSCST, Chandigarh

Citation

Tiwana, N.S.; Jerath, N.; Puja; Chadha, J. (2004). State of Environment: Chandigarh, 2004, Punjab State Council for Science & Technology, pp:88

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27 August 2004

Foreword

Agriculture, industrialization and urbanization have all impacted in their different ways on the environment. The 'emergent' relationship between the economic activity of Homo sapiens and the environment is not fully understood in all its enormous complexity, and there is a view that the science behind the argument is not entirely limpid either. Nevertheless, there is a commonly experienced dissatisfaction with the state of the environment in various parts of the world and a widely shared belief that corrective action is needed with varying degrees of urgency. Prevention is always better - and cheaper - than cure, and we are fortunate that in Chandigarh we are still at a stage where mostly preventive measures are necessary.

I am glad that the Punjab State Council for Science & Technology has carried out a bench-marking exercise for Chandigarh Administration in consultation with The Energy & Resources Institute, New Delhi, Chandigarh Pollution Control Committee, the Department of Environment and other concerned departments and R&D bodies. The causal chains involved are long and complex. In many ways this is a first step, and a sustained effort will be needed to benefit fully from the foundation that has been laid.

I am sure this State of Environment report will provide the basis for a coherent, sustained and systematic plan of action for improving the quality of life in Chandigarh.

(Lalit Sharma)

Acknowledgements

Contribution of the following is gratefully acknowledged:

- Mr. Ishwar Singh, Director Environment, UT, Chandigarh
- Mr. P.J.S. Dadhwal, Member Secretary, Mr. Anil Kumar, Junior Scientific Officer & Mr. Nitin Gupta, Junior Research Fellow, Chandigarh Pollution Control Committee
- Dr. P.K. Sharma, Director, Dr. Rajiv Chopra, Scientist-SF and Dr. V.K. Verma, Scientist-SE, Punjab Remote Sensing Centre, Ludhiana
- Dr. Basudeo Prasad, Professor & Head, EMID, Central Scientific Instruments Organization, Chandigarh
- Dr. Sibi John, Assistant Professor, Deptt. of Civil Engineering, Punjab Engineering College, Chandigarh
- Dr. G. Dewan, Deputy Medical Superintendent, General Hospital, Sector-16, Chandigarh
- Dr. G.C. Bansal, Municipal Health Officer and Mr. Hardial Singh, Project Officer, Municipal Corporation, Chandigarh
- Ms. Swati Anand, Assistant Chief Town Planner, Deptt. of Architecture, Chandigarh
- Mr. H. S. Kharab, Sub-divisional Soil Conservation Officer, Deptt. of Forests & Wildlife, Chandigarh
- Mr. Suresh Kumar, Research Officer, Deptt. of Economics and Statistics, Chandigarh
- All Members of Steering Committee

Separate mention must be made of Mr. P.V. Sridharan, Senior Visiting Fellow, Mr. Harpreet Kandra, Research Associate & Mr. Sunil Pandey, Research Associate, TERI for critical review, guidance and monitoring of the project. Suggestions of Dr. T.S. Panwar, TERI are also thankfully acknowledged.

The authors also thank officers and staff of PSCST for help provided in compiling the report.

Dr. N.S.Tiwana, Executive Director
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Ms. Puja Nangia, Senior Research Fellow
Mr. Jatinder Chadha, Senior Research Fellow

Preface

The Ministry of Environment & Forests, Government of India has launched a scheme under the 10th Five Year Plan to bring out Status of Environment (SoE) Reports for all States and Union Territories on a regular basis. The Punjab State Council for Science & Technology (PSCST) has been identified as the State Host Institution (SHI) and The Energy and Resources Institute (TERI), New Delhi as the National Host Institution (NHI) for SoE Report, Chandigarh.

Chandigarh, 'the city beautiful' was planned by Le Corbusier, the famous French architect. It is one of the best experiments of urban planning in modern India and is rated as the best city to live-in by a popular magazine. Founded in 1952 as the new capital of eastern Punjab after partition, the Chandigarh area was carved out of the erstwhile Ambala district. The Punjab Government, in its attempt to maintain the character of the city, enacted the Periphery Controlled Area Act in 1952 to control haphazard growth around Chandigarh. This covers an area of 16 km radius around the city.

Chandigarh enjoys a very special status being the city of power of three governments: its own as a Union Territory, and the Capital of the States of Punjab & Haryana. It also occupies a special status in terms of having the maximum number of vehicles per person in the country. As such, the driving forces determining the quality of environment in Chandigarh are, human and vehicle population. These two have created a piquant situation as the States of Punjab & Haryana have built Mohali & Panchkula as satellite towns violating the Periphery Controlled Area Act. The problem is much more severe in areas which are not under urban limits of Mohali, Panchkula and Chandigarh. Unplanned construction of houses and shops in these open areas have created slums. The Administration is fully aware of the problems but can take effective steps only if necessary political will and support is available from the three governments which need to work hand-in-hand to plan the entire area as a future metropolis. The combined population of vehicles from neighbouring towns is creating alarming levels of air pollution (including noise). There is, therefore, a dire need of carrying out studies to quantify environmental problems and conduct cost benefit analysis of driving forces and responses. This should include demographic surveys, estimation of requirement of urbanization & epidemiological studies to relate impacts of deteriorating environment on health. Studies for providing a Mass Rapid Transport System (MRTS) to overcome the problem of vehicular pollution and parking be taken in hand immediately. It is world wide experience that MRT systems are not looked in to at early stages and become prohibitively costly by the time pressure to provide MRTS is felt. In this case, early initiatives are all the more necessary as three governments will have to sit across the table to plan and fund the scheme. The city could also develop elevated corridors in areas where vehicular pressure is already high to cater to through traffic on long routes.

Le Corbusier had designed the city with a certain concept in mind i.e. it was designed like a human body. The density of population in various sectors was also determined as a part of this concept. This is a characteristic feature which needs to be protected even when the city is under intensive demographic pressure.

It is hoped that this report would provide a strong base for improved decision making at all levels, facilitate the measurement of progress towards sustainability, help to raise the information level of common citizen of the Union Territory about the current state of their environment, highlight issues that warrant immediate remedial measures, and prompt the government and the public towards positive action.

Authors

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Abbreviations

AC	Air Conditioner
APCDs	Air Pollution Control Devices
C	Centigrade
CAWEDS	Chandigarh Animal Welfare and Eco Development Society
Cd	Cadmium
CFCs	Chlorofluorocarbons
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CPCB	Central Pollution Control Board
CPCC	Chandigarh Pollution Control Committee
Cr	Chromium
CrPC	Criminal Procedure Code
CSIO	Central Scientific Instruments Organization
Cu	Copper
dB (A)	Decibel on scale A (relatable to human hearing)
DG	Diesel Generators
DoE	Department of Environment
DST	Department of Science & Technology
E	East
g	grams
GH	General Hospital
GoI	Government of India
ha	Hectare
HC	Hydrocarbons
HCFC	Hydro Chloro Fluoro Carbons
HTV	Heavy Transport Vehicle
HUDA	Haryana Urban Development Authority
ISBT	Inter State Bus Terminus
J & K	Jammu & Kashmir
km	kilometre
km^2	square kilometre
KBK	Khad Banao Kendra
LPG	Liquefied Petroleum Gas
LTV	Light Transport Vehicle
m	metre
MC	Municipal Corporation
mcm	million cubic metres
MoEF	Ministry of Environment & Forests
MRTS	Mass Rapid Transport System
MSW	Municipal Solid Waste
MT	Metric Tons
MTV	Medium Transport Vehicle
N	North
NAAQM	National Ambient Air Quality Monitoring
NAAQS	National Ambient Air Quality Standard
NAMP	National Ambient Air Quality Monitoring Program
NGOs	Non-Governmental Organizations
Ni	Nickel
NOx	Nitrogen Oxide
O_3	Ozone
ODS	Ozone Depleting Substances
PAN	Peroxy-Acyl-Nitrite
Pb	Lead
PEC	Punjab Engineering College
PGI	Post Graduate Institute for Medical Education & Research
PRSC	Punjab Remote Sensing Centre
PSCST	Punjab State Council for Science & Technology
PU	Panjab University
PUC	Pollution Under Control
PUDA	Punjab Urban Development Authority
R & D	Research and Development
RSPM	Respirable Suspended Particulate Matter
S	South
SAS	Sahibjada Ajit Singh
SBSAP	State Biodiversity Strategy and Action Plan
SO_2	Sulfur Dioxide
SPM	Suspended Particulate Matter
sq km	square kilometre
SSK	Sahaj Safai Kendra
UT	Union Territory
VOCs	Volatile Organic Compounds
W	West
WHO	World Health Organization
Zn	Zinc
µg	micro gram

Executive Summary

Chandigarh, 'the city beautiful' was planned by Le Corbusier, the famous French architect. It is one of the best experiments of urban planning in modern India and is rated as the best city to live in. Founded in 1952 as the new capital of eastern Punjab after partition, the Chandigarh area was carved out of the erstwhile Ambala district. Subsequently, at the time of reorganization of the State in 1967 in to Punjab, Haryana & Himachal Pradesh, the city assumed the unique status of being the capital city of both, Punjab & Haryana, while it itself was declared as a Union Territory.

The Union Territory of Chandigarh is spread in 114 sq km area (+ 25.42 sq km additional area declared as Wildlife Sanctuary). The current population is over 9 lakh (2001 census) with a population density of 7900 persons/sq km. About 69.6% of land area is under urban category, 5.4% under village habitation, 7.2% under agricultural use, 7.7% under forests & plantations, 4.72% under water bodies and the rest under vacant land and miscellaneous uses.

The Master Plan of Chandigarh was conceived by Le Corbusier as analogous to the human body with a head (Capitol Complex, Sector 1), heart (the City Centre, Sector 17), lungs (the leisure valley, open spaces and sector parks), intellect (cultural & educational institutions), circulatory system (the road network) and viscera (the industrial area).

The Union Territory of Chandigarh was planned for a finite population of half a million. However, it has recorded an unprecedented rate of population increase. This was 144.59% between 1961 & 1971, 75.55% between 1971 & 1981, 42.16% between 1981 & 1991 and 40.33% between 1991 & 2001. The industrial growth has been gradual. Currently there are 528 registered factories including 15 large & medium scale units. Agriculture has shown a down trend. However, the per capita income of the city is the highest in the country. It has increased from Rs. 19,761 in 1993-94 to Rs. 44,397 in 2000-2001 at current prices and Rs. 29,208 at constant prices.

Besides the city of Chandigarh, the Union Territory comprises Manimajra, Shivalik Enclave, 18 villages in the outskirts, four villages under municipal limits (under the control of the Municipal Corporation), 14 slum colonies and 4 slum settlements. The Periphery Controlled Area Act was promulgated in 1952 to control haphazard growth around Chandigarh. However, both, the States of Punjab & Haryana have developed new cities in violation of the Act.

Air

The ambient air quality of Chandigarh is being monitored by Chandigarh Pollution Control Committee (CPCC) at two stations (Sector 17 representing residential-cum-commercial area, and Industrial area) since 1991. The major driving forces which affect the air quality of the city are population, transport, industrial growth & municipal pollution. Increase in vehicular population by about 42 times between 1971 to 2001 (which includes a 48% increase in 2/3-wheelers and 35% increase in 4-wheelers in the last decade), increased industrial activity (there are about 45 air polluting industrial units under red category in Chandigarh), burning of dry leaves and litter from trees & gardens in the city and operation of generator sets in certain areas exert major pressure on the air quality. Data indicate that the suspended particulate matter in the city remains higher than the permissible limits throughout the year at both, residential-cum-commercial & industrial area (especially in commercial areas). However, the SO_2 & NOx levels are well within permissible limits. The CPCC has also calculated pollution load for the city which indicates an increase from 26 Tonnes per day in 1981 to 397 Tonnes per day in 2001. A traffic census was also carried out by CPCC in 1997 and John *et. al.* in 2004 at Sector 22 grid, one of the most congested commercial-cum-residential areas of the city. Data indicates that all categories of vehicles put together emit 436 kg of carbon monoxide, 168 kg of hydrocarbons, 31.5 kg of nitrogen oxides, 4.5 kg of particulates and 2 kg of sulphur dioxide per sq km area during peak traffic hours (2003). A study of respirable dust load by CSIO in 1999-2000, followed by CPCC in 2002-2003 indicates an increase over the years. CSIO has also studied ozone, carbon monoxide, lead & benzene levels at certain specific sites in Chandigarh. Though ozone, lead & benzene remain within permissible limits, CO levels are above the prescribed limits.

Increasing air pollution can adversely affect human, animal & plant health. However, specific studies are not available. In response to increasing pollution, the Union Territory Administration declared Chandigarh as Air Pollution Control area in 1988. To abate industrial pollution, the industrial area has been located towards southeast of the city in leeward direction. The railway station is strategically located adjacent to the industrial area. All the 45 air polluting industries have installed pollution control devices. Specific efforts are being carried out to phase out production and use of ozone

depleting substances in the city. Further, to reduce vehicular pollution, compulsory 'Pollution under control' certificates have been introduced for vehicles by Chandigarh Traffic Police. On an average about 700 challans are also issued every year to defaulting vehicles. Further, lead free petrol was introduced in the Union Territory in early 2000. The Administration has also shifted parts of ISBT to Sector 43 and has specified routes for HTV and Inter-state buses. The auto repair market has also been shifted from Sector 21 in the city centre to Sectors 43 & 48 at the outskirts. Several traffic regulations are also operative. To reduce air pollution from municipal & commercial sources, burning of leaves & operation of unauthorized gensets is discouraged. Regular public awareness campaigns are also carried out.

Noise

Noise has also been recognized as an air pollutant under the Environment (Protection) Act, 1986. The prominent sources of noise in the city are: traffic, commercial activities, community noise & festive celebrations, industry, diesel gensets, etc. Ambient noise levels in various sectors were monitored by CSIO in 1989 & 1999-2000 and CPCC in 2004. Data indicate an increase in noise levels at almost all locations. Exceptionally high noise levels were recorded at major shopping centres and hospital OPDs. Monitoring of traffic noise at major roads of Chandigarh was carried out by PEC in 2002. The maximum noise level of 90.02 dB (A) was recorded near Kisan Bhawan, Sector 35/36. Further, noise levels on non-working days were significantly lower at Sector 22, Aroma Chowk & Tribune Chowk but increased at Uttar Marg near the Lake. Monitoring of noise levels on Diwali by CPCC indicate higher noise levels at suburbs like, Manimajra town & Kaimbwala & Kajheri villages (probably due to canyon effect). Regular monitoring of noise levels at Sector 22 during Diwali indicates a slight decrease from 2001 onwards probably due to higher awareness about its ill effects amongst the general public. No specific studies on impact of noise on health of residents have been carried out. However, in response to the increasing noise levels the U.T. Government is strictly implementing the existing legal framework as specified by Government of India. The system of 8-tier roads also helps to filter high traffic noise from residences.

Land

Maximum land in the Union Territory is under urban area (79.4 sq km). Out of this, 19.68% area is under roads. As per remote sensing data 7.7% area in the U.T. is under forests. However, 25.42 sq km additional area was acquired by the erstwhile Punjab Government from 1962 to 1964 for soil conservation works (which vests with U.T. for administrative control but is still under revenue records of Punjab & Haryana). This area has been declared as 'Sukhna Wildlife Sanctuary'. Hence, the total area under forests comprises 32.41 sq km. The northeast part of the Union Territory comprises Shivalik rocks constituting conglomerates, friable sand stone, silt stone and clay stone. Soils of the Union Territory have been grouped into 9 soil series.

The major driving forces affecting land in the Union Territory are population, unplanned expansion of villages, growth of slums & unplanned development around periphery zone. These have resulted in change in land use pattern and pollution from solid waste. At present the city produces about 300 to 325 tons per day of municipal solid waste which is disposed of by land filling at village Dadu Majra at a specifically designated landfill site spread in an area of 45.11acres. As per CPCC, 153 hazardous waste generating units also operate in Chandigarh which generate about 835.7 MT hazardous waste per annum which is collected and stored by individual units within their premises. Further, there are 474 biomedical waste generating establishments which generate about 292 tons per annum of biomedical waste.

The Sukhna Lake is an important characteristic feature of Chandigarh. It was declared a wetland of national importance in 1988. The pondage capacity of the lake has reduced from 10.74 mcm to 4.2 mcm since the time of its construction due to inflow of sand & silt from 42.07 sq km of upper catchment area. Soil conservation works have been taken up in the catchment (by construction of silt retention dams across various rivulets and plantation of trees & grasses) to reduce inflow of silt. Desilting of lake has also been taken up as a major activity with public participation.

Frequent change in land use pattern to bring more area under urbanization, developmental activities in peripheral zone, deforestation and generation of high volumes of solid wastes are leading to land degradation and deteriorating environmental quality in the Union Territory. The Chandigarh Administration has appointed a high powered coordination committee for control of violation of Periphery Controlled Area Act, 1952. For municipal solid waste management, a demonstration project sponsored by the Central Pollution Control Board and the Sahyog Waste

Management Project has been taken up by the Municipal Corporation with the help of NGOs & Resident Welfare Associations. This includes establishment of *Sahaj Safai Kendras* & *Khad Banao Kendras* at various locations throughout the city where garbage is systematically collected & segregated and organic waste is converted into compost. Treatment, collection & segregation of biomedical waste is also being taken up by the CPCC. Three incinerators have been installed at Post Graduate Institute of Medical Education & Research, Sector 12; Government Hospital, Sector 16 and Government Medical College & Hospital, Sector 32. A private company has also been authorized by CPCC for door-to-door collection and disposal of biomedical waste.

Recommendations

In addition to continuing and strengthening existing actions by the Union Territory Administration, the present report recommends the following initiatives:

- Prevention based environmental policy needs to be put in place for retaining the character and environs of Chandigarh.
- To control air pollution, the following actions be taken up:
  - o A comprehensive urban air quality management strategy be formulated based on emission inventory, dispersion models and urban policy.
  - o For industrial pollution control, clean & energy efficient technologies may be promoted and incentives be provided for waste minimization and adoption of waste utilization technologies.
  - o To control vehicular pollution, existing public transport be improved, alternate fuels (like, CNG, Propane) be promoted, emission norms & fuel quality specifications be tightened, synchronization of traffic lights be taken up (to allow smooth flow of traffic along major roads), routes of slow moving vehicles be specified and links to satellite towns (especially, Panchkula) be increased. Elevated roads be planned for long route vehicles.
  - o Air quality monitoring network be expanded to cover new areas and additional pollutants.
  - o Mass Rapid Transport System be planned in conjunction with satellite towns of Panchkula, Zirakpur, Mohali, Dera Bassi & Kharar to reduce floating vehicular population in the city.
- To control noise pollution, regular monitoring at strategic locations be taken up. For this, protocols be standardized and existing infrastructure available with CPCC, CSIO & PEC be coordinated and optimally utilized. Further, noise barriers & vegetation in southern sectors be promoted.
- For control of degradation of land it is proposed that:
  - o A coordinated approach in consultation with State Governments of Punjab & Haryana be adopted to ensure implementation of Periphery Controlled Area Act, 1952 and stop further expansion of satellite towns by PUDA & HUDA. At the same time, it is important to realize that such pressures would continue. As such, planning for catering to these pressures be initiated (e.g. development of MRTS, prevention of encroachments, etc.) to promote sustainable development.
  - o Land use changes in peri urban areas be strictly curbed.
  - o Solid waste characterization studies be taken up and projects for energy generation from municipal waste be promoted.
  - o Hazardous waste disposal be taken up in conjunction with Punjab at a common hazardous waste disposal site.
- To understand and quantify the impact of environmental protection on health, epidemiological studies be promoted.
- Access to data for public be improved and thrust be provided to awareness & participation of the community for preservation of environmental quality.
- Regular training & education of government agencies, industries, students & public be promoted.

Overall it is proposed that an effective environmental management plan encompassing environmental monitoring, strategy, institutional capacity building and economic incentives be devised.

CHAPTER-1

INTRODUCTION

Open Hand Monument

Goddess Chandi Temple

Chandigarh, the dream city of India's first Prime Minister, Sh. Jawahar Lal Nehru, was planned by the famous French architect Le Corbusier. Picturesquely located at the foothills of Shivaliks, it is known as one of the best experiments in urban planning and modern architecture in the twentieth century in India.

HISTORICAL BACKGROUND

Chandigarh derives its name from the temple of Goddess 'Chandi' (the goddess of power) located in the area and a fort or 'garh' lying beyond the temple. The city has a pre-historic past. The gently sloping plains on which modern Chandigarh exists, was in the ancient past, a wide lake ringed by a marsh. The fossil remains found at the site indicate a large variety of aquatic and amphibian life which was supported by that environment. About 8000 years ago the area was also known to be a home to the Harappans (Source: www.citco.nic.in).

Since the medieval thru' modern era, the area was part of the large and prosperous Punjab Province which was divided into East & West Punjab during partition of the country in 1947. The city was conceived not only to serve as the capital of East Punjab, but also to resettle thousands of refugees who had been uprooted from West Punjab.

In March, 1948, the Government of Punjab, in consultation with the Government of India, approved a 114.59 sq km tract of land at the foothills of the Shivaliks as site for the new capital. The location of the city site was a part of the erstwhile Ambala district

as per the 1892-93 gazetteer of District Ambala. The site was selected by Dr. M.S. Randhawa, the then Deputy Commissioner of Ambala. Before the new city came up, the original site had about 59 villages (Singh *et.al.,* 1998). The foundation stone of the city was laid in 1952. Subsequently, at the time of reorganization of the state on 1st November, 1967 into Punjab, Haryana and Himachal Pradesh, the city assumed the unique status of being the capital city of both, Punjab and Haryana, while it itself was declared as a Union Territory under the direct control of the Central Government.

GEOLOGY & LAND USE

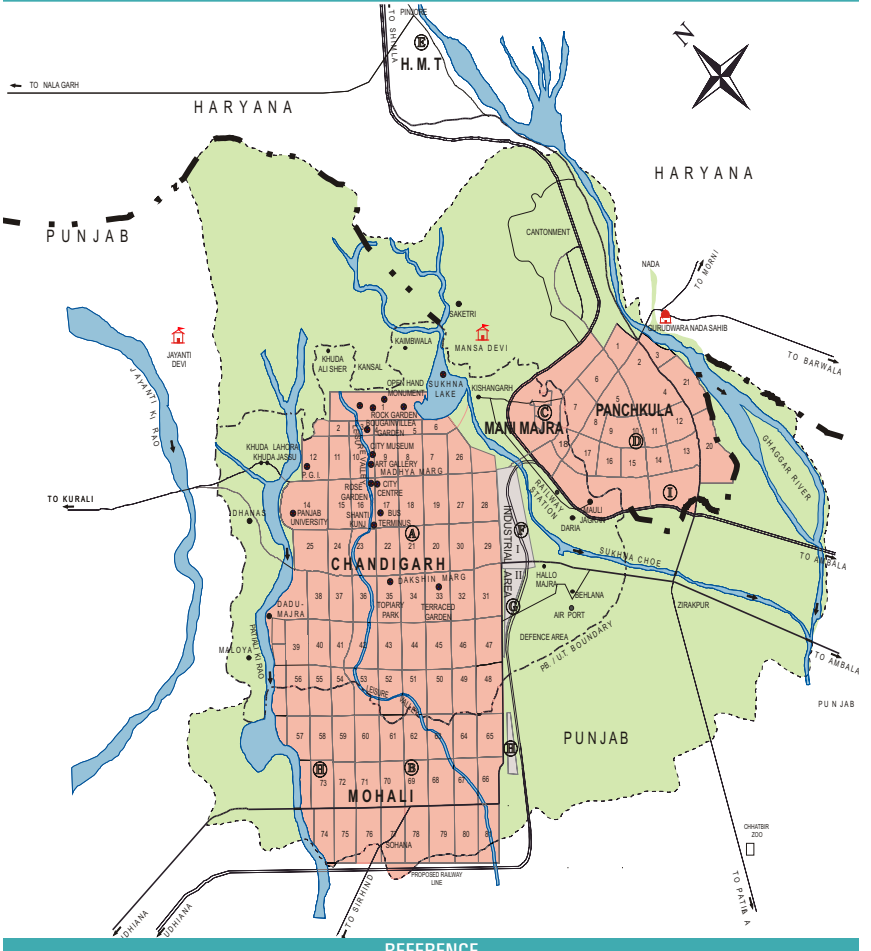
The Union Territory of Chandigarh is located in the foothills of the Shivalik hill ranges in the north, which form a part of the fragile Himalayan ecosystem. It is occupied by Kandi (Bhabhar) in the north east and Sirowal (Tarai) and alluvial plains in the remaining part. The subsurface formation comprises beds of boulders, pebbles, gravel, sand, silt, clays and some kankar. The area is drained by two seasonal rivulets *viz.* Sukhna Choe in the east and Patiala-Ki-Rao Choe in the west. The central part forms a surface water divide and has two minor streams. The stream passing through the central part is called N-Choe and the other is Choe Nala which initiates at Sector 29. The general lay out of the Union Territory is at Map 1.1.

Table 1.1 Basic Statistics

Area	114 sq km (+25.42 sq km additional hilly catchment area declared as Wildlife Sanctuary)
Longitude	76° 47' 14E
Latitude	30° 44' 14N
Altitude	304-365 meters above MSL with 1% drainage gradient
Annual Rainfall	111.4 cm/year average
Monsoon	July-September
Temperature	Winter Min. (Nov-Jan) 4°C 14°C Summer Max. (April-July) 37°C-44°C
Prevalent Winds	From the North West to South East in Winter and reverse in Summer.
Villages	18 (with 17 Panchayats)
Population (2001 census)	9,00,635(vs 1,028,610,328 National data)
Density of population per sq km	7900 (Second most populated city after Delhi)
Birth Rate (per 1000)*	21.17
Death Rate (per 1000)*	10.01
Infant Mortality (per 1000)*	45.60
Sex Ratio (females per 1000 males)	777(vs 933 National data)
Decennial Population Growth	40.33%
Literacy Rate	81.9%

** 2003 data Source: Statistical Abstract of Chandigarh, 2003*

Map 1.1 A general layout of the Union Territory



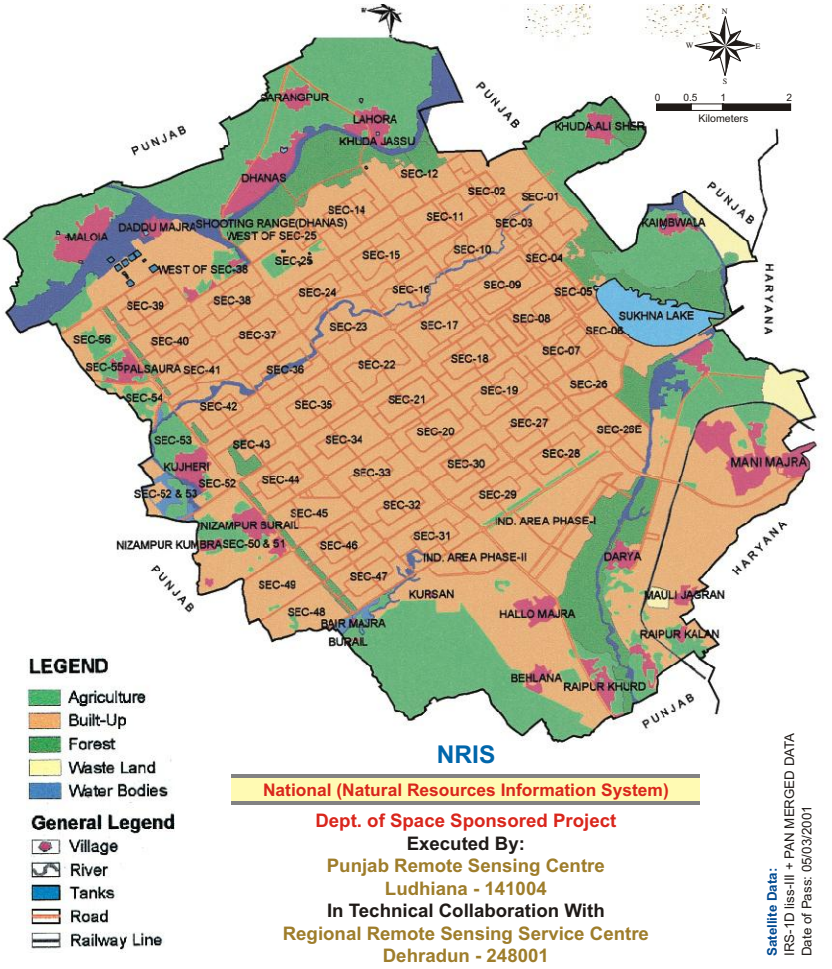
REFERENCE

(A) Chandigarh (B) Sahibzada Ajit Singh Nagar (C) Manimajra (D) Panchula (E) H.M.T.
(F) Industrial Area Phase-I (G) Industrial Area Phase-II (H) Industrial Area SAS Nagar (I) Industrial Area panchkula

Source: A Road Guide to Chandigarh (Discover India series),2002

The distribution of various land uses as per Punjab Remote Sensing Centre, Ludhiana (PRSC) is presented in Maps 1.2 & 1.3. Data indicates that a large portion of the land (about 69.6%) falls under urban category, 5.4% of the area is under village habitation, 7.2 % of the area is under agricultural use, 7.7% under forests & other plantations, 1.6% is under Sukhna Wetland, 3.1% under other water bodies and rest of the area is under vacant land (3.8%) and miscellaneous uses(1.6%). In addition to the above, 25.42 sq km additional area has been acquired and declared as Sukhna Wetland Sanctuary. Hence, the total area under forests is 32.41 sq km, out of which 26.10 sq km area is under hilly forest, 3.90 sq km is under Sukhna Choe forest & Patiala-Ki-Rao forest and 1.05 sq km of the area is under Lake forest (Map 1.4).

Map 1.2 Distribution of various land uses in Chandigarh



NRIS

National (Natural Resources Information System)

Dept. of Space Sponsored Project

Executed By:

Punjab Remote Sensing Centre

Ludhiana - 141004

In Technical Collaboration With

Regional Remote Sensing Service Centre

Dehradun - 248001

Satellite Data: IRS-1D liss-III + PAN MERGED DATA

Date of Pass: 05/03/2001

Map1.3 Details of distribution of various land uses in Chandigarh

LEGEND

- BANKS
- BHAWAN/GUEST HOUSE
- BOOTHS
- BRICK KILN
- BUS STANDS
- CHANDIGARH HOUSING BOARD
- CINEMA HALL/THEATRE
- CLUB
- COMMUNITY CENTRE
- CREMATION GROUND/GRAVEYARD
- CURRENT FALLOW
- DATA NOT AVAILABLE
- DHARMSALA/SARAI
- DISTRICT COURTS
- DOUBLE CROPPED
- EDUCATIONAL INST.
- FIRE STATION
- GODOWNS
- GOLF COURSE
- GOVT. HOUSES
- HISTORICAL
- HOSTELS
- HOTELS
- INDUSTRIAL AREA
- INSTITUTIONAL HOUSES
- JAIL
- JUDICIAL COURTS
- LAND WITH SCRUB
- LEGISLATIVE ASSEMBLY
- MANGO ORCHARD
- MEDICAL FACILITIES
- MIXED PLANTATIONS
- MUSEUM/ART GALLERY
- NURSERY
- OFFICES
- OLD AGE HOME/CRECHE
- OPEN MIXED FOREST PLANTATION
- OPEN MIXED JUNGLE
- OPEN SPACES/VACANT LAND
- PARKING
- PARKS/GARDENS
- PETROL/KEROSENE PUMPS
- PLAY GROUNDS/GROUNDS
- POLICE STATION/LINES
- POND
- PRINT MEDIA
- PRIVATE HOUSES
- REHRI MARKET
- RELIGIOUS PLACES
- RESERVED FOREST
- RESERVED SITES
- ROUND ABOUT ON ROAD CROSSING
- SEASONAL RIVULET
- SHOP CUM FLATS
- SHOP CUM OFFICES
- SLUM AREAS
- SPRITUAL CENTRE/LIBRARY
- STADIUM
- SUKHNA LAKE
- SWIMMING POOL
- TIMBER MARKET
- TRANSPORT AREA
- WATER WORKS
- POND

- VILLAGE
- ROAD
- RAILWAY LINE

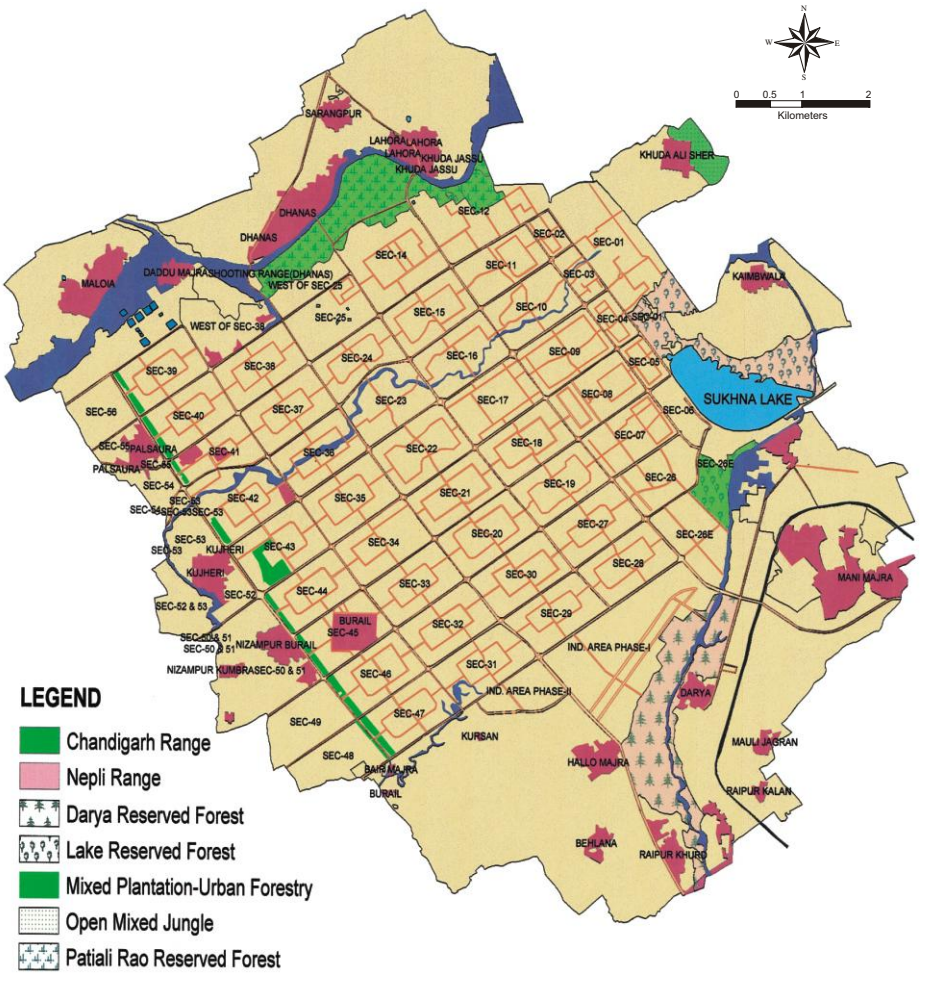
Source : PRSC, Ludhiana

CLIMATE

Chandigarh falls under Koeppen's Cwg category (Source: www.chandigarh.nic.in) i.e. it has cold dry winter, hot summer and sub tropical monsoon. Evaporation usually exceeds precipitation and the weather is generally dry.

The area experiences four seasons: (i) Summer or hot season (mid-March to mid-June) (ii) Rainy season (late-June to mid-September); (iii) Post monsoon autumn/transition season (mid September to mid-November); (iv) Winter (mid-November to mid-March). The dry spell of summer is long but with occasional drizzles or thunder storms. May and June are the hottest months of the year with mean daily maximum & minimum temperatures being about 40^{0}C & 25^{0}C, respectively. Maximum temperatures can rise up to 46^{0}C. Southwest monsoons with high intensity showers commence in late June. The weather at this time is hot and humid. The variation in annual rainfall on year to year basis is appreciable i.e. 700 mm to1200 mm. The twenty year average rainfall for Chandigarh is 1100.7 mm. January is the coldest month with mean, maximum and minimum temperatures being around 24^{0}C and 1.8^{0}C, respectively. Winds are generally light and blow from northwest to southeast direction with exception of easterly to southeasterly winds that blow on some days during the summer season.

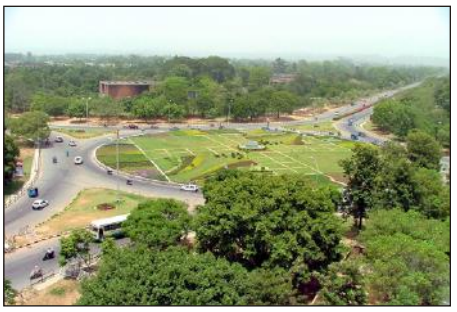
Map1.4 Distribution of forests in Chandigarh



Source : PRSC, Ludhiana

THE MASTER PLAN OF CHANDIGARH

Le Corbusier conceived the master plan of Chandigarh (Source: www.chandigarh.nic.in) as analogous to human body, with a clearly defined head (the Capitol Complex, Sector 1), heart (the City Centre), lungs (the leisure valley, innumerable open spaces and sector greens), the intellect (the cultural and educational institutions), the circulation system (the network of roads) and the viscera (the Industrial Area). The concept of the city is based on four major functions : living, working, care of the body & spirit and circulation. Residential sectors constitute the living part whereas the Capitol Complex, City Centre, Educational Zone (Post Graduate Institute for Medical Education & Research, Punjab Engineering College, Panjab University, etc.) and the Industrial Area constitute



A Roundabout

Capitol Complex

Type of Road Functions/Names

V-1 Roads connecting Chandigarh with other cities like Ambala, Kharar and Shimla. They have dual carriage way, good tree plantation and distinctive central verge lighting. The Madhya Marg and Dakshin Marg are two roads which merge into V-1s leading to Kalka and Ambala, respectively.

V-2 They are the major avenues of Chandigarh, with important institutional and commercial functions running alongside.In Chandigarh they are identifiable as 'Margs'. Madhya Marg, Dakshin Marg, Jan Marg, Himalaya Marg, Uttar Marg and Purv Marg are important examples.

V-3 They are the corridor-streets for fast moving vehicular traffic. A Sector is surrounded either by V-2 or V-3 roads.

V-4 Roads bisecting the Sectors with shopping complexes located along their southern edge.

V-5 Roads meandering through the Sector giving access to its inner lands.

V-6 Roads coming off of the V-5s and leading to the residential houses.

