State of Environment Report: Maharashtra

(FINAL DRAFT)




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SoER Team Members

Abbreviations

AFM	Advanced Forest Management
AGNI	Action for Good governance through Networking India
AID	Association for India 's Development
AIILSG	All India Institute of Local Self Government.
ALM	Advance Locality Management
AMC	Akola Municipal Corporation
AQMN	Air Quality Monitoring Network
APDRP	Accelarated Power Development and Reform Programme
ARI	Acute Respiratory Infections
ARTI	Appropriate Rural Technology Institute, Pune
ARWSP	Accelerated Rural Water Supply Programme
ASI	Annual Survey of Industries
AuMC	Aurangabad Municipal Corporation
AWR	Annual Water Resource per capita
BAIF	Bharatiya Agro Industries Foundation
BCM	billion cubic metres
BEST	Bombay Electric Supply and Transport Undertaking
BMC	Brihanmumbai Municipal Corporation
BMW	Bio-Medical Waste
BOD	Biological Oxygen Demand
BOO	Build-Own-Operate
BOOT	Build Own Operate and Transfer
BOT	Build Operate and Transfer
BPCL	Bharat Petroleum Corporation Limited
BPL	Below Poverty Line
BRIMSWD	Brihanmumbai Stormwater Drain
BSES	Bombay Suburban Electric Supply
BUTP	Bombay Urban Transport Project
BVIEER	Bharati Vidyapeeth Institute of Environment Education & Research
CAG	Comptroller and Auditor General of India
CBD	Convention on Biological Diversity
CBP	Community Biogas Plants
CBMWTDF	Common Biomedical Waste Treatment and Disposal Facility
CDM	Clean Development Mechanism
CETPs	Common Effluent Treatment Plants

CFCs	Chloro Fluoro Carbons
CIDCO	City and Industrial Development Corporation
CITES	Convention on International Trade in Endangered Species
CNG	Compressed Natural Gas
COD	Chemical Oxygen demand
COMPAS	Coastal Ocean Monitoring and Prediction System
COPD	Chronic Obstructive Pulmonary Disease
CPCB	Central Pollution Control Board
CPT	Candidate Plus Trees
CRD	Centre for Rural Development
CRT	Cathode Ray Tubes
CRZ	Coastal Regulation Zone
CSIA	Chatrapati Shivaji International Airport.
CSO	Central Statistical Organisation
CSS	Centrally Sponsored Schemes
CTSDF	Common Treatment, Storage and Disposal Facility
C-WET	Centre for Wind Energy Technology
CWPRS	Central Water & Power Research Station
DDMP	District Disaster Management Plan
DDT	Dichlorodiphenyl trichloroethane
DFID	Department For International Development
DO	Dissolved Oxygen
DPAP	Draught Prone Area Programme
DTPS	Dahanu Thermal Power Station
EAS	Employment Assurance Scheme
EE	Environmental Education
EF	Exceedence Factor
EIS	Environmental Improvement Society
EM	Effective Micro-organisms
EOU	Export-Oriented Units
ESP	Electrostatic precipitator
ESR	Environment Status Report
EST	Environmentally Sound Technology
EW	East West
Exim	Export-Import
FDA	Forest Development Agencies
FDCM	Forest Development Corporation of Maharashtra
FG	Flue Gas

FGD	Flue Gas Desulphurisation
FIRE (D)	Financial Institutions Reform and Expansion Project-Debt Market Component
FO	Furnace Oil
FPC	Forest Protection Committee
FSI	Forest Survey of India
GCA	Gross Cropped Area
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEMS	Global Environmental Monitoring System
GHGs	Green House Gases
GLOBE	Global Learning and Observation to Benefit the Environment
GoI	Government of India
GoM	Government of Maharashtra
GSDA	Groundwater Surveys and Development Agency
GSDP	Gross State Domestic Product
GQ	Golden Quadrilateral
HCs	Hydrocarbons
HCV	Heavy Commercial Vehicles
HP	Horse Power
HPCL	Hindustan Petroleum Corporation Limited
HSD	High Speed Diesel
HUDCO	Housing and Urban Development Corporation Limited
HW	Hazardous wastes
IBP	Institutional Biogas Plants
IBRD	International Bank for Reconstruction and Development
ICEF	India Canada Environmental Facility
IDA	International Development Association
IDF	Infrastructure Development Fund
IDR	India Development Report
IFW	Interfacial Free Water
IGWDP	Indo German Watershed Development Project
IH&RA	International Hotel & Restaurant Association
IIPS	International Institute for Population Sciences
IL&FS	Infrastructure Leasing & Financial Services
IMR	Infant mortality rate
INP	Ichalkaranji Nagar Parishad
IPCC	Intergovernmental Panel On Climate Change
IPM	Integrated Pest Management

IPP	Independent Power Producer
IRDP	Integrated Road Development Project
IRG-SSA	International Resources Group-Systems South Asia Private Limited
IRSA	Institute for Remote Sensing Applications
ISI	Indian Statistical Institute
IT	Information Technology
IWDP	Integrated Wastelands Development Programme
JBIC	Japan Bank of International Cooperation
JFM	Joint Forest Management
JMC	Jalgaon Municipal Corporation
JNPT	Jawaharlal Nehru Port Trust
KfW	Kreditanstalt for Wiederaufbau (German Bank)
KDMC	Kalyan-Domivali Municipal Corporation
KMC	Kolhapur Municipal Corporation
KWh	Kilo Watt per Hour
LCV	Light Commercial Vehicle
LDO	Light Diesel Oil
LISP	Land Infrastructure Servicing Programme
lpcd	litres per capita per day
LPG	Liquified Petroleum Gas
LSI	Large Scale Industry
LSHS	Low Sulphur Heavy Stroke
MBMC	Mira Bhayander Municipal Corporation
MCs	Municipal Corporations
Mcft	million cubic feet
MCBM	Municipal Corporation of Brihan Mumbai
MCGM	Municipal Corporation of Greater Mumbai
MDR	Major District Road
MEDA	Maharashtra Energy Development Agency
MEDC	Maharashtra Economic Development Council
MEPCO	Maharashtra Environment Protection Consultancy Origination
MERC	Maharashtra Electricity Regulatory Commission
Mfps	Minor Forest Products
MGWA	Maharashtra Ground Water Authority
mha	million hectares
MHADA	Maharashtra Housing and Area Development Authority
MIDAS	Maharashtra Infrastructure Development and Support Act
MIDC	Maharashtra Industrial Development Corporation

MINARS	Monitoring of Indian National Aquatic Resources
MIS	Maharashtra Infrastructure Summit
MJP	Maharashtra Jeevan Pradhikaran
MLD/mld	Million Litres a Day
MMB	Maharashtra Maritime Board
MMRDA	Mumbai Metropolitan Region Development Authority
MNP	Minimum Needs Programme
MNES	Ministry of Non-conventional Energy Sources
MoEF	Ministry of Environment and Forests, Govt. of India
MOT	Ministry of Tourism
MoWR	Ministry of Water Resources, Govt of India
MPCB	Maharashtra Pollution Control Board
MPN	Most Probable Number
MRTP	Monopolistic and Restrictive Trade Practice
MSDP	Mumbai Sewage Disposal Project
MSDR	Maharashtra State Development Report
MSEB	Maharashtra State Electricity Board
MSI	Medium Scale Industry
MSRDC	Maharashtra State Road Development Corporation
MSTI	Maharashtra State Transport Information
MSW	Municipal Solid Waste
MTDC	Maharashtra Tourism Development Corporation
MTPD	Metric Tonne Per Day
MUDP	Mumbai Urban Development Project
MVSS	Maharashtra Van Sanshodhan Sanstha
MW	Mega Watt
MWRC	Maharashtra Water and Waste Water Regulatory Commission
MWRPRA	Maharashtra Water Resource Planning and Regulatory Authority
NAAQM	National Ambient Air Quality Monitoring Programme
NAAQS	National Ambient Air Quality Standards
NABARD	National Bank for Agricultural and Rural Development
NAEB	National Afforestation and Eco-Development Board
NAMP	National Air Monitoring Programme
NAP	National Afforestation Programme
NBP	Night-Soil based Biogas Plants
NBSSLP	National Bureau of Soil Survey and Land Use Planning
NC	Nature Club
NCAER	National Council of Applied Economic Research