V-7 They are intended for pedestrian movement and run through the middle of the sectors in the green areas. A few examples are along the Jan Marg, in the Punjab University & Sector 15.

V-8 They are intended to run parallel with V-7s for the bi-cycles. Not properly developed, as yet.

the working part. The Leisure Valley, Gardens, Sector Greens and open Courtyards, etc. are for the care of body and spirit. The circulation system comprises 7 different types of roads known as 7Vs. Later on pathways for cyclists called V8 were added to this circulation system.

The Capitol complex comprises three architectural masterpieces: the Secretariat, the High Court and the Legislative Assembly, separated by large piazzas. In the heart of the Capitol Complex stands the giant metallic sculpture of 'The Open Hand', the official emblem of Chandigarh, signifying the city's credo of “open to give, open to receive”.

The city centre (Sector 17) is the heart of Chandigarh's activities. It comprises the Inter-State Bus Terminus, Parade Ground, District Courts, etc. on one hand, and vast business and shopping center on the other. The 4-storey concrete buildings house banks and offices above and showrooms / shops at the ground level with wide pedestrian concourses. The Neelam piazza in the center has fountains with light and water features. Proposal to set up an eleven storey building in Sector 17 is in the offing. Sector 34 is another newly developed commercial sector. At least three blocks in Sector 34 are proposed to have 10 storey buildings to house offices, multiplexes and hotels. As per the new proposal each building will have its own style and will not conform to the grey look (source: Chandigarh Tribune 1.6.2004).

An eight km long linear-park, known as the Leisure Valley, runs through the city from its north eastern tip to its south-western end. The Rose Garden, Bougainvillea Garden, Shanti Kunj, Fitness Trail, Topiary Park, Terraced Garden, Hibiscus Garden, Garden of Fragrance, Garden of Annuals, Garden of Herbs & Shrubs, Champa Park, Botanical Garden, etc. all form a part of this green belt in the city, combining modernity with ecology.

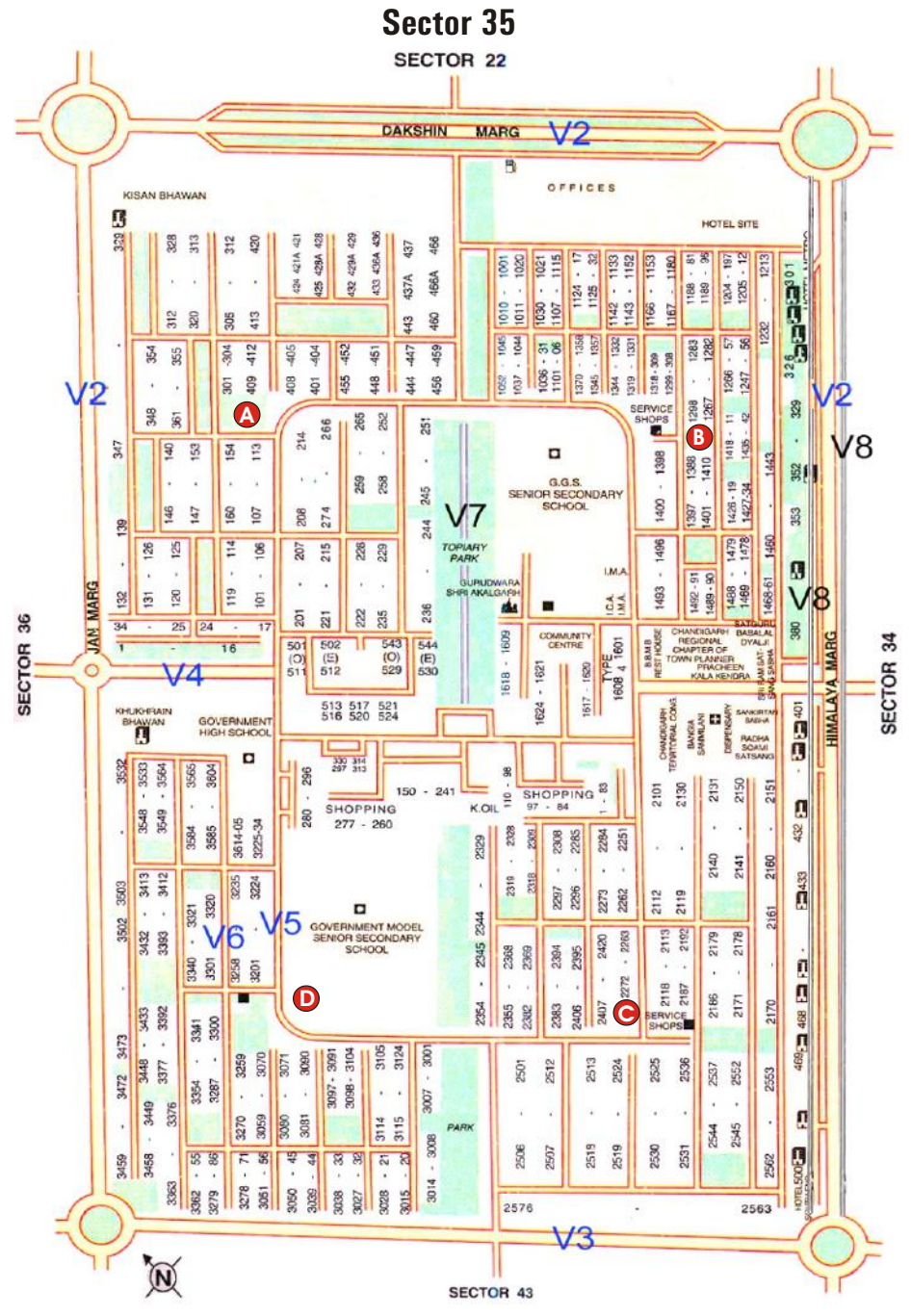
One unique feature in the layout of Chandigarh is its roads, classified in accordance to their functions. An integrated system of seven roads was designed to ensure efficient traffic circulation. Corbusier referred to these as the 7 Vs. The city's vertical roads run northeast/southwest (the 'Paths'). The horizontal roads run northwest/southeast (the 'Margs'). They intersect at right angles, forming a grid or network for movement.

This arrangement of road-use leads to a remarkable hierarchy of movement, which also ensures that the residential areas are segregated from the noise and pollution of traffic.

Map1.5 presents a diagrammatic representation of the same.

Each 'Sector', or the neighbourhood unit, is quite similar to the traditional Indian 'mohalla'. Typically, each sector measures 800 metres by 1200 metres, covering 250 acres of area. Each sector is surrounded by V2 or V3 roads, with no buildings opening on to them. Access from the surrounding roads is available only at four controlled points which roughly mark the middle of each side. Typically a sector is divided in four parts by a V4 road running from east to west and a V5 road running from north to south. These four parts are easily identifiable as A, B, C and D corresponding to North, East, South and West sides. However, Sectors 1 to 6 have no sub sectors and sectors 7 and 8 have only three parts A, B and C (this is because they are developed according to the concept proposed by the first planner of the city, Albert Mayer, to give his concept some recognition). In case of quardipartite sectors, the houses from 1 to 1000, 1001 to 2000, 2001 to 3000 and 3001 to 4000 are located in sub sectors A, B, C and D in clockwise direction. Though all the sectors are structured more or less similarly, but they have their own characteristics and individuality. Each sector is meant to be self-sufficient, with shopping and community facilities within reasonable walking distance. The sectors of the city are numbered commencing from the northern most edge of the city with the highest numbers located at the southern edge. There is no Sector 13 in Chandigarh, but the addition or subtraction of the number of any two adjacent sectors along 'Paths' amounts to 13 or its multiple (*e.g.* Sector 2 + Sector 11 = 13, Sector 11 + Sector 15 = 26, etc.). Though it is generally believed that No. 13 was left out due to superstition but records indicate that Sectors 12 and 13 were

Map 1.5 Diagrammatic representation of a typical sector



Source : Atlas of Chandigarh, CITCO, 2002

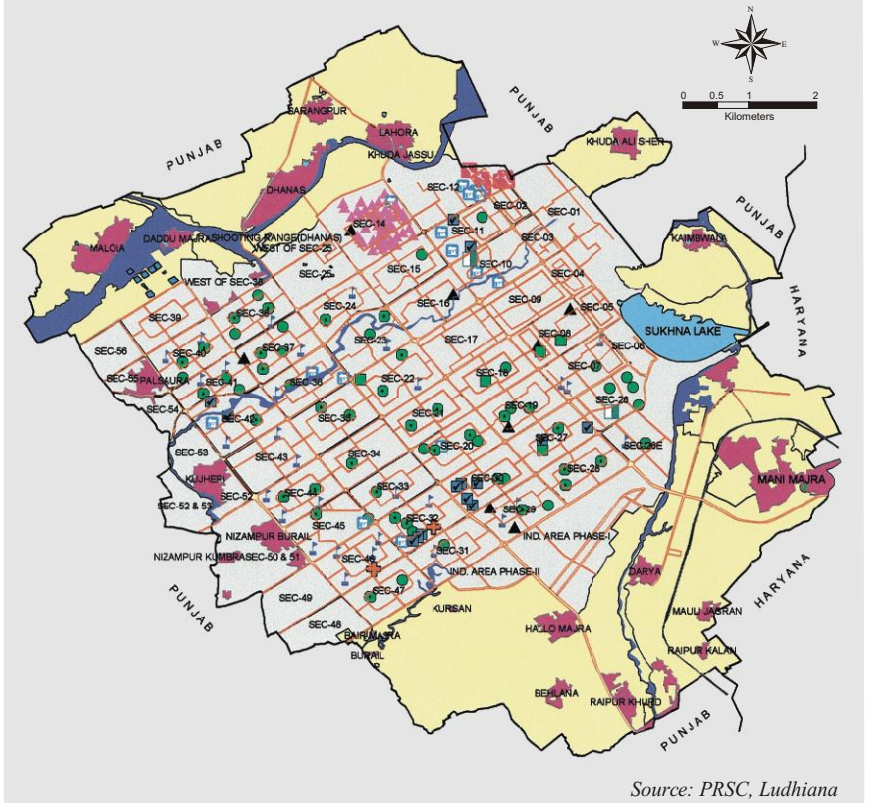
demarcated initially as a cultural zone in the lower halves of Sector 10 and 11 but later removed to avoid confusion. However, later No. 12 was assigned to residual area at the edge of Sector 11 but No. 13 was left out in absence of an appropriate area for its location. The location of Sectors 26, 27, 28, 29 and 30 is also somewhat anomalous. As per records, the phase-I of the master plan was up to Sector 25. Later the city was extended in the space available east of Sector 7, 19 and 20 and numbered 26, 27, 28, 29 and 30.

Though educational (Map 1.6), cultural and medical (Map 1.7) facilities are spread all over the city, however, major institutions are located in Sectors 10, 11, 12, 14 and 26. These cater to neighbouring states as well. The Post Graduate Institute for Medical Education & Research is a major referral hospital of the region catering to all northern states.

The industrial area comprises 2.35 sq km, set-aside in the Master Plan for non-polluting, light industry on the extreme southeastern side of the city near the railway line, as far away from the educational sectors and Capitol Complex as possible. Of this, 136 hectares was developed in the first phase. In the event of expansion, creation of an additional industrial area in the southern part of the city was envisaged. While the Industrial area is directly connected to the civic centre by a V3 road, a wide buffer of fruit trees was planted to screen off this area from the rest of the city. Architectural controls have been established regarding site coverage and materials of construction, ultimately requiring all plans to be formed in consultation with the Capital Project Office. A maximum site coverage up to 50 per cent is allowed with 2.5 per cent of the space permitted to be used as quarters for essential staff. In Sector 30, which is sufficiently close to the Industrial Sector, multi-storeyed buildings for providing suitable tenements for the workers have been developed. Besides this, industrial housing is also provided in Sectors 28 and 29.

Tree plantation and landscaping has been an integral part of the city's Master Plan. Twenty six different types of flowering and 22 species of evergreen trees (Singh *et. al.,* 1998) have been planted along the roads, in

Map 1.6 Educational facilities in Chandigarh



Source: PRSC, Ludhiana

LEGEND

- Panjab University
- Punjab Engg. College
- Govt. Medical/Ayurvedic College
- College
- Polytechnic
- ITI
- Higher/Sen. Secondary School
- High School
- Public/Model/Other School
- Primary School
- Nursery School
- Institute/Training Institute

General Legend

- Village
- River
- Tanks
- Road
- Railway Line

NRIS
National (Natural Resources Information System)
Department of Space Sponsored Project
Executed By
Punjab Remote Sensing Centre
Ludhiana - 141 004
In Technical Collaboration with
Regional Remote Sensing Service Centre
Dehradun - 248001

parking areas, shopping complexes, residential areas and in the city parks, to ameliorate the harsh climate of the region, especially the hot and scorching summers.

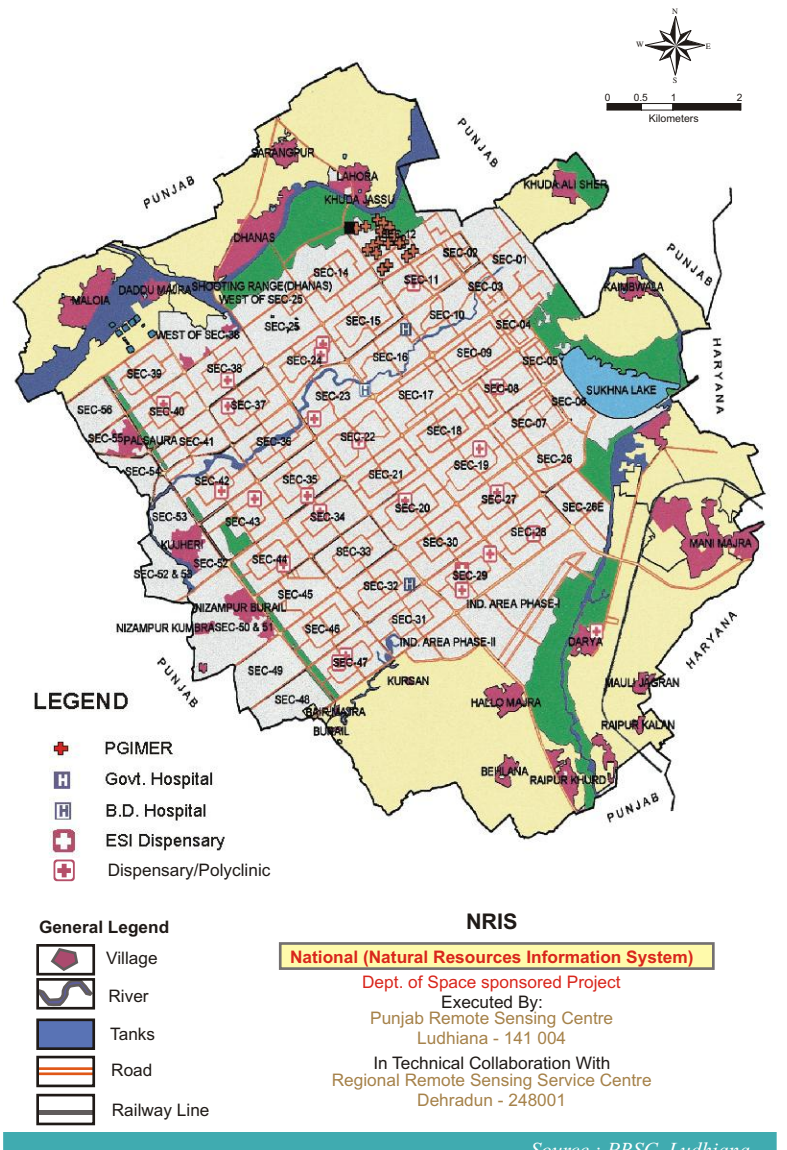
VILLAGES & SLUM AREAS

Manimajra, at the east of Chandigarh city, falls under the Municipal Corporation of Chandigarh along with areas like Shivalik Enclave, etc in the form of two wards. At present there are 18 villages namely Kaimbwala, Khuda Alisher, Khuda Jassu, Khuda Lahora, Sarangpur, Dhanas, Dadumajra, Maloya, Palsora, Kajheri, Hallomajra, Behlana, Raipur Khurd, Raipur Kalan, Makhanmajra, Kishangarh, Mauli Jagran and Daria with 17 Panchayats. Four villages i.e. Badheri, Butrela, Burail and Attawa are now under the municipal limits of Chandigarh and are under the control of the Municipal Corporation. In addition, according to a survey by Labour department and Department of Food & Supplies, 14 slums namely, (1) Ambedkar colony (2) Gursagar Bhattal colony (3) Kabari colony (4) Kalyan colony (5) Kumhar colony (6) Labour colony-4 (6) Labour colony-5 (8) LBS colony (9) Madrasi colony (10) Nehru colony (11) Rajiv colony (12) Sanjay Labour colony (13) SBS Mauli Jagran and (14) Shahpur, exist in/around the city with a population of about 70,000.

POPULATION GROWTH IN THE CITY

Chandigarh was planned for a finite population of half-a-million. In Phase-I, 36 sq km of land was acquired by the city administration for construction of 30 sectors. Land for seventeen additional sectors (Sectors 31 to 47) was acquired and developed during the second phase to cater to a population of 350,000. The predominance of 3/4 storey apartments in the second phase provide for higher population density. However, Chandigarh has now grown beyond its planned capacity. Hence, development in the third phase has started in Sectors 48 and beyond. Demographic data indicate that between 1961 and 1971, the population increased by 144.59 per cent, one of the highest for urban areas in India. According to 1981 census, it grew by another 75.55 per cent, followed by 42.16 per cent in 1991 and by 40.33 per cent in 2001 (with a total population of 9,00,65). By 2021 the population of Chandigarh is projected to be around 19.5 lacs (at current rate of growth), almost four times for which it was originally built (Fig. 1.1).

Map 1.7 Medical facilities in Chandigarh



Source : PRSC, Ludhiana.

INDUSTRIAL GROWTH IN THE CITY

The growth of industry over the past 40 years has been gradual. According to the Directorate of Economics and Statistics, Chandigarh Administration, 528 registered factories are located in the city including 15 large and medium scale units. Of the small scale industries, roughly 40 per cent are ancillary units producing parts for the tractor industry around Chandigarh. Light engineering is heavily represented; other units produce industrial fasteners, electric/electronic items, machine tools, pharmaceuticals, plastic goods, sanitary fittings, leather goods, steel furniture and food products.

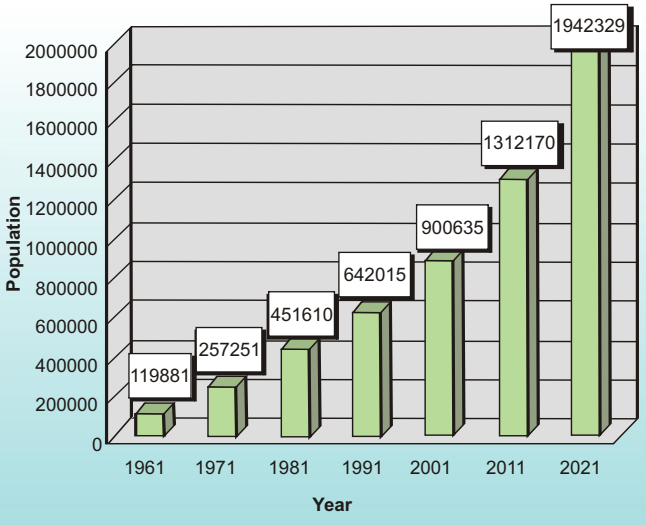
ECONOMIC GROWTH IN THE CITY

The per capita income of the city is highest in the country amongst all States and UTs followed by Goa (26,106 Rupees) and Delhi (24,450 Rupees). It has increased from 19,761 Rupees in 1993-94 to 44,397 Rupees in 2000-2001 at current prices and 29,208 Rupees at constant prices. The Gross State Domestic Product (SDP) has increased from 1,46,785 lac Rupees in 1993-94 to 5,37,067 lac Rupees (at current prices) and 3,07,046 lac Rupees (at constant prices) in 2002-03. Out of this 70.7% is through tertiary services like transport, railways, communication, trade, financial services, real estate, etc., 28.5% is through secondary sources like manufacturing, and only 0.9% is from primary sources like agriculture & forestry. The Net SDP has increased from 19,761 lac Rupees in 1993-94 to 52,795 lac Rupees at current and 29,767 lac Rupees at constant prices (2002-03).

CHANDIGARH PERIPHERY ZONE

Due to expanding population (including influx of migrants) Chandigarh has not been able to retain its identity as a fully planned urban area surrounded by a green belt of countryside. Not only has there been considerable non-planned development within the city but also extensive haphazard growth has taken place in its periphery even though the Periphery Controlled Area Act was enacted in 1952 to pre-empt this. Under the Act a peripheral zone was delineated up to a distance of 8 km on all sides from the boundary of the land acquired for the capital project. This limit was later extended upto 16 km in 1962. The stipulated objectives were to check the expansion of the city beyond the planned site, prevent speculation in land, and provide green environs to the city beautiful.

Fig. 1.1 Population trend in Chandigarh from 1961 to 2021

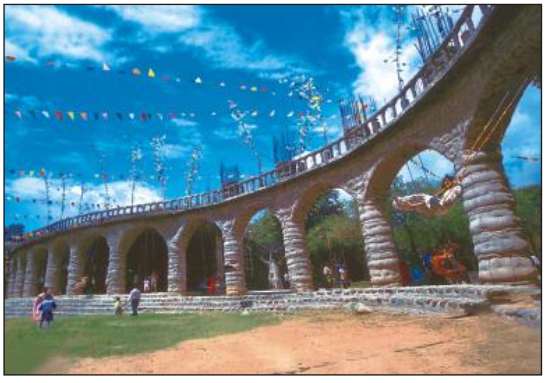


Source: Statistical Abstract of Chandigarh, 2002 & Department of Town Planning, Chandigarh

However, with the violation of the Chandigarh Periphery Zone the pressure on Chandigarh's infrastructure continues to intensify. The States of Punjab & Haryana have developed new cities, SAS Nagar and Panchkula, respectively in the immediate periphery area. Other areas exerting a pressure on the city's infrastructure are Mansa Devi Complex in Haryana, and Zirakpur, Dera Bassi and Kharar towns in Punjab. Unauthorized development in north west of Chandigarh (Naya Gram, Forest Hill Resort in Karoran, etc.) also violates the Periphery Controlled Area Act.

Shanti Kunj

Sukhna Lake



Rock Garden (Courtesy : CITCO)

AREAS OF INTEREST

Chandigarh is famous for its architecture and landscaping world over. It combines elegant architectural forms with wide tree-lined avenues, green belts and gardens and is hence, referred to as the 'City Beautiful'.

Green open space comprise about 8 sq km out of 114 sq km of the capital project area. Major open areas include the Leisure Valley, Sukhna Lake, Rock Garden and many theme gardens. In addition, the sectors are vertically integrated by a green belt oriented in the direction of the mountains.

Various structures such as the Government Museum and Art Gallery, Museum of Evolution of Life and Fine Arts College have come up in the leisure valley forming the cultural zone of the city.

Sukhna Lake, a major tourist attraction, was constructed in 1958 across Sukhna choe and was planned as an integral part of master plan of the city. The lake spreads on the foothills of the Shivalik mountain range. The reservoir of the lake is in the shape of a bean seed bounded by a 12.8 m high rock fill earthen dam. The total catchment area of the lake is 42.07 sq km, of which 34.42 sq km falls in the Union Territory of Chandigarh (including 25.42 sq km newly acquired area) and 7.7 sq km falls in the state of Haryana. This additional area is prone to erosion.

Rock Garden, the creation of Nek Chand, is another tourist attraction which is built with construction and municipal waste. It expresses the fragility of the environment, the need for conservation of the earth's natural resources and the importance of balancing industrial development with sound environmental practices.

The Zakir Rose Garden, spread in an area of over 0.12 sq km of land, is Asia's largest Rose Garden with 50,000 rose bushes of 1600 different varieties of roses.

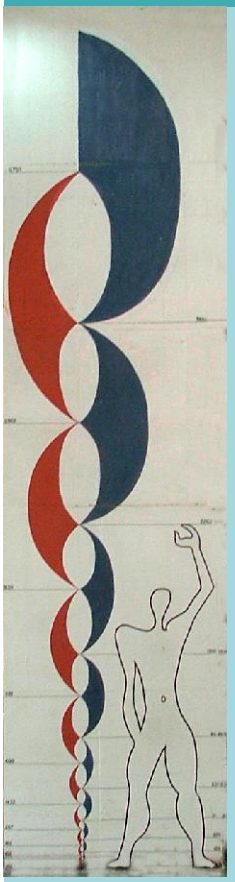
BIODIVERSITY OF CHANDIGARH

Flora

The flora of Chandigarh is very rich. About 860 species of flowering plants have been recorded in the area and its neighbourhood (as cited in SBSAP, Department of Environment, UT) . These represent 526 genera from 116 families. About 80 percent of the species belong to families Gramineae, Papilionaceae, Compositeae, Cyperaceae and Euphorbiaceae (with 92, 83, 49, 36 and 33 species, respectively).

The most fascinating feature of the city's landscape is the tree plantation along avenues, open spaces, green belts and building complexes. In 1952 the Tree Preservation Order was passed which prohibited cutting down, lopping or willful destruction of trees in Chandigarh. The green spaces like parks, gardens, green belts, Leisure valley and

EDICT OF CHANDIGARH



The edict of Chandigarh proposes to enlighten the present and future citizen of Chandigarh about the basic concepts of planning of the city so that they become its guardians and save it from whims of individuals. The edict highlights that the city is planned to human scale putting its residents in touch with the infinite cosmos and nature. It provides places and buildings for all human activities so that the citizen can live a full and harmonious life.

The central plaza in Sector 17 was designed by Le Corbusier as "Pedestrian's Paradise". No vehicular traffic is permitted in the plaza.

The edict also specifies that no personal statues shall be erected in the city or in parks of Chandigarh. The city is planned to breathe the new sublimated spirit of art. Commemoration of persons is confined to suitably placed bronze plaques.

The edict also proposes that the truthfulness of materials of construction, concrete, bricks and stone, shall be maintained in all buildings constructed or to be constructed.

The seed of Chandigarh is well sown. It is for the citizen to see that the tree flourishes.

road avenues, etc. are in addition to the forest cover. In accordance with the road system of the city, V2 and V3 roads are planned for fast traffic. Hence, single rows of trees with light evergreen foliage (to avoid need of sweeping) are planted. Plantation along these roads is planned keeping in view the sun's position, ensuring favourable conditions for motorists in relation to its glare. As such vertical V3s (where the sun's rays in winter are disadvantageous) are planted with Mango (*Mangifera indica*), Imli (*Tamarindus indica*), Mahua (*Bassia latifolia*), pilkhan (*Ficus infectoria*), kusum (*Schleichera trijuga*), etc. However, along horizontal V3s which run from South East to North West, not much of Sun's glare is faced. Hence, plantations include single species avenues of mahagony (*Swietenia mahagoni*) along Udyog Path and arjun (*Terminalia arjuna*) along Dakshin Marg. The V4 roads are neighbourhood shopping streets. Since most Shopping Centres face east wards, trees have been planted strategically to provide shade especially in the afternoons. These include amaltas (*Cassia fistula*) & related species (*Cassia javanica, C. renigera* & *C.nodosa*), smunder phall (*Barringtonia acutangula*), Kadam, (*Anthocephalos cadamba*), Lagerstroemias (*Lagerstroemia thorelli*), etc. The V5 roads circulate through the entire sector. Keeping in view the sun's direction only one side of the road is usually planted. Hence, evergreen trees with a combination of flowering trees have been planted to break the monotony of buildings. These include cassias, kachnar, neem, silver oak, bahera, etc. Since houses are located on V6 roads, tree plantation has been carried out keeping in view the sun's direction and location & height of houses. An important aspect kept in view is that trees should not block the winter sun from residences. This

would also avoid requests for pruning in winters. Hence, winter deciduous trees like Lagerstroemias, Acacias, etc. have been planted. Along V7 pedestrian paths trees providing thick shade in summer are planted. Hence, these trees, with their vast, thick spreading canopies offer shade over many of the city's roads. In all, more than 100 different tree species have been planted in Chandigarh.

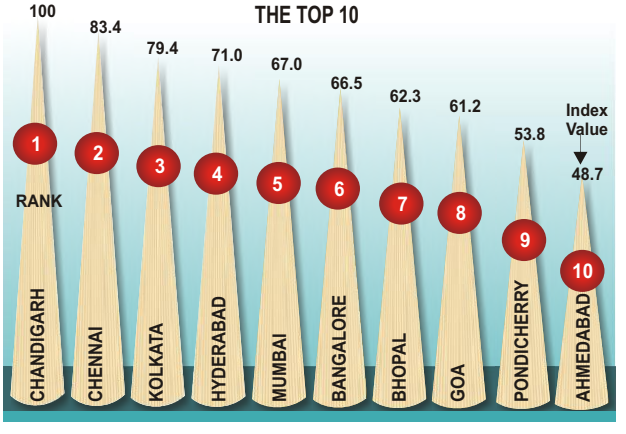
Chandigarh Museum

Fauna

The Sukhna Wildlife Sanctuary was notified in 1977 covering 25.41 sq km of hilly forest area u/s 18 of the Wild Life (Protection) Act, 1972. The predominant animals in the sanctuary area are sambhar, wild boar, porcupine, jungle fowl, peacock, grey partridges, etc. The city Bird Sanctuary in Sector 21 was established in 1988 and houses parakeets. The Sukhna Wetland provides home to 37 species of fish and about 129 species of resident and 98 species of migratory birds (Source: SBSAP, Chandigarh) besides other vertebrate and invertebrate fauna.

Chandigarh, the elegantly designed city, has been rated as the 'Best City to Live In' by Outlook Money-Indicus Analytics study in 2003 (Fig. 1.2). This study takes into account 12 parameters (jobs & income, education, health, safety, prices, transport, housing, pollution, finance network, entertainment, consumption, weather), 50 sets of indices & 60 variables and is based on 3,600 direct responses and 9,974 statistical nuggets.

Fig. 1.2 Top 10 livable cities in India



Source : www.outlookmoney.com

To retain its character, the Chandigarh Administration has notified the Chandigarh Municipal Corporation (Sanitation & Public Health) Bye Laws, 1998 (Annexure 1.1).

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CHAPTER-2

AIR

Air is a precious natural resource. However, human activities like industrial production, motor transport and burning of fuels are triggering off a host of global and regional environmental problems by adding harmful pollutants to the atmosphere. Yet, the concern for clean air and protection of environment from these pollutants is only recently recognized.

Air pollution denotes any solid, liquid or gaseous substance present in the atmosphere in such concentrations as may be or tend to be injurious to human beings, living creatures, plants, property or environment. Major air pollutants and their characteristics are presented in Box 2.1.

To monitor the status of ambient air quality in the country the Central Pollution Control Board has established a national network of 290 stations spread over 92 cities and towns under the National Air Quality Monitoring Program (NAMP, formerly known as National Ambient Air Quality Monitoring-NAAQM). The program envisages determining ambient air quality status and trends, identifying appropriate actions for maintenance of desired quality, providing background air quality data as needed for industrial siting, regulating pollution to meet the prescribed ambient air quality standards and assessing its potential health hazards and damage to property.

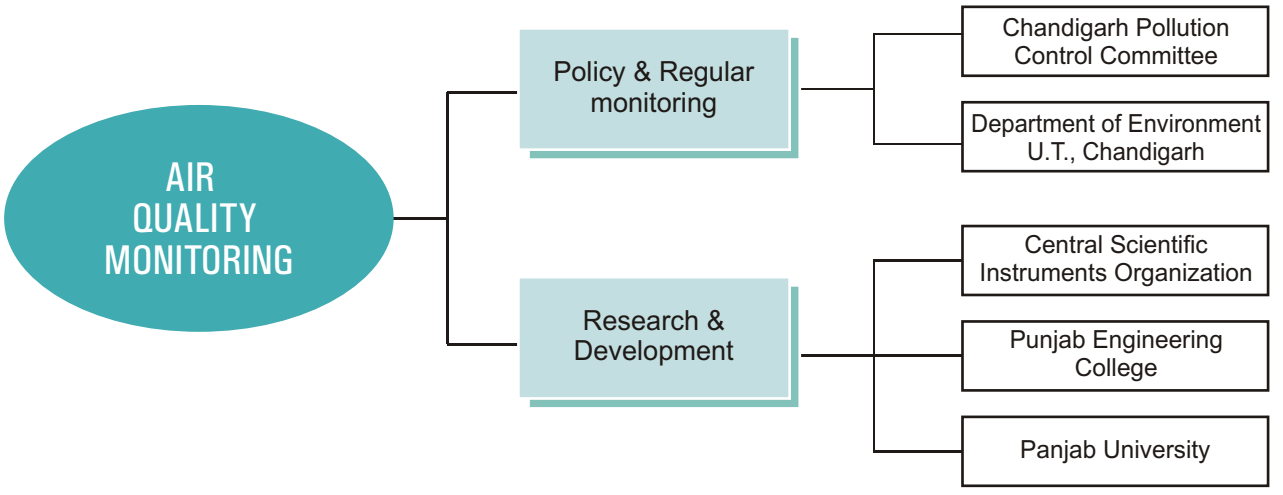
Box 2.1 Major Air Pollutants

- Particulate Matter is any type of solid in the air in form of smoke, dust, and vapours, which can remain suspended for extended periods. Particulates are produced by many sources, including burning of fuels, road construction, industrial processes, such as operation of fireplaces and woodstoves in slums & burning of leaves in Chandigarh.
- Nitrogen Oxides (NOx) are produced by burning fuels, including gasoline & coal. Nitrogen oxides react with volatile organic compounds to form smog.
- Sulfur Dioxide (SO_2) is an odorless gas at low concentrations, but can have a very strong smell at high concentrations. It is produced by burning coal. Some industrial processes, such as production of paper and smelting of metals also produce sulfur dioxide. Like nitrogen oxides, SO_2 is a major contributor to smog and acid rain.
- Carbon Dioxide (CO_2) is the principal greenhouse gas emitted as a result of activities like burning of coal, oil, and natural gas.
- Carbon Monoxide (CO) is an odorless, colorless gas. CO is produced by the incomplete burning of carbon-based fuels, including gasoline, oil, and wood. It can build up in high concentrations in enclosed areas such as garages, poorly ventilated areas, and even along roadsides in heavy traffic.
- Ozone (O_3) in the stratosphere shields the earth from the sun's dangerous ultraviolet rays. However, it is a pollutant in the troposphere. Ground-level ozone comes from the breakdown (oxidation) of volatile organic compounds found in solvents. It is also a product of reactions between chemicals that are produced by burning coal, gasoline, other fuels, and chemicals found in paints and hair sprays. Vehicles and industries are major sources of ground-level ozone.
- Chlorofluorocarbons (CFCs) are chemicals used in great quantities in industry, for refrigeration and air conditioning, and in consumer products. CFCs, when released into the air, rise into the stratosphere where they take part in chemical reactions that result in reduction of the stratospheric ozone layer.
- Lead is contributed by paint industry (for houses and cars), smelters, manufacture of lead batteries, and a few hair dye products. Vehicles were a major contributory factor before lead free petrol was introduced in the country.
- Volatile Organic Compounds (VOCs) include gasoline, industrial chemicals such as benzene, solvents such as toluene and xylene, and perchloroethylene (principal dry cleaning solvent). VOCs are released from burning fuel, such as gasoline, wood, coal, natural gas and from solvents, paints, glues, and other products. Vehicle emissions are also an important source of VOCs.

Institutional Framework

The entire Union Territory of Chandigarh was declared 'Air Pollution Control Area' under Air (Prevention & Control of Pollution) Act, 1981 on 1st, February, 1988. The Act was implemented by the Central Pollution Control Board (CPCB). Subsequently, the Chandigarh Pollution Control Committee (CPCC) was established in 1991 which is now responsible for performing the functions of the State Pollution Control Board. The CPCB has prescribed the National Ambient Air Quality Standards for various pollutants (Annexure 2.1). These are the levels of air quality to protect public health, vegetation and property.

Major institutions, which work towards air quality monitoring & preservation in Chandigarh are:



In addition to the above, the Transport department is responsible for taking action for control of vehicular pollution whereas the Municipal Corporation is responsible for control of pollution from municipal waste.

Driving Forces

Chandigarh, being the capital of two states, as well as being a Union Territory, and due to its geographical location, has witnessed a spurt in population and industrial & commercial activities in the past forty years. Due to this, the number of vehicles has also increased at an exponential rate. All these have caused deterioration of its air quality. The major driving forces include:

1. **Population**
   The exponential growth of population and resultant human activity in the city is one of the major forces leading to air quality deterioration. Though the city was designed for a maximum population of 5 lacs, demographic data indicates that the population has increased about 8 times between 1961 to 2001 with the current population being over 9 lacs (2001 census). Further, it is estimated by the Town and Country Planning Department that by the year 2021 the population of Chandigarh would be around 19.5 lacs (at current rate of growth) *i.e.* almost four times for which it was originally built.

2. **Transport**
   Petrol & diesel driven vehicles are major contributors to air pollution especially in urban areas. The vehicular population in Chandigarh has increased 10 times since 1981. Data indicates that the per person motorized vehicular population has also increased.

3. **Industrial growth**
   Industrial growth is generally perceived as a major contributor to air pollution. Though the city showed

almost five fold increase in the number of industries since 1971, however, these are not a major contributor to air pollution as industrial growth is restricted only to a few polluting industries. Most industries permitted in the city are in the green category. Further, industrial area is restricted to one side (SE) of the city and separated from residential areas with a green belt.

4. Municipal/Domestic pollution

As pointed out in Chapter 1, the city has a rich green cover. However, most trees are deciduous with leaf fall during autumn or early spring. This results in high volumes of leaf litter. The uncontrolled burning of dry leaves, is hence, a major cause of air pollution in the city. The use of wood and coal as cooking fuel by the large slum population is also a contributing factor.

Pressure

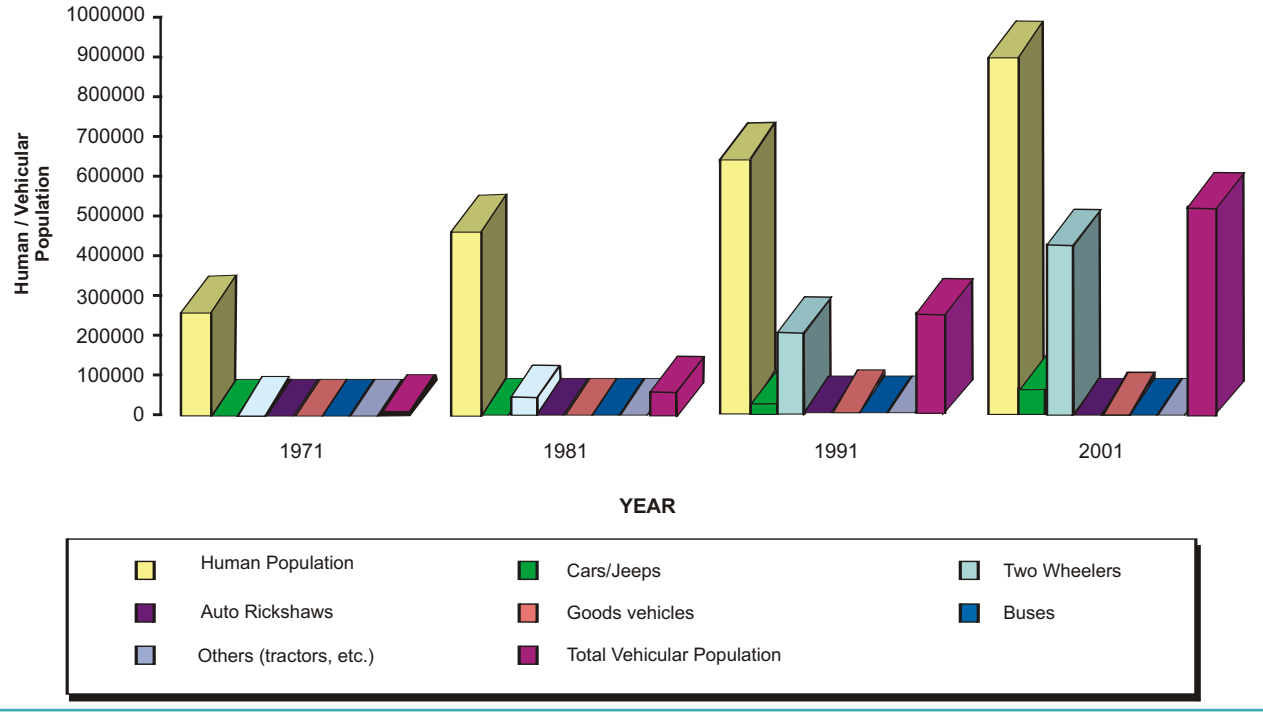
The Pressures on air quality caused by the above driving forces include:

- **Vehicular Pollution**

During the past three decades the population of Chandigarh has nearly tripled, from 2,57,251 in 1971 to 9,00,914 in 2001 (Fig.2.1). With the increasing population, urbanization, industrial and commercial activities, demand for transport has also increased. Inadequate public transport system in the city has led to the use of personalized vehicles. The total number of motorized vehicles in Chandigarh has increased by approximately 42 times from about 12,345 in 1971 to more than 5,22,435 in 2001 (Fig.2.1).

Vehicles during peak traffic hours

Fig. 2.1 Growth of human population vs. number of registered vehicles in Chandigarh



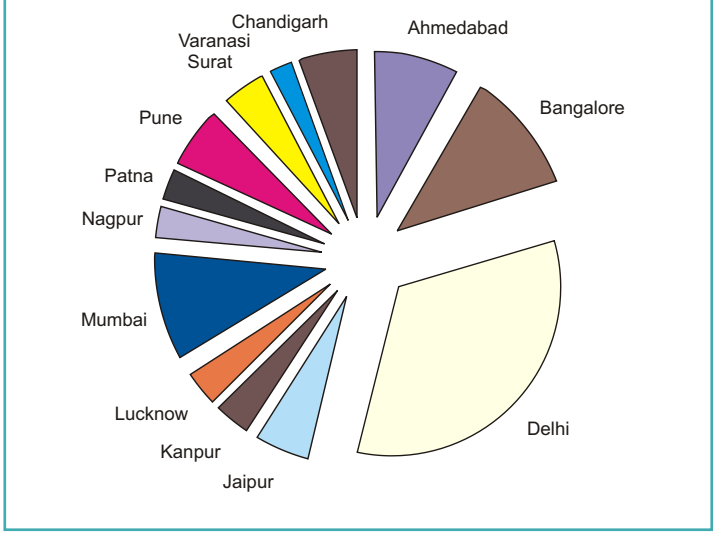
Source: Department. of Transport, UT & Statistical Abstract, Chandigarh

The vehicular population of Chandigarh is also very high as compared to other cities of the country. The number of vehicles in Chandigarh *vis a vis* some of the major cities is presented in Fig. 2.2. Further, data indicates that there is one registered vehicle for every 1.7 persons in the Union Territory (Source: Registration and Licensing Authority, Chandigarh). This ratio is very high as compared to other metropolitan cities like Delhi which has one vehicle for every four persons whereas Pune has one vehicle for every sixteen persons (Source: CPCC,1998).

Data further indicates that out of the total vehicular population, 2/3 wheelers account for about 83% (with two & 4 stroke engines), 4 wheelers for about 14% and buses & trucks (diesel vehicles) for only about 3%. Due to easy availability of loans for purchase of vehicles, the percentage of registered 2/3 wheelers has increased by 48% and the number of 4 wheelers has increased by 35% from 1991 to 2002 (Fig.2.3).

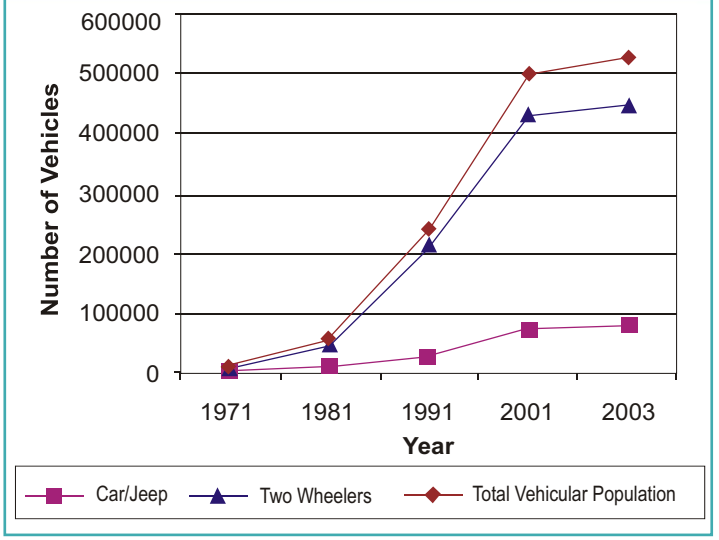
Another distinctive feature of Chandigarh is the high rate of floating vehicular population which visits the city everyday from neighboring states, especially from the twin cities of Mohali (SAS Nagar) and Panchkula. However, no specific data on this is available.

Fig. 2.2 Vehicular population of Chandigarh *vis a vis* other major cities of the country



(Source: www.automeet.com)

Fig. 2.3 Growth of two wheelers *vis a vis* car/jeep and total vehicular population in Chandigarh



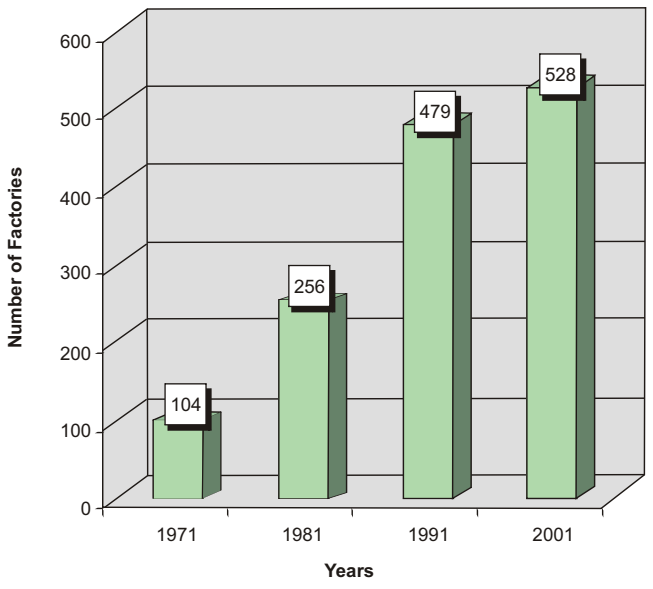
Source: Registration and Licensing Authority, Chandigarh

Whereas diesel vehicles emit higher quantities of particulate emissions and oxides of sulphur, petrol driven vehicles contribute to CO, CO_2, hydrocarbons and benzene into the atmosphere. Since the combustion process is not perfect, several by-products like oxides of nitrogen and sulphur are also emitted during the process.

- **Increased Industrial Activity**

The number of registered factories has increased from 104 units in 1971 to 528 units in 2001(Fig.2.4). Data provided by CPCC indicates that there are about 45 air polluting industrial units under red category in Chandigarh (which include Pit furnaces, Battery units, Zinc reprocessing units, Hot mix plants, Brick kiln and Engineering Industries, Milk and Beverages plants, etc.). Air Pollution Control Devices (APCDs) have been installed in all these units and their regular operation is ensured by the CPCC; hence, they contribute little towards air pollution. The rest of the units are either under Orange or Green category. These include rice

Fig. 2.4 Industrial growth from 1971 to 2001 in Chandigarh



Source: Statistical Abstract, Chandigarh (2003)

Leaf Litter Burning

mills, flour and dal mills, spice grinding units, screw manufacturing units and light engineering industry which are known to contribute to air pollution through dust and fugitive emissions generated by them. However, the city has a clearly defined and delineated Industrial zone towards its South East. The wind for major parts of year also flows from North West to South East thus protecting the residents from the hazards of industrial air pollution.

- **Municipal and Domestic Pollution**

The burning of dry leaves and litter from trees and innumerable gardens in the city during September-October and March-April is a major contributor to air pollution. However, no specific data is available on the extent of leaf burning in the city during these months. Though the administration is discouraging this practice, specific data on quantities of leaf litter generated, air pollution caused and remedial actions is not available. Data on use of coal and wood as fuel for cooking purposes by the slum population also needs to be generated.

- **Other Sources of Pollution**

Chandigarh boasts of a good infrastructure and round the clock availability of power. Hence, the problem of air pollution from gensets is restricted to certain commercial sectors (like Sectors 17, 22, 34 & 35) and industrial area only, usually during summer months. A survey was conducted by CPCC in the year 2003 to enumerate the number of gensets in Sectors 22 and 17. Notices were issued to the owners of gensets which were not as per specifications. As a result, these have either been removed or provided with Air Pollution Control Devices. Follow up surveys are being taken up.

Further, a large section of people in Chandigarh belong to the upper and upper middle class categories with a high life style. Hence, population of ACs and refrigerators in offices and for domestic use is high, contributing to CFCs. AC manufacturing and assembling units and rubber & foam industries are also operative.

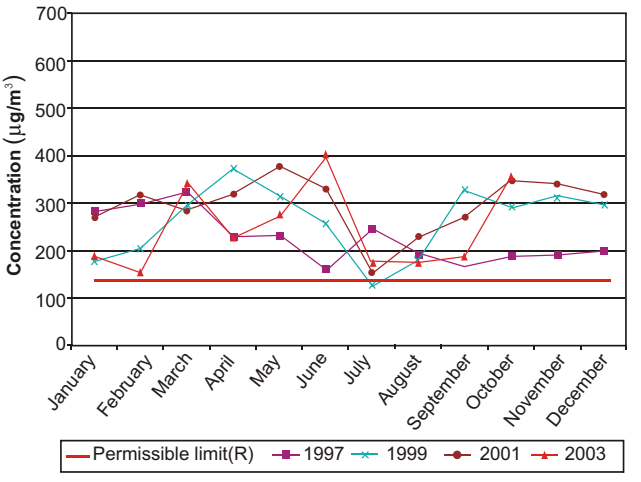
Ambient Air Quality of Chandigarh

The CPCC is currently operating two NAMP (National Air Quality Monitoring Program) stations, one at industrial area and the other at Sector 17 (representative of commercial-cum-residential area) in Chandigarh.

The pollutants monitored under this program are Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM), Sulfur dioxide (SO_2) and Nitrogen oxides (NOx). The target sampling duration for monitoring is 24 hours and more than 16 hour values in a day are considered as representative of the air quality for that particular day. The permissible limits are presented in Annexure 2.1.

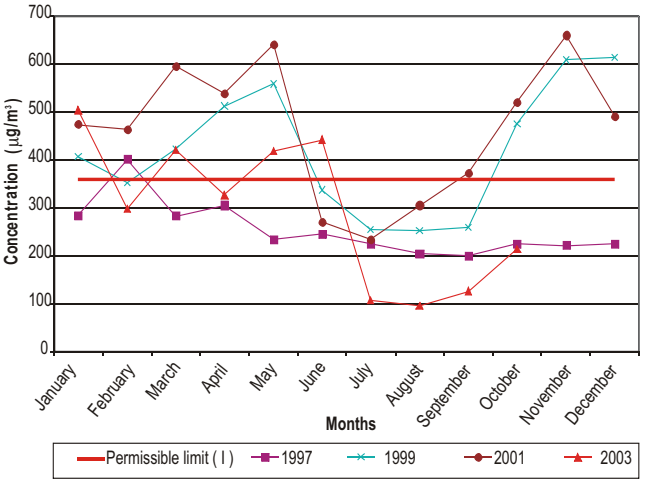
As per the data provided by CPCC, both, the 24 hourly and annual averages of SPM at the Sector 17 monitoring station (Fig. 2.5) generally exceed the permissible limits for residential areas (24 hourly permissible limits: 200µg/m^3 and annual average permissible limits: 140µg/m^3) throughout the year, with higher concentration during the dry summer months (when the background pollution load is also high due to dry & dusty conditions). This could be attributed to the ever increasing vehicular pollution load. The CPCB has also reported Chandigarh to be one of the 14 cities with critical level of SPM in residential areas (CPCB, 2000).

Fig. 2.5 SPM concentrations (annual average) in residential-cum-commercial area (Sector 17) at Chandigarh (1997-2003)



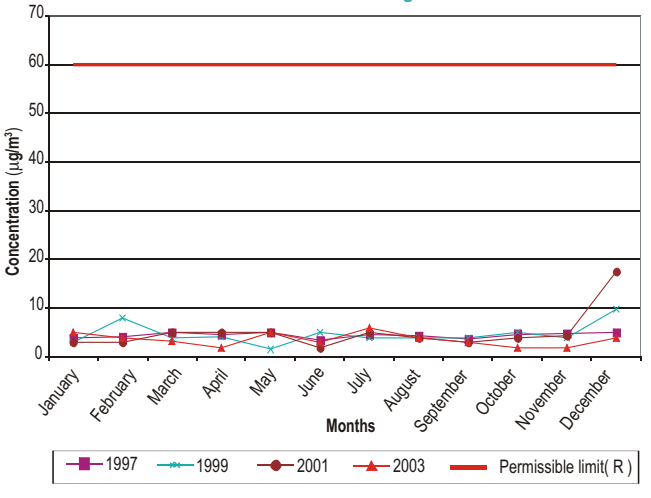
Source: CPCC, 2003

Fig. 2.6 SPM concentrations (annual average) in Industrial area at Chandigarh (1997-2003)



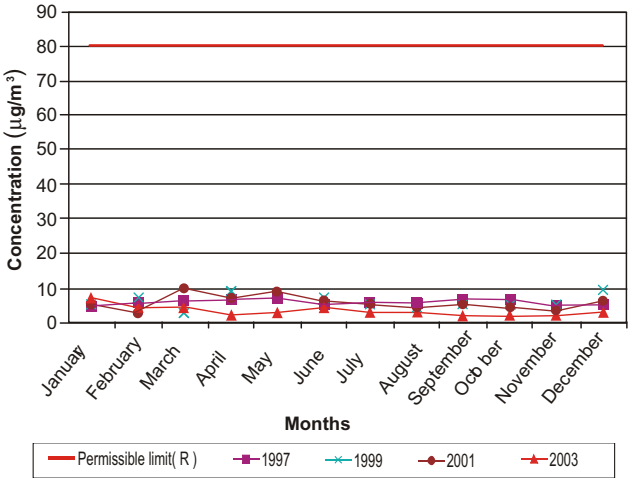
Source: CPCC, 2003

Fig. 2.7 SO_2 concentrations (Annual average) in residential-cum-commercial area at Chandigarh (1997-2003)



Source: CPCC, 2003

Fig. 2.8 SO_2 concentrations in Industrial area at Chandigarh (1997-2003)



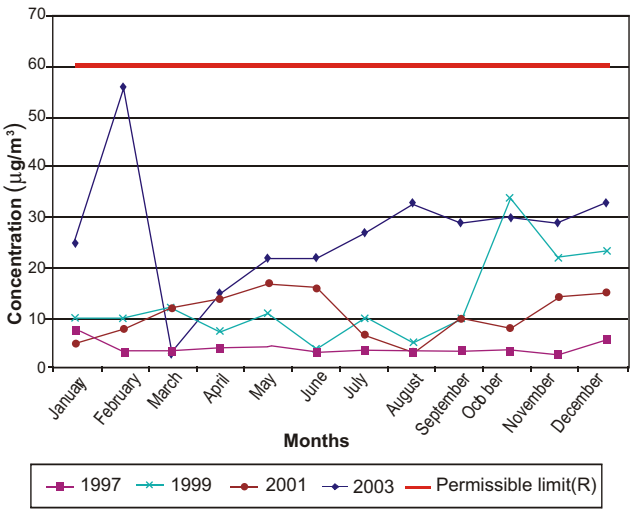
Source: CPCC, 2003

In the Industrial area, however, SPM levels are usually below permissible limits of 500µg/m^3 for 24 hourly data but it remains above the permissible limits of 360µg/m^3 for annual averages (Fig.2.6). There is a general increase in total SPM value in recent years as compared to 1997 data indicating increasing industrial activity in the city.

The SO_2 and NOx levels, both in commercial & industrial areas (Figs. 2.7 to 2.10) are, however, well within permissible limits and hence, are not a cause of concern.

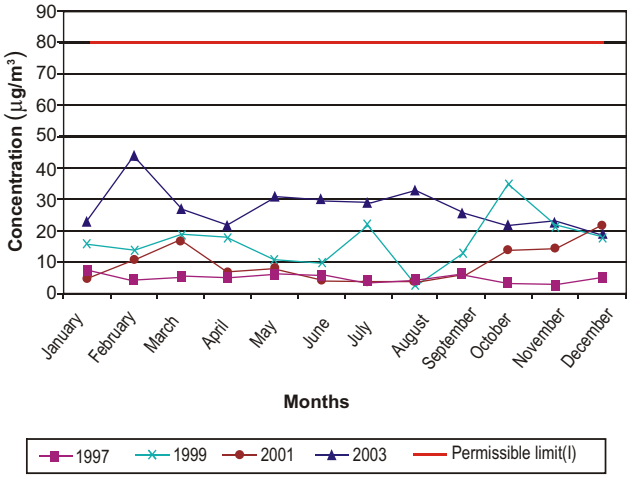
CPCB (2000) has compared concentration of air pollutants in important cities of the country from 1990 to 1998. The data with respect of SPM, SO_2 and NOx is presented in Figures 2.11 to 2.13. Figures 2.14, 2.15 & 2.16 compare annual averages in 2002 of these pollutants in residential and industrial areas in major cities.

Fig. 2.9 NOx concentrations in residential-cum-commercial area at Chandigarh (1997-2003)



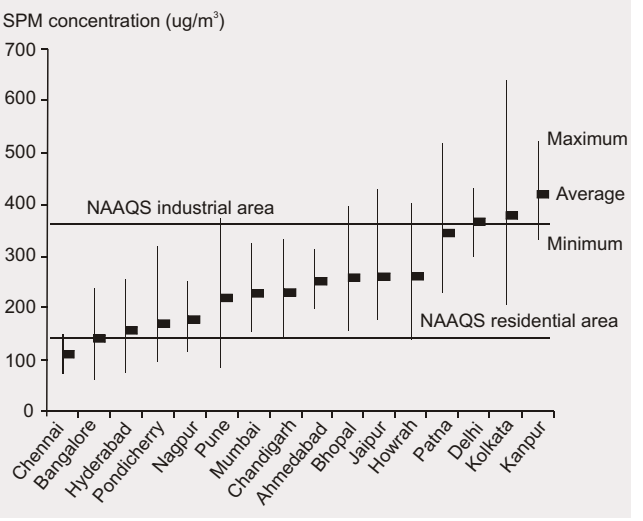
Source: CPCC, 2003

Fig. 2.10 NOx concentrations in Industrial area at Chandigarh (1997-2003)



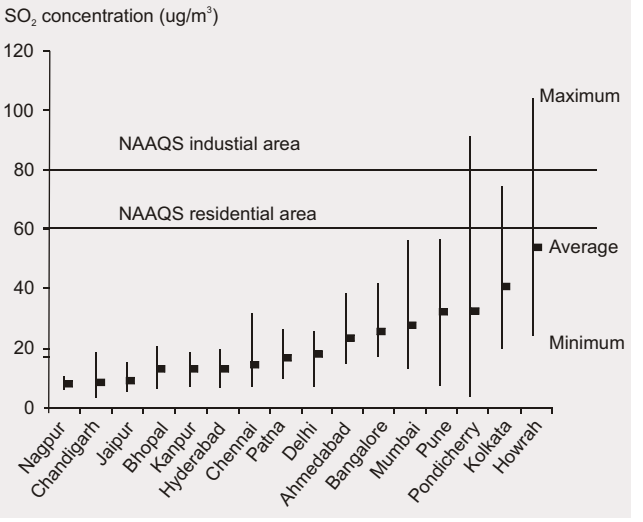
Source: CPCC, 2003

Fig. 2.11 Range and mean of annual averages of SPM (1990-98) in various cities



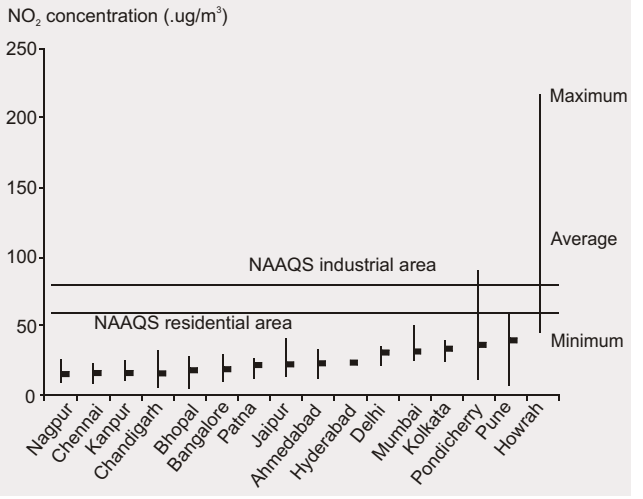
(NAAQS: National Ambient Air Quality Standard) *Source: CPCB, 2000*

Fig. 2.12 Range and mean of annual averages of SO_2 (1990-98) in various cities



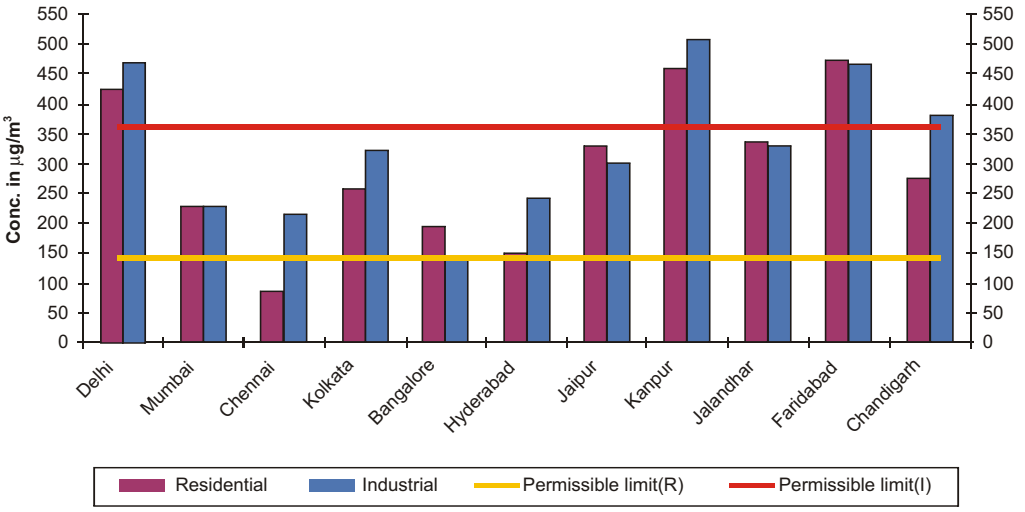
Source: CPCB, 2000

Fig. 2.13 Range and mean of annual averages of NOx (1990-98) in various cities



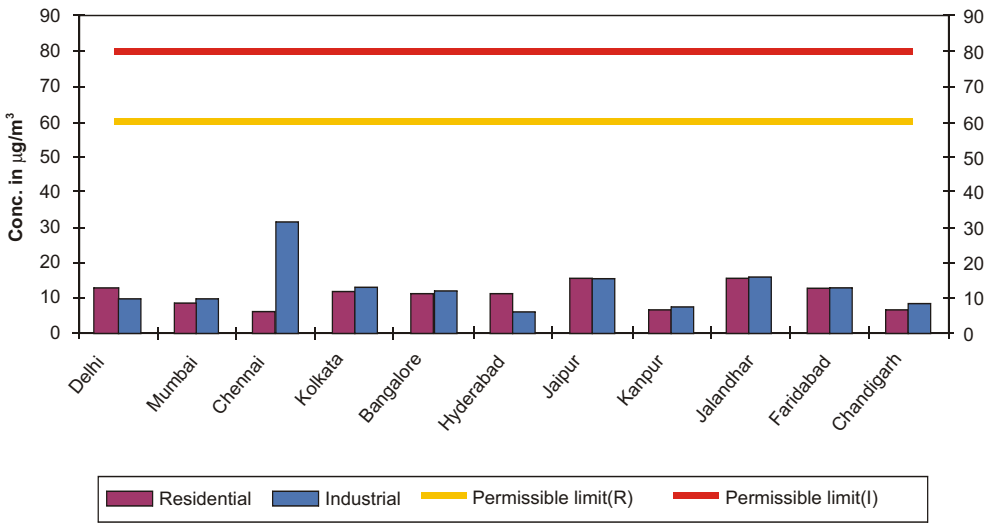
Source: CPCB, 2000

Fig. 2.14 SPM levels (μg/m³) in residential and industrial areas in major cities, 2002



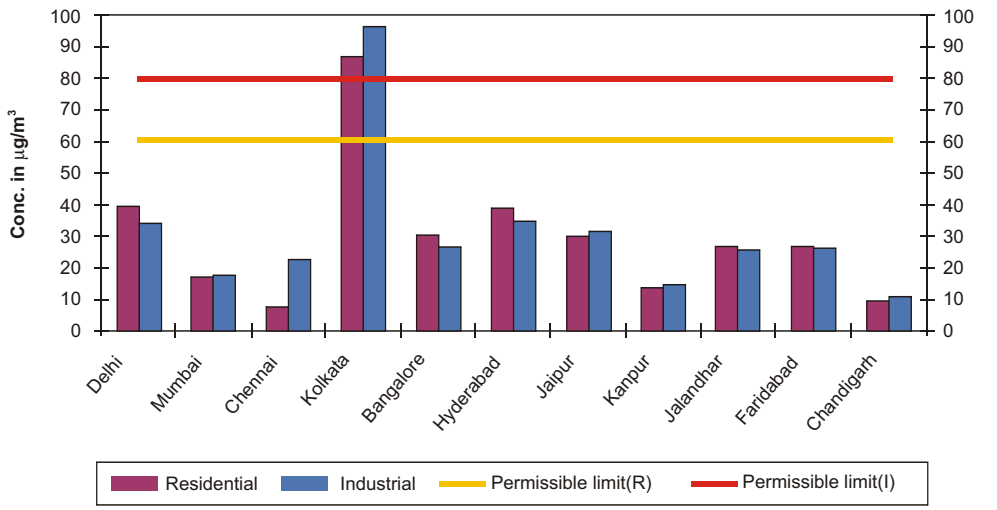
Source: www.cpcb.delhi.nic.in, PPCB & CPCC

Fig. 2.15 SO_2 levels (μg/m³) in residential and industrial areas in major cities, 2002



Source: www.cpcb.delhi.nic.in, PPCB & CPCC

Fig. 2.16 NOx levels (μg/m³) in residential and industrial areas in major cities, 2004



R : Residential, I : Industrial

Source: www.cpcb.delhi.nic.in, PPCB & CPCC

Vehicular Pollution Load

As per studies by Central Pollution Control Board (1998) vehicular emissions are responsible for most of the hydrocarbons (90-95%) and carbon monoxide (70-80%) emissions. In addition, nitrogen oxides (around 40-60%) are also contributed by vehicles. CPCC has calculated the pollution load for the city for the years 1981 and 1991 and John *et.al.*(2004) have calculated values for 2001 and 2011 using the correlation between average pollution load per vehicle and total number of vehicles (Fig.2.17).

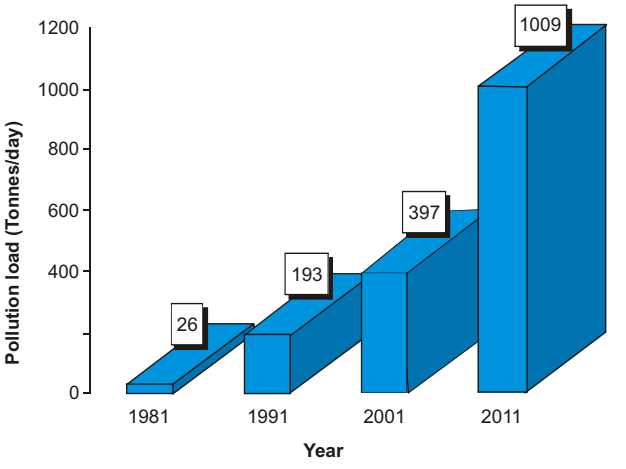
A comparison of data with other major cities (Table 2.1) indicates that in 2001 the city had reached almost the same vehicular pollution load as of Delhi in 1994 (CPCB, 1995).

Table 2.1 Estimated vehicle pollution load in some major cities in 1994

City	Vehicular Pollution Load (Tonnes/day)
Delhi	1046.3
Mumbai	659.6
Bangalore	304.5
Kolkata	293.7
Chennai	226.3
Jaipur	89.0
Kanpur	86.2

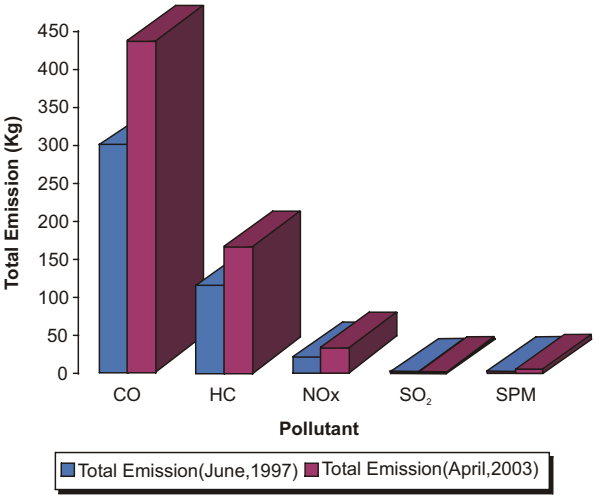
A traffic census was also carried out by CPCC in 1997 at Sector 22 grid (one of the most congested commercial-cum-residential area of the city) and by John *et. al.* in 2004 (under a CPCC sponsored project). The vehicle kilometers were worked out for three groups of vehicles *viz* LTV, MTV and HTV. The vehicle kilometer emission factors provided the pollution load in the grid (Fig.2.18). Per square km data of the study area during peak traffic hours (9-10 AM and 5-6 PM) indicates that the pollution load has increased considerably for all pollutants. Contribution of various pollutants by different categories of vehicles for 2003 is presented in Fig. 2.19.

Fig. 2.17 Vehicular Pollution load in Chandigarh (Tonnes/day)



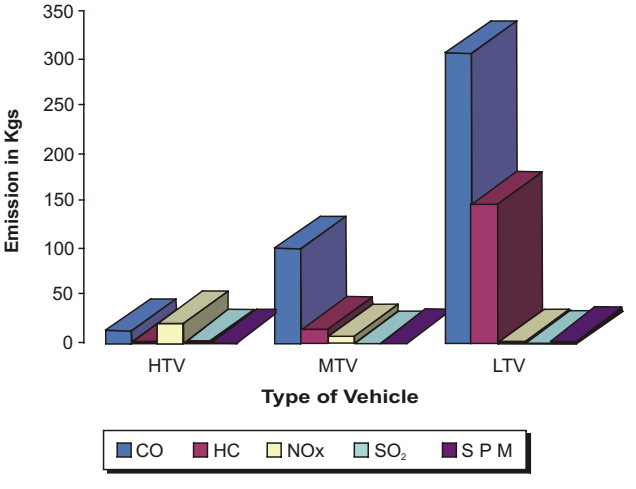
Values for 2011 are estimated.
Source: CPCC, 1998 and John et. al. 2004

Fig. 2.18 Total emissions (kg/sq km) in study area w.r.t Peak Hour Traffic flow



Source: As cited in CPCC, 1998 and John et. al. 2004

Fig. 2.19 Vehicle category wise emissions (kg/sq km) in study area w.r.t Peak Hour Traffic flow



Source: John et. al. 2004

Respirable dust load in Chandigarh

A study on Respirable dust load in Chandigarh was conducted by Garg & Prasad, CSIO in the year 1999-2000. The survey was carried at the following eight sites where maximum dust concentration was expected due to high traffic density/industrial activities:

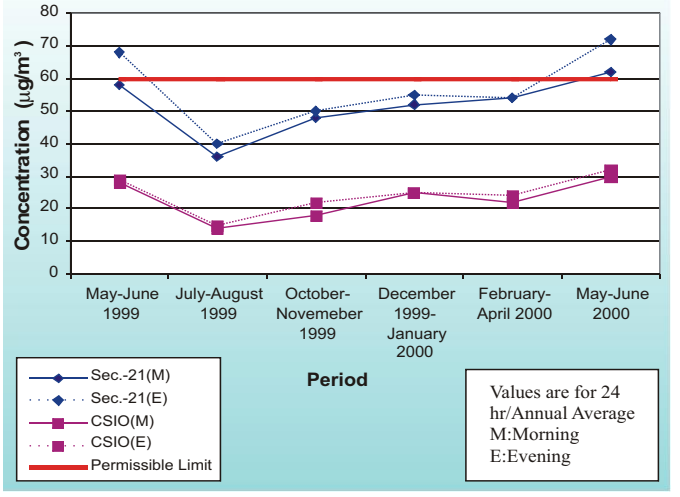
1. Scooter Market, Sector-21 2. CSIO campus	Representing Commercial Zone	(Fig.2.20)
3. Aroma Chowk, Sector 22 4. ISBT, Sector 17 5. Market Complex, Sector-17	Representing Commercial Zone	(Fig.2.21)
6. Railway Station Crossing 7. Ambala Road (Near Medical College Hospital), Sector-32 8. Industrial Area, Phase-I	Representing Commercial Zone with high intensity of HTV	(Fig.2.22)

The observations at different survey points are presented in Figures 2.20 - 2.22.

Data indicates that most of the values were within permissible levels of 60 and 100 $\mu g/m^3$ for residential and industrial area, respectively. However, the values cross the permissible level at commercial areas, especially at Aroma Chowk, which recorded maximum respirable dust load, and at ISBT. A variation in values was also observed between May-June, 1999 and May-June, 2000. The data in the latter period was, in general, 15-20% higher than the former, but, is too meagre to specifically indicate increasing trend.

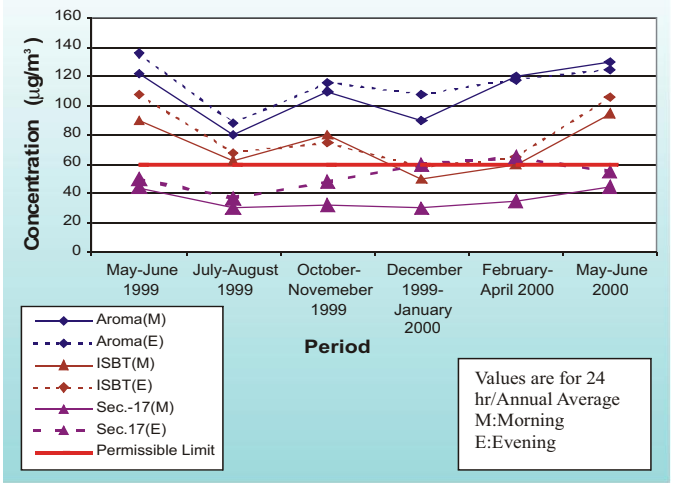
Subsequently, CPCC has also initiated monitoring of Respirable Suspended Particulate Matter (RSPM) since the year 2003-2004. Data indicates that the RSPM values (Fig.2.23) generally exceed the permissible limits (100 $\mu g/m^3$ for industrial area and 60 $\mu g/m^3$ for residential area).

Fig. 2.20 Respirable dust load at various points representative of residential zone at Chandigarh (1999-2000)



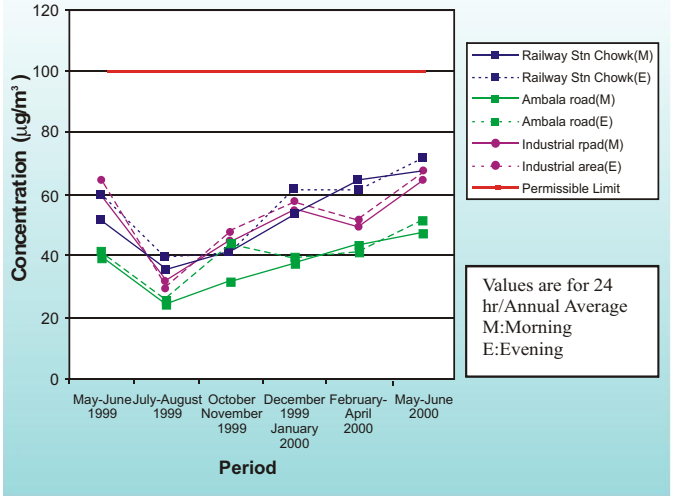
Source: Garg & Prasad, 2000

Fig. 2.21 Respirable dust load at various points representative of commercial zone at Chandigarh (1999-2000)



Source: Garg & Prasad, 2000

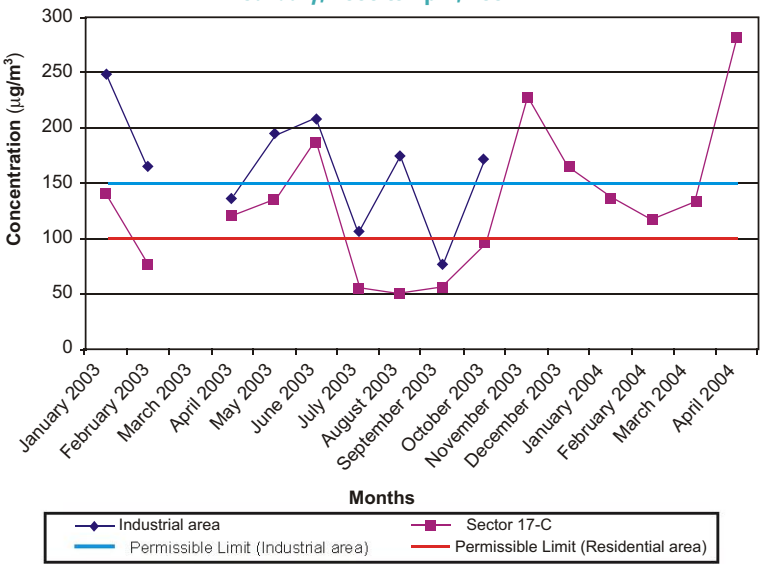
Fig. 2.22 Respirable dust load at various points representing high intensity HTV at Chandigarh (1999-2000)



Source: Garg & Prasad, 2000

Specific studies on Ozone concentration at ground level at CSIO (residential area), concentration of carbon monoxide at high traffic density zones along Madhya Marg and Dakshin Marg and lead & benzene at specific points in the city have also been conducted by various workers at CSIO between 1984 to 2001. The data is presented in boxes 2.2 - 2.4. John *et.al.*(2004) have also conducted studies on CO concentration along major roads.