ND	Nuisance Detection
NDP	Net Domestic Product
NEAC	National Environment Awareness Campaign
NEERI	National Environmental Engineering Research Institute
NFHS	National Family Health Survey
NFP	National Forest Policy
NG	Natural Gas
NGO	Non-Governmental Organisation
NH	National Highway
NHDA	National Highways Development Authority
NHDP	National Highways Development Project
NIO	National Institute of Oceanography
NLCP	National Lake Conservation Programme
NLRP	National Lake Restoration Programme
NMC	Nashik Municipal Corporation
NMMC	Navi Mumbai Municipal Corporation
NOC	No Objection Certificate
NOCIL	National Organic Chemical Industries Ltd.
NOx	Oxides of Nitrogen
NPs	Nagar Parishads
NPBD	National Project on Biogas Development
NPIC	National Programme on Improved Chulhas
NPK	Nitrogen Phosphate and Potassium
NPMC	Nagpur Municipal Corporation
NRAP	National River Action Plan
NRCD	National River Conservation Directorate
NRSE	New and Renewable Sources of Energy
NS	North South
NSA	Net Sown Area
NSS	National Sample Survey.
NTFP	Non-Timber Forest Produce
NTPI	National Tourism Policy of India
NWDB	National Wasteland Development Board
NWDPRA	National Watershed Development Project For Rainfed Areas
NWIP	National Wetlands Identification Project
NWP	National Water Policy
ODS	Ozone Depleting Substances
OECD	Office of Environmental Compliance and Documentation

O&M	Operation and Maintenance
ORZ	Ocean Regulation Zone
PA	Protected Areas
PBDE	Polybrominated Diphenyle Ether
PCI	Per Capita Income
PCMC	Pimpri Chinchwad Municipal Corporation
PHC	Primary Health Centre
PHD	Public Health Department
PHDCCI	Progress Harmony Development for Chamber of Commerce and Industry
PIB	Press Information Beureau
PIL	Public Interest Litigation
PMC	Pune Municipal Corporation
PMGY	Pradhan Mantri Gramodaya Yojana
PMGSY	Pradhan Mantri Gram Sadak Yojana
PMU	Project Management Unit
POP	Persistent Organic Pollutants
PRI	Panchayati Raj Institution
PSP	Public Sector Participation
PUC	Pollution Under Control
PVC	Poly venyl chloride
RBC	Rotating Biological Contactor
RCF	Rashtriya Chemicals & Fertilizers
REEID	Rural Energy Entrepreneurship and Institutional Development
REL	Reliance Energy Ltd
RET	Renewable Energy Technologies
RFO	Range Forest Officer
RPM	Respirable Particulate Matter
RSPM	Respirable Suspended Particulate Matter
SBI	Subsidiary Body on Implementation
SBCWL	ST-BSES Coal Washeries Ltd
SBSTA	Subsidiary Body on Scientific and Technological Advice
SCERT	State Council of Educational Research and Training
SCMC	Supreme Court Monitoring Committee
SD	Standard Deviation
SDP	State Domestic Product
SEEPZ	Santacruz Electronics & Export Processing Zone
SEZ	Special Economic Zone
SFI	State of Forest Report

SGVSY	Samanvit Gram Vanikaran Samriddhi Yojna
SH	State Highway
SMK-MC	Sangli Miraj Kupwad Municipal Corporation
SMEs	Small and Medium Enterprises
SO_2	Sulphur Dioxide
SPM	Suspended Particulate Matter
SS	Suspended Solids
SSIs	Small Scale Industries
SSP	Slum Sanitation Programme
SSPI	Small Scale Private Initiative
STAP	Science And Technology Advisory Panel
STP	Sewage Treatment Plant
SUP	Slum Upgradation Programme
SWD	Storm Water Drain
SWM	Solid Waste Management
TBIA	Thane-Belarpur Industrial Area
TAR	Third Assessment Report
TBU	Technical Back up Unit
TEAP	Technology and Economic Assessment Panel
TEC	Tata Electric Companies
TE	Triennium Ending
TIE	The Indian Express
TKN	Total Kjedahl Nitrogen
TMC	Thane Municipal Corporation
TOF	Trees Outside Forests
TOI	Times of India
TPCL	Tata Power Company Ltd.
TPD	Tonnes per day
TPP	Thermal Power Plant
TRTI	Tribal Research and Training Institute
TSDF	Treatment, Storage and Disposal Facility
TSP	Total Suspended Particulate
T&D	Transmission and Distribution
UFW	Unaccounted For Water
UGD	Under Ground Drainage
ULB	Urban Local Bodies
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme

UNFCCC	United Nations Framework Convention on Climate Change
URBAIR	Urban Air Quality Management Strategy in Asia
USAID	United States Agency for International Development
UT	Union Territory
VKT	Vehicle Kilometers Travelled
VOC	Volatile Organic Compounds
VVF	Vegetable Vitamin Foods Company Private Limited
WB	World Bank
WCL	Western CoalFields Ltd.
WDF	Watershed Development Fund
WDP	Watershed Development Programme
WEEE	Waste Electrical and Electronic Equipment
WHO	World Health Organisation
WRA	Water Regulatory Authority
WSP	Water and Sanitation Programme
WSSD	Water Supply and Sanitation Department
WTO	World Trade Organisation
WTTC	World Travel & Tourism Council
WUA	Water Users' Association
WWF	World Wildlife Fund
ZPs	Zilla Parishads

Executive Summary

India needs to sustain accelerated economic growth in order to enhance the quality of life of people and compete in the global market. However, for sustainable development, it is imperative to minimise the ecological degradation and environmental pollution resulting from economic activities. Impacts of these activities can be seen in the form of rapid industrialisation, the resultant migration, unplanned urbanisation, which are continuously depleting the natural resources and deteriorating the environmental quality. In recent years, the development plans in India are focused on sustainable growth, which is evident from the increased allocation of resources for the Ministry of Environment and Forests (MoEF). The budget of the MoEF has increased from Rs 3014 crores in the 9th Five Year Plan to Rs 5945 crores in the 10th Five Year Plan. The Annual Plan outlay has also shown an increase from Rs 1050 crores in 2004-05 to Rs 1235 crores in 2005-06 (Union Budget, 2005-06).

Depletion and pollution of water are the major problems of water resources in India. Rural India lacks proper water supply infrastructure and people do not have access to safe drinking water. The urban areas, on the other hand, are faced with the problem of inadequate supply and low quality of these services. India has about 20 percent of the world's population but only about 4 percent of the world's fresh water resources. The per capita water availability in the country is expected to drop to 1500 cubic meters in 2005 from 2384 cubic metres in 2000, which is lower than 1700 cubic metres - the benchmark for water scarce regions. Water contamination is so severe that about 70 percent of all diseases in India are water borne and about 73 million workdays are lost each year due to them(Sharma, 1998 and 2002).

High levels of *indoor and ambient air pollution,* particularly in urban areas are serious issues in the country. At times, indoor air pollution levels, within homes and work places, could be more than the ambient levels. Though gaseous pollutants are not very harmful, the high emission levels of both suspended particulate matter (SPM) and respirable particulate matter (RPM), cause various health hazards. Several studies conducted in the rural and urban poor areas, where low quality fuels such as coal, wood etc. are used for cooking and other household activities, have indicated the presence of high levels of harmful pollutants in the domestic environment. At the same time, industries and various modes of transportation are major man-made sources of ambient air pollution. The UNEP (2001) has provided some broad estimates of the increase in air pollution load from various sectors in India. The total estimated pollution load from the transport sector increased from 0.15 million tonnes in 1947 to 10.3 million tonnes in 1997, the major pollutants being carbon mono-oxide (CO) having the largest share (43 percent) of this total, followed by oxides of nitrogen (NO_X) at 30 percent, hydro-carbons (HC's) at 20 percent, SPM at 5 percent, and sulphur dioxide (SO_2) at 2 percent. Likewise, in the thermal power sector, the total estimated pollution load of SPM, SO_2 and NOx increased from 0.3 million tonnes in 1947 to 15 million tonnes in 1997. In the industrial sector, the total estimated emissions of SPM from the seven critical industries (iron and steel, cement, sugar, fertilisers, paper and paper board, copper and aluminium) increased from 0.2 million tonnes in 1947 to 3 million tones in 1997. SPM claimed the largest share (86 percent) of the total air pollution load in 1997.

Maharashtra is one of the most industrialised and urbanised states of India. The State has an impressive annual growth rate of seven percent over the past three years compared to 3.4 per cent during 2000-01. The target of 8 percent annual growth rate has been set in the 10th plan. All major towns of Maharashtra are experiencing an unprecedented population growth and thereby exerting a tremendous pressure on the urban infrastructure and civic amenities. About 42 per cent of the state's population is living in urban areas though the levels of urbanisation are uneven across regions and districts within the state. Both inter-state and intra-state migrations are responsible for enormous growth of urban population.

The notable feature of Maharashtra's agriculture is that the cropping pattern is shifting towards commercial crops. The state utilises the largest area and has the highest production in the country devoted to fruits and fifth largest area under vegetables. It had a 20 percent share in the country's fruit production and 5 percent share in the vegetable production. The consumption of pesticides in the state has declined to 173 g/ha from 320 g/ha due to Integrated Pest Management (IPM) programme. The state accounts for about 12 percent of India's total installed capacity in the power sector of the country and about 80 percent of its population has access to electricity. Maharashtra ranks second highest in the country, in the production of power from renewables, having around 639 MW installed capacity, which is about 4.5 percent of total installed capacity in the state. The state occupies a significant position in the manufacturing of refined petroleum products, basic chemicals and other chemical products.

To achieve a sustainable and targeted growth rate, Maharashtra should optimise its entrepreneurial, financial and administrative resources. Increasing the scope for private sector, may improve both availability of infrastructure and efficiency through competition. Integration of some of the infrastructure schemes, such as, construction of roads with the employment and income generation programmes will help in the alleviation of poverty. In the agricultural sector, priority should be given to the promotion of irrigation facilities and watershed development programmes. Growth of less water intensive commercial crops, fruits and vegetables should be encouraged. In order to make the manufacturing sector globally competitive, improvements in the infrastructure of roads, power, mass transport and communication are required. A planning approach, which involves sustainability and people's participation is necessary to boost tourism in the state.

Chapter 2 on *"Water Resources and Sanitation"* focuses on scenario of water resources and sanitation in both rural and urban areas of the State. The condition of water bodies like rivers, lakes etc., marine pollution and its effects and the various measures undertaken to reduce water pollution are examined. The chapter reveals how growing population; rapid industrialisation and large-scale urbanisation increase the demand for water supply and put a stress on water resources.

Per capita water availability in the state is lower than the national average. Water demand for various consumptive uses, such as drinking, agriculture, industrial etc., both from ground and surface water resources, is higher than the availability. Distribution of rainfall is highly uneven in the State and in many areas the soil conditions and topography are unfavourable to ground water recharge through percolation. Further, over-use and misuse of resources is responsible for the water scarcity. Wide disparities exist in the sanitation facilities in the urban and rural areas. Thus, meeting the increased needs for the water supply and sanitation facilities are a challenge for the authorities.

Solid waste problems are more obvious in the urban rather than in rural areas. They cover many issues such as collection of mixed waste, lack of use of sanitary landfills, dumping of waste in open grounds, technical and socio-economic problems etc. The daily per capita solid waste generated in small, medium and large towns in India is around 0.1 kg, 0.3-0.4 kg and 0.6 kg, respectively, with the recyclable content varying from 13 percent to 20 percent. Improper disposal of such large quantities of SW has caused significant land degradation. The drive for increased agricultural production has resulted in the loss of genetic diversity in the country. For instance, by the end of the year 2005, India is expected to produce 75 percent of its rice from just 10 varieties compared to the 30,000 varieties traditionally cultivated. Terrestrial biodiversity losses in various ecosystems have been identified as a major concern but these have still to be quantified (UNEP, 2001).

Thus, in order to deal with resource depletion and environmental degradation, prudent environmental management is necessary in India. Since the country's environmental problems are diverse, their solutions have to be region-specific. Preparation of the State of Environment Reports (SoERs) is a timely step, initiated by the MoEF, Government of India (GoI) and State Pollution Control Boards (SPCBs), aimed at producing an informative account of the environmental conditions so as to achieve sustainable growth in each state.

Maharashtra is one of the most industrialised states, and its capital, Mumbai, is termed as the financial capital of India. The State's Gross Domestic Product (GDP) was about 13 percent of India's GDP for 2003-04 at 1993-94 constant prices (GoM, 2005). According to the 2001 census, Maharashtra accounts for 9.42 percent of the total population and is the second most populated state in the country. Given the fact that Maharashtra accounts for a large share of both India's GDP and population, concerns for environmental degradation in the state are far more serious than in the rest of the country. In fact, Maharashtra is one of the foremost states, which encountered various environmental problems and undertook appropriate remedial measures. Preparation of SoER-Maharashtra, thus, is a very relevant exercise for the State. Its objective is to assess the status of various natural resources and environmental sectors in the State so that future strategies could be planned which ensure sustainable growth with minimal damage to ecology and environment.

Major areas identified for an in-depth study in the SoER are – Socio-economic Profile, Water Resources and Sanitation, Air and Noise Pollution, Solid Waste Management, Land Degradation, Forests and Biodiversity, Disaster Management, Relevant Global and Other Issues, which are organised in nine chapters. The road map of SoER, summarising each chapter briefly, is as follows.

Chapter 1 on *"Socio-Economic Profile of Maharashtra"* explains the geographic, socio-economic and administrative profiles of Maharashtra. It includes social and economic aspects such as demography, literacy, housing, urbanisation, poverty, etc. The economic progress of the state and the contribution of different sectors are highlighted. The Infrastructure sector covers various modes of transport, particularly the road development initiatives of the state. Details of medical and health provisions and services are also discussed. Further, it examines the status of agriculture, cropping pattern, horticulture and allied activities such as livestock development and fisheries. The Energy sector provides information not only on the current status of power generation, and consumption but also enlists the major new energy projects of the state including renewable energy. The industrial clusters, categorisation of industries based on the economic scale and the levels of pollution and their impacts are discussed under the sub topic, Industrial sector. Various tourist sites, facilities and the concept of sustainable tourism are also covered.

Introduction of a supply-demand management strategy to avoid water shortage in the state has been recommended. People should be educated through awareness and training programmes about the importance of saving water, methods of rain-water harvesting, sustainable use of groundwater resources, reuse and recycling of wastewater for irrigation and gardening, etc. Concerned authorities, alongwith promotion of integrated water and sanitation projects, should ensure that the concept of environmental sanitation and personal hygiene is adopted by the masses.

Chapter 3 on *"Air and Noise Pollution"* includes the sources and levels of air pollutants and also describes noise pollution. The effects of air pollution, particularly health hazards; air monitoring and abatement measures are discussed in this chapter. The increasing number of vehicles and their contribution to pollution is reported under the sub-section -Vehicular pollution. The status of noise pollution, its sources and effects are explained.

Monitoring results show that the air pollution in residential areas is mostly moderate though the SPM levels are a cause for concern in most cities in the state. In terms of RPM levels, which are also responsible for health damages, Maharashtra's towns are better than northern cities like Delhi, Calcutta and Ahmedabad, but worse than southern cities like Chennai, Bangalore and Hyderabad. The noise levels in some cities exceed the prescribed standards in all categories, for both day and night and the situation worsens during festivals and functions.

To reduce ambient air pollution, particularly in urban areas, improvement in transport infrastructure, specially roads, improved vehicle design, alternate clean fuels and better traffic management, is required. Source identification and source apportionment exercises to find out the qualitative and quantitative contribution of various sources are needed. Indoor air pollution could be reduced by facilitating access to clean fuels and electricity in rural areas, reducing the cost of energy supplied to low-income households, promotion of renewable energy systems such as biogas, solar water heaters and other systems.

***"Solid Waste Management,"* discussed in Chapter 4,** deals with generation, handling and disposal of municipal, industrial, hazardous, electronic and bio-medical waste. The quantity and composition of municipal solid waste generated in major cities like Mumbai, Navi Mumbai, Thane, Pune, Nashik and Aurangabad is discussed and the status of solid waste management is described.

The State generates a large amount of municipal solid waste and other types of wastes and the quantity generated in major cities and class I towns, due to consumption patterns and higher standard of living, is more than the class II towns. It is found that Mumbai generates the highest proportion of MSW followed by Pune and Thane. The existing SWM system in urban areas has several shortcomings such as low removal frequency, uncontrolled dumping and obsolete methods.

Management of MSW needs improvement at all stages i.e. collection, transportation, treatment and disposal. Source separation of waste is of utmost importance for using the waste as secondary resource for recycling process, composting, waste-to-energy generation etc. Models of SWM used in some developed countries may be replicated in the state. Socio-economic issues attached to the informal sector's participation in SWM need an increased attention. Policies for SWM should be framed using the principle of the "4 R's" i.e. Reduce, Recover, Reuse and Recycle.

Chapter 5 deals with the issues in *"Forests and Biodiversity"* of Maharashtra. The forests in the State are divided into five types namely southern tropical semi-evergreen, southern evergreen moist deciduous, southern tropical dry deciduous, southern tropical thorns, and littoral and swamp. Data

on district wise forest cover is tabulated and afforestation and other forest management plans are discussed in this chapter.

Maharashtra is among the states, which have largest forest cover in India. The actual forest cover in at the end of 2003-04, was 20.13 per cent of State's geographical area, which shows a substantial increase from 15.43 percent in 2001. The Sahyadri region is the hotspot of biodiversity in Maharashtra. The MoEF has declared hill stations such as Matheran, Panchgani and Mahabaleshwar as eco-sensitive zones. The state's tiger population has increased from 238 to 303 in the last four years but looking at the past trend, it is under threat.

Efficient enforcement of rules and regulations, promotion of JFMs and increased people's participation would add to the efforts of concerned authorities. Various municipal corporations should undertake programmes for increasing green cover and beautify their towns, as exemplified by some of the MCs.

***"Land Resources and Degradation,"* which is discussed in Chapter 6** gives information on the land resources, land-use pattern, and wastelands of Maharashtra. Land degradation, its cause and effects, different types of soil and related problems like soil erosion, lack of nutrients, loss in productivity etc. are also discussed.

Around 23 percent of the total available land area is under forest and tree cover, while the net sown area is about 57 percent and the remaining is almost equally distributed between barren, non-agricultural and fallow land (MoEF, 2004). Soils are deficient in nutrients and excessive use of water for irrigation leads to increased salinity in soils. Water induced erosion is the major cause for soil erosion and land degradation, which is aggravated by the reducing vegetation cover. Uncontrolled land-use change for various purposes to facilitate urban development is also responsible for deterioration and degradation of land.