Fig. 2.23 RSPM levels at Sector-17 and Industrial Zones in Chandigarh from January, 2003 to April, 2004.

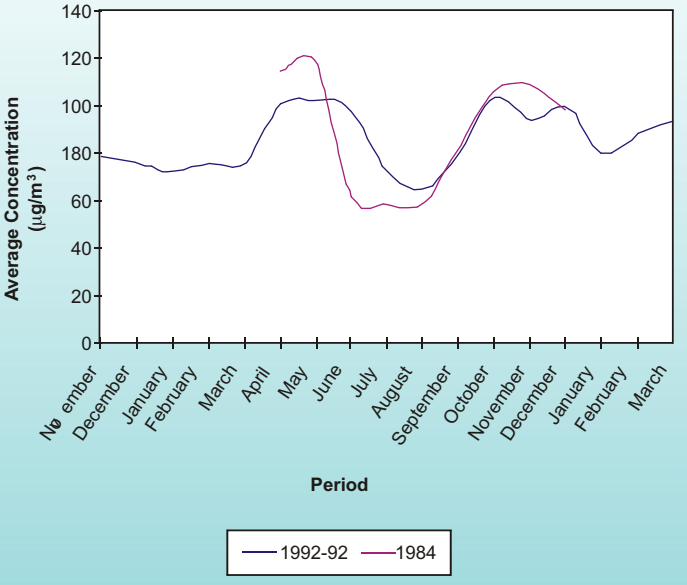


Source: CPCC, 2004

Box 2.2 Ozone Concentration at Ground level

Bhatnagar, *et.al.* (1992) have recorded the average ozone concentration during two periods i.e. April to December, 1984 and November, 1990 to March, 1992 (Fig.2.24). Data indicates that the average values of O_3 for the two periods were almost same at 90 µg/m^3 and 86 µg/m^3 respectively which are within prescribed WHO standards. However, the cumulative frequency data indicates a rise from 132 µg/m^{3}observed in 1984 to 160 µg/m^{3}observed in 1992 which is a cause of concern and deserves immediate corrective action. NOx from the automobile exhausts could be a predominant factor for further increase of ozone at the ground level air in Chandigarh due to high density of vehicles in the city.

Fig. 2.24 Ozone levels from April-December, 1984 and January-March, 1992 in Chandigarh

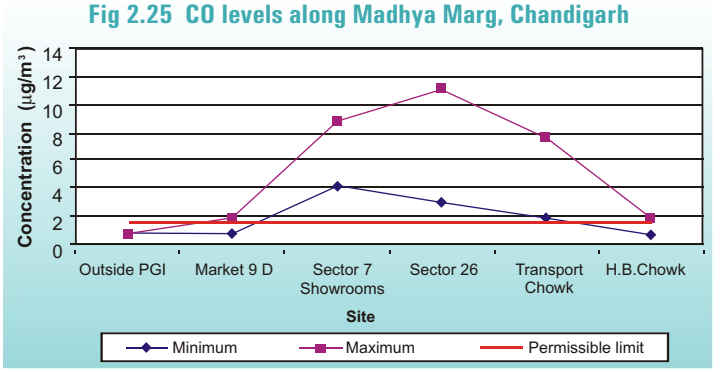


Source: Bhatnagar, et.al.,1992

Box 2.3 Carbon-monoxide concentrations at Ground level

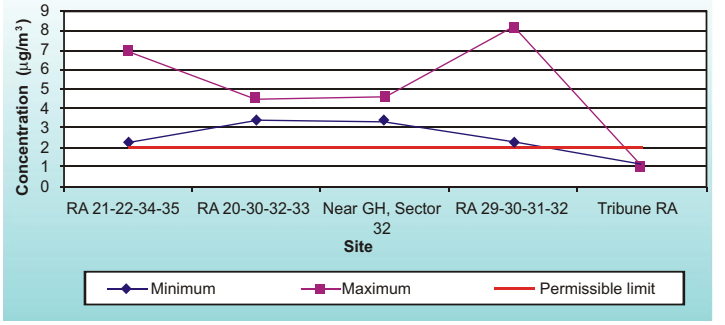
The permissible limit for CO is 2.0 $\mu g/m^3$ as per the NAMP standards. CO levels were monitored by Garg & Prasad in 1999-2000 at various locations at Chandigarh. The data indicates (Figs. 2.25 and 2.26) that at most of the locations monitored, the CO level has crossed its permissible limits. CO hotspots in the city are Sector 7, 26 and Transport Chowk at Madhya Marg and Kisan Bhawan, Sector 21-22-34-35 and Sector 29-30-31-32 roundabouts at Dakshin Marg. These findings have also been confirmed by John *et. al.*(2004) during a recent study sponsored by CPCC. They have reported exceptionally high concentration of CO at Kisan Bhawan roundabout (15$\mu g/m^3$) and Transport Chowk (12$\mu g/m^3$) on working days. This is a cause of concern and warrants immediate remedial action.

Fig 2.25 CO levels along Madhya Marg, Chandigarh



Source: Garg & Prasad, 2000

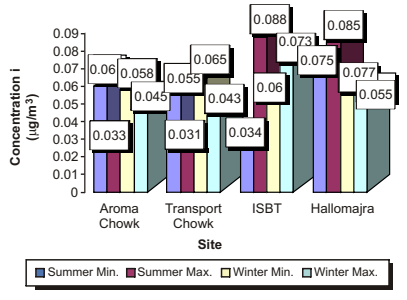
Fig 2.26 CO levels along Dakshin Marg, Chandigarh



Source: Garg & Prasad, 2000

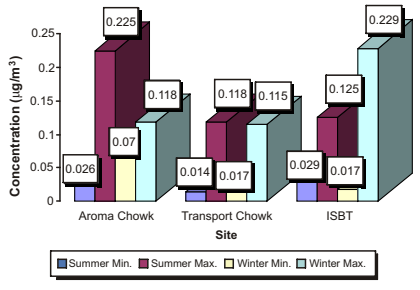
Box 2.4 Lead and Benzene levels in Ambient Air in Chandigarh

Fig. 2.27 Lead Concentration in Chandigarh during December 1999 to June, 2000



Source: Prasad & Garg, 2001

Fig.: 2.28 Benzene Concentration in Chandigarh during December 1999 to June, 2000



Source: Prasad & Garg, 2001

According to Prasad and Garg (2001) lead and benzene levels in ambient air in Chandigarh fall within the permissible limit of 1 $\mu g/m^3$.

The values for lead were recorded at various dense traffic areas in Chandigarh between December 1999 to June 2000 (Fig. 2.27). These sites include Aroma Chowk, Transport Chowk, ISBT and Hallomajra. Data indicates that the lead concentration is maximum at ISBT during summer and winter months. The rise may be due to heavy traffic density of four wheelers and two wheelers plying in the area round the clock. Further, the dispersion of dust load and lead concentration is restricted due to closed surroundings, congestion and less plantations in the area.

High Lead concentration in Hallomajra could be due to location of many paint and lead acid battery manufacturing and repair units in the area. Since lead free petrol has been introduced in Chandigarh since April, 2000, its positive impact, if any, on air quality needs to be monitored.

Concentration of Benzene was also measured at three sites i.e Aroma Chowk, Transport Chowk and ISBT from December, 1999 to June, 2000 (Fig. 2.28).

It was generally lower during summer months probably due to quick dispersal of its molecules due to vapourization in hot summer conditions. However, between the three sampling sites, it was highest (0.225$\mu g/m^3$) at Aroma Chowk during summer. This could be due to higher traffic density and longer working hours in the commercial area. ISBT recorded highest benzene concentration (0.229$\mu g/m^3$) during winter.

IMPACT

The general impacts of air pollutants on human and animal health, plants and materials are discussed in Box 2.5.

Box 2.5

Impacts of Air Pollution

I. Impact on human health:

The major impacts caused by individual pollutants on health of humans is given below. However, specific data regarding the city is lacking.

- Particulates reduce visibility. Microscopic particles in the air can be inhaled and they become lodged in the lung tissue and respiratory tract. This causes increased respiratory disease and lung damage.
- RSPM causes asthma and respiratory diseases. Sustained exposure to it can cause lung cancer.
- Smog, in high doses, can harm humans by causing breathing difficulty for asthmatics, coughs in children, and general illness of the respiratory system. Prolonged exposure to smog damages lung tissue. Because of their small size, these particles have great penetration and get lodged deep in the respiratory tract, causing diseases.
- SO_2 can cause breathing problems and permanent damage to lungs. It can form sulfuric acid in moist conditions.
- NOx can also cause lung problems and skin and eye irritation. It can form nitric acid in moist conditions.
- CO_2 is an asphyxiating gas which, if inhaled, can be toxic in high concentrations, causing an increase in the breathing rate, unconsciousness, and death.
- CO molecules can enter the bloodstream after being inhaled where they inhibit the delivery of oxygen throughout the body. Low concentrations can cause dizziness, headaches, and fatigue; high concentrations can be fatal.
- Lead is a highly toxic metal that produces a range of adverse health effects particularly in young children. Lead can cause nervous system damage leading to reduction in IQ levels, digestive problems, etc. Some lead-containing chemicals can cause cancer.
- Ground level ozone can irritate the respiratory tract, cause chest pain, persistant cough, inability to take deep breath, and an increased susceptibility to lung infection.
- VOCs are hazardous air pollutants and are usually carcinogenic.

II. Impact of Pollutants on Plants :
The general effects of pollutants on plants are as below:

Pollutant	Dose	Effect
Dust	Severe	Low chlorophyll content, suppressed growth and low productivity
Sulphur dioxide	Mild	Interveinal chlorotic bleaching of leaves
	Severe	Necrosis in interveinal areas and skeletonized leaves
Ozone	Mild	Flecks on upper surfaces, premature aging and suppressed growth
Fluorides	Cumulative effect	Necrosis at leaf tip
Nitrogen dioxide	Mild	Suppressed growth, leaf bleaching
Ethylene	Mild	Epinasty, leaf abscission
PAN (Peroxly-acyl-nitrite)	Mild	Bronzing of lower leaf surface (upper surface normal), suppressed growth. Young leaves more susceptible

III. Impact of air pollutants on Materials:
Air pollution can damage buildings, monuments, statues, and other structures as under:

Materials	Principal air pollutants	Effects
Metals	SO_2, acid gases	Corrosion, spoilage of surface, loss of metal, tarnishing
Building materials	SO_2, acid gases particulates	Discolouration, leaching
Paint	SO_2, H_2S,	Discolouration
Textiles and Textile dyes	SO_2, acid gases and NO_2, Ozone	Deterioration, reduced tensile strength, Discolouration and fading
Rubber	Oxidants, ozone	Cracking, weakening
Leather	SO_2, acid gases	Disintegration, powdered surface
Paper	SO_2, acid gases	Embrittlement
Ceramics	Acid gases	Change in surface appearance

No specific studies have been carried out in Chandigarh to assess the impact of increasing air pollution on human health or on plants and materials. However, Prasad and Garg (2001) have reported that as a result of high concentration of Benzene at Aroma roundabout, the inhabitants residing around the area often complain of unusual symptoms of fatigue. Further, the only visible impact on plants is the lowering of production of mango orchard adjacent to the Industrial area (as informed by the local contractors) or the drying up of the Imli trees in Sector 26. However, scientific data needs to be collected on this aspect.

Other impacts of high traffic density in the city include:

- Congestion on roads and longer travel time resulting in high fuel consumption,
- Frequent braking and idling at light points resulting in higher emission of pollutants,
- Increase in the number of road accidents from 483 in 1999-2000 to 508 in 2001-2002 (Statistical Abstract of Chandigarh, 2002).

RESPONSES

A. Legislative & Policy responses

1. The entire Union Territory of Chandigarh was declared as 'air pollution control area' vide notification no. G.S.R. 71(E) [NO.Q-14012/87-CPA] dated 1st February, 1988 with the aim of exercising the powers conferred by sub-section/(1) of section 19 of the Air (Prevention and Control of Pollution) Act, 1981.
2. The Central Pollution Control Board started monitoring the air quality in Chandigarh in 1989 and Chandigarh Pollution Control Committee was set up in 1991. The ambient air quality is currently being monitored at two points (one industrial and the other residential-cum-commercial area) since then. However, the number of monitoring sites is now being increased to five. Monitoring is proposed to be carried out at Punjab Engineering College, Sector 12, Sector 39 & Kaimbwala from 2004.
3. The Environment (Protection) Act, 1986; The Motor Vehicles Act, 2000 and rules notified there under, and all other legislations of the central government are being implemented in the UT.
4. Directions have been issued u/s 5 of The Environment (Protection) Act, 1986 to the Municipal Corporation, as well as, other concerned institutions for promoting organic composting to prevent air pollution by burning of leaves (Annexure-2.2). Punitive action has also been taken against 3 sweepers of MC who were found violating these directions.
5. Mass emission standards for new vehicles were notified in the country in 1991. In Chandigarh, Euro I norms are applicable since April 2000. Euro II norms will be applicable from 1-04-2005.

B. Infrastructural responses

a. Industrial Pollution Control

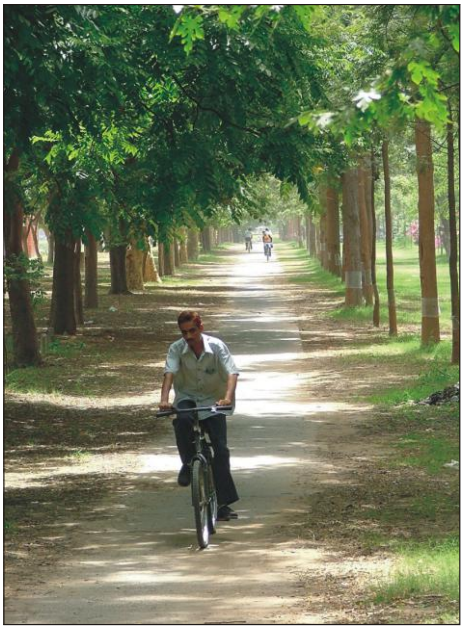
1. As stated earlier the industrial zone is situated towards southeast of the city in the leeward direction. Further, it is separated from the residential sectors with a green buffer. Its location next to the railway station ensures that minimum local transportation of raw materials and goods takes place. Further, Industrial Area Phase-III is proposed to be located similarly at Raipur Kalan near the railway station. The IT Park is also set up in non-polluting zone.
2. All the 45 air polluting industries under Red category in the Union Territory have installed air pollution control equipments.
3. To phase out production and use of Ozone Depletion Substances, a study was conducted by the Department of Environment, Chandigarh in 2003. The study has revealed that:

- There are only 6 registered units manufacturing refrigeration equipments such as air-conditioners, deep freezers, freezer cabinets, water coolers, etc. and only one unit producing flexible polyurethane foam.
- Three out of these 6 units have already availed assistance under the Montreal Protocol. The other units are also willing to switch over to non-ODS technologies.
- The total quantity of ODS phased out by these three units is approximately 60 MT/annum which includes CFC-11, CFC-12 and HCFC-22 while the other 2 units which have expressed their desire to phase out are using about 14 MT of ODS (mainly CFC-11, CFC-12 and HCFC-22).
- The only unit manufacturing polyurethane foam is already using gas which does not fall in the category of ODS (to be phased out under the country programme).
- There is no registered unit manufacturing products such as aerosol cans, fire extinguishers, etc. using CFC 11/12 or Halon-1211/1301 or using methyl chloroform, carbon tetrachloride or methyl bromide.
- The total consumption of ODS in UT Chandigarh is estimated to be less than 50 MT which is less than 0.3 percent of the total ODS consumption in the country.

4. No air polluting industry is allowed to operate in non confirming areas (outside Industrial area).

b. Vehicular Pollution Control

1. Compulsory 'Pollution Under Control' (PUC) Certificates for vehicles have been introduced by Chandigarh Traffic Police as per Central Motor Vehicle Rules, 1989. Pollution monitoring facilities are available at most of the petrol pumps & vehicle repair maintenance units in the city. As per data provided by State Transport Authority, Chandigarh, 20 authorized stations are operative for issuing PUC Certificates. Regular monitoring by the Traffic Police ensures reduced pollution of air from vehicles. On an average about 700 challans are issued every year. This ensures compliance.
2. Lead free petrol was introduced in Chandigarh in early 2000. This is expected to reduce lead pollution in air. However, compulsory use of catalytic converters in older models of petrol vehicles and use of CNG in diesel vehicles is lacking.
3. Many roundabouts which were facing traffic congestion problems especially during peak hours have been converted into traffic light points with timers and slip roads to ensure easy flow of vehicles. These include Sector 8-9-17-18 round-about, Sector 21-22-34-35 round about, Transport Chowk and many more.
4. Cycle tracks have been developed along all major Margs and important Paths in Chandigarh. The Chandigarh Traffic Police has also started compulsory segregation of slow moving vehicles in separate lanes especially during peak hours.
5. Routes of HTV and interstate buses in the city are specified. No trucks can enter Madhya Marg and Dakhshin Marg between 7.00 AM to 9.00 PM.
6. To reduce incoming interstate buses within the city center, a new ISBT was set up in Sector 43 in 2002. Thus, buses coming from Punjab do not enter the city. For Interstate buses from Delhi, Himachal Pradesh and Haryana one way routes are prescribed.
7. The scooter repair market was shifted from Sector 21 in the city center to Sectors 43 & 48 at the outskirts in 2002.



A cycle track

8. Proposal to run local buses on parallel roads is in the offing. Implementation was to begin in August, 2004 but has been delayed.
9. No railway line passes through the city. The railway station is adjacent to the Industrial area in the south west. A new railway line is under construction which will bypass the city along Sectors 31, 47 and 48.
10. Studies are being sponsored/conducted by CPCC to assess existing vehicular pollution load in the city.

c) Air Pollution control from Municipal & Commercial Sources

1. To assess the pollution caused by diesel generator sets in Chandigarh a survey was conducted by CPCC in 2002. Notices were issued and remedial actions taken.
2. Burning of leaves has been banned by the Municipal Corporation. Composting is being promoted instead.
3. Burning has also been banned at the Chandigarh land fill site and regular compaction is carried out.
4. CPCC has closed down small kilns being operated at 8 Dhobhi Ghats and at Kumhar colony (for baking clay pottery) and initiated disciplinary action against junk dealers burning plastic wastes. The Administration is modernizing the dhobi ghats to control pollution.

C. Public Response

1. Regular awareness campaigns are conducted by the CPCC, DoE and DST, Chandigarh though NGOs and schools. Hence, the general awareness level of residents is high. 100 Eco clubs have been set up in schools which take up special drives during Diwali, etc.
2. Tree plantation along road dividers and berms are a regular feature. About 50 species of trees exist along roads in Chandigarh (Singh *et al.,* 1998). The Municipal Corporation also takes up regular maintenance of parks, gardens, and leisure valleys.

RECOMMENDATIONS

Despite the aforementioned actions taken by the Union Territory government, air pollution in Chandigarh remains a major concern. Hence, besides continuing and strengthening the existing actions, new initiatives needs to be formulated. These include:

A. Policy Initiatives

- Prevention based environmental policy needs to be put in place. For this, rules related to health/load based standards instead of concentration based standards be enforced.
- A comprehensive urban air quality management strategy be formulated which includes information related to urban policy, ambient air quality emission inventory and air quality dispersion models.

B. Industrial Pollution Control

- Cleaner & energy efficient technologies and waste minimization in industry needs to be given priority.
- Incentives be provided to promote waste utilization technologies.

C. Vehicular Pollution Control

- To allow smooth flow of traffic along major roads, traffic lights synchronization be taken up.
- Although the city has several link roads to Mohali, however, there is only one link road to Panchkula (extension of Madhya Marg) which also serves as the link to Himachal Pradesh. Hence, to ensure spread of traffic, more links to Panchkula need to be constructed. These could be along Udyog Path & Dakshin Marg. (The new link to Manimajra behind Sector 26 has already set an example by helping ease traffic volumes to this town).
- Existing public transport system be improved to discourage private ownership.
- MRTS be planned in conjunction with satellite towns of Panchkula, Zirakpur, Mohali, Dera Bassi & Kharar.
- Elevated roads be planned for long route vehicles, especially for through traffic from Haryana to Punjab and Himachal Pradesh.
- Use of alternative fuels like CNG, Propane, etc. be promoted and two stroke engines be discouraged.
- Emission norms & fuel quality specifications be tightened.
- A study needs to be conducted on average distance traveled per vehicle in Chandigarh for assessment and modeling of vehicular pollution and taking advance remedial actions accordingly.
- The use of rickshaws inside Sector 17 may be banned. Rickshaws from the ISBT may be routed on V8 roads along Himalaya Marg & Jan Marg.

D. Strengthening of Monitoring Network

- Monitoring network be expanded to cover new areas especially in the southern sectors where a number of housing colonies are coming up. Central sectors and rural areas also need to be brought under the monitoring net.
- A combined Policy be drawn in conjunction with neighbouring states for control of transboundary air pollution from industry and burning of stubble in fields. Specific studies are recommended for assessment of background pollution to work out the actual pollution contributed by vehicles, etc. for devising an effective action program.
- In addition to SPM, RSPM, SO_2 & NOx, pollutants like, Benzene, CO, O_3, PAH, etc. need to be regularly monitored. Out of these the former two are specifically important in light of introduction of lead free petrol in the city since 2000.
- Monitoring of hotspots/traffic intersections be taken up & emission load mapping be conducted at regular intervals.
- Air pollution modeling as a tool for urban planning and environmental quality forecasting be taken up.
- Private/community participation in monitoring activity could be promoted.

E. Other Measures

- Carrying Capacity based development be promoted in the entire region. For this EIA studies in 50 km radius area be taken up.
- Epidemiological studies be undertaken and air quality standards be based on local dose-response relationships.
- Green cover be further increased especially in southern sectors. Planting of a minimum number of trees be made mandatory in housing colonies before grant of consent for occupation.

- Access to data for public be improved & thrust be provided to awareness and participation of the community for air quality preservation.
- Training & education for government agencies, industry, students and public be promoted and coordination amongst institutions (especially R&D bodies and line departments) improved.

Overall, it is recommended that an effective environmental management plan be devised which includes environmental strategy, monitoring regulation, institutional capacity building and economic incentives & penalties.

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CHAPTER-3

NOISE

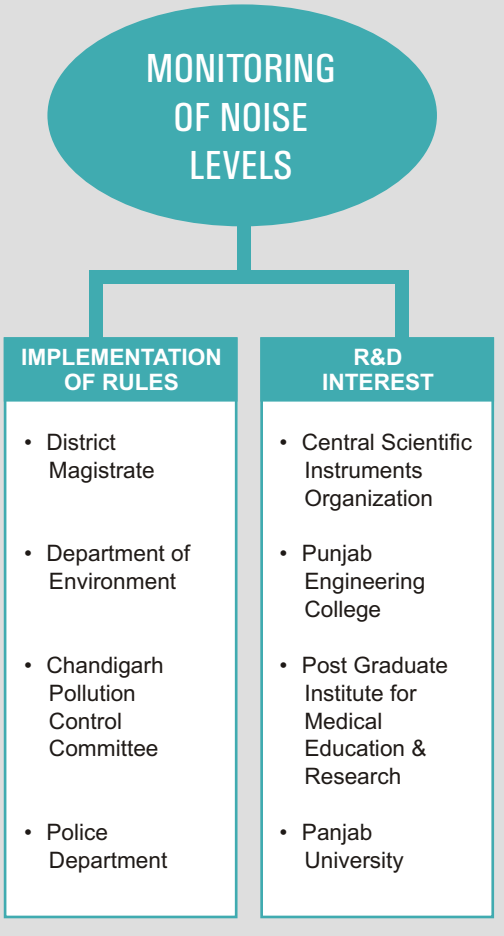
Noise is that 'unwanted sound' which adversely affects the physiological or psychological well being of a person. Although a soft rhythmic sound in the form of music stimulates brain activities and removes boredom and fatigue, but its excess can prove detrimental. Ambient noise is unwanted or harmful sound created by human activities, including transport - road, rail & air traffic, industrial and construction activity, generator sets, loud speakers, public address systems, music systems and other mechanical devices which has a deleterious effect on human health and psychological well being of people. Hence, it is considered necessary to regulate and control it.

Legal & Institutional Framework

Noise is recognized as an air pollutant under the Environment (Protection) Act, 1986 by the Government of India. The Ministry of Environment and Forests vide Notification No. S.O. 123(E) dated 14 February, 2000 published Noise Pollution (Control and Regulation) Rules, as amended.

The organizations/academic institutions working with regard to ambient air quality with respect to Noise in Chandigarh are represented in Box 3.1.

Box 3.1



Regular monitoring of noise pollution is not being carried out in Chandigarh except monitoring by CPCC during Diwali festival every year since 1998. However, a few sporadic studies have been conducted by various academic and research institutions like, CSIO and PEC during the last two decades at various residential & commercial areas of the city and vehicular noise pollution at different roads, respectively.

These studies indicate that noise levels at various points in the city are considerably higher than the permissible limits. The National Ambient Air Quality Standards with respect to Noise are at Annexure-3.1.

DRIVING FORCES

In spite of the fact that care was taken to exclude nuisance from noise in Chandigarh during its planning through a series of measures such as, ban on movement of heavy vehicles on internal roads, a separate industrial area, a dense vegetational cover, etc., however, the problem of noise pollution has grown steadily with time. The most prominent sources of noise in the city are:

- **Traffic**

  Increase in vehicular traffic is a major cause of increasing noise pollution in Chandigarh. As pointed out in Chapter 2 vehicular traffic has increased 42 times since 1971. The running of vehicle engines, as well as, the use of horns, especially in congested areas contribute to high levels of noise. Traffic noise is, therefore, higher along major roads/ margs of the city, in areas of high commercial activity (Sectors 22, 17 and 34) and in dense residential areas like, the southern sectors.

  Since the Chandigarh railway station is located at one side (SW) and no rail tracks pass through most of the city, noise from railways is not of major concern. (A new rail track is, however, under construction which will pass behind a few residential sectors like Sectors 31, 47 & 48, but it will also bypass the main city).

- **Commercial activities**

  Major commercial activity in Chandigarh is restricted to commercial sectors 17, 22 and 34. However, each sector is self sufficient with a shopping complex. The noise generated by commercial activities is, therefore, restricted to these sectors/parts of sectors only. However, increasing number of shopping complexes with increased shop density is leading to higher noise in these areas. Further, many shopkeepers use high volume musical instruments and equipments contributing to high noise. The rehri markets/ apni mandis (weekly vegetable markets) in other sectors of Chandigarh also contribute towards noise pollution on specific days.

- **Community Noise**

  Everyday living also introduces several unwanted sounds in the environment through high volume radios/ TVs, religious or social gatherings, etc. Saturday Carnival at Sector 17 and promotional activities at the lake on Sunday evenings are regular features. The city also holds several open air musical nites which contribute to high noise. Family functions and weddings also contribute towards community noise.

- **Industries**

  Most industrial noise in Chandigarh is restricted to the Industrial area which is separated by a buffer zone (green belt) from the residential areas. Hence, industrial noise is restricted to this zone itself. However, construction activity also contributes to high noise levels.

- **Festive celebrations**

  Indian festivals, particularly Diwali/Deepawali (the festival of lights), are usually noisy where fireworks and crackers are burst, generating high volume neighborhood noise for several hours. Specific data is presented in subsequent paras.

- **Diesel Generators**

  Chandigarh is placed comfortably with respect to power availability as compared to neighbouring states. Hence, the city faces fewer power cuts (except for maintenance purposes). Use of diesel gensets is, therefore, limited. These are used in limited areas in Sectors 17, 22, 34, 35, rehri markets of certain sectors & Industrial area. These generators cause a very high level of noise. Sometimes generators are installed in the open as no provision for the same has been made in the sanctioned building plan, and thus cause annoying noise pollution.

- **Architectural design of Buildings**

  Most shopping and residential complexes built in the city have matchbox like buildings which run parallel to each other. This can contribute to canyon effect. Further, housing complexes in certain new sectors (like 47, 48, 49, 50, etc.) and Manimajra have open pockets between multistoreyed flats, which can potentially trap sounds.

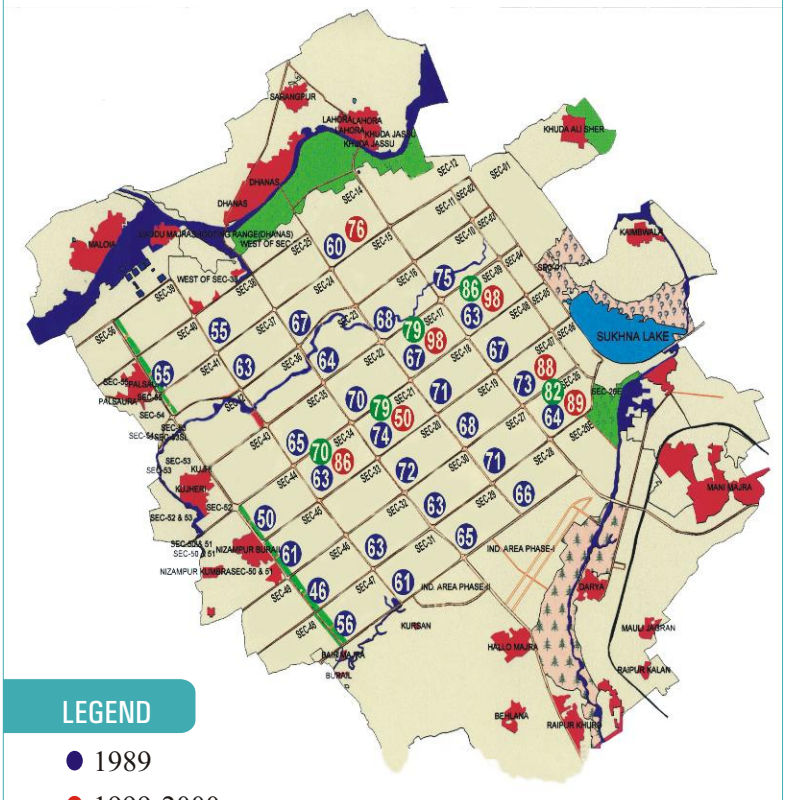
PRESSURES

- **Increase in Vehicular noise**

  During recent years vehicular traffic has become a major source of noise in Chandigarh. A high per capita income and higher standard of living contributes around 60 new vehicles to this city every day (Source: Registration and Licensing Authority, Chandigarh).

  Further, Chandigarh being the capital of Haryana and Punjab and a Union Territory in itself, many central and state government offices are situated here adding to the floating vehicular population. The satellite towns of Panchkula and Mohali also contribute significantly to this. Its strategic location also contributes to heavy traffic flows in the city from several areas of Jammu & Kashmir, Punjab, Himachal Pradesh, Haryana and Delhi. This leads to traffic congestion especially along Madhya Marg & Dakshin Marg and frequent acceleration and deceleration and use of horns inspite of wide, well planned roads. Although certain areas of the city are closed to heavy transport vehicles especially during the day, the fleet of Chandigarh Transport Undertaking and State Transport Buses (which are themselves noisy) is also a major contributor to noise pollution.

Map 3.1 Noise level data in markets of Chandigarh.



- **Increasing number of noise producing industrial units**

  Increasing number of flour & grinding mills and engineering industry are a major contributor to industrial noise in the city.

- **Increase in residential and recreational noise**

  The increasing population density (from 5631 to 7900 persons/km^2 from 1991 to 2001) and increased use of domestic appliances like, ACs, coolers, high volume televisions and stereos, etc. constitute an important source of this type of noise pollution. As already pointed out, the city regularly hosts several fairs (like festivals of gardens, chrysanthemum show, trade fairs, musical nights, etc.) which contribute to the ambient noise level on specific days.

STATE

In light of the above mentioned driving forces and pressures, the following is the state of noise levels in Chandigarh:

Ambient Noise level in various sectors of Chandigarh

Bhatnagar and Srinivas (1989) and Garg and Prasad (2000), CSIO, Chandigarh conducted studies on ambient noise levels and monitored these at several locations (out of which 11 locations were common).

A comparison of average noise levels in market areas alone in various sectors as observed in 1989 and again in 1999-2000 are given in Map 3.1. Data indicates that noise levels have increased in almost all markets from 1989 onwards. As per Ambient Air Quality Standards for Noise, permissible noise level for commercial locations is 65 dB (A). The map indicates that most of the markets have noise levels more than the permissible limits. However, it may be noted that in 1989 the southern sectors i.e Sectors 39 to 56 had not been developed, hence, there was hardly any commercial activity. Subsequently, studies conducted by CPCC in 2004 at five common sites corroborates the observations (Map 3.1 and Table 3.1).

A comparison of noise levels at certain specific locations like, PGI, Sector 12; PU, Sector 14; General Hospital, Sector 16; Grain Market, Sector 26; ISBT, Sector 17; etc. also indicate an increasing trend (Map 3.2 & Table 3.1). However, noise levels recorded by CPCC in 2004 are lower than those recorded by CSIO in 1999-2000 although both, population density and commercial activity, has increased during this period. This warrants further investigations as well as standardization of monitoring techniques and collaborative efforts to generate comparable data besides optimally utilizing existing infrastructure.