It is recommended that the authorities should find ways to prevent/minimise soil erosion, through measures such as preventing the felling of trees and adopting afforestation programmes in the state, particularly in the Western Ghats. Pollution control measures and reuse of abandoned quarries as landfill sites must be made mandatory for the quarrying sector. Stringent regulation and monitoring of no development/green zones must also be undertaken to prevent further deterioration of land resources.

Chapter 7 on *"Disaster Management"* examines the occurrences of natural and man-made disasters, the losses incurred and the relief work undertaken by the government to deal with them. It identifies the disaster prone zones and mitigation plans undertaken.

It is revealed that in addition to natural disasters, several man-made disasters occur in the State. While Koyna reservoir and its surrounding areas are earthquake prone, the industrial belt of Pune, Mumbai and Nashik are prone to the risk of industrial accidents and hazards and disasters like fire and road accidents. Low rainfall areas of the state are under the constant risk of drought while low-lying villages are prone to floods during the monsoons. As a part of overall preparedness of the state, the Government of Maharashtra has a State Disaster Management Plan to support and strengthen the efforts of district administration.

Natural hazards cannot be prevented but their impact on society can be minimised. Applications of advance IT is necessary for use in pre-disaster activities such as early warning, preparedness and

prevention. Post-disaster activities such as provision of basic amenities to victims, their rehabilitation and re-settlement must be quick and effective in practice. Civil Engineering and architectural concepts must be used in design of buildings and other infrastructure projects to make them earthquake, fire and accident resistant. All disaster management programmes should focus on public awareness and education so that people are prepared to face the situation under disasters.

***"Relevant Global and Other Issues"* are discussed in Chapter 8.** It covers global issues such as Climate Change, Ozone Depletion and Trade and Environment Linkages and their possible impacts on state's economy. The Global Environmental Facility (GEF) and other multilateral agreements and projects are also discussed..

For a coastal state like Maharashtra, climate change may have severe implications. The coastal regions are agriculturally fertile and sea level rise will make them highly vulnerable to inundation and salinisation. Coastal infrastructure, tourist activities, and oil exploration may also be at risk. The performance of the State in the environment infrastructure sector and the ameliorative measures undertaken by the authorities are given. The efforts made by MPCB and other agencies in conducting awareness programmes and implementing environmentally benign technologies are also mentioned.

Accelerating the on-going projects and promoting new projects on CDM and ODS phase out programmes in the State are needed. Proactive role of industry and authorities on issues of trade and environment would benefit the industry and State to compete in the global market. Environmental education and awareness require significant capacity building in all sub-sectors of environment and at all levels such as schools, colleges, community, government

Based upon a comprehensive analysis of available data and information, sector-wise conclusions drawn and recommendations made are given in **"Chapter 9: *Conclusions and Recommendations.*"**

Chapter 1: Socio-Economic Profile of Maharashtra

Introduction

It is believed that the words Marathi and Maharashtra originated from "*Maharathi*"- meaning "the great charioteer." *Maharathis* denoted a strong "fighting force" in the ancient Maratha history. Although the region is believed to have gained prominence as early as in 90 A.D., the first inscription of Maharashtra appeared way back in the seventh century. In the sixteenth century, regional Muslim powers ruled the Deccan region, which basically served the Mughal Empire. Shivaji Bhosle, born in 1627, was the founder of the Maratha Empire and engaged in a lifelong struggle against the Mughals to establish supremacy of the Maratha kingdom. By 1680, the year of his death, nearly the entire Deccan region belonged to the Marathas.

In 1800s, Pune city, the capital of Marathas, was considered to be one of the best built native towns in India. The first step towards establishing a municipal government in this city was taken in 1856, when the Pune Municipality came into existence under the Act of 1850. At the time of the Indian Independence in 1947, western Maharashtra and present-day Gujarat were joined as Bombay state. The eastern districts were then a part of the State of Hyderabad, but were later added to Bombay in 1956. The present state of Maharashtra was formed in 1960 when the Marathi and Gujarati linguistic areas of former Bombay state were separated. Bombay city, presently known as Mumbai, became the capital of the new state.

In Maharashtra one can find the relics of about 175 forts, which are linked to the great Maratha emperor Chhatrapati Shivaji Maharaj, who is believed to have either built or fortified them. Some important forts include Toma, Raigad, Purandar, Pratapgad, Vishalgad, Sinhagad, etc. The State has a long and varied tradition of art and crafts, which have flourished under many rulers including the Marathas, the Mughals and the British. The artistic tradition is well reflected in the Ajanta and Ellora caves, the Warli paintings, etc. The lacquer crafts of Sawantwadi are more than 300 years old and consist mainly of traditional hand-painted and lacquered furniture, light fittings, paintings etc. Bidri ware, Aurangabad's ancient craft involves intricate workmanship of pure silver, embossed, overlaid or inlaid on a metal surface. Maharashtra is also famous for its Paithani sarees made from pure silk and *zari* drawn from pure gold and the traditional Narayan Peth sarees. Kolhapur is famous for its hand-made leather sandals and chappals, popularly known as *"Kolhapuri Chappals,"* in addition to its textiles and cotton products.

The state of Maharashtra is the most industrialised, the second most urbanised and, judged by the per capita income, the second richest state in India. It is spread over a total area of 3,07,713 sq.km, and area wise, it is the third largest state in India after Madhya Pradesh and Rajasthan. Mumbai, the State capital, is considered the financial and commercial capital of the country.

Geographic Profile and Physical Divisions

The state is located between 16° N and 22° N latitudes and 72° E and 80° E longitudes and falls in the western part of India, along the Arabian Sea. The state of Gujarat and the Union Territories of Daman, Dadra and Nagar Haveli are to the North-West; Madhya Pradesh is to the North; Chhattisgarh to the East; Andhra Pradesh to the South-East and Karnataka and Goa lie to the South of Maharashtra. A 720 km long coastline stretches from Daman in the North to Goa in the South, which falls in the resource development zone called the Western Plateau and Hill Regions of India.

Physical divisions of the State comprise of three parts based on its physical features, viz, Maharashtra Plateau, the Sahyadri Range and the Konkan Coastal Strip as explained below.

Maharashtra Plateau: The major physical characteristics of the state include many small plateaux and river valleys. In the north the plateau is flanked by Satpuda ranges, which run in the East-West direction in Maharashtra. The river Narmada flows along the north boundary of Maharashtra, and other major rivers like Krishna, Godavari, Bhima, Penganga-Wardha, and Tapi-Purna have carved the plateau in alternating broad river valleys and intervening highlands.

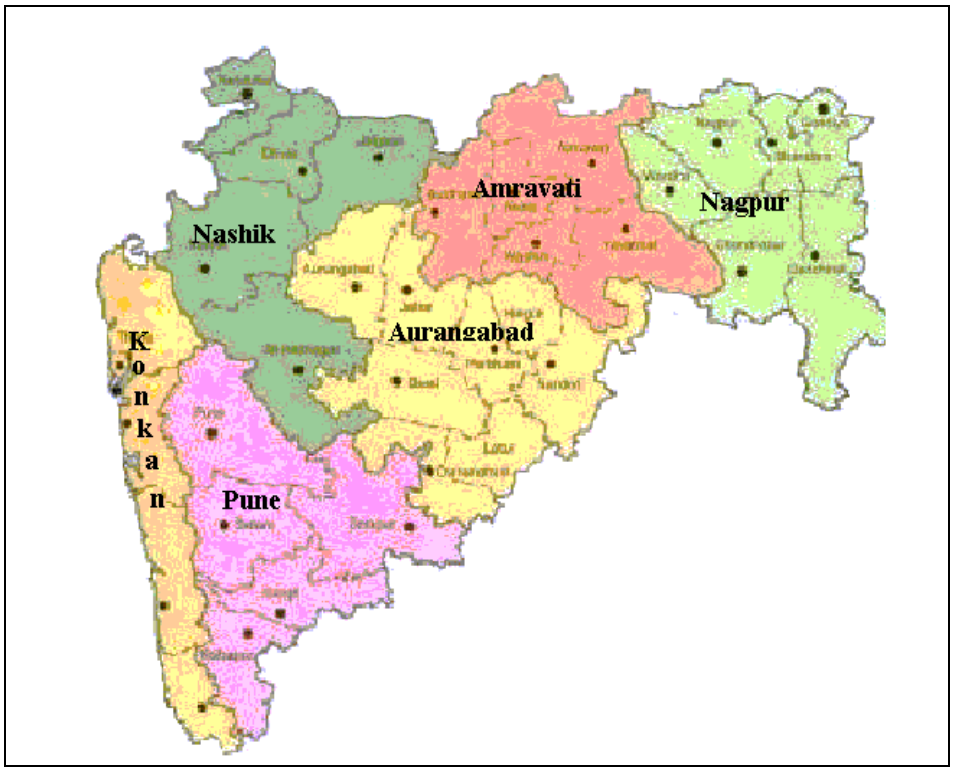
The Sahyadri Range: The Western Ghats of Maharashtra known as the **'Sahyadri'** mountain ranges have an average elevation of 1000-1200 m above the MSL. The Sahyadri hills run parallel to the seacoast, with many offshoots branching eastwards from the main ranges (Satmala, Ajanta, Harishchandra, Balaghat and Mahadeo). The special features are the hills of Trimbakeshwar, Matheran and the Mahableshwar plateau. Its highest peak is **Kalsubai** at an altitude of 1650 m. Most of the rivers in Maharashtra originate in the Sahyadri and then divide to join the eastward and westward flowing rivers. These ranges are also characterised by a number of ghats, the important ones being Thal, Bor, Kumbharli, Amba, Phonda and Amboli.

The Konkan Coastal Strip: The narrow strip of coastal land between the Sahyadri and the Arabian Sea is called the Konkan coastal strip. It is barely 50 km in width; it is wider in the north and narrows down in the south. River creeks and branches of the Sahyadri, which reach right up to the coast, dissect this coastline. The important creeks in Konkan are Terekhol, Vijaydurg, Rajapuri, Raigad, Dabhol, Daramthar, Thane and Vasai. The rivers of Konkan rise from the cliffs of Sahyadri and have a short swift flow into the Arabian Sea. Some important rivers are Ulhas, Savitri, Vashishthi and Shastri.

Administrative Divisions

Maharashtra has been divided into six divisions for administrative purposes viz. Amravati, Aurangabad, Konkan, Nagpur, Nashik, Pune (Figure 1.1). Table 1.1 shows the number of towns with different modes of administration in Maharashtra. The state consists of 35 districts, 33 Zilla Parishads, 353 Tehsils, 27,946 Gram Panchayats, 349 Panchayat Samitis, 222 Municipal Councils, 22 Municipal Corporations, 3 Nagar Panchayats, 7 Cantonment Boards, 41,095 inhabited villages, 2616 un-inhabited villages and 378 towns. Further, on socio-cultural basis, the State is divided into five regions, namely, Greater Mumbai, Marathwada (Aurangabad division), Konkan, Vidarbha (Amravati and Nagpur divisions) and Western Maharashtra (Pune and Nashik divisions) (Census, 2001; GoM 2004).

Figure 1.1: Administrative Divisions of Maharashtra



Source: MSDR, 2005

Table 1.1: Administrative Units of Maharashtra

Status	1981	1991	2001	2003-04
No. of Districts	26	30	35	35
No. of Tehsils	232	300	353	353
No. of Villages	41833	43025	43711	43711
No. of Towns	307	336	378	378
Municipal Corporations	5	11	15	22
Municipalities	220	228	229	222
Cantonment Boards	7	7	7	7
Census Towns	75	90	127	127

Source: Census 2001; GoM, 2004

The area and climate of the districts of the state is given in Table 1.2. Ratnagiri records the highest average annual rainfall followed by the other districts in the Konkan region. Amravati, Akola and Nandurbar are regions with dry climate and have recorded lower average annual rainfall.

Table 1.2: District-wise Land Area and Climate Data

District	Area sq. km.	Climate Data		
		Temp. (^{0}C)		Annual Average Rainfall
		Min	Max	
Ahmednagar	17021	5	40	501
Akola	10575	4	47	100-750
Amravati	12626	8	47	858.7
Aurangabad	10107	5	41	718
Beed	10432	12	40.3	600-700
Bhandara	9213	8.2	43	1318.9
Buldhana	9661	11	46	900
Chandrapur	10443	5	44	1214
Dharashiv	7369	8	43	770.7
Dhule	14380	6	45	771
Gadchiroli	15434	5	46.3	1510
Gondia	4843	7.4	47.5	1197
Hingoli	4526	10.6	42.6	859
Jalgaon	11765	10.3	42.7	700.7
Jalna	7912	10	40	650-750
Kolhapur	7620	14	41.5	1015
Latur	7372	14	39.6	802.4
Mumbai	69	19	32.9	1917.3
Nagpur	9931	6.9	48.1	1161.5
Nanded	10332	11	41	1022
Nandurbar	5023	Dry	-	552
Nashik	15530	9.9	38.2	650
Parbhani	10972	6	41.9	888.5
Pune	15622	6.6	45.8	1150
Raigad	7152	11	41	3028.9
Ratnagiri	8249	18	33.2	3225
Sangli	8602	10	38.2	620
Satara	10480	10	34	600
Sindhudurg	5207	15	33.2	2750
Solapur	14845	12	39.9	623
Thane	9558	9	41	2293.4
Wardha	6309	10	47.9	1100
Washim	10574	-	-	-
Yavatmal	13584	4.8	44.2	1029

Source: Infochange, 2005

Demography

The population of Maharashtra, as per 2001 census, stood at 9.67 crores. Having a share of 9.42 per cent in India's population, Maharashtra ranked second among all States and Union Territories in the country. The decadal growth of population in the State has come down from 25.7 during 1981-1991 to 22.6 in 1991-2001(Table 1.3). The population growth of Maharashtra has been higher than that of India for the decades 1961-71, 1981-91 and 1991-2001. For the past three decades (1971-2001), Konkan division had the highest population due to the large population base of Greater Mumbai. During 1991-2001, the decadal growth rate of the Konkan division was the highest (28.03 percent) followed by the Aurangabad division (21.78 per cent).

Table 1.3: Population of Maharashtra and India

Year	Total Population (in Crores)				Decennial Percentage increase (+) or decrease (-)	
	Maharashtra			India	Maharashtra	India
	Rural	Urban	Total			
1961	2.8	1.1	4.0	43.9	(+) 23.6	(+) 21.5
1971	3.5	1.6	5.0	54.8	(+) 27.5	(+) 24.8
1981	4.1	2.2	6.3	68.5	(+) 24.5	(+) 25.0
1991	4.8	3.1	7.9	84.6	(+) 25.7	(+) 23.9
2001	5.6	4.1	9.7	102.7	(+) 22.6	(+) 21.4

Source: GoM, 2003

Population Growth of the Districts

The district wise population data (Table 1.4) reveals that Mumbai, Pune, Thane, Nagpur, Nashik and Ahmednagar are largely populated. Sindhudurg district recorded the lowest population in 2001. The decadal growth rates of the districts show that during 1991-2001, Thane, Aurangabad, Pune, Nashik, Mumbai (suburb), Nanded and Nagpur were the districts, which grew at a rate faster than that of the state. Thane continued to grow at the highest rate during 1991-2001. The point worth noticing is that decadal growth rate during 1991-2001 was lower than that during 1981-91 for all districts except Nashik, Amravati, Wardha, Gondia and Mumbai. The States's population density was 314 persons per sq.kms, which was almost equal to that of India (312). During the decade 1991-2001, there was an addition of 57 persons per sq.kms.

About 42.4 per cent (4.10 crores) of the state population resides in the urban areas as against 27.8 per cent (28.53 crores) for all India. The rural population (5.57 crores) constitutes about 57.6 per cent of the total population. During the decade 1991-2001, the increase in rural population in the state was 15.1 per cent, which was lesser than the corresponding increase of 18.0 per cent for all India. The percentage increase of rural population in the state in 1991-2001 decade was slightly lower than earlier decade of 1981-91(18.6 per cent) during the decade 1991-2001, the total number of villages (including uninhabited) in the state increased from 43,025 to 43, 722.

The rural and urban population of various districts as given in Table 1.4 indicates that after Mumbai, Thane has the highest per cent of urban population (72.58) followed by Nagpur (64.3) and Pune (58.7) while maximum rural population is concentrated in Gadchiroli and Sindhudurg districts.. The sex ratio (i.e., the number of females per thousand males) has also declined from 934 in 1991 to 922 in the present census.

In Maharashtra, nearly 10 percent of the total population belongs to tribal groups, which differ from each other in various aspects such as language, culture and socio-economic categories. In total, there are 47 scheduled tribes in the State inhabiting the Sahyadri, Satpuda and Gondwan ranges comprising of 17 major tribal groups. In the Sahyadri ranges there are the Mahadeo Koli, Katkari, Warli, Malhar Koli and Kokana groups. Among Satpuda ranges, Bhil, Pawara, Korku and Tadvi are the major groups. The Madia, Gond, Pardhan, Halbi Otkar, and Andha are found in the Gondwan range. Table 1.4a indicates the district-wise distribution on tribal communities in Maharashtra.