Table 3.1 : Comparison of noise levels in dB (A) at some locations of Chandigarh

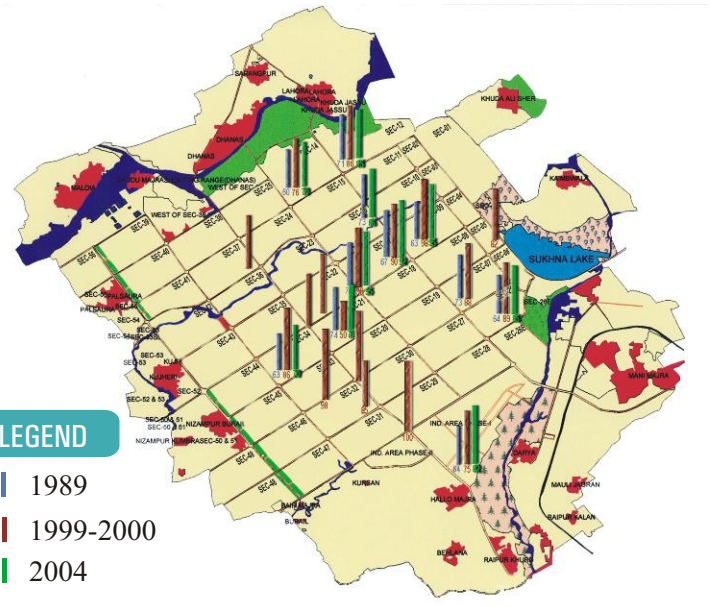
Locality	1989 (noise levels) in dB (A) (Source: CSIO)	1999-2000 (noise levels) in dB (A) (Source:CSIO)	2004 (noise levels) in dB (A) (Source:CPCC)
Shopping Complex Sector 17	67	90	73.5 (Near Fountain Sector-17) 73.3 (Near Neelam Theatre , Sec.17) 76.7 (Near Sindhi sweets) 92.0 (Near Mehfil Restaurant)
ISBT, Sector 17	76	98	95.2
Grain Market, Sector 26	64	89	82.5
PGI, Sector 12	71	86	85.2 (At main road 100 m away from main gate)
P.U., Sector 14	60	76	69.4 (Student center) 70.6 (Market)
General Hospital, Sector 16	73	---	86.4 (In front of Emergency/OPD)
Scooter Market, Sector 21	74	50*	79.2
Furniture Market, Sector 34	63	86	70.2
Industrial Area	64	75	82.2 (Near Hind Motors)
Market, Sector 9 D	63	98	95.0 (Near Bank of Punjab) 84.5 (Near Amartex) 79.5 (Near ICICI bank)
Market, Sector 7	73	88	--

**Figure appears anomalous*

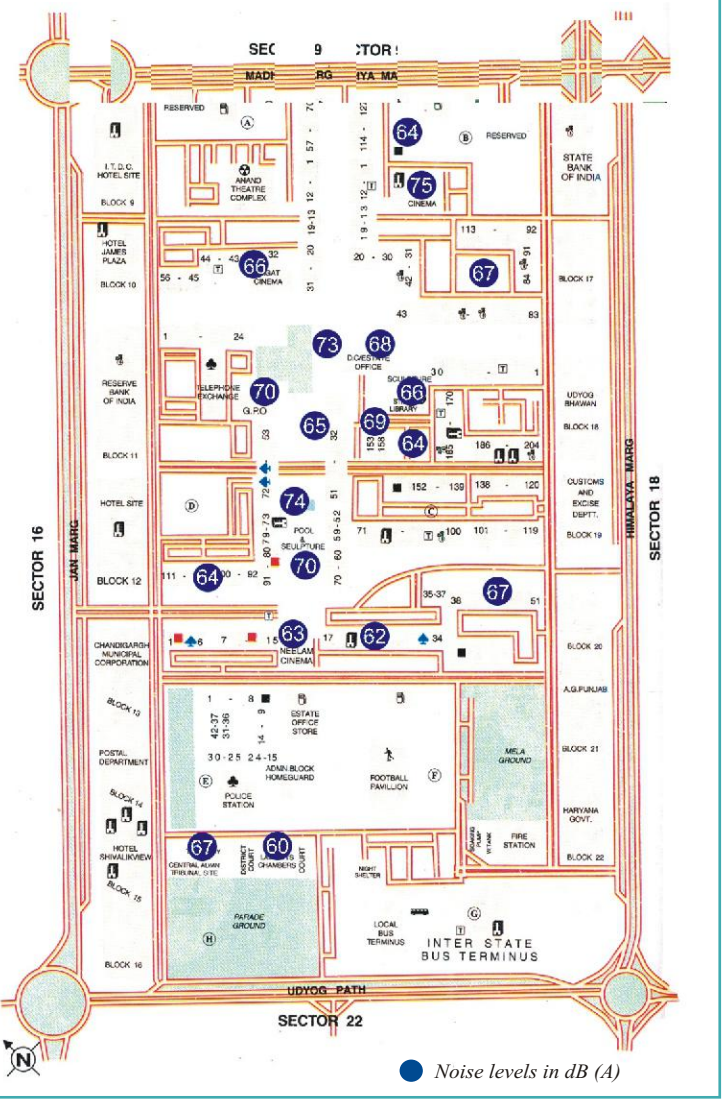
Further, detailed investigations at specific locations were carried out by Bhatnagar & Srinivas during 1989. Some of the data is presented below:

- Sector 17 is the major city shopping complex. This sector has three cinema halls, the main City Bus Terminus, Inter State Bus Terminus, General Post Office, Civil Courts, branches of numerous banks and various shops. The noise levels measured in various locations of this sector in 1989 by CSIO are shown in Map 3.3. The maximum ambient noise of 75 dB (A) was observed near KC Theatre and minimum noise level of 60 dB(A) was observed near Civil Courts with an average of 67 dB(A). Comparable data at four common sites (near Fountain, Neelam Theatre, Sindhi Sweets shop & Mehfil restaurant) generated by CPCC in 2004 (Table 3.1) indicates increase in noise level at all four locations.
- A similar study was taken up in the shopping area of Sector 22 (one of the oldest and densely populated sectors with high commercial activity) (Map-3.4). The maximum level of noise observed in the sector was 70 dB (A) at the area opposite ISBT and the shopping area facing Sector 21 (route for outgoing interstate buses + hotels and dense shopping area). The minimum levels recorded were 62 dB (A) at the corner-facing Sector 16 (opposite Cricket Stadium).
- Within the industrial area the average noise level recorded was 64 dB (A). The maximum noise level of 72 dB (A) was recorded near Modella crossing and a minimum level of 59 dB (A) was recorded near Plot No. 102/56. These were within permissible limit of 75 dB (A) for industrial zones. However, recently CPCC (2004) has recorded

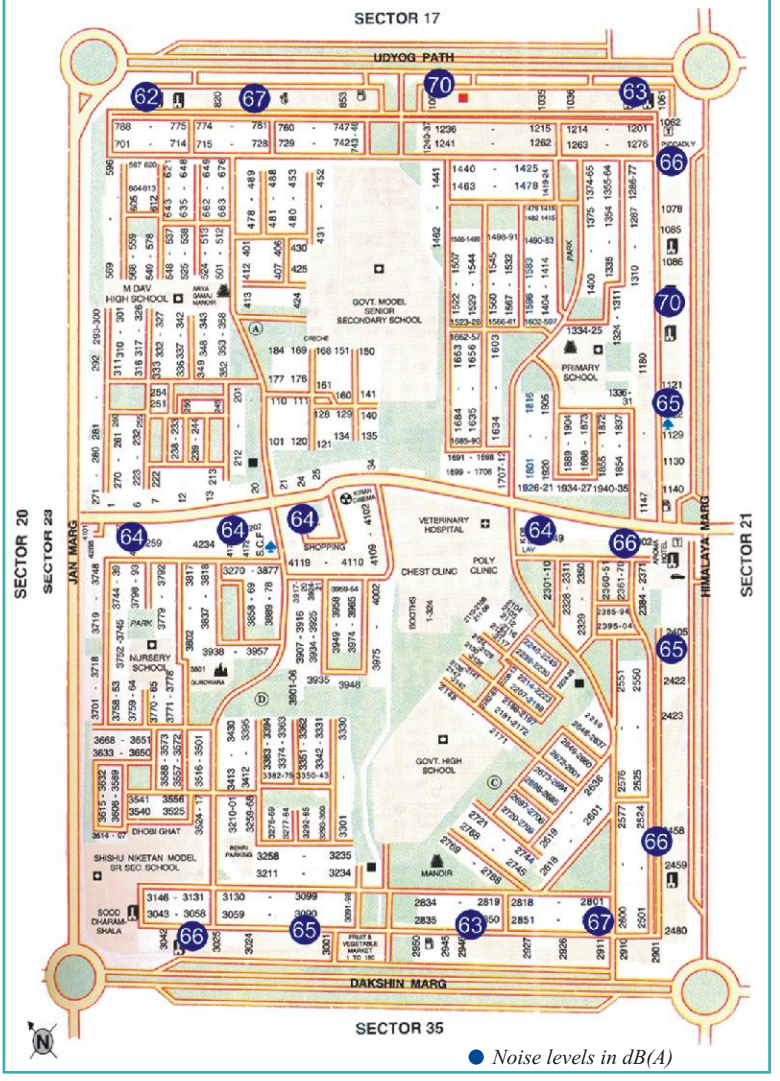
Map 3.2 : Comparison of Noise Level Data at Some Locations of Chandigarh



Map 3.3 : Spatial Distribution of Noise Levels in Sector-17



Map 3.4 : Spatial Distribution of Noise Levels in Sector 22



82.2 dB (A) near Hind Motors which is higher than permissible limits.

- The average noise level recorded at Panjab University was 60 dB (A) which is higher than the permissible limit of 50 dB (A). This has increased to 69.4 dB (A) near Student Centre (CPCC, 2004).
- The spatial variation of noise at the Inter State Bus Terminus was also determined by measuring noise levels at different locations. The maximum noise level observed was 82 dB (A) and minimum was 69 dB (A) with an average of 76 dB (A). These are higher than the desirable levels of 65 dB (A). CPCC (2004) has recorded 95.2 dB (A) noise level at ISBT at 11.00 AM. This is inspite of part of ISBT being shifted to Sector 43.
- Some other locations selected for the study include enclosed/ specific high noise level areas which are frequented by a common citizen during day to day activities.
- Indoor noise levels in certain areas are presented in Box 3.2.

Box 3.2 : Indoor Noise Pollution

1. Hospitals

Hospitals are categorized under the silence zone with maximum permissible limit at 50 dB (A). The average noise level recorded at General Hospital, Sector 16 was 73 dB (A) with a maximum of 78 dB (A) in the Emergency OPD and minimum of 67 dB (A) near the main entrance. CPCC (2004) has recorded 86.4 dB (A) level at Emergency OPD.

Similarly, average noise level at Post Graduate Institute for Medical Education and Research, Sector 12 was 71 dB (A) with a maximum of 77 dB (A) at more than one location (reception area, emergency OPD, medical OPD and near main lifts) A minimum of 62 dB (A) was recorded near the Chemist shops. Data on noise levels in wards and OTs is not available which would, predictably be lower. CPCC (2004) has recorded 85.2 dB (A) at 100m from PGI main gate indicating an increasing trend. Since this area is categorized as silence zone specific remedial actions need to be initiated.

2. Public Places

The noise levels inside a State Bank of India branch in Sector 30, which is relatively a quieter sector, varied from a minimum of 63 dB (A) to a maximum of 76 dB (A) with an average of 70 dB (A) during working hours.

3. CTU Repair Workshop

Noise levels inside a CTU repair workshop were also measured. The average noise level recorded was 75 dB (A) with a maximum of 95 dB (A) and minimum of 65 dB (A). These are high enough to cause physical discomfort to the workers.

4. Noise in Buses

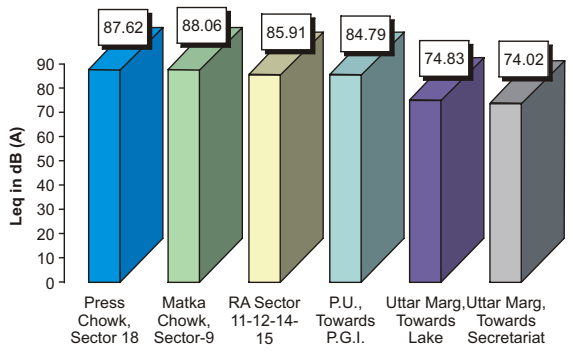
The noise levels were also measured inside a CTU (Chandigarh Transport Undertaking) bus. The average noise level observed was 85 dB (A) with a maximum of 91 dB (A) and a minimum of 79 dB (A). This can cause discomfort to passengers sitting inside the bus as the permissible limits as per GoI norms is 85 dB (A) at 1 m from the bus outside.

Table 3.2: Noise levels in Chandigarh as compared to other metropolitan cities

City	Year of Study	Noise Levels dB (A) & Locality			
		Day		Night	
		Minimum	Maximum	Minimum	Maximum
Chennai	1997	51(Residential) Anna Nagar Town Park 61(Commercial) Children Garden School Society	71(Residential) Basant Nagar 83(Commercial) Egmore	NA	NA
Delhi	1999	67 Friends Colony	85 Wazirpur Ind. Area	56 Friends Colony	80 Wazirpur Ind. Area
Kolkata	1999	77 Dunlop bridge	83 Manictala more	70 Jadupur	78 Nagar Barar More
Mumbai	2000	68 Parel	79 Chhtrapati Shivaji Terminus & BHC Office	NA	NA
Chan-digarh	1999-2000	50 Sector 21	98 ISBT, Sector 17 & Market, Sector 9-D	NA	NA

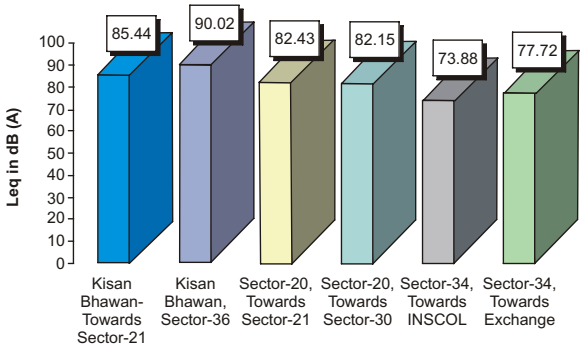
NA : Not Avaialble *Source : CPCB, 2001*

Fig. 3.1 Noise level data along Madhya Marg & Uttar Marg, Chandigarh (April - May, 2002)



Source: John & Sharma,2003

Fig. 3.2 Noise level data along Dakshin Marg, Chandigarh (April - May, 2002)



Source: John & Sharma,2003

A comparison with noise level data of some metropolitan cities (based on the studies conducted by CPCB from 1997 to 2000) indicates rather high noise levels in Chandigarh (Table 3.2). Hence, noise is a cause of concern.

Noise Level Data Along Different Roads In Chandigarh

John and Sharma from Punjab Engineering College have monitored traffic noise levels at twenty locations in Chandigarh under a 'Nationally Coordinated Project on Urban Transport Environment Interaction' (NCPUTEI) sponsored by AICTE during April-May, 2002. The locations were segregated representing different Margs, commercial activity zones, silent zones and areas representing heavy traffic zones (Figures 3.1 to 3.4). The maximum noise level of 90.02 dB (A) was observed near Kisan Bhawan, Sector 35/36. The minimum noise level of 73.88 dB (A) was observed at Sector 34 near INSCOL hospital followed by Uttar Marg. In general, northern sectors in the city are relatively quieter whereas areas around Dakshin Marg (Sector 35) & Madhya Marg (Sector 9) are noisier due to higher activity.

Noise Levels on Working and Non Working Days

An assessment of noise levels during various times of the day and on a typical working day (Wednesday) and a non working day (Sunday) at important sites was also made (Figures 3.5 to 3.7). It was observed that noise levels remained high and relatively unchanged throughout the day at Kisan Bhawan Chowk, Press

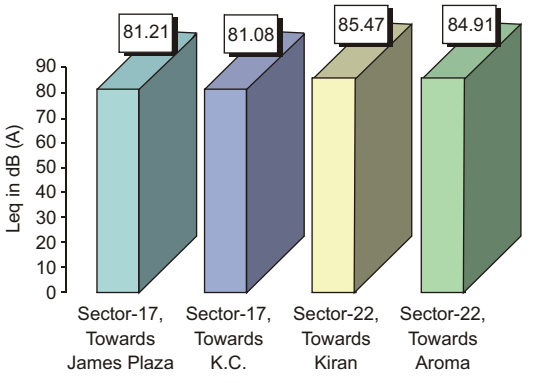
Chowk, Tribune Chowk, Aroma Chowk and Transport Chowk. Noise levels on non-working days were significantly lower at Sector 22, Aroma Chowk and Tribune Chowk. An interesting trend was noted at Uttar Marg near Lake. Whereas on working days the noise level remained low at mornings, it increased significantly during lunch time and evenings because of higher visitors during this period at a place of recreation. During non working days higher noise levels were recorded at Uttar Marg in evenings only. Data also indicates that at all the points throughout the day the noise levels exceed the specified permissible limit for that particular area.

Noise Pollution during Diwali Festival

CPCC has been regularly monitoring noise levels on Diwali nights at the residential area of Sector 22-A (Fig.3.8) since 1998. This is one of the oldest and densely populated sectors of the city. Data indicates that noise levels during the evenings of Diwali exceed the permissible limit at each measurement. However, there appears to be a decrease in noise levels from 2001 onwards. This could probably be due to higher awareness about adverse effects of air & noise pollution amongst the general public. This aspect, however, needs to be verified.

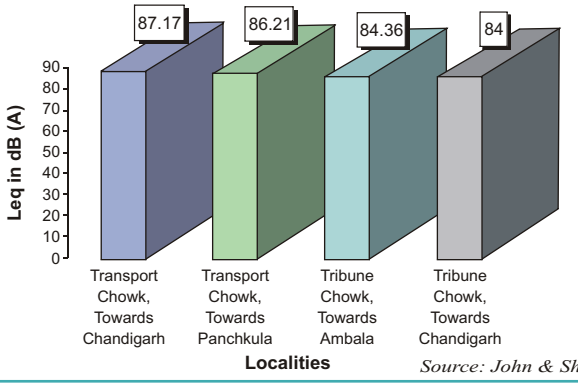
Further, during the year 2003, CPCC measured noise levels at various sites in and around Chandigarh one day before Diwali and another on the Diwali day. Figure 3.9 depicts that the ambient noise levels on Diwali day are far higher than the pre-Diwali day values at all sites. In some cases the noise levels have even exceeded

Fig. 3.3 Noise level data along Commercial areas, Chandigarh (April - May, 2002)



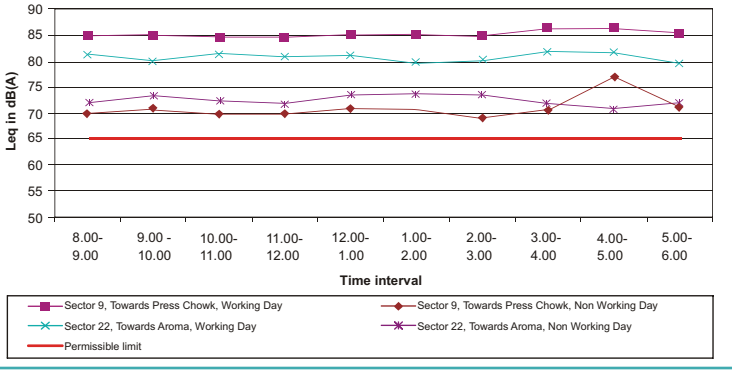
Source: John & Sharma,2003

Fig. 3.4 Noise level data along Heavy Traffic Zones, Chandigarh (April - May, 2002)



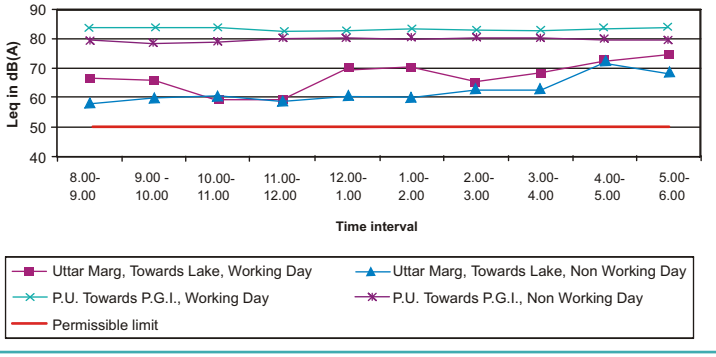
Source: John & Sharma,2003

Fig. 3.5 Noise levels on working and non-working days along Commercial Zones of Chandigarh (April - May, 2002)



Source: John & Sharma,2003

Fig. 3.6 Noise levels on working and non-working days along Silent Zones of Chandigarh (April - May, 2002)



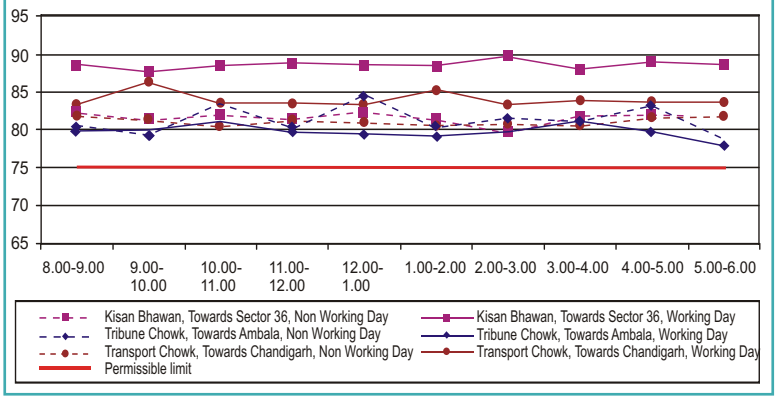
Source: John & Sharma,2003

90 dB(A) which is considered to be harmful for physiological well being of people. Another interesting observation was higher levels of noise on Diwali day at Manimajra, followed by Kaimbwala and Kajheri, all these sites being suburbs of the city. This could be attributed to lower buffering of noise due to lesser number of trees as well as canyon effect.

IMPACT

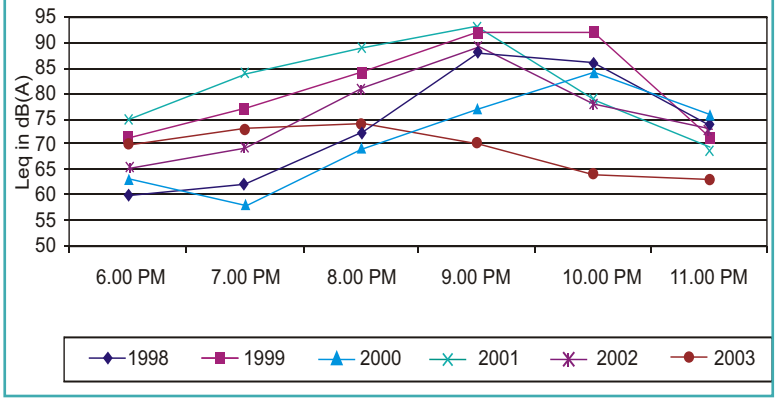
High-pitched sounds seem to be louder and more annoying than low-pitched sounds. Normally sound pressure measurement in decibel-A [dB(A)] units is weighted for high-pitched sounds. As a general rule, any noise above 90 decibels risks injury to the ears and the louder the noise the shorter exposure needed for damage. Under the Factories Act, 1948, continuous exposure to noise up to 90 dB(A) is allowed for only 8 hours per day. However, an exposure to 115 dB(A) noise level is allowed for 15 minutes only to avoid health damage due to high noise levels. Though in the city of Chandigarh high traffic zones and industrial zones are separated from residential areas by green belts and vacant areas (leisure valleys) which act as noise absorbers, however, increasing noise levels can have a negative impact on health of its residents. The general effect of noise on human heath is presented in Box 3.3. However, no specific data on noise related health impacts in Chandigarh is available.

Fig. 3.7 Noise levels on working and non-working days along Heavy Traffic Zones of Chandigarh (April - May, 2002)



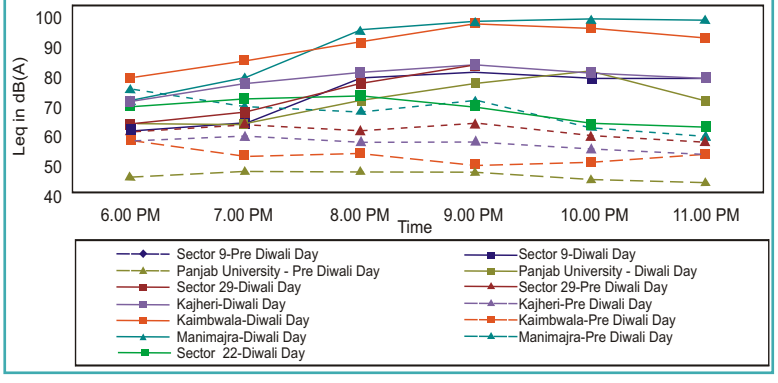
Source: John & Sharma,2003

Fig. 3.8 Noise levels on Diwali Days (Sector 22-A, Chandigarh)



Source: CPCC, 2003

Figure 3.9 Noise levels on Pre Diwali and Diwali Day at different localities of Chandigarh



Source: CPCC, 2003

RESPONSES

A. Legal Framework

The following laws are applicable in Chandigarh for controlling noise pollution:

1. The Noise Pollution (Regulation and Control) Rules, 2000 (Annexure 3.1) are enforceable by the Sub Divisional Magistrate, Police department and CPCC as notified by the Chandigarh Administration. It is a

comprehensive legislation for controlling noise level in Industrial (permissible limit 75 decibels), commercial (permissible limit 65 decibels) and residential zones (permissible limit 55 decibels). The Deputy Commissioner is the regulatory authority. These Rules include the creation of silence zones (upto 100 meters from educational institutions, courts and hospital premises). The following are the highlights :

- No permission can be granted by any authority (except the Deputy Commissioner for functions within closed premises) for use of public address system in the open after 10.00 PM and before 6.00 AM. Any person or organization making noise on amplified system during this period can be prosecuted under the provisions of the EPA, 1986. In case permission has been procured the sound must remain within the sound limits prescribed in the Noise Rules.
- Any person violating the Rules is liable to be arrested under the stringent provisions of EPA, 1986.
- A citizen can also file a complaint in the Court after 60 days notice to authorities.

2. Noise has also been identified as a 'nuisance' and action is possible Under Section 133 of CrPC.

3. Guidelines for installation of DG sets have also been notified under Noise Rules which specify noise limits for sets (upto 100KVA) manufactured before and after 01-07-2003 (Annexure 3.2).

4. Provisions of the Punjab Instruments (Control of Noise) Act, 1956 are applicable in Chandigarh. This

Box 3.3 : Impact of Noise Pollution on human health

Each individual is affected differently by noise. However, certain health hazards linked to excessive exposure to noise heighten the need for taking action for noise control.

It has been found that the general impact of noise includes headaches, irritability, insomnia, the reduction in sexual desire and loss of appetite. The following are the common impacts of community noise:

- Tiredness and headache
- Impairment of visual acuity by the presence of loud music
- Tension, uncertainty and faster talking
- Decrease in informal interaction amongst neighbours
- Poor scholastic performance
- Elevated blood pressure
- Loss of appetite
- Impact on sleep

Physiological Effects

- If sound waves consist of regular vibrations it is often judged to be pleasing, whereas random waveforms are experienced as noise. Excessive noise results in decreased hearing sensitivity. This effect is at first temporary and should a person remain in a quiet environment his hearing soon recovers. Exposure to very loud noise or repeated exposure to more moderate noise may result in permanent hearing loss. Sounds above 120 dB (A) can cause permanent hearing loss by initiating tinnitus, a distressing disorder (whine or ringing in ears). Induced hearing loss can be prevented but can never be cured. The danger is that a person may not perceive the noise to be a problem, but may already have experienced hearing loss.
- Noise also produces peripheral vasoconstriction (constriction of small blood vessels in the limbs) resulting in reduced blood volume and blood flow in parts of the body accompanied by an increase in blood flow to the head. Noise also induces changes in blood pressure, heart rate, cardiac output and pulse volume.
- Noise affects vision and balance. It has been established that man becomes dizzy on exposure to high intensity sound and his ability to select relevant from irrelevant information can be impaired.
- Noise causes a reduction of the blood flow to the placenta, responsible for the nourishment of the foetus. Various abnormalities and impaired brain formation in the foetus of animals have been attributed to noise-induced alteration in hormone balance in the mother.
- Noise can create a stress response in humans, affecting the endocrine and nervous systems. Adaptation and habituation can occur, but prolonged exposure may be detrimental.

Psychological Effects

- Noise that affects feelings and reactions has a psychological effect on humans. This normally occurs at noise levels that do not cause a physical effect. Annoyance, stress and hypertension are symptoms of the psychological impacts of noise pollution.
- Further, noise levels interfere dramatically with communication that may often lead to loss in productivity. It can also lead to low understanding of facts.

includes restrictions, limitations and penalties on the use of instruments (loud speakers, amplifiers and such other apparatus as may be declared to be an instrument under this act).

Implementation of laws is relatively better in Chandigarh as compared to other cities.

B. Infrastructural Response

1. The city of Chandigarh is well planned with Industrial Area, Railway Station & Airport at one side (SW). Further, no railway line passes through the city thus protecting it from unwanted sound. The new railway track under construction also bypasses major parts of city.

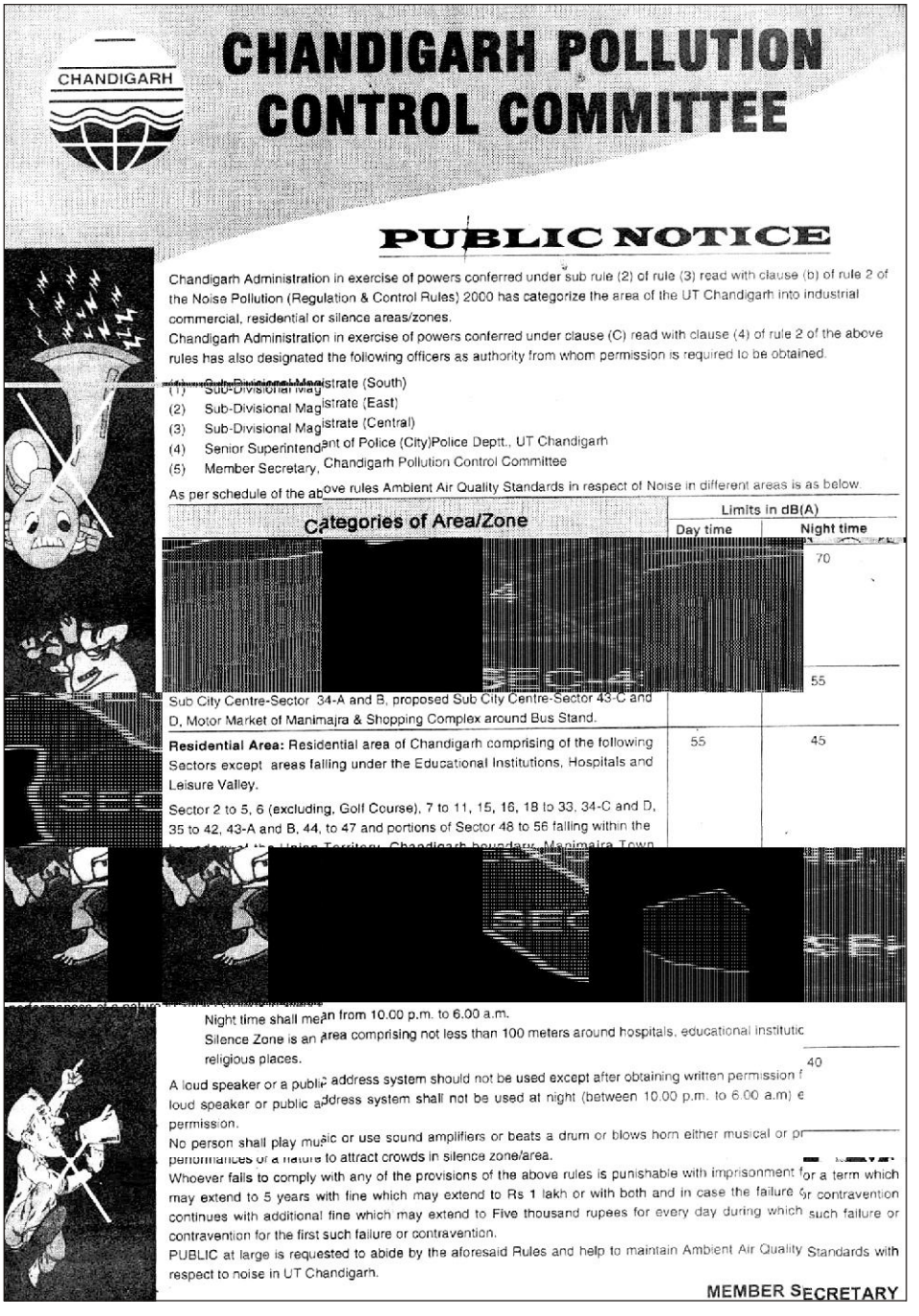
2. In an effort to reduce traffic congestion in the city center, the Inter State Bus Terminus (ISBT) has been partially shifted to Sector 43 (south of Chandigarh). Hence, all buses coming from Punjab do not enter the city between 8 AM to 8 PM. Further, bus routes for buses from/to Himachal Pradesh, Haryana & Delhi have been fixed (one way) to ensure that there is minimum traffic congestion (and hence traffic noise) around ISBT. Routes for HTV have also been specified. Major parts of the city are closed to HTV from 7 AM to 9 PM.

3. Solar blinkers have been provided at traffic light points to ensure smooth flow of traffic and reduce use of horns even in case of power failure.

4. In an effort to reduce traffic congestion on major roads cycle tracks and slip roads have been constructed for slow moving traffic.

5. In an effort to improve the public transport

Box 3.4 Awareness on Noise Pollution by CPCC.



system, a proposal to run parallel buses along Margs and Paths is under consideration to avoid HTVs on V5 roads. This proposal was to be implemented from 15.8.04 but has been delayed.

6. A proposal for circular routes & sky buses is in the offing.
7. Further, parks, green belts and tree avenues exist which act as good noise absorbers. This needs to be strengthened in the newly developed southern sectors also where avenue plantations need to be improved.
8. A survey was carried out by CPCC on unauthorized and high noise & air pollution generating DG sets. Based on this notices were issued and mitigation action initiated. As a result most users have complied to the government's directions or withdrawn DG sets. A follow up survey, however, needs to be taken up.

C. Community Response

1. CPCC is regularly creating public awareness about noise pollution. A press clipping is presented at Box 3.4.
2. Regular interaction with public through stalls on fairs and exhibitions and distribution of leaflets is carried out.
3. NGOs and schools have been involved in creating awareness about reduction of air & noise pollution during Diwali. This has resulted in decreasing noise levels over past years as manifest in the Diwali noise observations.

RECOMMENDATIONS

- Monitoring of noise at strategic locations like recreational places and major roundabouts should be taken up as a regular feature. For this, the existing infrastructure needs to be optimally utilized. The CPCC may set protocol for the same, as well as, identify specific locations, timings and standardized equipment for data monitoring and comparison.
- The present public transport system needs to be strengthened to discourage use of personalized vehicles.
- Noise at source be reduced by ensuring that equipment specifications are met. Equipments (like DG sets) be installed in acoustic chambers. This may be strictly enforced.
- Regular survey for implementation of DG set rules needs to be carried out.
- Noise barriers and vegetation in southern sectors needs to be promoted.
- Special efforts need to be made to reduce noise level around silence zones. Indoor noise (especially in hospitals) be controlled by providing proper insulation of OPD/ waiting rooms. For this, the Chandigarh Administration may issue necessary directions to the concerned authorities for proper arrangement and planning of outdoor patients, as well as, better insulation of buildings.
- In industries generating high noise, workers be provided noise filtering equipments (like, earmuffs) and duty hours be regulated as prescribed.

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CHAPTER-4

LAND AND ITS DEGRADATION

Land is the fundamental basis for most human or natural activities and is one of the major natural resources on earth. It supports various components of the environment, like, water, flora & fauna, etc. which are organized in the form of an ecosystem. The city of Chandigarh, which is well known for its unique architecture and well planned landscaping is a harmonious blend of buildings, trees and other landscape elements, with the backdrop of Shivalik hills which enhances its aesthetic value. The most fascinating feature of the city's landscaping is the tree plantation along avenues, open spaces, green belts and also around building complexes.

Majority of Land in the Union Territory of Chandigarh is under urban area (69.6%). As per map prepared by Punjab Remote Sensing Centre (Fig.4.1) other land use elements include village settlements (5.4%), area under agriculture (7.2 %), area under forests & plantation (7.7%), area under Sukhna Wetland (1.6%) and area under other water bodies (3.1%). The rest of the area is under vacant land (3.8%) and miscellaneous uses (1.6 %). Detailed status is described subsequently.

Land degradation is the decline in the quality of the land and its resources, commonly caused by inappropriate human usage. It includes soil degradation/ erosion and the deterioration of natural vegetation, landscapes and water resources and encompasses the adverse effects of urbanization, road construction, erosion, overgrazing, excessive tillage and sediment deposition.

Box 4.1

Preservation of land quality & prevention of erosion	• Department of Forests & Wildlife • Department of Environment
Determining Land use pattern	• Department of Architecture & Urban Planning
Control of land degradation due to municipal, hospital & hazardous waste pollution	• Chandigarh Pollution Control Committee • Municipal Corporation

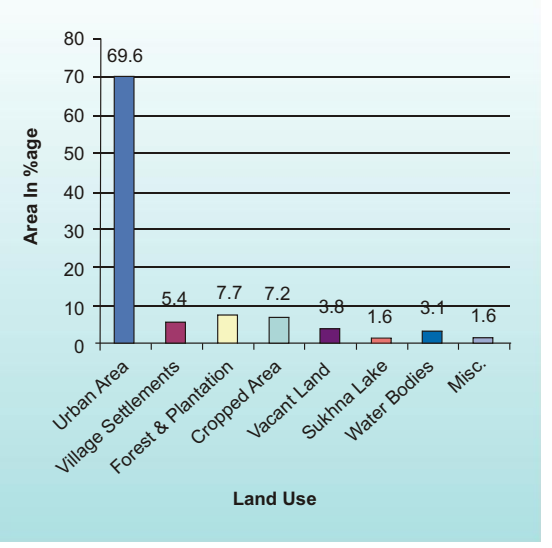
Institutional Framework

Land use in Chandigarh (and factors which cause its degradation) is controlled by the departments listed in Box 4.1.

DRIVING FORCES

As the seat of three governments, the city is under enormous population and developmental pressures. The major driving forces causing change in land use pattern of city include:

Fig. 4.1 Percentage Land use Pattern in the Union Territory of Chandigarh



Source : PRSC, Ludhiana

- **Population**

The population of Chandigarh has increased more than 7 times since 1961. This includes extra ordinary growth of population of villages falling within and outside the master plan area and squatter population. The city recorded the highest growth rate among Class I cities of the country during 1961-71 (145%). This continued to be very high during 1971-81 also (75.5%). Since then, the trend has continued. The city exceeded its targeted population of half a million in 1991 within three decades of its establishment. It is estimated to increase four fold by 2021 at current growth rate. Further, growth in rural & squatter population has been of the order of 130% as against 36% of urban growth during the last decade. This is a clear danger signal (since it reflects concealed urban growth by overcrowding of villages by migrant population and by unauthorized development around villages). This unprecedented increase in population has lead to pressures on Chandigarh's infrastructure and drastic changes in socio economic structure of the city. The areas adjoining Chandigarh (falling in the States of Punjab and Haryana) have also witnessed rapid growth. Further, growth in population and urbanization is known to increase per capita waste generation. The present per capita municipal waste generation is 360.85 g per day in contrast to 274.29 g per day reported in 1970 (CDC,1999).

- **Unplanned expansion of villages**

As enumerated in Chapter 1, four villages (Attawa, Burail, Butrela and Badheri) already fall within municipal limits of Chandigarh due to their expansion. There are 18 other villages in the outskirts of city limits. These face problems of unplanned development due to absence of any control on development outside the 'lal dora' areas (especially in villages, like, Khuda Ali Sher & Kaimbwala). This is leading to haphazard growth. Despite best of efforts, the administration has not been able to curb this trend. New building byelaws are being framed to regulate their development.

- **Growth of slums**

As per a survey conducted by Estate office, Labour Department and Food & Civil Supplies Department unauthorized colonies have come up at 14 locations in the city. These are enumerated in Chapter 1.

As per official records the total unauthorized slum population is 70,000 with 21,385 'jhuggies'. The largest concentration is found in Labour Colonies no. 4 & 5, Madrasi Colony, Kumhar colony and Nehru colony. In addition, there are four more locations namely, Gwala colony, Pandit colony, Kuldeep colony and Mazdoor colony which are small settlements with estimated population of about 4,000. Despite the fact that the Chandigarh Administration has resettled about 20,000 squatter dwellers in the resettlement colonies since 1970, the rate of growth of 'jhuggi' population is accelerating. With the city becoming a beehive of economic and governmental activities offering better employment opportunities, the growth of informal sector is bound to increase more rapidly. The task is difficult and challenging requiring innovative solutions for tackling the problem (Source: http://chandigarh.nic.in).

Another issue, which has emerged as a cause of concern, is the encroachment of public land in commercial areas. The administration has constructed some booths but this has aggravated the problem rather than solving it. An additional demand of 4000 such booths is still pending.

A Slum

- **Development around Periphery**

The Periphery Controlled Area Act of 1952 created a wide green belt (initially 8 km, increased to 16 km in 1962) around the entire Union Territory. This proposed to regulate development, prohibit establishment of any other town or village and forbade commercial or industrial activity in the periphery zone. The idea was to guarantee that Chandigarh would always be surrounded by countryside. However, re-organization of Punjab in 1966 proved a turning point in the growth and development of the city. Chandigarh became the capital city for the state of Punjab, as well as, for the state of Haryana. It was given the status of Union Territory with a separate administrative set up. Periphery of Chandigarh was also sub divided with majority of area going to states of Punjab (1021 sq km) & Haryana (295 sq km) and only a small portion left with the Union Territory.