Table 1.4: District-wise Population Distribution of the State

Districts	No. of Tehsils/ Talukas/ Mandals	Population		Population Densities (Per Sq. Km.)		Sex Ratio (Females Per 1000 Males)		Population Division (Per cent in 2001)	
		1991	2001	1991	2001	1991	2001	Rural	Urban
Ahmednagar	14	3,372,935	4,088,077	198	240	949	941	80.3	19.7
Akola	7	1,351,959	1,629,305	249	300	934	938	61.5	38.5
Amravati	14	2,200,057	2,606,063	180	213	936	940	65.5	34.5
Aurangabad	9	2,213,779	2,920,548	219	289	922	919	62.8	37.2
Beed	11	1,822,072	2,159,841	170	202	944	927	82.1	17.9
Bhandara	7	1,021,408	1,135,835	250	292	980	982	84.6	15.4
Buldhana	13	1,886,299	2,226,328	195	230	953	946	78.7	21.3
Chandrapur	14	1,771,994	2,077,909	155	182	948	961	67.6	32.3
Dharashiv	8	1,276,327	1,472,256	169	195	937	930	84.2	15.8
Dhule	5	1,473,170	1,708,993	183	212	945	945	73.9	26.7
Gadchiroli	12	7,87,010	969,960	55	67	976	976	93.1	6.9
Gondia	8	1,086,221	1,200,151	209	221	995	1005		-
Hingoli	5	8,23,931	986,717	185	218	952	953		-
Jalgaon	15	3,187,634	3,679,936	271	313	940	932	71.4	28.6
Jalna	8	1,364,425	1,612,357	177	209	958	952	80.9	19.7
Kolhapur	12	2,989,507	3,515,413	389	457	961	949	70.4	29.6
Latur	10	1,676,641	2,078,237	234	290	942	934	76.4	23.6
Mumbai*	-	9,925,891	11,914,398	35,359	48,215	811	800	0	100
Mumbai Suburbs	3	6,751,002	8, 587,561	15137	19255	831	826	0	100
Nagpur	14	3,287,139	4,051,444	332	410	922	933	35.6	64.3
Nanded	16	2,330,374	2,868,158	221	272	945	943	76.0	24.0
Nandurbar	5	1,062,545	1,309,135	211	260	975	975		
Nashik	15	3,851,352	4,987,923	248	321	940	924	61.2	38.8
Parbhani	7	1,293,104	1,491,109	197	229	954	957	67.5	32.5
Pune	14	5,532,532	7,224,224	354	462	933	917	41.9	58.7
Raigad	15	1,824,816	2,205,972	255	308	1010	975	75.8	24.2
Ratnagiri	9	1,544,057	1,696,482	188	207	1205	1135	88.7	11.3
Sangli	9	2,209,488	2,581,835	258	301	958	957	75.5	24.5
Satara	11	2,451,372	2,796,906	234	267	1029	995	85.8	14.2
Sindhudurg	7	8,32,152	861,672	160	165	1137	1077	90.4	9.5
Solapur	11	3,231,057	3,855,383	217	259	934	937	68.2	31.8
Thane	15	5,249,126	8,128,833	549	850	879	857	27.4	72.6
Wardha	8	1,067,357	1,230,640	169	195	939	936	73.6	26.4
Washim	6	8,62,312	1,019,725	167	198	946	939		
Yavatmal	16	2,077,144	2,460,482	153	181	951	942	81.3	18.7
Maharashtra	**353**	**78,937,187**	**96,752,247**	**257**	**314**	**934**	**922**		

Source: GoM, 2003; *Office of Collector

With a population of 85.77 lakhs, the scheduled tribes accounted for 8.9 per cent of the population of Maharashtra (Census, 2001). The Tribal Research and Training Institute (TRTI), Pune (1997), conducted a benchmark survey covering a population of 34.15 lakhs.

Table 1.4a: District-wise Tribal communities in the State

Name of the District	Tribal Group
Ahmednagar	Thakur
Amravati	Korku
Dhule	Pawara, Kokana
Gadchiroli	Otkar, Halbi, Rajgond, Madia, Gond
Jalgaon	Tadvi, Pawara
Nanded	Andha, Pardhan
Nandurbar	Bhil
Nashik	Kokana, Mahadeo Koli
Pune	Mahadeo Koli, Thakur, Katkari
Raigad, Ratnagiri	Katkari, Thakur
Thane	Malhar Koli, Warli, Thakur
Yavatmal	Kolam, Pardhan, Madia, Gond

Source: Compiled by IGIDR

Social Development Indicators

Social Development refers to an approach to social welfare, which offers an effective response to current social problems. Social Development Indicators (SDIs) are the key statistics or quantifiable measures of social development/welfare, which indicate the "social conditions" in different communities and societies. Box 1.1 briefly explains some SDIs used by the Government of India (GoI). The SDIs of the state for 2000-2001 are given in Table 1.5.

Box 1.1: Some Social Development Indicators

- **Crude Birth Rate (CBR)** is the number of live births in a given year (Mid year population) per 1000
- **Crude Death Rate (CDR)** is the number of deaths in a given year (Mid year population) per 1000
- **Infant Mortality Rate (IMR)** per 1000 live births is the probability of dying between birth and before completing one year
- **Total Fertility Rate (TFR**) per woman in a given year is the average number of children born to a woman during the reproductive span (age 15–49 years) provided she experiences the current age-specific fertility rates
- **Life Expectancy at Birth (LEB)** is the average number of years (expected to be lived) at the time of birth if current mortality trends were to continue.

Table 1.5: Social Development Indicators (SDIs) for Maharashtra (2000-2001)

Social Development Indicators (SDIs)	Maharashtra		India	
	1991	2001	1991	2001
Birth Rate	26.2	21.10	29.5	25.8
Sex Ratio (per 1000 males)	934	922	927	933
Crude Death Rate	8.2	7.50	9.8	8.5
Infant Morality Rate	60	55	80	67
Total Fertility Rate	3.0	2.70	3.6	3.2
Life Expectancy	64.8 (1991-95)	65.4	60.9 (1991-95)	63.3
Literacy Rate	64.9	77.03	52.21	64.84
Below Poverty Line (in percent)	41.43	36.86	31.55	34.7

Source: Global HDR, 2003, NFHS, 1991-93, SRS, 1993, Registrar General of India, Ministry of Home Affairs, and Economic Survey of India, Infochange (2005) and Agricultural Statistics at a Glance, (2004)

Infant Mortality Rates

Infant mortality rate (IMR) is defined as the number of deaths in the first year of a child's life, per 1000 live births, in a given year. Thus, IMR reflects the probability of a child dying before reaching age one. Table 1.6 shows that the infant mortality rates have decreased from 60 in 1991 to 45 in 2001 but continue to remain high when compared to the internationally accepted norms of 5 per 1000 live births.

Table 1.6: Birth Rate, Death Rate and IMR (per thousand of population) based on the sample registration

Year	Rural			Urban			Combined		
	Birth Rate	Death Rate	IMR	Birth Rate	Death Rate	IMR	Birth Rate	Death Rate	IMR
1991	28.0	9.3	69	22.9	6.2	38	26.2	8.2	60
1992	27.4	9.1	67	21.5	5.6	40	25.3	7.9	59
1993	27.1	9.3	63	22.8	4.8	32	25.2	7.3	50
1994	26.9	9.2	68	23.0	5.6	38	25.1	7.5	55
1995	26.0	8.9	66	22.4	5.4	34	24.5	7.5	55
1996	24.9	8.7	58	21.0	5.4	31	23.4	7.4	48
1997	24.4	8.6	56	21.0	5.4	31	23.1	7.3	47
1998	23.6	8.9	58	20.8	5.8	32	22.5	7.7	49
1999	21.6	8.7	58	20.3	5.6	31	21.1	7.5	48
2000	21.4	8.6	56	20.4	5.8	33	21.0	7.5	48
2001	21.1	8.5	55	20.2	5.9	28	20.7	7.5	45

Source: GoM, 2004

Health and Nutrition

Table 1.7 gives the district wise health and medical facilities available in Maharashtra. As of 2003, there were 38 medical colleges and 3446 hospitals with a total of 99062 beds. Life expectancy has increased from 64.8 years in 1991 to 65.4 years in 2001 (MSDR, 2005). Since majority of the tribal populace spread over the Sahyadri, Satpuda and Gondwan ranges, live isolated in remote forest areas, untouched by civilization, they do not benefit from the developmental processes of the State and remain backward, particularly in health, education and socio-economic aspects. The health status indicators of the tribal communities, vis-a-vis that of the State are given in Table 1.7a.

In terms of nutrition, about 57 per cent of the rural and 55 per cent of the urban households consumed lesser than the required 2,700 calories per day. Only 25 per cent of rural and 28 per cent of the urban households reported adequate calorie intake (GoM, 2002). Low level of food/calorie intake results in poor nutrition in women and children. Nearly half the married women between 15-49 years old suffer from anaemia. The incidence is higher, about 51 per cent, in rural Maharashtra compared to 45 per cent in urban Maharashtra. Among children 16 per cent below 2 years of age were severely undernourished, 41 per cent were moderately undernourished. It is reported that there is severe under and malnutrition among the tribal population and backward areas of the State(IIPS, 2000).

Table 1.7: District-wise Health Facilities in Maharashtra.

District	No. of Govt. Hospitals/PHCs/ Pvt Clinics	No. of Blood banks
Ahmednagar	240 Govt Hospitals	9
Akola	NA	7
Amravati	210 Govt Hospitals	8
Aurangabad	81 Govt Hospitals	36
Beed	17 Govt Hospitals	2
Bhandara	3 Govt Hospitals	1
Buldhana	1 Civil hospital, some Govt-run primary health centres (PHC's), sub-centres and dispensaries	NA
Chandrapur	3 Govt Hospitals	4
Dhule	1 Govt Hospitals	3
Gadchiroli	5 Govt., 10 Private hospitals	1
Gondia	1 Civil hospital, 9 Rural hospitals, 39 PHC's	NA
Hingoli	20 PHC's	NA
Jalgaon	45 Govt Hospitals	2
Jalna	3 Hospitals & 19 Blood banks	NA
Kolhapur	13 Rural hospitals, 66 PHC's, 29 Dispensaries	3
Latur	3 Govt hospitals, 11 PHCs, 9 Dispensaries	2
Mumbai	19 Hospitals, 52 PHC's, 8,100 Dispensaries, 455 Nursing homes	165
Nagpur	11 Govt hospitals &	8 Govt, 11 Private
Nanded	2 Govt hospitals	2
Nandurbar	14 Rural hospitals, 49 PHC's	NA
Nashik	7 Govt hospitals	8
Dharashiv	2 Govt, 24 Private hospitals	1
Parbhani	1 Govt, 2 Private hospitals	2
Pune	31 Govt hospitals	9 (Govt), 17 (Private)
Raigad	1 Govt. hospital	NA
Ratnagiri	4 Govt hospitals, 43 PHCs	2
Sangli	2 Hospitals	5
Satara	1 Gen Hosp, 10 Rural Hosp, 2 Cottage Hosp, 1 Ayurvedic Hosp, 69 PHCs, 309 sub-centres	3
Sindhudurg	3 Govt hospitals, 25 Private practitioners	1 (Public), 3 (Private)
Solapur	14 Hospitals, 66 PHCs, 32 Dispensaries, 1 Primary mobile unit	1
Thane	33 Hospitals, 22 PHC's	8
Wardha	11 Govt hospitals, 4 Private hospitals	5
Washim	1Govt hospital, 7 Rural hosp, 24 PHC's, 14 Dispensaries	NA
Yavatmal	7 Govt hospitals	3

Source: Compiled by IGIDR (2005)

Table 1.7a: Health Status Indicators of the Tribal Communities vis-à-vis the State

Indicators	Maharashtra	Tribal Communities
Infant Morality Rate	59	110
Crude Death Rate	7.9	13
Maternal Morality Rate	2	NA
Low Birth Weight (LBW) babies	28%	40%
Family Size	3.8	4.2
Delivered by Traditional Birth Attendant (TBA)	86%	12%

Source: Harvard, 2005

The GoM has initiated a programme to eradicate malnutrition, in Thane, Nandurbar, Amravati, Dhule and Gadchiroli districts, which and at a later stage, would be implemented in ten other districts. It will follow the Hon'ble Supreme Court of India's guidelines on diet, based on the age of the child (TIE, 2004 and 2005).

Education

Table 1.8 represents the growth in education institutions and enrolments in Maharashtra. The state operates two Universities at Mumbai, including one for women only, and one each at Nagpur, Pune, Aurangabad, Ahmednagar, Akola, Amravati and Kolhapur. In addition, there are three Agriculture Universities and several engineering and medical colleges. About 700 colleges affiliated with the Universities offer various degrees. As per the census 2001, the total number of literates is 64,566,781 in the state, in which 37,487,129 are males and 27,079,652 are females. Maharashtra's literacy rate exceeds the national average as the state provides free compulsory education for children between the ages of six and fourteen. As seen in table 1.9 the literacy rate of the state has increased by 12.4 per cent during 1991-2001, the increase in female literacy rate (15.2) is higher than that for males (9.7). The total literacy rate in the State has shown an upward trend. This has increased to 77.27 per cent in 2001 from 64.87 per cent in 1991. The literacy rate of people aged 7 years and above, increased from 73 per cent in 1999-2000 to 77 per cent in 2000-01, placing the State second in the country after Kerala with 91 per cent. This is also higher than the Indian average of 65 per cent. The adult literacy rate (15 years and above) was about 67 per cent in Maharashtra and 89 per cent in Kerala (GoM, 2004).

Table 1.8: Growth of Educational Institutions in Maharashtra

Year	Primary				Secondary (includes Higher Secondary)				Higher (All types)*	
	Institutions	Enrolments (In thousand)	Teachers (In thousand)	No. of students per teacher	Institutions	Enrolments (In thousand)	Teachers (In thousand)	No. of students per teacher	Institutions	Enrolments (In thousand)
2000-01	65,960	11,857	313	38	15,389	9,267	255	36	1528	1086
2001-02	65,960	11,837	315	38	16,917	9,864	267	37	1786	1035
2002-03	67,800	11,897	324	37	17,530	10,261	272	38	1878	1111

Source: GoM (2004); *-Medical, Engineering and Agricultural Institutes excluded

Table 1.9: Literacy Rate of Maharashtra (per cent)

	Rural		Urban		Total		Increase in Literacy Rates
Year	**1991**	**2001**	**1991**	**2001**	**1991**	**2001**	**1991-2001**
Male	69.71	81.9	86.4	91.0	76.5	86.2	9.7
Female	41.0	58.4	70.9	79.1	52.3	67.5	15.2
Total	**55.5**	**70.4**	**79.2**	**85.5**	**64.8**	**77.2**	**12.4**

Source: GoM (2004)

Poverty

The coexistence of prosperity and deprivation in the state is a matter of serious concern. A poverty line, which separates the poor and non-poor, has been derived by putting a price on the minimum required consumption levels of food, clothing, shelter and social needs like education and health. The national-level official poverty lines for the base year (1973-74) expressed as monthly per capita consumption expenditure of Rs.49.09 in rural areas and Rs.56.64 in urban areas correspond to a basket of goods and services, which satisfy the calorie norms of per capita daily requirement of 2400 Kcal in rural areas and 2100 Kcal in urban areas, which is medically enough, to prevent death.

In 2002-03, the per capita income of Maharashtra at current prices was Rs.26,291 ranking second to Haryana at Rs.26,632, which is higher than Indian average of Rs.19,040 (GoM, 2004). District wherein scheduled areas pertaining to tribal people exist are Thane, Pune, Nashik, Nandurbar, Dhule, Jalgaon, Ahmednagar, Nanded, Amravati, Yavatmal, Gadchiroli and Chandrapur. Given the scenario of relative prosperity in the state, the issue of widespread tribal poverty cannot be dismissed (MSDR, 2005).

Housing

Table 1.10 gives the classification of various housing structures in urban and rural areas of the state vis-à-vis those in the country and indicates that housing conditions and amenities differ in urban areas of Maharashtra and urban India.

Table 1.10: Distribution of Households in India & Maharashtra (Per cent)

	Urban Households			Rural Households		
	Pucca	Semi-Pucca	Kutcha	Pucca	Semi-Pucca	Kutcha
India	75.2	17.4	7.4	38.4	31.6	30.0
Maharashtra	75.5	19.7	4.7	39.7	44.4	15.9

Source: GoI (2002: b)

Table 1.11 compares housing and related amenities in urban Maharashtra and urban India. It shows that almost 80 per cent of all housing facilities in urban Maharashtra and 77 per cent in urban India were used only for residential purposes. Nearly two-thirds of the households considered their houses to be in good condition and almost a third thought that they were in a liveable condition in both urban and rural locations. Only three per cent of the households stated that they considered their houses to be in a dilapidated state. This undoubtedly reveals that the poor state of housing in the country in general, makes most households accept whatever shelter they have. Compared to households in urban India, a smaller share of households in urban Maharashtra, were likely to use "non-permanent" materials for their dwellings. Nearly 47 per cent of the households in urban Maharashtra compared to 35 per cent in urban India were housed in one-room tenements. The share of two-roomed tenements was marginally higher in urban India.

Table 1.12 and Figure 1.2 give the classification of houses in the state based on their conditions. As can be seen from the latter, around 50 per cent of the houses in Maharashtra are in good condition.