Hence, not only the city came under lot of pressure after re-organisation, but its periphery also witnessed enormous developmental activities. The state of Punjab used the area in the immediate vicinity of Chandigarh to develop SAS Nagar (Mohali) in an area of 5500 acres for housing a population of 2.5 lacs (subsequently increased to 8000 acres for catering to a population of 5 lacs). The state of Haryana also used the periphery area close to Chandigarh to develop a new city of Panchkula in an area of 4853 acres for a population of 1.5 lacs (Panchkula extension has now been planned across Ghaggar River in a linear strip, along Ramgarh road in an additional area of 2945 acres, which would bring in another 1 lac population). Zirakpur and its surrounding areas towards the south of the city, the towns of Dera Bassi further south and Kharar towards west have also put a lot of pressure on city's infrastructure. Besides this, Mansa Devi complex has also been planned in the periphery north of Capitol complex in 1550 acres, to cater to a population of 0.5 lac. Other developmental activities in villages around Chandigarh like, Naya Gram, Karoran (Forest Hill Resort), etc. also violate the Periphery Controlled Area Act, 1952. Thus, the periphery of Chandigarh, which was originally created to cater to the day-to-day needs of capital city, has been subjected to a lot of planned and unplanned urbanization. This has emerged as one of the most critical issues requiring immediate remedial action as most problems are a result of pursuing the path of isolated and independent development of satellite towns by the respective state governments. Hence, a conceptual framework involving the U.T. and its surrounding areas within which entire future development could be undertaken needs to be evolved.

PRESSURES

An exponential increase in population, unplanned development in peri urban areas and infrastructure development non-commensurate with growing demands of urbanization, has put pressure on the scarce land resources of the Union Territory. This has created land degradation and soil pollution problems. Factors leading to these problems include:

- **Change in Land use pattern**

  The area was originally planned to cater to a population of 5 lacs. Only 30 sectors were planned in the first phase. However, the number of sectors has increased to 58 to cater to increasing population. The urban area has increased from 62% to approximately 70% in the past decade due to acquisition of additional land for

residential sectors. The Phase-III of industrial area is also proposed to be developed in vacant land near Raipur Kalan, besides acquiring of village land (under agriculture) for IT Park in Kishangarh and for Institutional/recreational sites in Maloya. Further, since 1966, area under agriculture has reduced from 47% to 8.6% in 2001-02. Change in land use has thus, exerted tremendous pressure on the land of Chandigarh.

- **Pollution from Solid Waste**

Pollution/land degradation in Chandigarh mainly results from inadequate disposal of municipal, hazardous and biomedical wastes that are being generated in the city.

- **Municipal Solid Waste (MSW) Pollution**

As per data provided by the Municipal Corporation, the city presently generates about 300 to 325 tons/day of municipal solid waste which is disposed off by the process of landfilling at the landfil site situated in the west of Sector 38 near Dadumajra spread over an area of 45.11 acres.

The city has 45 bins each of 6.5 m^3 capacity, 485 bins each of 4.5 m^3 capacity and 75 bins of 1 m^3 capacity placed at different locations for storage and collection of municipal solid waste. The corporation has provided 31 Dumper placers, 4 refuse collector compactors, 2 open trucks and 19 tractors for transportation of waste to dumping ground and 1 JCB and 2 tippers for making provisions for spreading of soil over garbage at the dumping ground. A heavy chain bulldozer is used to push garbage in low lying areas. One bob cat and one mechanical sweeper is also available. At present three Health Supervisors, 7 Chief Sanitary Inspectors, 16 Sanitary Inspectors along with over 2200 staff, work to collect and dispose off the municipal waste generated in the city (Municipal Corporation, Chandigarh, 2004).

Though composition of solid waste generated in the city needs to be studied, however, plastic is a great nuisance amongst the various components of municipal waste and is growing at an alarming rate. More than half of this is contributed by packaging materials (CPCC, 1998). The volume of plastic waste, especially in the form of bags needs to be reduced.

The disposal of leaf litter is also a great challenge in the city. Burning of leaves is a common practice, which pollutes the air. Their large quantity makes it difficult to remove the entire volume to the solid waste disposal site.

The Municipal Corporation has set up 'Sahaj Safai Kendras' for ensuring proper collection and disposal of municipal solid waste. The scheme is discussed subsequently.

Garbage bin

- **Hazardous Waste Pollution**

The Ministry of Environment & Forests, Government of India has framed the Hazardous Waste (Management & Handling) Amendment Rules, 2003 under the Environment (Protection) Act, 1986 (Annexure 4.1).

There are 153 hazardous waste generating units in Chandigarh, which generate about 835.68 MT/Year of hazardous waste (Table 4.1) under 11 categories (Annexure 4.2). Out of these the maximum waste is generated by pickling industry, whereas the minimum amount of waste is in the form of sludge

Plastic waste

(residue containing oil). The quantity of hazardous waste generated by various industries in Chandigarh is presented in Figure 4.2. In addition, discarded containers of hazardous and toxic wastes (Category-18) are also generated. These are washed, punctured and sold as scrap. In the absence of any common hazardous waste disposal site, the individual units are collecting and storing their hazardous waste within their premises.

- **Biomedical Waste Pollution**

Biomedical waste means any waste, which is generated during the diagnosis, treatment or immunisation of human beings or animals, or in research activities pertaining thereto, or in the production or testing of biologicals.

The medical facilities in the Union Territory have grown over time and cater to both, the population of the Union Territory as well as the neighboring states. There are 474 biomedical waste generating establishments (hospitals, clinics, laboratories, research institutes, veterinary hospitals, etc.) in Chandigarh. Out of these, 335 are clinics of which 72% are located in urban area & remaining in rural areas of U.T. (Table 4.2).

As per CPCC the maximum waste is generated by Government hospitals like Post Graduate Institute of Medical Education & Research and Nehru Hospital, Sector 12; Government Hospital, Sector 16 and Government Medical College & Hospital, Sector 32 (Figures 4.3 & 4.4).

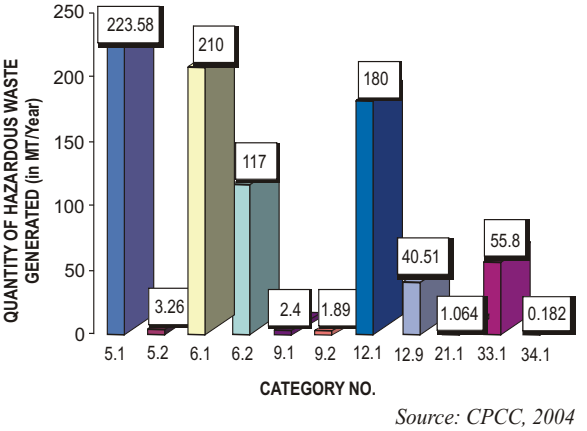
This waste includes non-liquid tissue, body parts, blood, blood products, and body fluids from humans and other animals, laboratory and veterinary wastes, which contain human disease-causing agents, and discarded sharps (including needles, syringes, blades, scalpels, slides, broken glass, etc.).

The total quantities of each category of biomedical waste (refer Annexure 4.3) generated in the city are presented in Figure 4.5. The maximum waste generated pertains to category 8 (liquid waste) followed by category 6 (soiled waste). Minimum waste generated is of category 5 (discarded

Table 4.1 Hazardous waste producing units in Chandigarh

Catg. No.	Type of Hazardous waste	No. of Units
5.1	Used/Spent Oil	39
5.2	Waste/residues containing oil (sludge)	37
6.1	Sludge and filter cake arising out of zinc sulphate production	3
6.2	Zinc fines/dust/ash/skimming (dispersible form)	3
9.1	Lead slag/lead bearing residues	1
9.2	Lead Ash/Particulate from flue gas	1
12.1	Pickling acid residues	1
12.9	Chemical sludge from waste water treatment	63
21.1	Wastes and residues	3
33.1	Chemical containing residue from decontamination and disposal	1(closed at present)
34.1	Flue gas cleaning residue	1(closed at present)

Fig. 4.2 Quantity of Hazardous waste produced in Chandigarh



Source: CPCC, 2004

Table 4.2 Total Number of Medical Institutions in Chandigarh

Sr. No.	Medical Institutions	No. of Units (U-Urban, R-Rural)
1	Nursing homes	36 (U)
2	Clinics	335 (U 241, R-94)
3	Dispensaries	40 (U 26, R-14)
4	Veterinary institutions	19 (U 11, R-8)
5	Animal houses	1 (U)
6	Pathological labs	40 (U)
7	Government hospitals	3 (U)

Source: CPCC, 2002

medicines and cytotoxic drugs). A considerable amount of animal wastes and slaughterhouse wastes are also generated in the city. In addition, illegal slaughtering of poultry birds is also rampant (CPCC, 1998).

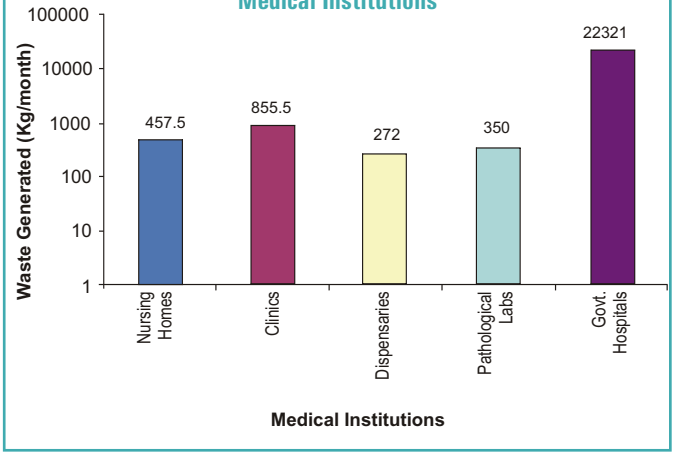
The category wise waste generated by various biomedical waste generating institutions is presented in Figure 4.6.

About 1350 indoor and 3,00,000 outdoor patients (including lab patients) visit the 451 medical institutions (excluding Veterinary Hospitals and Animal Houses) every month. The three Government hospitals generate approximately 1200 kg /day of waste and the 36 nursing homes generate about 15kg/day of waste. About 20 kg/day of waste is generated by approximately 350 small hospitals. Almost all the biomedical waste generating institutions have waste disposal arrangements.

- **Pollution from Agriculture run-off**

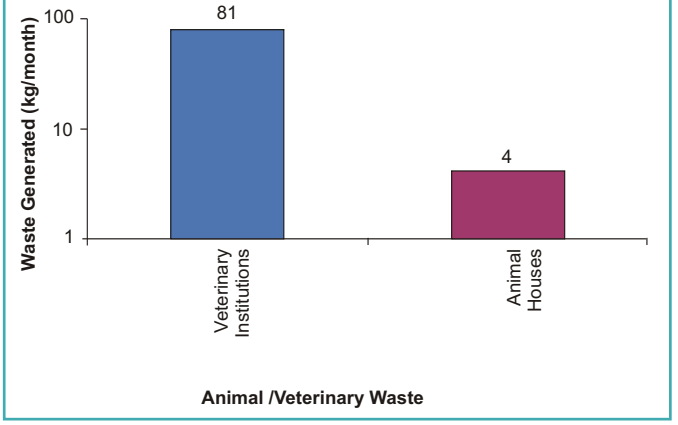
The area under cultivation (including double cropping) in the Union Territory was 54.42 sq km in 1966 (i.e. 47% as per Environment Department U.T.). This has been reduced to less than 14 sq km in 2001-2002. However, as per remote sensing data this is only 8.6% of the total geographic area. Data indicates that the production of food grains increased from 3340

Fig. 4.3 Biomedical waste generated in Chandigarh by Medical Institutions



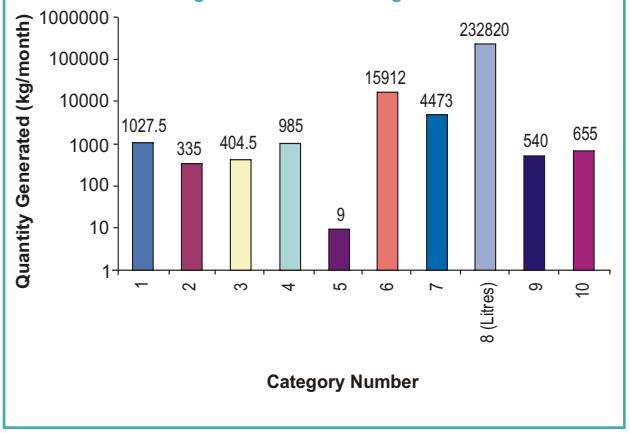
Source: CPCC, 2002

Fig. 4.4 Biomedical waste generated in Chandigarh by Veterinary Institutions



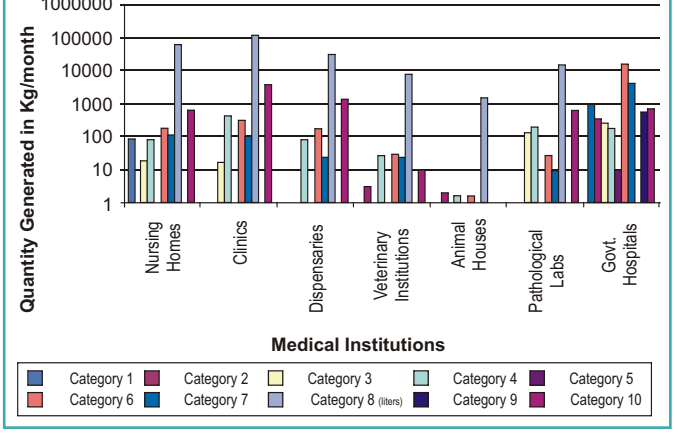
Source: CPCC, 2002

Fig. 4.5 Category wise total biomedical waste generated in Chandigarh



Source: CPCC, 2002

Fig. 4.6 Category wise biomedical waste generated by different medical institutions in Chandigarh

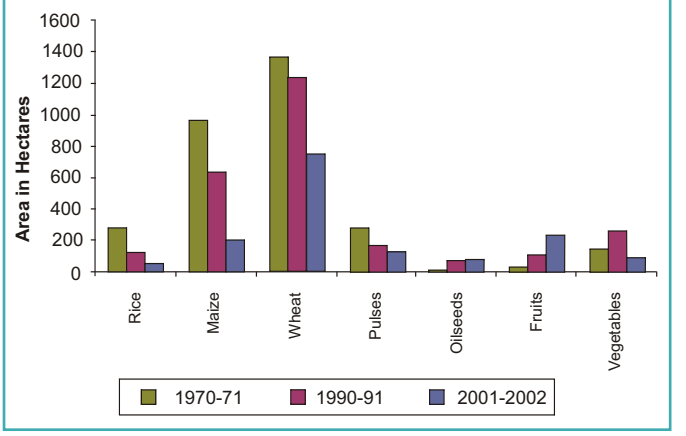


Source: CPCC, 2002

Metric Tons (M.T.) in 1980-81 to 4075 M.T. in 2001-2002. This has been possible by the use of high yielding varieties and increasing application of fertilizers and pesticides.

Further, over the years farmers have shifted to cultivation of vegetables and fruits from wheat and maize. The area under fruits has increased more than 10 times since 1970 although overall it is very low. The area under vegetables increased till 1990, however, it has reduced thereafter (Figure 4.7). These crops provide more profit to the farmers particularly in and around urban areas. However, a large number of fertilizers, pesticides and growth regulators are used to grow these crops.

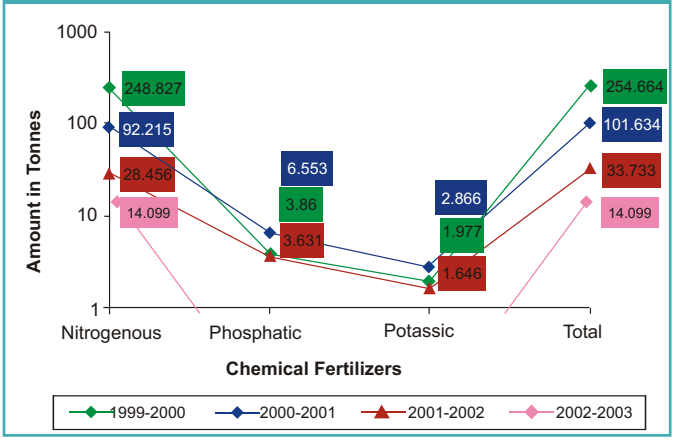
Fig. 4.7 Change in area of different crops in Chandigarh (1970 onwards)



Source: As cited in CPCC, 1998 and Statistical Abstract of Chandigarh, 2002.

More than 18 different pesticides are reported to be consumed in the Union Territory. The estimated consumption of pesticides is around 1.5 MT. The total consumption of NPK in Chandigarh was reported to be approximately 255 tonnes in 1999-2000. However, it decreased to about 14 tonnes in terms of nutrients in 2002-2003 (Figure 4.8). This could be due to decrease in area under agriculture. (Statistical Abstract of Chandigarh, 2003).

Fig. 4.8 Consumption of chemical fertilizers (1999-2003)



Source: Statistical Abstract of Chandigarh, 2003

STATE

Geology

The north-east area under the Union Territory of Chandigarh comprises Shivalik rocks constituting conglomerates, friable sand stone, silt stone, and clay stone. The conglomerates have sandy base with cobbles and pebbles of quartizities. Stray pebbles of granite, limestone, sandstone and lumps of clay stones are also present. The matrix consists of medium to coarse grained sandstone, and at places, calcareous cement which imparts certain degree of hardness. The sand stones are partly lithified and medium to coarse grained. The general slope of the land is towards the south.

The Quaternary sediments in the area are composed of boulders, cobbles, pebbles, sand, silt and clay. The depth of ground water ranges between 5 and 35 metres.

Geomorphologically, the area has been classified into six units (Map 4.1) *viz.* residual hills (eroded), upper piedmont slope, lower piedmont slope, piedmont slope dissected, shallow flood plain and abandoned river channel.

Soil Types

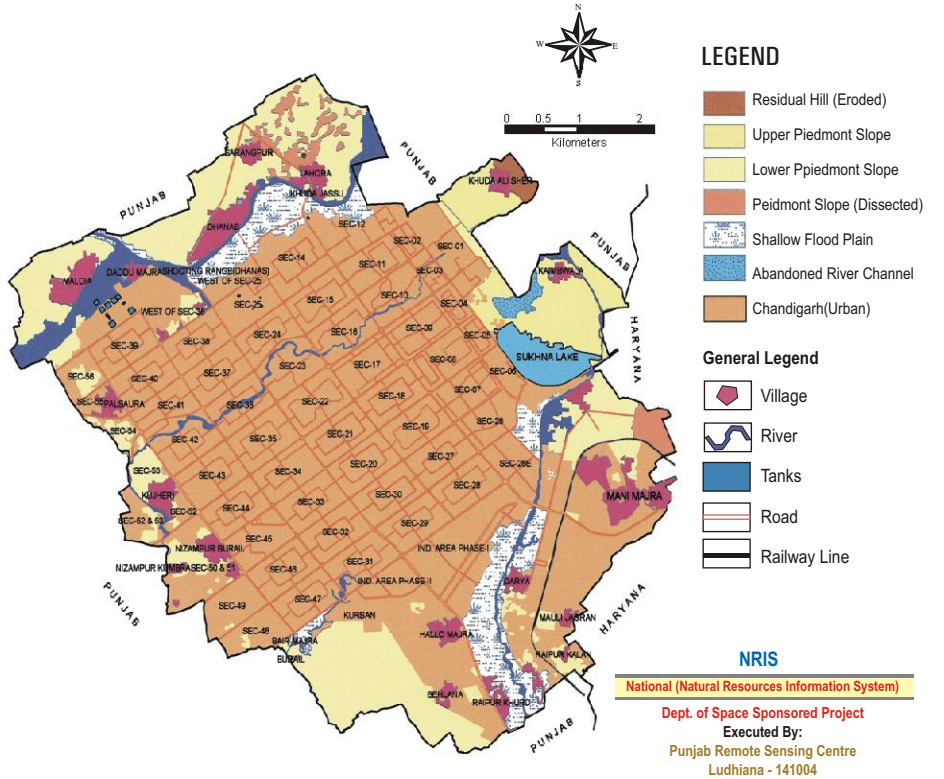
Soils in the Union Territory have been grouped into 9 soil series (Map 4.2). These vary with respect to texture, drainage and profile development. Soils are generally alkaline and the electrical conductivity and organic carbon are low and calcium carbonate variable. Soils along hill side slopes are well to excessively drained with rapid

permeability. At places the profiles are truncated due to removal of original soil. The soil texture varies from sand to sandy loam with 10-40% gravel. The dominant soils are loamy skeletal Typic Ustorthents.

The soils of the upper piedmont plain are very deep, excessive to well drained and slightly to moderately eroded. The soil texture varies from loam/silt loam with 3-8% gravels. The dominant soils are coarse loamy Typic Ustochrepts and Typic Ustipsammnts. However, in dissected piedmont plain in the western part of the area, very deep, well drained and moderately to severely eroded soils are found. The texture of the soils ranges from sandy loam to silt loam/silty clay loam. The dominant soils are fine to coarse loamy Typic Ustochrepts. The lower piedmont plain soils are dominantly sandy loam to loam in texture and qualify for coarse loamy Typic Ustochrepts.

The soils of the flood plains along the seasonal rivulets (choes) are coarse textured, stratified, well to excessively drained, have irregular distribution of organic carbon with depth, and are variable in texture. The dominant soils are Typic Ustifluvents and Typic Ustipsammnts.

Map 4.1 Geomorphology of Chandigarh



Satellite Data:
IRS-1D liss-III + PAN MERGED DATA
Date of Pass: 05/03/2001

Source: PRSC,Ludhiana

Map 4.2 Major Soil types of Chandigarh

Source: PRSC,Ludhiana

Land use

The major land use of Chandigarh is presented in Maps 1.2 & 1.3. Important components are discussed below:

i. Urban area

Maximum land use of Chandigarh is in urban category. The total urban area in Chandigarh city is about 79.4 sq km (69.6% of UT area). The distribution of urban area into different categories is presented in Table 4.3.

Data indicates that a significant part of city area is under roads (19.86%) and public & semipublic uses (10.34%). Areas under recreational purposes (6.53%) include major gardens, green belts, Leisure Valley and sector parks.

Table 4.3 The distribution of urban area into different categories

LAND USE CATEGORY	% OF THE TOTAL AREA
Residential	38.20
Commercial	5.36
Industrial	6.69
Public & Semi-Public	10.34
Recreational	6.53
Major Roads	19.86
Miscellaneous	13.02

Source: Department of Urban Planning, Chandigarh, 2004

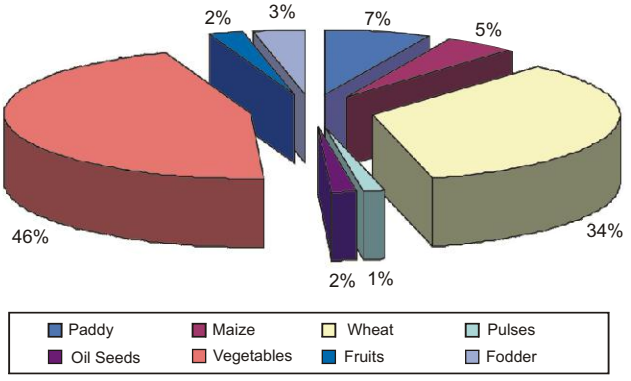
i. Village habitation

As discussed in Chapter 1, four villages are under municipal limits of the city and 18 villages are in the periphery. This area covers only inhabited parts of the villages.

ii. Agriculture

The area under agriculture includes 7.2% of the total area. Out of this most area is double cropped. The principal crops grown are paddy, maize, wheat and fodder in addition to fruits and vegetables. The area under cultivation of various crops is presented in Figure 4.9.

Fig. 4.9 Percent Area under agriculture in U.T. of Chandigarh



Source: Statistical Abstract of Chandigarh, 2003.

iv. Forests & Plantations

As per Punjab Remote Sensing Center data, 7.7% area in U.T. is under forests. This amounts to about 8.85 sq km which is divided into Chandigarh and Nepli ranges. The distribution of various types of reserve forests, mixed plantations and open mixed jungles within the geographical boundary of U.T. is presented in Map 1.3.

However, 24.98 sq km of additional hilly area was acquired by the Forest department of erstwhile Govt. of Punjab in the year 1962 to 1964 for soil conservation works. This area vests with UT as per Section 48 (5) of Punjab Reorganisation Act, 1966. However, in revenue records the area is still under Punjab & Haryana and is yet to be transferred to UT. Hence, overall U.T. and its surroundings comprise a total of 32.41 sq km of forest area (including 24.98 sq km). This is divided into hilly forests, lake forests, Sukhna choe forests and Patiala-ki-rao forests (Figure 4.10).

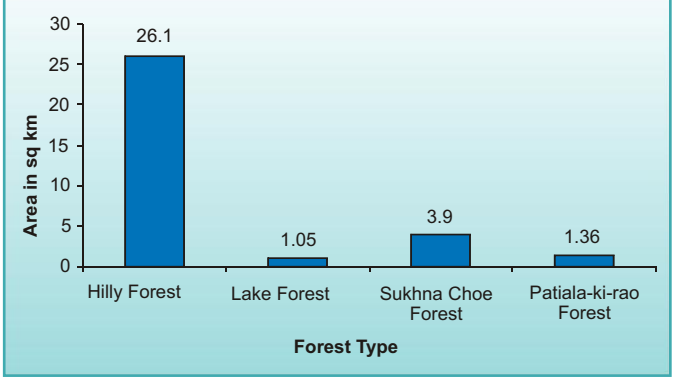
Reserve Forest Area

These forests have been developed from conservation forestry point of view. The tree plantations include Shisham, Khair, Kikar, Musket, Eucalyptus, Su-Babul, Mulbrery, Amla, Kachnar, Simbal, Siris, Bahera, Ber, Peepal, Pilkhan, Tun and Mango. Felling is completely banned and only miscellaneous grasses are allowed to be removed and sold from the Sukhna choe and Patiala-ki-Rao.

v. Water Bodies

About 4.72 % of the total area of the U.T. is under water bodies. This includes Sukhna wetland (1.6%) and seasonal rivulets (3.12%), like Sukhna Choe, Patiala-ki-Rao, N Choe and Choe Nallah.

Fig. 4.10 Area covered by forests in U.T. of Chandigarh



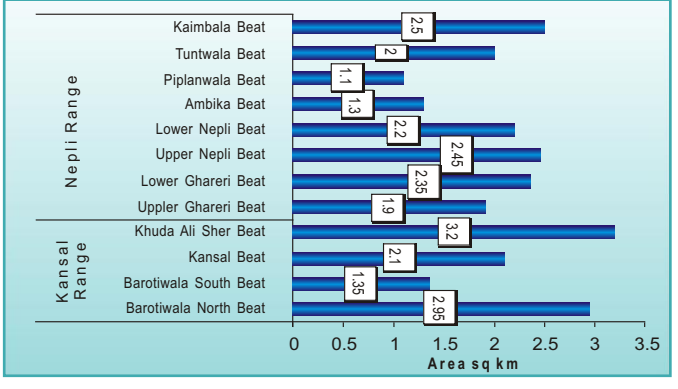
Source: Forest Department, UT

The Sukhna Lake was constructed in 1958 across Sukhna choe as an integral part of the master plan of the city. The Sukhna Lake and the surrounding area was identified as a wetland of National importance as it attracted a large number of migratory birds. It was notified as a wetland of National importance by Chandigarh Administration vide notification dated 6th July, 1988 and has been identified by National Wetland Committee, Ministry of Environment Forests, Government of India for conservation and management. The wetland covers an area of 2.28 sq km (out of which pond area is 1.8 sq km). It extends up to barbed wire fencing between agricultural fields of village Kaimbwala and Capitol Project area on northern side, up to forest plantation between lake and agriculture fields of Lake Bandh on eastern side and up to Lake Club on western side.

On the southeast corner of the lake a three-span spillway with crest at 349.91 m has been provided. At the time of its construction the pondage capacity was 10.74 MCM (million cubic meters) with 2.28 sq km of spread area. It has reduced to 4.2 MCM and the water-spread area at 353.87 m has reduced to 1.52 sq km due to siltation (CPCC, 1998).

The total catchment area of the lake is 42.07 sq km of which 29.08 sq km falls in the Union Territory of Chandigarh, 10.22 sq km falls in the state of Haryana and 2.77 sq km falls in the state of Punjab. Of the areas falling in Chandigarh, 25.42 sq km is hilly area (Shivalik hills) prone to erosion and about 3.68 sq km is under agricultural use. The catchment is drained by two seasonal rivulets, namely Kansal and Nepli which originate in Haryana and are fed by a number of tributaries and sub-tributaries. The 25.42 sq km of the hilly catchment area with the U.T. Government forms a major part of the catchment and is divided into ranges and beats for better administration and control as per details given in Figure 4.11. The Kansal Range covers a total of 9.6 sq km of area, while 15.8 sq km falls under the Nepli Range. The maximum area falls under Khuda Ali Sher Beat (Kansal Range), whereas the minimum falls under Piplanwala Beat (Nepli Range).

Fig. 4.11 Catchment areas of Sukhna Lake in Chandigarh



Source: Source: Forest Department, U.T.

Heavy sedimentation in the lake has been a major cause of concern ever since its creation. All the seasonal rivulets and their tributaries

originate in the steep slopes of the Shivalik hills, which are ecologically fragile and unstable. The entire area is in the shape of rugged terrain, its face incised with gullies and numerous seasonal streams. The soil is sandy, embedded with pockets of clay, which is highly susceptible to erosion by run off water action. The degree of slope being steep and with precipitous slopes the occurrence of landslips in the upper area of the catchment is very common. The maximum rainfall (about 80%) is received during the months of July-August. The raindrop impact, turbulent flow of run off, exposed soil, etc. are some of the prominent factors responsible for massive soil erosion and hill denudation (soil particles coming in contact with rainwater, get detached from the land mass under the raindrop impact and are carried by the run off to be deposited in the bed of the lake). Under these geo-climatic conditions the lake has been receiving huge quantities of silt year after year, as a result of which its very existence was at stake. Promotion of soil conservation activities in the catchment areas of wetland was one of the primary reasons for acquiring additional 25.42 sq km area by Punjab government in 1962-1964 this includes 43.7 ha area of Khuda Alisher village which is in the Union Territory). Desilting of lake has also been taken up as a major activity. These activities are discussed subsequently.

A study on Sukhna Wetland was also carried out by PRSC, Ludhiana in 1994 (Fig.4.12) under the nation wide Wetland Mapping Project sponsored by the Ministry of Environment & Forests, GoI (Garg *et. al.*, 1998) . The study indicates that about 71% of the catchment is under forests whereas gullied/ravenous wasteland is 12.31%. Nearly 10% area of the catchment below the hills is crop land (Table 4.4).

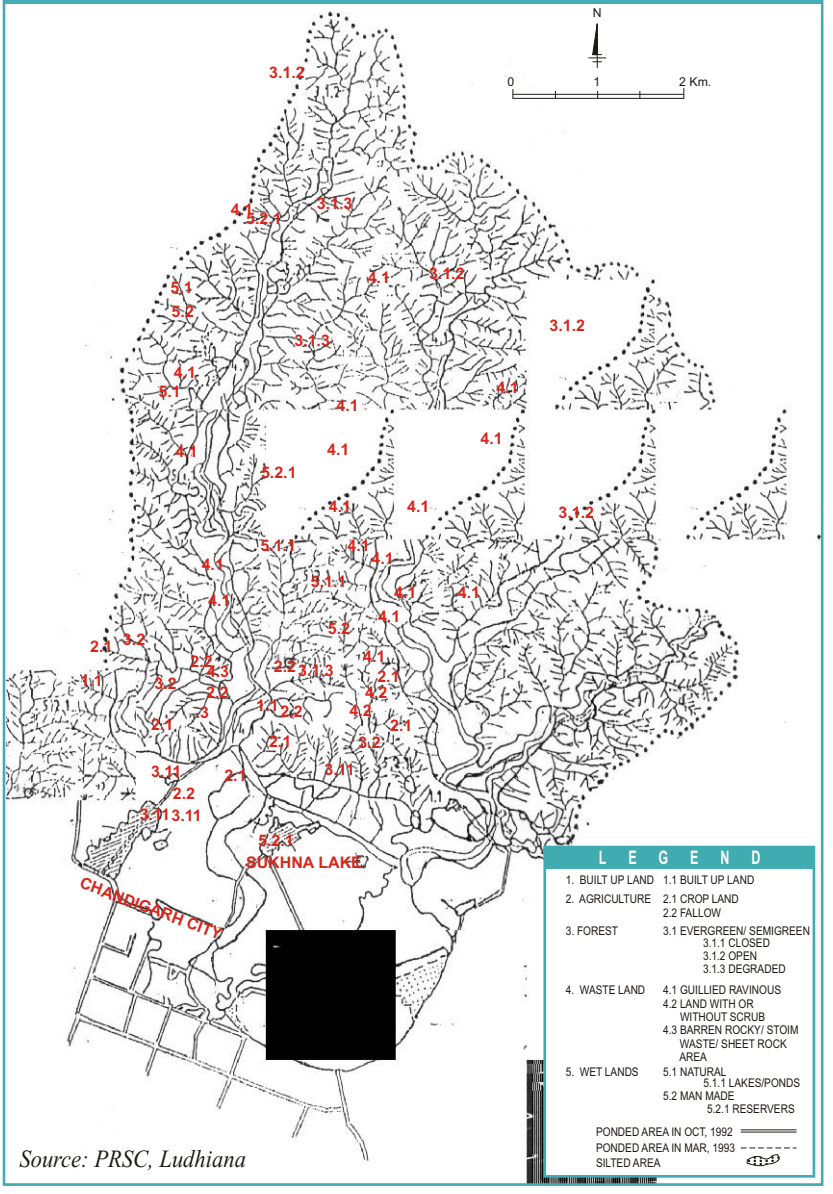
Table 4.4 Area under various land use categories in the catchment of Sukhna wetland

LAND USE CATEGORY	AREA (Ha)
Built up land	32.10
Crop land	436.50
Fallow land	30.00
Closed forest	147.70
Open forest	3019.60
Degraded forest	49.30
Plantation	3.00
Gullied/Ravinous	557.70
Wasteland with or without scrub	37.50
Barren/rocky/stony waste land	43.50
Lake/pond	156.30
Reservoir	16.30
Total	4529.50*

** Total differs from 42.07 sq km reported elsewhere by Forest Deptt.*

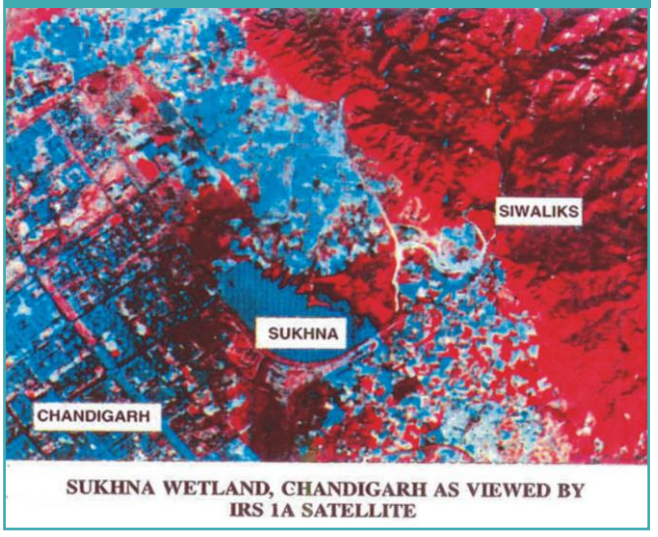
Source: Garg et. al., 1998

Map 4.3 Drainage and Land Use Map of Sukhna Wetland



Source: PRSC, Ludhiana

Fig. 4.12 Satellite Image of Sukhna Lake



SUKHNA WETLAND, CHANDIGARH AS VIEWED BY IRS 1A SATELLITE

Source: PRSC, Ludhiana

Table 4.5 Variations in water spread (ha) in Sukhna Lake

Data Set	Year	Season	Water Spread (ha)
SPOT TM	1986	Post-monsoon	142
LANDSAT TM	1987	Spring	120
B/W Aerial Photographs	1991	Spring	152
IRS-1A-LISS II	1992	Post-monsoon	153
IRS-1A-LISS II	1993	Pre-monsoon	134

** Total differs from 42.07 sq km reported elsewhere by Forest Deptt.*

Source: PRSC,1994

The drainage map (Map 4.3) reveals that the drainage pattern is dendritic and sub parallel. The high drainage density in the catchment indicates severe erosion.

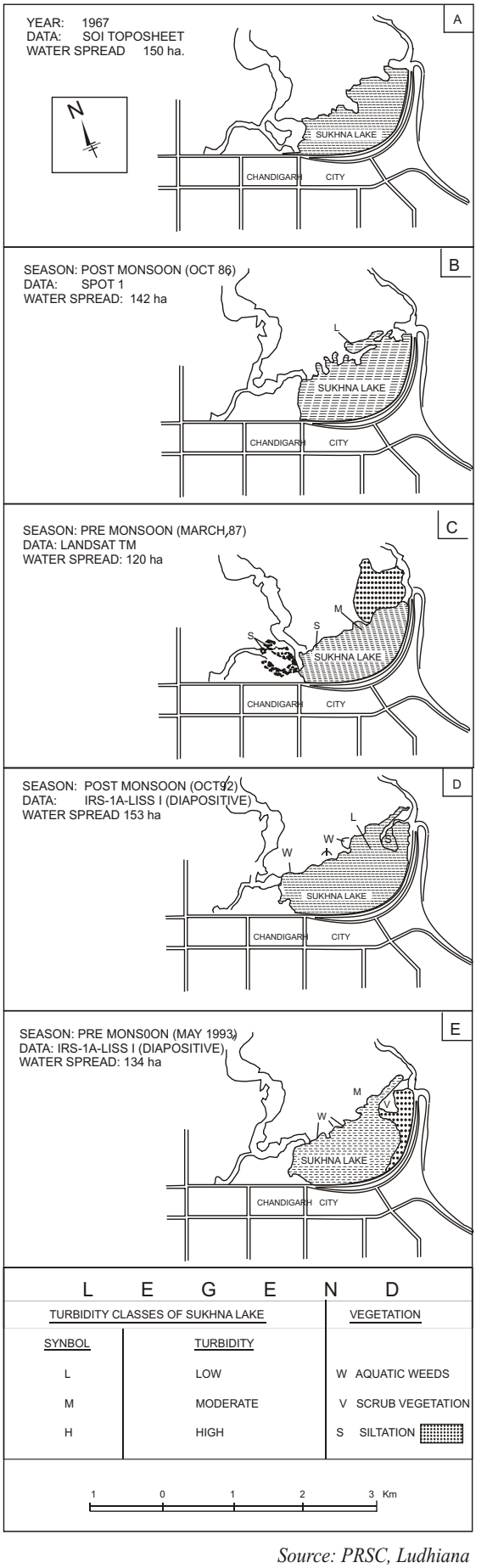
During the period 1967-1987, the course of Sukhna and Kansal nadis have changed considerably. Further, to check the influx of silt, the course of Kansal nadi was diverted towards Sukhna nadi in 1972 where it merges with it and ultimately feeds the lake. Seasonal variation in water spread of the lake (pre and post monsoon) has also been studied (Table 4.5).

Sukhna wetland has also been classified on the basis of turbidity using pre and post-monsoon data of 1986/1987 and 1992/ 1993. It has been observed that during post-monsoon season it has low turbidity whereas in pre-monsoon it has moderate turbidity (Figure 4.13).

IMPACTS

Frequent change in land use pattern to bring more areas under urbanization, developmental activities and deforestation in the peripheral zone, and generation of high

Fig. 4.13 Monitoring of water spread/aquatic vegetation and turbidity of Sukhna Lake



Source: PRSC, Ludhiana

volumes of solid waste has lead to land degradation and deteriorating environmental quality in the Union Territory. The Municipal Corporation is under enormous pressure to upgrade its efficiency of municipal waste disposal. Similarly, biomedical waste not only needs to be treated scientifically but also monitored regularly as large numbers of patients from Punjab, Haryana and Himachal Pradesh visit Chandigarh hospitals/nursing homes regularly.

- **Municipal Solid Wastes**

  Unscientific disposal practices of MSW have adverse impacts on not only the ecosystem but also on the human environment. These practices leave waste unattended at the disposal sites, which attract birds, rodents, fleas, etc. and create unhygienic conditions.

  High plastic content in municipal waste also creates problems like littering and choking of drains. Though most of it is picked up by rag pickers for recycling, however, most factories do not have adequate technologies to process them in a safe manner. This can expose the workers to toxic fumes and unhygienic conditions.

  Cattle deaths are also reported due to ingestion of polythene bags along with garbage.

- **Industrial and Hazardous Waste**

  Improper storage, handling, transportation, treatment and disposal of hazardous waste results in adverse impact on ecosystems including the human environment. When discharged on land, heavy metals and certain phytotoxic organic compounds can adversely affect soil productivity and aquifers. In the absence of a common hazardous waste disposal facility in the area, the industries generating hazardous wastes are currently storing it within their premises.

- **Biomedical Waste**

  Dumping of biomedical wastes (consisting of bandages, syringes, plastic and aluminum equipment, etc.) along with municipal solid waste can create several health problems. Rag pickers, who try to salvage discarded materials, are not only themselves exposed to the risk of injuries and various infectious diseases from contaminated needles and other sharp objects, but also expose unsuspecting public to these diseases. Further, unsanitary conditions are potential breeding ground for flies, mosquitoes, rodents and insects. The burning of plastic and untreated pharmaceuticals produce extremely toxic gases like dioxin and furans, which further add to environmental pollution. Efforts are being made by the CPCC to ensure that all biomedical waste produced in the city is appropriately treated.

- **Industrial Effluents, Sewage and Sullage**

  Industrial wastewater was used for irrigating agricultural fields in village Hallomajra in Chandigarh during the eighties. As a result, the contents of copper (Cu), Zinc (Zn), Nickel (Ni), Chromium (Cr), Cadmium (Cd) and Lead (Pb) increased from 26.0, 53.5, 27.0, 27.5, 1.4, 15.5 microgram/gram (µg/g) to 97.0, 3775.5, 75.0, 343.2, 7.7 and 63.5 µg/g respectively in the soil from early to late eighties (CPCC, 1998). However, since 1992, under the directions from Chandigarh Pollution Control Committee, its land application has been stopped and the waste water is released into the main sewer and sent to the sewage treatment plant.

RESPONSES

A. Legislative and Policy responses

- **Steps taken in response to violation of Periphery Controlled Area Act, 1952**

  The Capital of Punjab (Development and Regulation) Act, 1952 and the Periphery Controlled Area Act, 1952 are the two specific laws passed to guarantee the development of Chandigarh as per the 'edict'. However,

violations of the provisions of the above acts are witnessed in the city. As of today, the Chandimandir Cantonment, satellite towns of Mohali, Zirakpur and Panchkula adversely affect the Chandigarh region in violation of these acts.

With a view to identify the potential impact of large scale development in the close vicinity of Chandigarh, a high powered coordination committee was appointed to review and evolve strategies for planned development of the areas surrounding the Union Territory (to ensure minimal impacts on the city environs). The co-ordination committee approved in 1984 the adoption of regional approach (as envisaged in the Chandigarh Inter State Capital Region Plan, 2001) to achieve the objective. The strategy suggested:

i) Development of small and medium towns in the influence zone of Chandigarh (beyond designated periphery area) and dispersal of population and economic activities over a wider area.

ii) Adoption of spatial development strategy providing effective linkage between cities, medium and small sized towns and rural hinter land in order to sustain urban agglomeration of Chandigarh city and to hold back excessive urban migration to Chandigarh besides ensuring equitable distribution of population and resources for orderly growth and development in the area.

iii) The regional plan identified some immediate action to be taken which *interalia* included:

a) Preparation of Sub regional plans by respective State Governments for the area falling under their jurisdiction.

b) Preparation of development plans for all Regional and Sub regional towns and all future developments to be taken up in accordance with these plans.

c) Unauthorized structures near Zirakpur, Chandimandir on Kalka road and on other major road crossings to be removed.

d) Regional transport systems for Chandigarh urban complex and inter city movement be prepared and developed.

e) Strict control on environmental protection and pollution be observed.

f) Industries should be dispersed in the Regional and Sub regional towns by developing necessary infrastructure.

g) Features like Shivalik hills, lake, choes and rivers must be retained green to promote natural environment and protect the ecosystem. It should be further augmented by development of city forest, bird sanctuaries and deer parks, etc.

However, despite the Committee's recommendations expansion of the new Urban Centers of Panchkula, SAS Nagar, Naya Gram, Kharar and Zirakpur has continued.

- The Chandigarh Pollution Control Committee is implementing the Hazardous Waste (Management & Handling) Rules, 1989 and The Biomedical Wastes ((Management & Handling) Rules, 1995.

- With a view to control the menace of plastic containers & polythene carry bags the Municipal Corporation has framed bye laws known as "Chandigarh Municipal Corporation (Ban on Manufacture and usage of Polythene Bags & Containers) Bye laws,2000 (Annexure 4.4). The said bye laws are implemented by the Inspectorate staff of the Corporation. Besides, Recycled Plastic (Manufacture & Usage) Rules, 1999 as amended, are also being implemented in Chandigarh. The Chandigarh Administration vide notification no.

ED/2003/543 dated 16th September 2003 has prohibited the manufacture, sale & use of polythene/plastic carry bags of thickness less than 30 microns and of size less than 8"X12".

B. Soil Conservation Efforts

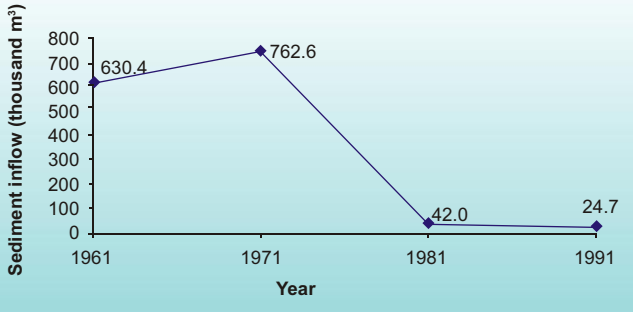
- **Efforts by Government**

As already pointed out the Sukhna catchment area is facing the problem of soil erosion due to poor geological formation which is highly susceptible to water erosion. Efforts to save Sukhna started with acquisition of 25.42 sq km of adjoining hilly area in phases and taking up massive tree plantations. However, it was observed that even well planned plantation schemes could not yield the desired results because it was a formidable task to achieve reasonable success rate in this difficult terrain. The soil conservation works were successfully implemented through silt retention dams and small check dams. In all 172 silt retention dams (out of these 61 are silted up dams and 111 are partially silted) were constructed up to 2003-04 which helped to control inflow of silt into the Sukhna Lake. Soil conservation and plantation works were successfully demonstrated by Check dams. The silt retention dams keep hold of the silt, as well as, help in ground water recharge and support vegetation. In addition, soil conservation measures in the form of live hedge plantation, bhabbar grass plantation, etc have been taken up in several areas. Further, a large number of small loose stone structures, crate wire structures, retaining walls, masonry spurs, grade stabilizers, etc. have been constructed along the beds of the streams so as to guide their course to minimize soil erosion. Besides, massive afforestation schemes have also been taken up.

- **Community Efforts**

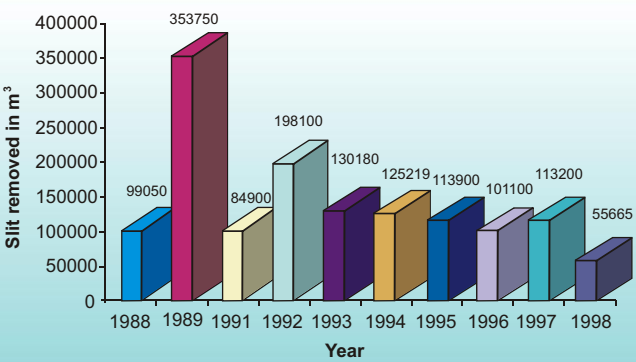
The problem of heavy siltation in the lake has been a major cause of concern ever since its creation. In the year 1987, the lake had dried up considerably as a result of comparatively less rainfall and prolonged summers. Realizing the seriousness of the problem, the Chandigarh Administration decided to launch a desiltation drive in the lake. A tremendous response from the people of Chandigarh was received and hundreds of volunteers came to the lake to contribute to the effort for desiltation. Since then this manual desiltation operation, which is popularly known as 'Shramdan', became an annual feature. Keeping in the view the net output of manual desiltation it was essential to supplement it with the mechanized desiltation operation. The machinery is contributed by State Governments of Punjab and Haryana, Bhakra Beas Management Board (BBMB), Indian Army (Western Command) and Chandigarh Administration. This local initiative has been very effective as

Fig. 4.14 Sediment inflow into the Sukhna Lake



Source: As cited in CPCC, 1998.

Fig. 4.15 Amount of silt removed from Sukhna (1988-1999)



Source: As cited in CPCC, 1998.

almost all the fresh silt received during the monsoon season every year is, by and large, removed before the next monsoon. The silt deposition rate over the years is shown in Figure 4.14. Data of silt removed from the lake bed since 1988 through 'shramdan' (including mechanized desilation) is presented in Figure 4.15. As a result sediment inflow into the lake over the years has been reduced considerably.

Inspite of the above mentioned preventive measures in the catchment area and desiltation operation at a rather modest scale, the lake is still facing several pressures. The water holding capacity of the lake has reduced. Since its only source of water is run-off during rainy season, the erratic behavior of the monsoons can cause serious problems during low rainfall periods. Hence the need for a comprehensive and integrated development and conservation project for the lake. Steps taken by the U.T. administration have resulted in getting the lake declared as National Wetland in 1988 and its identification under National Lake Conservation Plan in 1995.

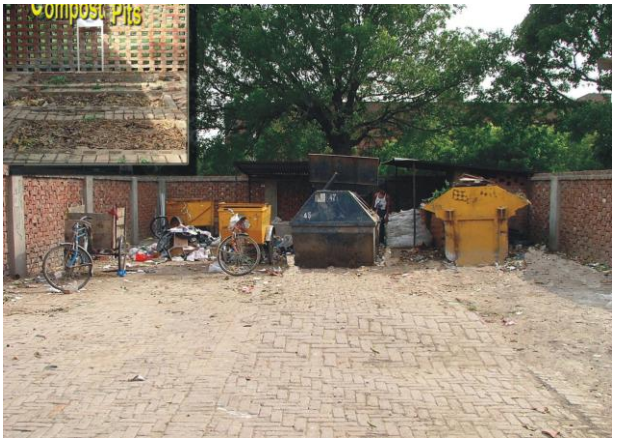
C. Actions for control of land degradation due to municipal solid waste

- **Sahyog - Waste Management Project**

In order to reduce volume of waste for disposal on land fill site and utilize organic waste, Chandigarh Administration and Municipal Corporation, with active involvement and participation of Resident Welfare Associations, NGOs like, CAWEDS (Chandigarh Animal Welfare and Eco Development Society) and Yuvsatta, and institutions like, hospitals, colleges, hotels and the university have initiated a project 'SAHYOG' for the effective and meaningful disposal of waste.

This project envisages the conversion of waste to wealth. The household waste is taken to *Sahaj Safai Kendras* (S.S.K.) and *Khad Banao Kendras* (K.B.K.), which are established at various locations in the sectors. The Municipal Corporation initiated the scheme in 2002 from Sector 15 for ensuring proper collection and transportation of municipal solid waste in the city. So far the Corporation has

Sahaj Safai Kendra before seggregation of waste



Sahaj Safai Kendra after seggregation of waste (Inset: Compost pit)

Table 4.6 Sector wise List of Sehaj Safai Kendras

Hospitals
General Hospital, Sector-16
Government Medical College & Hospital, Sector-32
Institutions
Government College for Girls, Sector 11
Punjab Engineering College, Sector 12
Panjab University, Sector 14
Commonwealth Youth Programme, Asia Center, Sector 12
Chandigarh Industrial & Tourism Corporation
Parkview, Sector-24
Lake Chef, Sector 1
Sectoral Centers
Khad Banao Kendra, Sector-15 C
Khad Banao Kendra, Sector-15 D
Khad Banao Kendra, Sector-33
Khad Banao Kendra, Sector-36
Sahaj Safai Kendra, Sector-27 A
Sahaj Safai Kendra, Sector-21 C
Sahaj Safai Kendra, Sector-41 A
Police Colony, Sector 26

identified about 100 sites for the construction of above mentioned Kendras. Under the scheme all garbage containers from these sectors are removed and two sites are designated for disposal of garbage, horticulture and other waste material collected from house to house by the Sector Welfare Associations on cost recovery basis. The collected waste is then segregated into recyclable material, organic and inorganic waste. The organic materials are converted into compost (including vermicompost with the help of earthworms). Hence, the waste is converted into an excellent manure produced most economically. The project 'SAHYOG' has been implemented in the institutions and sectors presented in Table 4.6. The entire city including slums and rehabilitated areas will be covered and all SSKs would be established by December, 2005.

Present Dumping Ground with partial compaction

- **Disposal of Municipal Solid Waste**

  For disposal of the solid wastes in a scientific manner a land fill site exists at village Dadu Majra. The city waste, collected from all sectors, is being transported to the Dumping Ground for 'land filling'. Regular compaction of waste is being carried out here. The corporation has deployed one heavy chain bulldozer, two tippers and one J.C.B for providing fresh soil. The Corporation has started constructing a high boundary wall around the dumping ground and is in the process of providing internal roads and computerized Way Bridge, etc. The ambient air quality at the site is also being monitored at regular intervals.

  CPCB has sanctioned a 'Demonstration Project' (amounting to Rs. 315.36 lacs for implementation of first phase and Rs. 580.00 lacs for implementation of second phase) for management of municipal solid waste in the Union Territory. Under the project the existing landfill site is proposed to be scientifically designed to convert it into a sanitary landfill site. The project will include house to house garbage collection work for which cycle carts are being provided to resident welfare associations which are persuaded to dispose off garbage at designated Sahaj Safai Kendras.

- **Management of Institutional Waste**

  The corporation has motivated bigger institutions like Punjab Engineering College, Government Hospitals, Police Lines & Government Colleges to make arrangements for segregation and processing of organic waste in their respective premises. The non biodegradable waste is being transported by the Corporation to the Dumping Ground whereas most of the organic and biodegradable waste is converted into compost by the respective institutions.

- **Disposal of Fallen Tree Leaves**

  At present the garden waste and waste of fallen tree leaves is being disposed of with domestic and other waste at the existing landfill site. Instructions have been issued to the field workers not to burn any type of garbage or dry leaves. The corporation has invited 'expression of interest' from various agencies promoting different technologies for the setting up of a garbage processing unit. A proposal for setting up of a separate unit for the disposal of horticulture waste and fallen dry leaves, etc. is under consideration.

- **Disposal of Construction Waste**

  For disposal of construction 'malba' the Municipal Corporation has launched the Malba Collection Scheme. A mobile helpline has been established which can be contacted telephonically or via e-mail for collection of 'malba' within 48 hours at a small charge. The scheme also bans malba dumping in front of houses and proposes a penalty of Rs. 500/- for the same.

- Action has been initiated to identify a suitable site for carcass disposal.

D. Initiatives for hazardous waste management

The Hazardous wastes (Management & Handling) Rules, 1989 framed by the Ministry of Environment & Forests, Government of India under the Environment (Protection) Act, 1986 specify the responsibilities of the occupier, the role of the Central/State Pollution Control Boards, State Government and Central Government. These rules categorize hazardous wastes into 36 categories (Annexure 4.2). The MoEF has also published 'Guidelines for the Management and Handling of Hazardous Wastes' in 1991. These guidelines pertain to the labelling, packaging, storage, treatment and disposal of hazardous and toxic wastes. CPCC ensures that Hazardous waste generated in the Union Territory is sorted accordingly.

E. Initiatives for biomedical waste management

The Bio-medical Wastes (Management & Handling) Rules were notified in 1995. These rules categorize bio-medical waste into 14 categories and lay down provisions for their segregation, packaging transportation and storage (Annexure-4.3).

OPTION	WASTE CATEGORY	TREATMENT MODE
Category No. 1	Human Anatomical Waste (*Human tissues, organs, body parts)	Incineration (YELLOW BIN)
Category No. 3	Microbiology & Biotechnology Waste (Waste from laboratory, cultures, stocks or specimens of micro-organisms live or attenuated vaccines, human and animal cell culture used in research and infections agents from research and industrial laboratories, wastes from production of biological, toxins, dishes and devices used for transfer of cultures)	
Category No. 6	Soiled Waste (Items contaminated with blood, and body fluids including cotton, dressings, soiled plaster casts, lines, bedding, other material contaminated with blood)	

OPTION	WASTE CATEGORY	TREATMENT MODE
Category No.5	Discarded Medicines and cytotoxic drugs (Waste comprising of outdated, contaminated and discarded medicines)	Disposal in Municipal Landfill (BLACK BIN)
Category No.9	Incineration Ash (Ash from incineration of any bio medical waste)	
Category No.10	Chemical waste (Chemical used in production of biological, Chemicals used in disinfecting, as insecticides, etc.)	

OPTION	WASTE CATEGORY	TREATMENT MODE
Category No. 4	Waste Sharps (Needle, syringes, scalpels, blades, glass etc. that may cause puncture and cuts, this includes both used and unused sharps)	Shredding (BLUE BIN)
Category No. 7	Soiled Waste (Wastes generated from disposable items other that the waste sharps such as tubing catheters, intravenous sets, etc.)	

Biomedical Waste Segregation at GH-16

Treatment and disposal options for biomedical wastes are disinfection followed by sanitary land filling and incineration (especially of infectious waste). More important, however, is its collection, segregation and packaging before treatment and disposal. In Chandigarh, three incinerators have been installed at Post Graduate Institute of Medical Education & Research, Sector-12, Government Medical College & Hospital, Sector-32 and General Hospital, Sector-16. Their capacities are presented in Table 4.7. Currently, CPCC has authorized one private

Table 4.7 Capacities of Incinerators for Biomedical Waste Treatment in Chandigarh

P.G.I.	400kg/hr
GMCH-32	10 kg/hr
GH-16	200 kg/hr
Temperature maintained in the incinerator of P.G.I.	
Primary Chamber	850-900^{0}C
Secondary Chamber	950-1050^{0}C

Incinerator at GH-16

company for door to door collection of the biomedical waste. The incinerable waste is being treated at PGI. For disposal of non- incinerable waste the company has developed its own facility at Industrial area Phase-II.

F. Other Initiatives

Alarmed at the fast depleting green cover around Chandigarh, the Administration plans to acquire all open areas in villages and build a 'green wall' around the city to effectively stop construction outside 'Lal Dora' of villages (Source: Chandigarh Tribune, dated 4.7.2004).

RECOMMENDATIONS

Despite the commendable actions taken by the Union Territory Government for protection of its land resources from degradation and pollution, the following initiatives are suggested:

- A coordinated approach in consultation with State Governments of Punjab and Haryana be adopted to ensure implementation of Periphery Controlled Area Act, 1952. Discussions be taken up with PUDA and HUDA to stop further expansion of satellite towns. However, it is important to realize that such pressures will continue in future. Hence, planning for catering to these pressures (like, MRTS, prevention of encroachment, etc.) be taken up.
- A strategy for integration of urban villages with adjoining planned sectors needs to be devised. Also, strategy for tackling problems of residential & commercial slums be defined.
- Commercial areas be augmented with concept of multi level shopping.
- Studies on characterization of solid waste need to be conducted and waste segregation at household level needs to be promoted. The citizens of Chandigarh are literate and environmentally aware. Hence, this activity can be successfully initiated here.
- Projects for energy generation from municipal solid waste be taken up.
- For disposal of construction waste, the Administration may provide skips which can be picked up by Municipal authorities conveniently.
- Since a small amount of Hazardous waste (835.68 MT/Year) is generated in the Union Territory (which is far less than 20,000 MT/Year which qualifies for construction of Hazardous waste disposal facility), a separate Hazardous waste disposal facility would not be economically and technically viable. Hence, the CPCC needs to take up the issue with neighboring states for transportation and disposal of this waste at a common facility as and when it is developed. Punjab has already identified a site near Dera Bassi.
- Soil conservation programmes in the catchment of Sukhna Wetland be further strengthened.
- Land use changes in peri urban areas should be strictly curbed to retain/freeze existing land use pattern.

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ANNEXURES

Chandigarh Municipal Corporation (Sanitation and Public Health) Bye-Laws, 1998

Government of India
Chandigarh Administration Gazette
EXTRAORDINARY
Publised by Authority
Chandigarh, Friday, December 18, 1998
Local Government Department
Notification
The 18th December,1998

DRAFT BYE-LAWS

1. Short Title:

i) These bye-laws may be called the Chandigarh Municipal Corporation (Sanitation and Public Health) Bye-Laws, 1998.

ii) They shall come into force on the date of their final publication in the official Gazette.

2. Definitions:

in these bye laws:

i) 'Act', means the Punjab Municipal Corporation Act, 1976 as extended to the Union Territory, Chandigarh by the Punjab Municipal Corporation Law (Extension to Chandigarh) Act, 1994 (Act No. 45 of 1994).

ii) 'Section' means a Section of the Act

3. Prohibition of certain Acts or Deeds:

1. No person shall:

i) Defacate at any place except especially earmarked for the said purpose.

ii) Spit on any place or building causing insanitation, annoyance to anyone.

iii) Urinate at any place not earmarked or segregated for the said purpose.

iv) Deposit/collect or dispose of any Malba, Garbage or any other waste material in the service lanes or road or park or any public place.

v) Allow or cause to allow any waste water except rain water of the household to be collected or thrown or spread, on any road or public place after cleaning or washing any car or jeep or any other vehicle of any description or otherwise due to leakage of water or sanitary installation.

vi) Use any house or shed or premises or any part thereof for human habitation, unless he has obtained sewer and water connection from the Competent Authority.

vii) Collect or deposit or caused to be collected or deposited any cattle during from any village or cattle shed in the public places/any city sector or container provided for the collection and removal of city garbage.

viii) Collect or deposit or throw or cause to be collected or deposited or thrown any waste building material or malba in public places or Municipal Container. However, the Horticulture or plantation waste may be put in a bin or container kept for refuse collection and removal in any part of the city.

ix) Spread or cause to be spread any oily or greasy material on pavement, road or in any part of the verandah of any building or premises/pavement/roads.

x) Scatter of collect any refuse from any bin or container kept by the Corporation for the collection and removal of city garbage in any part of the city or collect/scatter and segregate any type of kabar or rag or waste material at any public place in any part of the city.

G. VAJRALINGAM,
Finance Secretary-cum-Secretary
Local Government
Chandigarh Administration

National Ambient Air Quality Standards specified by The Central Pollution Control Board

Pollutants	Time-weighted average	Concentration in ambient air			Method of measurement
		Industrial Areas	Residential, Rural & other Areas	Sensitive Areas	
Sulphur Dioxide (SO_2)	Annual Average*	80 µg/m^3	60 µg/m^3	15 µg/m^3	• Improved West and Geake Method • Ultraviolet Fluorescence
	24 hours**	120 µg/m^3	80 µg/m^3	30 µg/m^3	
Oxides of Nitrogen as (SO_2)	Annual Average*	80 µg/m^3	60 µg/m^3	15 µg/m^3	• Jacob & Hochheiser Modified (Na-Arsenite) Method
	24 hours**	120 µg/m^3	80 µg/m^3	i) g /m^3	• Gas Phase Chemiluminescence
Suspended Particulate Matter (SPM)	Annual Average*	360 µg/m^3	140 µg/m^3	70 µg/m^3	• High Volume Sampling, (Average flow rate not less than 1.1 m^3/minute).
	24 hours**	500 µg/m^3	200 µg/m^3	100 µg/m^3	
Respirable Particulate Matter (RPM) (size less than 10 microns)	Annual Average*	120 µg/m^3	60 µg/m^3	50 µg/m^3	• Respirable particulate matter sampler
	24 hours**	150 µg/m^3	100 µg/m^3	75 µg/m^3	
Lead (Pb)	Annual Average*	1.0 µg/m^3	0.75 µg/m^3	0.50 µg/m^3	• ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	1.5 µg/m^3	1.00 µg/m^3	0.75 µg/m^3	
Ammonia	Annual Average*	0.1 mg/ m^3	0.1 mg/ m^3	0.1 mg/m^3	
	24 hours**	0.4 mg/ m^3	0.4 mg/m^3	0.4 mg/m^3	
Carbon Monoxide (CO)	8 hours**	5.0 mg/m^3	2.0 mg/m^3	1.0 mg/ m^3	• Non Dispersive Infra Red (NDIR)
	1 hour	10.0 mg/m^3	4.0 mg/m^3	2.0 mg/m^3	Spectroscopy
There is no safe level for air borne benzene. India is yet to notify its standards for benzene levels but the International standards are as low as 30mg/m^3					

* Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.
** 24 hourly/8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.

Note:
1. National Ambient Air Quality Standard: The levels of air quality with an adequate margin of safety, to protect the public health,, vegetation and property.
2. Whenever and wherever two consecutive values exceeds the limit specified above for the respective category, it would be considered adequate reason to institute regular/continuous monitoring and further investigations.
   The standards for H_2S and CS_2 have been notified separately vide GSR No. 7, dated December 22, 1998 under Rayon Industry - for details please see Sl. No. 65 of this document.

[S.O. 384(E)]
Air (Prevention & Control of Pollution) Act, 1981

1. Included vide Notification SO. 955 (E), Air (Prevention & Control of Pollution) Act, 1981 dated October 14, 1998

Ban on Leaf Burning
Directions u/s 5 of the Environment (Protection) Act, 1986.

Whereas dry leaves and other waste material are burnt on the roadside and at other locations of the city which not only causes air pollution but also creates health problems.

Whereas it has become necessary to control the air pollution from the burning of dry leaves and other waste material in the City. Therefore, the Administrator of Union Territory, Chandigarh in exercise of the powers conferred under section 5 of the Environment (Protection) Act, 1986 proposes to issue following directions:

1. Stringent measures by way of punitive fines should be taken against any person, officers/officials found responsible for burning of dry leaves and other waste material/garbage.

2. All dry/ fallen leaves and other bio-degradable wastes should be collected at decentralized collection pits and may be utilized to make compost/vermin compost manure.

3. Nurseries, Community centers, Parks, Campuses of big Institutions like Panjab University, CSIO, PGI, IMTECH, Punjab Engineering College, etc. should set up leaf collection and leaf composting centers with prominent notice boards for composting of dry leaves.

4. Municipal Corporation, Engineering Department and other departments should provide vermin-compost/ compost pits at appropriate locations like: Sector 33 Nursery, Sector-35, Sector-36, Sector-23, Sector-29, Sector-10, Lake, Rose Garden, Shanti Kunj, Terraced Garden, Leisure Valley, Botanical Garden and Backyards of Agricultural building next to General Hospital, Sector-16, Govt. Medical College & Hospital Sector-32. Further centers as may be started should be widely publicized by way of prominent sign boards, and advertisements and meantime schemes to encourage the public to deposit their leaf litter in these centers should be formulated.

5. Public Notice Boards should be erected by the Municipal Corporation and Engineering Deptt. to make awareness amongst the Safai Karamcharis and other individuals for dumping of dry leaves and other waste material to these composting sites as listed above or publicized from time to time.

6. The Municipal Corporation and Engineering Department should issue necessary advertisement for awareness of the general public for dumping of these leaves to the particular compost centers in that locality. Leaflets should be widely distributed in three languages to educate the public in this regard.

7. the Municipal Corporation should make Bye-laws making it mandatory for households of a particular size and house building societies to have organic composting of littered leaf and garden waste. The provision to penalize the defaulters of burning of littered leaf and garden waste be made in the Municipal Bye-laws and strictly implemented.

The compliance of the above direction are to be reported to Secretary Environment, Chandigarh Administration within 3 months of issue of these directions.

However, as provided under the Environment Protection Act, 1986 and rules made thereunder, you are hereby given an opportunity to the file objection, if any, to the Secretary Environment, Chandigarh Administration within 15 days from the issue of this order.

Secretary, Environment
Chandigarh Administration
Endst.No. ED/2002/1823-1829 Dated: 5.7.2002

THE NOISE POLLUTION (REGULATION & CONTROL) RULES, 2000

MINISTRY OF ENVIRONMENT AND FORESTS
NOTIFICATION
New Delhi, the 14 February, 2000

S.O. 123(E).- Whereas the increasing ambient noise levels in public places from various sources, inter-alia, industrial activity, construction activity, generator sets, loud speakers, public address systems, music systems, vehicular horns and other mechanical devices have deleterious effects on human health and the psychological well being of the people, it is considered necessary to regulate and control noise producing and generating sources with the objective of maintaining the ambient air quality standards in respect of noise;

Whereas a draft of Noise Pollution (Control and Regulation) Rule, 1999 was published under the notification of the Government of India in the Ministry of Environment and Forests vide number S.O. 528 (E) dated the 28th June, 1999 inviting objections and suggestions from all the persons likely to be affected thereby, before the expiry of the period of sixty days from the date on which the copies of the Gazette containing the said notification are made available to the public;

And whereas copies of the said Gazette were made available to the public on the 1st day of July, 1999;
And whereas the objections and suggestions received from the public in respect of the said draft rules have been duly considered by the Central Government;

Now, therefore, in exercise of the powers conferred by clause (ii) of sub-section (2) of section 3, sub-section (1) and clause (b) of sub-section (2) of section 6 and section 25 of the Environment (Protection) Act, 1986 (29 of 1986) read with rule 5 of the Environment (Protection) Rules, 1986, the Central Government hereby makes the following rules for the regulation and control of noise producing and generating sources, namely:-

The Noise Pollution (Regulation and Control) Rules, 2000

1. SHORT TITLE AND COMMENCEMENT

(1) These rules may be called the Noise Pollution (Regulation and Control Rules) 2000.)
(2) They shall come into force on the date of their publication in the Official Gazette.

2. DEFINITIONS

In these rules, unless the context otherwise requires,-

(a) "Act" means the Environment (Protection) Act, 1986 (29 of 1986);

(b) "area/zone" means all areas which fall in either of the four categories given in the Schedule annexed to these rules;

(c) "authority" means and includes any authority or officer authorised by the Central Government, or as the case may be, the State Government in accordance with the laws in force and includes a District Magistrate,

Police Commissioner, or any other officer not below the rank of the Deputy Superintendent of Police designated for the maintenance of the ambient air quality standards in respect of noise under any law for the time being in force;

(d) "court means a government body consisting of one or more duges who sit to adjudicate disputes and administer justice and includes any court of law presided over by a judge, judges or a magistrate and acting as a tribunal in civil, taxation and criminal cases;

(e) "educational institution" means a school, seminary, college, university, professional academies, training institutes or other educational establishment, not necessarily a chartered institution and includes not only buildings, but also all grounds necessary for the accomplishment of the full scope of educational instruction, including those things essential to mental, moral and physical development;

(f) "hospital" means an institution for the reception and care of sick, wounded, infirm or aged persons, and includes government or private hospitals, nursing homes and clinics.

(g) "person" shall include any company or association or body of individuals, whether incorporated or not.

(h) "State Government" in relation to a Union territory means the Administrator thereof appointed under article 239 of the Constitution.

3. AMBIENT AIR QUALITY STANDARDS IN RESPECT OF NOISE FOR DIFFERENT AREAS/ ZONES

(1) The ambient air quality standards in respect of noise for different area/zones shall be such as specified in the Schedule annexed to these rules.

(2) The State Government may categorize the areas into industrial, commercial, residential or silence areas/zones for the purpose of implementation of noise standards for different areas.

(3) The State Government shall take measures for abatement of noise including noise emanating from vehicular movements and ensure that the existing noise levels do not exceed the ambient air quality standards specified under these rules.

(4) All development authorities, local bodies and other concerned authorities while planning developmental activity or carrying out functions relating to town and country planning shall take into consideration all aspects of noise pollution as a parameter of quality of life to avoid noise menace and to achieve the objective of maintaining the ambient air quality standards in respect of noise.

(5) An area comprising not less than 100 metres around hospitals, educational institutions and courts may be declared as silence area/zone for the purpose of these rules.

4. RESPONSIBILITY AS TO ENFORCEMENT OF NOISE POLLUTION CONTROL MEASURES

(1) The noise levels in any area/zone shall not exceed the ambient air quality standards in respect of noise as specified in the Schedule.

(2) The authority shall be responsible for the enforcement of noise pollution control measures and the due compliance of the ambient air quality standards in respect of noise

5. RESTRICTIONS ON THE USE OF LOUD SPEAKERS/PUBLIC ADDRESS SYSTEM

(1) A loud speaker or a public address system shall not be used except after obtaining written permission from the authority.

(2) A loud speaker or a public address system shall not be used at night (between 10.00 p.m. to 6.00 a.m.) except in closed premises for communication within, e.g. auditoria, conference rooms, community halls and banquet halls.

6. CONSEQUENCES OF ANY VIOLATION IN SILENCE ZONE/AREA

Whoever, in any place covered under the silence zone/area commits any of the following offence, he shall be liable for penalty under the provisions of the Act:-

(i) whoever, plays any music or uses any sound amplifiers,

(ii) whoever, beats a drum or tom-tom or blows a horn either musical or pressure, or trumpet or beats or sounds any instrument, or

(iii) whoever, exhibits any mimetic, musical or other performances of a nature to attract crowds.

7. COMPLAINTS TO BE MADE TO THE AUTHORITY

(1) A person may, if the noise level exceeds the ambient noise standards by 10 dB(A) or more given in the corresponding columns against any area/zone, make a complaint to the authority. (2) The authority shall act on the complaint and take action against the violator in accordance with the provisions of these rules and any other law in force.

8. POWER TO PROHIBIT ETC. CONTINUANCE OF MUSIC SOUND OR NOISE

(1) If the authority is satisfied from the report of an officer incharge of a police station or other information received by him that it is necessary to do so in order to prevent annoyance, disturbance, discomfort or injury or risk of annoyance, disturbance, discomfort or injury to the public or to any person who dwell or occupy property on the vicinity, he may, by a written order issue such directions as he may consider necessary to any person for preventing, prohibiting, controlling or regulating:-

(a) the incidence or continuance in or upon any premises of-

(i) any vocal or instrumental music,

(ii) sounds caused by playing, beating, clashing, blowing or use in any manner whatsoever of any instrument including loudspeakers, public address systems, appliance or apparatus or contrivance which is capable of producing or re-producing sound, or

(b) the carrying on in or upon, any premises of any trade, avocation or operation or process resulting in or attended with noise.

(2) The authority empowered under sub-rule (1) may, either on its own motion, or on the application of any person aggrieved by an order made under sub-rule (1), either rescind, modify or alter any such order:

Provided that before any such application is disposed of, the said authority shall afford to the applicant an opportunity of appearing before it either in person or by a person representing him and showing cause against the order and shall, if it rejects any such application either wholly or in part, record its reasons for such rejection.

SCHEDULE
(see rule 3(1) and 4(1)
Ambient Air Quality Standards in respect of Noise

Area Code	Category of Area/Zone	Limits in dB(A)Leq*	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

Note :-

1. Day time shall mean from 6.00 a.m. to 10.00 p.m.
2. Night time shall mean from 10.00 p.m. to 6.00 a.m.
3. Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions and courts, religious places or any other area which is declared as such by the competent authority.
4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

*dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

A "decibel" is a unit in which noise is measured.

"A", in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.
Leq : It is an energy mean of the noise level over a specified period.

Source : Central Pollution Control Board (CPCB), Delhi
Date : May 17, 2002

[F. No. Q-14012/1/96-CPA]
VIJAY SHARMA. Jt. Secy.

Noise Limit for Generator Sets

Ministry of Environment and Forests
Notification
New Delhi, the 17th May, 2002

G.S.R. 371(E): In exercise of the powers conferred by sections 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby makes the following rules further to amend the Environment (Protection) Rules, 1986, namely:-

1. These rules may be called the Environment (Protection) second Amendment Rules, 2002.
2. They shall come into force on the date of their publication in the Official Gazette.

In the Environment (Protection) Rules, 1986 (herein after referred to as the said rules), in Schedule I

1. against serial number 47, item (d) relating to Diesel generators for domestic purposes and the entries relating thereto shall be omitted;
2. serial number 83 relating to standards/Guidelines for control of noise pollution from Stationary Diesel Generator(DG) sets and the entries relating thereto shall be omitted;
3. after serial number 93 relating to Primary Water Quality Criteria for Bathing Waters and the entries relating thereto, the following serial numbers and entries shall be inserted, namely:-

94. NOISE LIMIT FOR GENERATOR SETS RUN WITH DIESEL

1. Noise limit for diesel generator sets (upto 1000 KVA) manufactured on or after the 1st July, 2003. The maximum permissible sound pressure level for new diesel generator (DG) sets with rated capacity up to 1000 KVA, manufactured on or after the 1st July, 2003 shall be 75 dB(A) at 1 metre from the enclosure surface. The diesel generator sets should be provided with integral acoustic enclosure at the manufacturing stage itself. The implementation of noise limit for these diesel generator sets shall be regulated as given in paragraph 3 below.

2. Noise limit for DG sets not covered by paragraph 1. Noise limits for diesel generator sets not covered by paragraph 1, shall be as follows:

i. Noise from DG set shall be controlled by providing an acoustic enclosure or by treating the room acoustically, at the users end.

ii. The acoustic enclosure or acoustic treatment of the room shall be designed for minimum 25 dB (A) insertion loss or for meeting the ambient noise standards, whichever is on the higher side (if the actual ambient noise is on the higher side, it may not be possible to check the performance of the acoustic enclosure/acoustic treatment. Under such circumstances the performance may be checked for noise reduction upto actual ambient noise level, preferably, in the night time). The measurement for Insertion Loss may be done at different points at 0.5 m from the acoustic enclosure/room, and then averaged.

iii. The DG set shall be provided with proper exhaust muffler with insertion loss of minimum 25 dB(A).

iv. These limits shall be regulated by the State Pollution Control Boards and the State Pollution Control Committees.

v. Guidelines for the manufacturers/users of Diesel Generator sets shall be as under:

1. The manufacturer shall offer to the user a standard acoustic enclosure of 25 dB(A) insertion loss and also a suitable exhaust muffler with insertion loss of 25 dB(A).
2. The user shall make efforts to bring down the noise levels due to the DG set, outside his premises, within the ambient noise requirements by proper siting and control measures.
3. Installation of a DG set must be strictly in compliance with the recommendations of the DG set manufacturer.
4. A proper routine and preventive maintenance procedure for the DG set should be set and followed in consultation with the DG set manufacturer which would help prevent noise levels of the DG set from deteriorating with use.

3. Limits of noise for DG sets (upto 1000 KVA) manufactured on or after the 1st July, 2003

i. Applicability

1. These rules apply to DG sets upto 1000 KVA rated output, manufactured or imported in India, on or after Is' July, 2003.
2. These rules shall not apply to:
   a. DG sets manufactured or imported for the purpose of exports outside India; and
   b. DG sets intended for the purpose of sample and not for sale in India.

ii. Requirement of Certification

Every manufacturer or importer (herein after referred to as "supplier") of DG set (herein after referred to as "product") to which these regulations apply must have valid certificates of Type Approval and also valid certificates of Conformity of Production for each year, for all the product models being manufactured or imported from 1st July, 2003 with the noise limit specified in paragraph 1.

iii. Sale, import or use of DG sets not complying with the rules prohibited

No person shall sell, import or use of a product model, which is not having a valid Type Approval certificate and Conformity of Production certificate.

iv. Requirement of Conformance Labelling

1. The supplier of the 'product' must affix a conformance label on the product meeting the following requirements:
   a. The label shall be durable and legible.
   b. The label shall be affixed on a part necessary for normal operation of the 'product' and not normally requiring replacement during the 'product' life.
2. The conformance label must contain the following information:
   a. Name and address of the supplier (if the address is described in the owner's manual, it may not be included in the label).
   b. Statement "This product confirms to the Environment (Protection) Rules, 1986".
   c. Noise limit viz. 75 dB(A) at 1 m.
   d. Type approval certificate number.
   e. Date of manufacture of the product.

v. Nodal Agency

1. The Central Pollution Control Board shall he the nodal agency for implementation of these regulations.
2. In case of any dispute or difficulty in implementation of these regulations, the matter shall be referred to the nodal agency.
3. The nodal agency shall constitute a Committee to advise it on all matters; including the disputed matters, related to the implementation of these regulations.

vi. Authorized agencies for certification

The following agencies are authorized to carry out such tests as they deem necessary for giving certificates for Type Approval and Conformity of Production testings of DG sets and to give such certificates:-

1. Automotive Research Association of India, Pune
2. National Physical Laboratory, New Delhi
3. Naval Science & Technology Laboratory, Visakhapatnam
4. Fluid Control Research Institute, Palghat
5. National Aerospace Laboratory, Bangalore

vii. Compliance and Testing Procedure

The compliance and testing procedure shall be prepared and published by the Central Pollution Control Board, with the help of the certification agencies.

[F. No. Q-15022/2/2001-CPA]
C. VISWANATH, Joint Secretary,
Ministry of Environment & Forests,
Government of India.

The Gazette of India
Extraordinary

Part-II-Section-3-Sub-section (ii)
Published by Authority
No. 471
New Delhi, Friday, May 23, 2003

MINISTRY OF ENVIRONMENT AND FORESTS
NOTIFICATION
NEW DELHI, THE 20th May , 2003

S.O. 593(E).- Whereas the draft of certain rules called the **Hazardous Wastes (Management and Handling) Amendment Rules, 2002** was published under the notification of the Government of India in the Ministry of Environment and Forests number S.O. 553(E), dated 21st May, 2002 in the Gazette of India, Part-II, Section 3, Sub-section (ii) of the same date inviting objections and suggestions from all persons likely to be affected thereby, before the expiry of the period of sixty days from the date on which copies of the Gazette containing the said notification were made available to the public;

And whereas copies of the said Gazette were made available to the public on the 5th day of June, 2002;

And whereas the objections and suggestions received within the said period from the public in respect of the said draft rules have been duly considered by the Central Government;

Now, therefore, in exercise of the powers conferred by sections 6, 8 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby makes the following rules further to amend the Hazardous Wastes (Management and Handling) Rules, 1989, namely:-

1. (1) These rules may be called the Hazardous Wastes (Management and Handling) Amendment Rules, 2003.
(2) They shall come into force on the date of their publication in the Official Gazette.

2. In the Hazardous Wastes (Management and Handling) Rules, 1989 (herein after referred to as the said rules), in rule 2, after clause (c), the following clauses shall be inserted, namely: -

(d) bio-medical wastes covered under the Bio-Medical Wastes (Management and Handling) Rules, 1998 made under the Act;

(e) wastes covered under the Municipal Solid Wastes (Management and Handling) Rules, 2000 made under the Act; and

(f) the lead acid batteries covered under the Batteries (Management and Handling) Rules, 2001 made under the Act."

3. For rule 3 of the said rules, the following rule shall be substituted, namely:-
'3. Definitions - In these rules, unless the context otherwise requires, -

(1) "Act" means the Environment (Protection) Act, 1986 (29 of 1986);

(2) "applicant" means a person or an organisation that applies, in Form 1, for granting of authorisation to perform specific activities connected with handling of hazardous wastes;

(3) "auction" means bulk sale of wastes by invitation of tenders or auction, contract or negotiation by individual(s), companies or Government departments;

(4) "auctioneer" means a person or an organisation that auctions wastes;

(5) "authorisation" means permission for collection, transport, treatment, reception, storage and disposal of hazardous wastes, granted by the competent authority in Form 2;

(6) "authorised person" means a person or an organisation authorised by the competent authority;

(7) "Central Pollution Control Board" means the Central Board constituted under sub-section (1) of section 3 of the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974);

(8) "disposal" means deposit, treatment, recycling and recovery of any hazardous wastes;

(9) "export" with its grammatical variations and cognate expressions, means taking out of India to a place outside India;

(0) "exporter" means any person under the jurisdiction of the exporting country who exports hazardous wastes and the exporting country itself, who exports hazardous wastes;

(11) "environmentally sound management of hazardous wastes" means taking all steps required to ensure that the hazardous wastes are managed in a manner which will protect health and the environment against the adverse effects which may result from such wastes;

(12) "facility" means any location wherein the processes incidental to the waste generation, collection, reception, treatment, storage and disposal are carried out;

(13) "form" means a Form appended to these rules;

(14) "hazardous waste" means any waste which by reason of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances, and shall include-

(a) wastes listed in column (3) of Schedule-1;

(b) wastes having constituents listed in Schedule-2 if their concentration is equal to or more than the limit indicated in the said Schedule; and

(c) wastes listed in Lists 'A' and 'B' of Schedule-3 (Part-A) applicable only in case(s) of import or export of hazardous wastes in accordance with rules 12, 13 and 14 if they possess any of the hazardous characteristics listed in Part-B of Schedule 3".

Explanation: For the purposes of this clause, -

(i) all wastes mentioned in column (3) of Schedule-1 are hazardous wastes irrespective of concentration limits given in Schedule-2 except as otherwise indicated and Schedule-2 shall be applicable only for wastes or waste constituents not covered under column (3) of Schedule-1;
(ii) Schedule-3 shall be applicable only in case(s) of import or export;

(15) "hazardous wastes site" means a place for collection, reception, treatment, storage and disposal of hazardous wastes which has been duly approved by the competent authority;

(16) "illegal traffic" means any transboundary movement of hazardous wastes as specified in rule 15;

(17) "import" with its grammatical variations and cognate expressions, means bringing into India from a place outside India;

(18) "importer" means an occupier or any person who imports hazardous wastes;

(19) "manifest" means transporting document(s) prepared and signed by the occupier in accordance with rule 7;

(20) "non-ferrous metal wastes" means wastes listed in Schedule 4;

(21) "operator of facility" means a person who owns or operates a facility for collection, reception, treatment, storage or disposal of hazardous wastes;

(22) "recycler" means an occupier who procures and processes wastes for recovery;

(23) "recycling of waste oil" means reclamation by way of treatment to separate solids and water from waste oils using methods such as heating, filtering, gravity settling, centrifuging, dehydration, viscosity and specific gravity adjustment;

(24) "registered re-refiner or recycler" means a re-refiner or recycler registered for reprocessing wastes with the Ministry of Environment and Forests or the Central Pollution Control Board, as the case may be, for reprocessing wastes;

(25) "re-refining of used oil" means applying a process to the material composed of used oil so as to produce high quality base stock for further manufacture of lubricants or for other petroleum products by blending or any other process;

(26) "schedule" means a Schedule appended to these rules;

(27) "State Government" means a State Government and in relation to a Union territory, the Administrator thereof appointed under article 239 of the Constitution;

(28) "State Pollution Control Board or Committee" means the Board or Committee constituted under sub-section (1) of section 4 of the Water(Prevention and Control of Pollution) Act, 1974 (6 of 1974);

(29) "storage" means storing hazardous wastes for a temporary period, at the end of which the hazardous waste is treated and disposed off;

(30) "transboundary movement" means any movement of hazardous waste or other wastes from an area under the national jurisdiction of one country to or through an area under the national jurisdiction of another country or to or through an area not under the national jurisdiction of any country, provided at least two countries are involved in the movement;

(31) "transport" means off-site movement of hazardous waste by air, rail, road or water;

(32) "transporter" means a person engaged in the off-site transportation of hazardous waste by air, rail, road or water;

(33) "treatment" means a method, technique or process, designed to change the physical, chemical or biological characteristics or composition of any hazardous waste so as to render such wastes harmless;

(34) "used oil" means any oil -

(i) derived from crude oil or mixtures containing synthetic oil including used engine oil, gear oil, hydraulic oil, turbine oil, compressor oil, industrial gear oil, heat transfer oil, transformer oil, spent oil and their tank bottom sludges; and

(ii) suitable for re-refining if it meets the specifications laid down in Schedule 5, but does not include waste oil;

(35) "waste oil" means any oil -

(i) which includes spills of crude oil, emulsions, tank bottom sludge and slop oil generated from petroleum refineries, installations or ships; and

(ii) is unsuitable for re-refining, but can be used as fuel in furnaces if it meets the specifications laid down in Schedule 6;

(36) words and expressions used in these rules and not defined but defined in the Act shall have the meanings respectively assigned to them in the 'Act.'

4. In rule 4B of the said rules, for the word and figure "Schedule 4", the word and figure "Schedule 7" shall be substituted.

5. In rule 5 of the said rules, -

(a) for sub-rule (2), the following shall be substituted, namely:-

"(2) Every occupier handling, or a recycler recycling, hazardous wastes shall make an application in Form 1 to the Member-Secretary, State Pollution Control Board or Committee, as the case may be or any officer designated by the State Pollution Control Board or Committee for the grant of authorization for any of the said activities;

Provided that an occupier or a recycler not having a hazardous wastes treatment and disposal facility of his own and is operating in an area under the jurisdiction assigned by the State Pollution Control Board or Committee, as the case may be, for a common Treatment, Storage and Disposal Facility (TSDF) shall become a member of this facility and send his waste to this facility to ensure proper treatment and disposal of hazardous wastes generated failing which the authorization granted to the said occupier or recycler in accordance with this sub-rule may be cancelled after giving a reasonable opportunity to such occupier or recycler, as the case may be, of being heard or shall not to be granted by the State Pollution Control Board or Committee, as the case may be";

(b) for sub-rule (3), the following sub-rule be substituted, namely: -

"(3) Any person who intends to be an operator of a facility for the collection, reception, treatment, transport, storage and disposal of hazardous wastes, shall make an application in Form 1 to the Member-Secretary, State Pollution Control Board or Committee for the grant of authorization for all or any of the above activities specified in this rule.";

(c) in sub-rule (6), for clause(i), the following clause shall be substituted, namely:-

"(i) An authorization granted under this rule shall, unless suspended or cancelled, be in force during the period of its validity as specified by the State Pollution Control Board or Committee from the date of issue or from the date of renewal, as the case may be";

(d) in sub-rule (8),

(i) for clause (ii), the following clause shall be substituted, namely:-

"on steps taken, by the applicant wherever feasible, for reduction and prevention in the waste generated or for recycling or reuse;"

(ii) clause (iv) shall be omitted;

(e) after sub-rule (8), the following sub-rule shall be inserted, namely:-

"(9) Every State Pollution Control Board or Committee shall maintain a register containing particulars of the conditions imposed under these rules for any disposal of hazardous wastes, on any land or premises and it shall be open for inspection during office hours to any person interested or affected or a person authorized by him in this behalf. The entries in the register shall be considered as proof of grant of authorisation for management and handling of hazardous wastes on such land or premises and the conditions subject to which it was granted."

[File No. 23(16)/2001-HSMD]
Dr. V. Rajagopalan
Joint Secretary

Annexure 4.2

List of Hazardous Wastes

Schedule - 1
[Rule 3(14)(a) of Hazardous Wastes (Management & Handling) Amendment Rules, 2002

S.No.	Processes	Hazardous Wastes
1.	Petrochemical processes and pyrolytic operations	1.1 Furnace/ reactor residue and debris* 1.2 Tarry residues 1.3 Oily sludge emulsion 1.4 Organic residues 1.5 Residues from alkali wash of fuels 1.6 Still bottoms from distillation process 1.7 Spent catalyst and molecular sieves 1.8 Slop oil from wastewater 1.9 ETP sludge containing hazardous constituents
2.	Drilling operation for oil and gas production	2.1 Drill cuttings containing oil 2.2 Sludge containing oil 2.3 Drilling mud and other drilling wastes*
3.	Cleaning, emptying and maintenance of petroleum oil storage tanks including ships	3.1 Oil-containing cargo residue, washing water and sludge 3.2 Chemical-containg cargo residue and sludge 3.3 Sludge and filters contaminated with oil 3.4 Ballast water containing oil from ships
4.	Petroleum refinng/ re-refining of used oil/recycling of waste oil	4.1 Oily sludge/emulsion 4.2 Spent catalyst 4.3 Slop oil 4.4 Organic residues from process 4.5 Chemical sludge from waste water treatment 4.6 Spent clay containing oil
5.	Industrial operations using mineral/synthetic oil as lubricant in hydraulic systems or other applications	5.1 Used / spent oil 5.2. Wastes/ residues containing oil
6.	Secondary production and/or use of zinc	6.1 Sludge and filter press cake arising out of zinc sulphate production 6.2 Zinc fines/dust/ash/skimmings (dispersible form) 6.3 Other residues from processing of zinc ash/skimmings 6.4 Flue gas dust and other particulates
7.	Primary production of zinc/lead/copper and other non-ferrous metals except aluminium	7.1 Flue gas dust from roasting* 7.2 Process residues 7.3 Arsenic-bearing sludge 7.4 Metal bearing sludge and residue including jarosite 7.5 Sludge from ETP and scrubber

S.No.	Processes	Hazardous Wastes
8.	Secondary production of copper	8.1 Spent electrolytic solutions 8.2 Sludges and filter cakes 8.3 Flue gas dust and other particulates*
9.	Secondary production of lead	9.1 Lead stag/ Lead bearing residues 9.2 Lead ash/particulate from flue gas
10.	Production and/or use of cadmium and arsenic and their compounds	10.1 Residues containing cadmium and arsenic
11.	Production of primary and secondary aluminium	11.1 Sludge from gas treatment 11.2 Cathode residues including not lining wastes 11.3 Tar containing wastes 11.4 Flue gas dust and other particulates* 11.5 Wastes from treatment of salt slags and black drosses*
12.	Metal surface treatment, such as etching, staining, polishing, galvanizing, cleaning, degreasing, plating, etc.	12.1 Acid residues 12.2 Alkali residues 12.3 Spent bath/sludge containing sulphide, cyanide and toxic metals 12.4 Sludge from bath containing organic solvents 12.5 Phosphate sludge 12.6 Sludge from staining bath 12.7 Copper etching residues 12.8 Plating metal sludge 12.9 Chemical sludge from waste water treatment
13.	Production of iron and steel including other ferrous alloys (electric furnaces; steel rolling and finishing mills; Coke oven and by product plant	13.1 Process dust* 13.2 Sludge from acid recovery unit 13.3 Benzol acid sludge 13.4 Decanter tank tar sludge 13.5 Tar storage tank residue
14.	Hardening of steel	14.1 Cyanide-, nitrate-, or nitrite-containing sludge 14.2 Spent hardening salt
15.	Production of asbestos or asbestos-containing materials	15.1 Asbestos-containing residues 15.2 Discarded asbestos 15.3 Dust/particulates from exhaust gas treatment
16.	Production of caustic soda and chlorine	16.1 Mercury bearing sludge 16.2 Residue/sludges and filter cakes* 16.3 Brine sludge containing mercury
17.	Production of acids	17.1 Residues, dusts or filter cakes* 17.2 Spent catalyst*
18.	Production of nitrogenous and complex fertilizers	18.1 Spent catalyst* 18.2 Spent carbon* 18.3 Sludge/residue containing arsenic 18.4 Chromium sludge from water cooling tower 18.5 Chemical sludge from waste water treatment

S.No.	Processes	Hazardous Wastes
19.	Production of phenol	19.1 Residue/sludge containing phenol
20.	Production and/or industrial use of solvents	20.1 Contaminated aromatic, aliphatic or napthenic solvents not fit for originally intended use 20.2 Spent solvents 20.3 Distillation residues
21.	Production and/or industrial use of paints, pigments, lacquers, varnishes, plastics and inks	21.1 Wastes and residues 21.2 Fillers residues
22.	Production of plastic raw materials	22.1 Residues of additives used in plastics manufacture like dyestuffs, stabilizers, flame retardants, etc. 22.2 Residues of platicisers 22.3 Residues from vinylchloride monomer production 22.4 Residues from acrylonitrile production 22.5 Non-polymerised residues
23.	Production and/ or industrial used of glues, cements, adhesive and resins	23.1 Wastes/residues (not made with vegetable or animal materials)*
24.	Production of canvas and textiles	24.1 Textile chemical residues* 24.2 Chemical sludge from waste water treatment
25.	Industrial production and formulation of wood preservatives	25.1 Chemical residues 25.2 Residues from wood alkali bath
26.	Production or industrial use of synthetic dyes, dye-intermediates and pigments	26.1 Process waste sludge/ residues containing acid or other toxic metals or organic complexes 26.2 Chemical sludge from waste water treatment 26.3 Dust from air filtration system
27.	Production or industrial use of materials made with organo-silicone compounds	27.1 Silicone-containing residues 27.2 Silicone oil residues
28.	Production/ formulation of drugs/ pharmaceuticals	28.1 Residues and wastes* 28.2 Spent catalyst / spent carbon 28.3 Off specification products 28.4 Date-expired, discarded and off-specification drugs/ medicines 28.5 Spent mother liquor 28.6 Spent organic solvents
29.	Production, use and formulation of pesticides including stock-piles	29.1 Waste/residues containing pesticides 29.2 Chemical sludge from waste water treatment 29.3 Date-expired and off-specification pesticides
30.	Leather tanneries	30.1 Chromium bearing residue and sludge 30.2 Chemical sludge from waste water treatment

S.No.	Processes	Hazardous Wastes
31.	Electric Industry	31.1 Residues and wastes* 31.2 Spent etching chemicals and solvents
32.	Pulp & Paper Industry	32.1 Spent chemicals 32.2 Corrosive wastes arising from use of strong acid and bases 32.3 Sludge containing adsorbable organic halides
33.	Disposal of barrels/ containers used for handling of hazardous wastes/ chemicals	33.1 Chemical containing residue from decontamination and disposal 33.2 Sludge from treatment of waste water arising out of cleaning / disposal of barrels / containers 33.3 Discarded containers / barrels/ liners used for hazardous wastes/ chemicals
34.	Purification processes for air and water	34.1 Flue gas cleaning residue 34.2 Toxic metal-containing residue from used-iron exchange material in water purification 34.3 Chemical sludge from waste water treatment 34.4 Chemical sludge, oil and grease skimming residues from common industrial effluent treatment plants (CETPs) and industry-specific effluent treatment plants (ETPs) 34.5 Chromium sludge from cooling water treatment
35.	Purification process for organic compounds/ solvents	35.1 Filters and filter material which have organic liquids in them, e.g. mineral oil, synthetic oil and organic chlorine compounds 35.2 Spent catalyst* 35.3 Spent carbon *
36.	Waste treatment processes, e.g. incineration, distillation, separation and concentration techniques	36.1 Sludge from wet scrubbers 36.2 Ash from incineration of hazardous waste, flue gas cleaning residues 36.3 Spent acid from batteries 36.4 Distillation residues from contaminated organic solvents

* Unless proved otherwise by the occupier based on sampling and analysis carried out by a laboratory recognized under the Act not to contain and of the constituents mentioned in Schedule 2 to the extent of concentration limits specified therein

[File No. 23(16)/2001-HSMD]
DR. V. RAJAGOPALAN
Joint Secretary

Source: The Gazette of India, Extraordinary, Part-II-Section-3-Sub-section (ii)
Published by Authority No. 471, New Delhi, Friday, May 23, 2003
MINISTRY OF ENVIRONMENT AND FORESTS
NOTIFICATION
NEW DELHI, THE 20th May , 2003

Footnote: Principal rules were published in the Gazette of India vide S.O. 549(E) dated 28th July, 1989 and subsequently amended vide S.O. 24(E) dated 6th January, 2000.

BIO-MEDICAL WASTE (MANAGEMENT AND HANDLING) RULES, 1998 AS AMENDED UPTO SEPTEMBER, 2001

MINISTRY OF ENVIRONMENT AND FORESTS
NOTIFICATION
New Delhi, 20th July. 1998

S.O. 630 (E).- Whereas a notification in exercise of the powers conferred by Sections 6. 8 and 25 of the Environment (Protection) Act, 1986 (29 of 1986) was published in the Gazette vide S.O. 746 (E) dated 16 October, 1997 inviting objections from the public within 60 days from the date of the publication of the said notification on the Bio-Medical Waste (Management and Handling) Rules, 1998 and whereas all objections received were duly considered:

Now, therefore, in exercise of the powers conferred by section 6.8 and 25 of the Environment (Protection) Act, 1986 the Central Government hereby notifies the rules for the management and handling of bio-medical waste.

1 SHORT TITLE AND COMMENCEMENT :

(1) These rule may be called the Bio-Medical Waste (Management and Handling) Rules, 1998
(2) They shall come into force on the date of their publication in the official Gazette.

2. APPLICATION:

These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle biomedical waste in any form.

3. DEFINITIONS :

In these rules unless the context otherwise requires :-

(1) "Act" means the Environment (Protection) Act, 1986 (29 of 1986),

(2) "Animal House" means a place where animals are reared/kept for experiments or testing purpose;

(3) "Authorisation" means permission granted by the prescribed authority for the generation, collection, reception, storage, transportation, treatment, disposal and/or any other form of handling of bio-medical-waste in accordance with these rules and any guidelines issued by the Central Government;

(4) "Authorised person" means an occupier or operator authorised by the prescribed authority to generate collect, receive, store, transport, treat, dispose and/or handle bio-medical waste in accordance with these rules and any guidelines issued by the Central Government;

(5) "Bio-medical waste" means any waste, which is generated during the diagnosis, treatment or immunisation of human beings or animals or in research activities pertaining thereto or in the production and testing of biologicals and including categories mentioned in Schedule I,

(6) "Biologicals" means any preparation made from organisms or micro-organisms or product or metabolism and biochemical reactions intended for use in the diagnosis. immunisation or the treatment of human beings or animals or in research activities pertaining there to;

(7) "Bio-medical waste treatment facility" means any facility wherein treatments disposal of bio-medical waste or processes incidental to such treatment or disposal is carried out;

(7) "Form" means Form appended to these rules;

(8) "Occupier" in relation to any institution generating biomedical waste, which includes a hospital, nursing home, clinic dispensary, veterinary institution, animal house, pathological laboratory, blood bank by whatever name called, means a person who has control over that institution and/or its premises;

(9) "Operator of a bio-medical waste facility" means a person who owns or controls or operates a facility for the collection, reception, storage, transport, treatment, disposal or any other form of handling of bio-medical waste;

(10) "Schedule" means schedule appended to these rules.

6. SEGREGATION, PACKAGING, TRANSPORTATION AND STORAGE

(1) Bio-medical waste shall not be mixed with other wastes.

(2) Bio-medical waste shall be segregated into containers/bags at the point of generation in accordance with Schedule II prior to its storage, transportation, treatment and disposal. The containers shall be labeled according to Schedule III.

(3) If a container is transported from the premises where biomedical waste is generated to any waste treatment facility outside the premises, the container shall, apart from the label prescribed in Schedule III, also carry information prescribed in Schedule IV.

(4) Notwithstanding anything contained in the Motor Vehicles Act, 1988. or rules thereunder, untreated bio-medical waste shall be transported only in such vehicle as may be authorised for the purpose by the competent authority as specified by the government.

(5) No untreated bio-medical waste shall be kept stored beyond a period of 48 hours; Provided that if for any reason it becomes necessary to store the waste beyond such period, the authorised person must take permission of the prescribed authority and take measures to ensure that the waste does not adversely affect human health and the environment.

(6) The Municipal body of the area shall continue to pick up and transport segregated non bio-medical solid waste generated in hospitals and nursing homes, as well as duly treated bio-medical wastes for disposal at municipal dump site.

SCHEDULE I
(See Rule 5)
CATEGORIES OF BIO-MEDICAL WASTE

Waste Catg. No.	Waste Category (Type)	Treatment & Disposal (Option)
Category No.1	Human Anatomical Waste (human tissues, organs, body parts)	incineration[@]/deep burial[*]
Category No. 2	Animal Waste (animal tissues, organs, body parts, carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals colleges, discharge from hospitals, animal houses)	incineration[@]/deep burial[*]
Category No 3	Microbiology & Biotechnology Waste (wastes from laboratory cultures, stocks or specimens of micro-organisms live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of biologicals, toxins, dishes and devices used for transfer of cultures)	local autoclaving/ microwaving/ incineration[@]
Category No 4	Waste sharps (needles, syringes, scalpels, blades, glass, etc. that may cause puncture and cuts. This includes both used and unused sharps)	disinfection (chemical treatment[@@]/ auto claving/micro-waving and mutilation/shredding [##]
Category No 5	Discarded Medicines and Cytotoxic drugs (wastes comprising of outdated, contaminated and discarded medicines)	incineration[@]/destruction and drugs disposal in secured landfills

Waste Catg. No.	Waste Category (Type)	Treatment & Disposal (Option)
Category No 6	Solid Waste (items contaminated with blood and body fluids including cotton dressings, soiled plaster casts, lines, beddings, other material contaminated with blood)	incineration[@]autoclaving/microwaving
Category No.7	Solid Waste (wastes generated from disposable items other than the waste sharps such as tubings, catheters, intravenous sets. etc.)	disinfection by chemical treatment[@@] autoclaving/ microwaving and mutilation/shredding[##]
Category No.8	Liquid Waste (waste generated from laboratory and washing, cleaning, house-keeping and disinfecting activities)	disinfection by chemical treatment[@@] and discharge into drains
Category No.9	Incineration Ash (ash from incineration of any bio-medical waste)	disposal in municipal landfill
Category No.10	Chemical Waste (chemicals used in production of biologicals, chemicals used in disinfection, as insecticides, etc.)	chemical treatment[@@] and discharge into drains for liquids and secured landfill for solids

@@ Chemical treatment using at least 1% hypochlorite solution or any other equivalent chemical reagent. It must be ensured that chemical treatment ensures disinfection.
Multilation/shredding must be such so as to prevent unauthorised reuse.
@ There will be no chemical pretreatment before incineration. Chlorinated plastics shall not be incinerated.
* Deep burial shall be an option available only in towns with population less than five lakhs and in rural areas.

Schedule II
(see Rule 6)
COLOUR CODING AND TYPE OF CONTAINER FOR DISPOSAL OF BIO-MEDICAL WASTES

Colour Coding	Type of Container	Waste Category	Treatment options as perSchedule I
Yellow	Plastic bag	Cat. 1, Cat 2, and Cat 3, Cat. 6.	Incineration deep burial
Red	Disinfected container/plastic bag	Cat. 3, Cat. 6, Cat.7	Autoclaving/Microwaving Chemical Treatment
Blue/white translucent	Plastic bag/puncture proof container	Cat. 4, Cat. 7.	Autoclaving/Microwaving Chemical Treatment and destruction shredding
Black	Plastic bag	Cat. 5, Cat. 9 and Cat. 10. (solid)	Disposal in secured landfill

Notes:

1. Colour coding of waste categories with multiple treatment options as defined in Schedule I, shall be selected depending on treatment option chosen, which shall be as specified in Schedule 1.
2. Waste collection bags for waste types needing incineration shall not be made of chlorinated plastics.
3. Categories 8 and 10 (liquid) do not require containers/bags.
4. Category 3 if disinfected locally need not be put in containers/bags.

F.No,23(2)/HSMD
V.RAJAGOPALAN, Jt. Secretary

Note: The Principal rules were published in the Gazette of India vide number S.O.630(E), dated 20.7.98 and subsequently amended vide S.O.201(E), dated 6.3.2000.

Source : Central Pollution Control Board (CPCB), Delhi
Date : April 9, 2002

Chandigarh Municipal Corporation (Ban on Manufacture and Usage of Polythene Bags and Containers) Bye-Laws, 2002

Municipal Corporation, Chandigarh
Notification

No. SAE-II /MC / 2002 / 5436 — 28th February, 2002

In these bye-laws, unless the context otherwise requires,

(i) 'Act' means the Punjab Municipal Corporation Act, 1976 as extended to the Union Territory, Chandigarh, by the Punjab Municipal Corporation Law (Extension to Chandigarh) Act, 1994 (Act No. 45 of 1994).
(ii) Authorized Officer: Authorized Officer means a officer so appointed by the Commissioner, Municipal Corporation, Chandigarh to perform functions and duties under these bye-laws.
(iii) 'Section' means a Section of the Act.

Prohibition of manufacture and use of polythene bags/containers:

(i) No Trader or vender shall use carry bags or containers made of recycled plastic irrespective of the thickness of carry bags or container for the purpose of storing, carrying, dispensing or packaging of foodstuffs.
(ii) No person shall manufacture or no trader or vender shall sell or use any carry bags or containers made of virgin plastic or recycled plastic if the thickness of the said carry bag or container is less than 20 microns.

Prosecution

(i) Whosoever is found guilty of contravening any of the provisions of these bye-laws, shall on conviction by a Magistrate, be punishable with imprisonment for a term of one month or fine which may extend to Rs. 1000/- or with both.
(ii) Whosoever having been convicted of an offence under these bye-laws is subsequently convicted or any offence shall be punishable with double the penalty provided for the later offence.

Confiscation of banned material:

(i) The Commissioner or the authorized officer shall be competent to confiscate the banned material under proper inventory.
(ii) The banned/seized material shall not be returnable.
(iii) It shall be lawful for the Commissioner or authorized officer to get banned/seized material destroyed to avoid recirculation.
(iv) Any person aggrieved by the decision of the authorized officer regarding seizure/confiscation of his material, may make the representation to the Commissioner, Municipal Corporation, Chandigarh, within 5 days of such seizure/confiscation and the Commissioner shall decide the representation after affording opportunity to the said person to prove that his seized/confiscated material is upto the required standard as also in accordance with these bye-laws. The seized/confiscated material of such a person shall not be destroyed until his representation is decided.
(v) The decision of the Commissioner, Municipal Corporation, Chandigarh, shall be final.

Duties and functions of the Commissioner:

(i) The Commissioner, Municipal Corporation, Chandigarh shall be competent to appoint such number of authorized officers for carrying out the purposes of these bye-laws.
(ii) The Commissioner, Municipal Corporation, Chandigarh, shall be competent to allot areas to particular authorized officers for inspection, with a view to carry out the aims and objects of these bye-laws.

Inspection:

For implementing the provisions of these bye-laws, the Commissioner or the authorized officer may at any reasonable time enter and inspect any place/premises where he may reasonably believe that the banned material is being manufactured, stored, used or sold.
Provided that no entry in the private premises shall be made after the sun set and before the sun rise.

Assistance to Officers:

The traders, vendors, manufactures and their employees shall be duty bound to render all assistance and information to the Commissioner or his authorized officer for carrying out their duties under these bye-laws.

Protection of action taken in good faith:

No suit, prosecution or other legal proceedings shall lie against the Commissioner or the authorized officers of the Municipal Corporation, Chandigarh, in respect of anything done bonafide in the performance of their functions under these bye-laws.

Compounding of offences:

(i) Any offence punishable under these bye-laws may be compounded by the Commissioner or the officer specifically authorized in this regard by the Commissioner on payment of such fine as the Commissioner or the officer so authorized may prescribe.

(ii) Where any offence has been compounded under Sub bye-law (i) above, no other proceeding shall be taken against the offender in respect of the offence so compounded.

Directions for the manufacturers:

(i) The manufacturers shall mark 'end product' as per Bureau of Indian Standards Specification: IS 14534:1998 ('End product' means product made out of virgin/recycled/reprocessed plastics).

(ii) The carry bags and containers made of recycled plastics and used for purposes other than storing and packaging foodstuffs shall be manufactured using pigments and colorants as per Bureau of Indian Standards Specification IS 9833:1981, entitled 'List of pigments and colorants for use in plastics in contact with foodstuffs, pharmaceutical and drinking water'.

(iii) The recycling of plastics shall be undertaken strictly in accordance with the Bureau of Indian Standards Specification IS 14534:1998 entitled, 'The Guidelines for Recycling of Plastics'.

(iv) The carry bags and containers made of virgin plastic shall be in natural shade or white, meaning thereby that colour addition is not permitted.

(v) The minimum thickness of carry bag made of virgin plastic or recycled plastic shall not be less than 20 microns.

Commissioner,
Municipal Corporation, Chandigarh

In continuation of the above, Chandigarh Administration, Department of Environment, vide its Notification No. ED/2003/543 dated 16.09.2003 enforced the following rules which supercedes the above.

Chandigarh Administration
Department Of Environment

No. ED/2003/543 Dated 16.09.2003

Whereas draft notification was issued by the Administrator, Union Territory, Chandigarh in exercise of powers conferred on him under Section 5 of Environment (Protection) Act, 1986 (29 of 1986) read with Govt. of India's Notification bearing No. S.O. 667 (E) dated the 10th September, 1992 which was published in the Chandigarh Administration's Gazette vide No. ED/2003/175 dated 8th May, 2003 inviting objections from persons likely to be affected thereby within 60 days from the date of publication of the said draft notification.

And whereas objections and suggestions received within the aforesaid period have been duly considered by the Chandigarh Administration.

And whereas this notification shall come into force on the date of its publication in the Official Gazette.

Now, therefore, the Administrator, Union Territory, Chandigarh exercising the delegated powers under Section 5 of the Environment (Protection) Act, 1986 hereby directs that no person including a shopkeeper, vendor, retailer or rehriwala etc. shall supply any goods in polythene/plastic carry bags of thickness less than 30 microns and of size less than 8"x12", in the whole of Union Territory of Chandigarh and further directs that no person shall manufacture, store, import, sell or transport polythene/plastic bags of thickness less than 30 microns and of size less than 8"x12" and also directs that each polythene bag shall be marked at the bottom by the manufacturer as per provisions of Recycled Plastic Manufacture & Usage Rules, 1999 as amended vide notification No. S.O. 698(E) dated 17th June, 2003. The Administrator is pleased to further direct that the minimum weight of 50 carry bags of 30 microns of size 8"x12" made of virgin or recycled plastic shall be 150 gm (plus or minus 5% variation) and carry bags of larger size shall have proportionately higher weight.

[Karan A. Singh]
Secretary Environment and Forests
Chandigarh Administration.

Annexure 5.1

List of Steering Committee members
Notification No. ED/2002/1318 dated 16.9.2002

Secretary Environment, Chandigarh Administration	Chairperson
The Joint Secretary Environment, Chandigarh Administration	Member
Representative of National Host Institution (TERI), New Delhi	Member
Executive Director Punjab State Council for Science & Technology, Chandigarh	Member
Prof. S.C. Jain Department of Chemical Engineering, Panjab University, Chandigarh.	Member
Lt. Gen. Baljeet Singh (Retd.), H.No. 219, Sector 16, Chandigarh	Member
Dr. Sibi John Punjab Engineering College, Chandigarh	Member
	Neeru Nanda, IAS, Secretary Environment, Chandigarh Administration

List of Nodal Officers

Name & Address	Telephone No.
Mr. Ishwar Singh, Director, Department of Environment, Plot No. 3, Sector 19, Madhya Marg, Chandigarh, UT	2782645, 2775951
Mr. P.J.S. Dadhwal, Member Secretary, Chandigarh Pollution Control Committee, Additional Town Hall Building, 2nd Floor, Sector 17, Chandigarh	2705186
Mr. Vinod Sharma, Secretary, State Transport Authority, UT Government Press UT Madhya Marg, Sector 18, Chandigarh	2540444
Mr. Jaideep Kapoor, Director, Industries, UT 43, Industrial Area, Phase-II Ram Darbar, Chandigarh	2653140
Mr. G.S. Bains / Mr. Chaman Lal Deptt of Science & Technology, UT Town Hall Building, 2nd Floor, Sector 17-C, Chandigarh	2715053
Mr. Harbhajan Singh, S.E.,Public Health, UT Administration Secretariat, Sector 9, Chandigarh	2740721
Mr. Hardial Singh, Project Officer, O/o Medical Officer Health, UT Administration Secretariat, Sector 9, Chandigarh	2701235 2742083 (PBX)
Mr. Suresh Kumar, Research Officer, Economics & Statistical Cell, UT Administration Secretariat, Sector-9, Chandigarh	2741283
Mr. Y.P. Chhabra, Executive Engineer Project Public Health, Division No. 1, Sector-37, Chandigarh	
Dr. Neelima Jerath **(Project Coordinator)** Joint Director (Environment) Punjab State Council for Science & Technology, MGSIPA Complex, Sector 26, Chandigarh	2792325, 2793300, 2793600

PUNJAB STATE COUNCIL FOR SCIENCE & TECHNOLOGY

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