Table 1.11: Housing and Amenities in Urban Maharashtra and Urban India (Per cent)

Characteristic of Housing/Amenity	Urban Maharashtra	Urban India
Housing		
1. Purpose for which the Housing Unit was used		
Residential	79.3	77.3
Residential cum other use	2.1	2.8
2. Condition of the Housed used as Residences		
Liveable	34.2	32.2
Dilapidated	3.0	3.7
3. Households living in Houses with		
a) Material of the Roof		
i) Grass, bamboo etc.	2.2	7.0
ii) Plastic, Polythene etc.	1.2	0.8
b) Material of the Wall		
i) Grass, bamboo etc.	2.1	3.9
ii) Plastic, Polythene etc.	0.8	0.4
iii) Mud, unburnt bricks	12.6	12.8
iv) Wood	1.6	0.9
c) Material of the Floor		
i) Mud	13.9	13.9
ii) Wood/bamboo	0.2	0.4
4. Type of Structure in which Households lived.		
Permanent	81.6	79.2
Rest	18.4	20.8
5. Number of Rooms in which Households lived.		
i) No Exclusive Room	3.9	2.3
ii) One Room	46.7	35.1
iii) Two Rooms	26.9	29.5
6. Number of Rooms by Nature of Ownership		
Owned	67.2	66.8
i) No Exclusive Room	3.5	2.0
ii) One room	41.3	29.2
iii) Two Rooms	27.9	29.3
Rented	28.5	28.5
i) No Exclusive Room	4.3	2.8
ii) One room	57.6	46.9
iii) Two Rooms	25.4	30.4
Other	4.3	4.7
i) No Exclusive Room	6.6	3.7
ii) One room	58.3	46.8
iii) Two Rooms	20.8	28.1
Amenities		
1. Water supply		
All Sources		
i) Tap	89.2	66.7
ii) Hand Pump	4.5	16.2
Within Premises		
i) Tap	49.7	94.4
ii) Hand Pump	8.3	1.7
Near Premises		
i) Tap	80.3	59.7
ii) Hand Pump	10.9	23.3
Away from Premises		
i) Tap	54.7	41.7
ii) Hand Pump	15.9	22.3
2. Source of Lighting		
i) Electricity	94.3	87.6
ii) Kerosene	5.1	11.6
3. Bathroom within Premises	81.5	70.4
4. Latrine/ Drainage		
No Latrine	41.9	26.3
No Drainage	12.4	22.1
5. Households without separate kitchen	17.6	24.1
6. Fuel Used for Cooking		
i) Firewood	9.9	22.7
ii) Crop Residue	1.2	2.1
iii) Cow-dung cakes	0.3	2.0
iv) Coal/Charcoal	0.5	4.6
v) Kerosene	30.0	19.2
vi) LPG	57.0	48.0

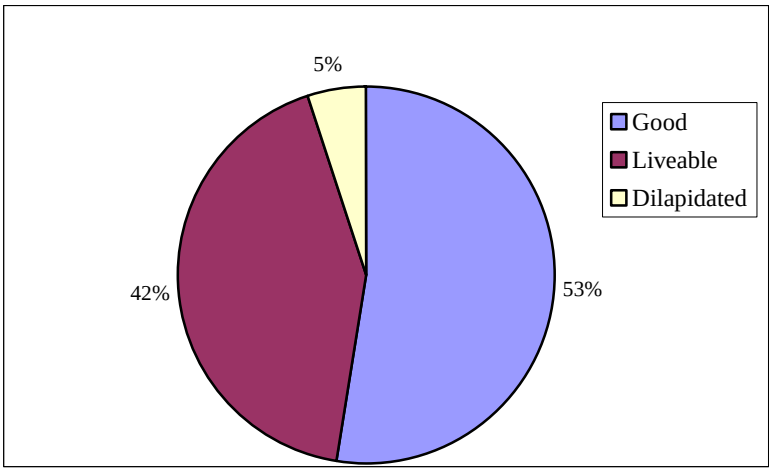
Source: Registrar General of India (2001:c)

Table 1.12: Condition of Houses used as Residence or Residence-Cum-Other Use in Maharashtra

Condition of houses	Rural	%	Urban	%	Total	%
Good	4,907,931	45.3	4,987,367	62.6	9,895,298	52.6
Liveable	5,246,567	48.4	2,734,716	34.3	7,981,283	42.4
Dilapidated	689,279	6.4	242,438	3.0	931,717	5.0
Total	10,843,777	100.0	7,964,521	100.0	18,808,298	100.0

Source: Census 2001.

Figure 1.2: Condition of Houses in Maharashtra



Source: Census 2001

Proliferation of Slums

Rapid growth of slums and squatter colonies in large cities show the apathy of the urban elite to the living conditions of the poor. When conditions of housing are generally poor as in India, slums are difficult to define and identify. Generally, they are defined with reference to the environmental and structural deficiencies. However, these definitions and estimates of the slum population differ among the agencies collecting such data. In 2001 Census, slum areas were defined as follows:

a) All areas notified as "slums" by State/Local government and Union Territory (UT) under any Act;
b) All areas recognised as "slums" by State/Local and UT administration which had not been formally notified as "slums" under any Act;
c) A compact area of at least 300 persons or about 60-70 households of poorly built congested tenements, in unhygienic environment usually with inadequate infrastructure and lacking in proper sanitary and drinking water facilities.

Based on this definition, the number of slums was highest in Maharashtra (32 per cent), followed by West Bengal (16 per cent) and Andhra Pradesh (15 per cent). Table 1.13 shows that share of urban slum population has been decreasing for India for the past 20 years, while it has remained constant for Maharashtra over the same period. Condition of Urban Slums, NSS Report No. 486, 58th Round (July 2002-December 2002) shows that among the notified slums 24 per cent are private and 75 per cent are public. Whereas among the non-notified ones 44 per cent are private and 56 per cent are public.

Table 1.13: Comparison of Slum Population of Maharashtra with India (in Lakhs)

States/Uts	1981			1991			2001		
	Urban	Slum	Per cent	Urban	Slum	Per cent	Urban	Slum	Per cent
India	66.9	46.0	27.5	237.7	65.0	27.3	325.6	88.5	27.2
Maharashtra	14.5	2.6	18.0	19.8	3.6	18.0	30.7	5.5	18.0

Source: GoI (2001)

About 10.5 million persons lived in slums in 62 out of the 65 urban units in Maharashtra in the year 2001. Three urban units namely, Cantonment Boards of Pune and Kirkee and Karad Municipal Council did not report slums. The size of slum population in 30 cities is reported in table 1.14. Nearly 93.4 per cent of the slum dwellers in 62 urban units in Maharashtra lived in these 30 cities, of which almost 55 per cent of lived in Greater Mumbai alone. Nagpur had the second largest number but they formed barely 7 per cent of the total in the state. Together, six of the 7 million-plus cities accounted for nearly 73 per cent of the slum population living in the 62 cities of Maharashtra.

Slum dwellers in the State are mainly concentrated in Mumbai, their share in the city's population of 11.9 million was alarmingly high, nearly 49 per cent. The corresponding share in a small city like Kamptee, with barely 84 thousand dwellers in 2001, was enormous, nearly 94 per cent. In 14 of the 30 cities, the share of slum population in the city's population was higher than the state average of 31.5 per cent. Of these 5 were Class I cities of which, three were million-plus cities of Mumbai, Nagpur and Thane and 2 municipal councils of Yavatmal and Gondia with more than 120 thousand residents in 2001. Four were Class II cities with a population between 50 and 99 thousand, three had a population between 20 and 49 thousand while two had less than 20 thousand residents. The share of slum population in the city's population was the lowest, 11.4 per cent in Ulhasnagar. Despite being million-plus cities, in both Pimpri Chinchwad and Nashik, barely 13 per cent of the city dwellers resided in slums in 2001, reflecting relatively better housing conditions than other million-plus cities.

Being the richest district in the State, on the basis of per capita income, Mumbai has always attracted migrants from the rest of Maharashtra and other states in India. Though this growth of population was always accompanied by an increase in the real per capita incomes in this prosperous city, the supply of formal housing failed to increase along with the population. Scarcity of land in relation to the growing demand for it resulted in the skyrocketing prices of land over time. Legal interventions, especially the Rent Control Act 1948 and Urban Land (Ceiling and Regulation) Act 1976, further distorted Mumbai's land market. The city was unable to provide affordable housing to the poor who migrated to Mumbai for sheer survival, thereby forcing many migrants to squat on open lands owned by private individuals and local, State and Central governments. This was the main cause of proliferation of slums in the city (GoM, 1998).

Census 2001 data indicates that the process of migration and slum formation has now spread to Nagpur, Thane and Pune though the problem is not very severe. Nashik and Pimpri-Chinchwad also had fewer slum dwellers, suggesting that the poor could probably still afford formal housing in these cities. A bigger share of slum population in medium sized cities like Kamptee, Achalpur, Ballarpur and Bhandara and smaller cities like Malegaon, Amravati and Akola suggest poor housing conditions in these cities and inability to cope with the growing population.

Table 1.14 indicates the share of slum population in the total population for some cities in Maharashtra for the year 2001. Division-wise percentage of slum population is reported as 47.0 for Amravati, 28.7 for Aurangabad, 54.9 for Konkan, 36.0 for Nagpur, 19 for Nashik and 32.5 for Pune. Further, the total slum population for all Class I cities of Maharashtra is 44.1 per cent (AIILSG, 2003).

Table 1.14: Share of Population in Slums for Some Cities of Maharashtra in 2001

City	Slum Population	Total Population	Share in Population of the City (per cent)
Achalpur	66,790	1,07,304	0.6
Akola	1,35,009	3,99,978	1.3
Ambernath	64,195	2,03,795	0.6
Amravati	2,32,619	5,49,370	2.2
Aurangabad	1,36,276	8,72,667	1.3
Ballarpur	49,298	89,995	0.5
Beed	74,283	1,38,091	0.7
Bhandara	46,271	85,034	0.4
Bhiwandi	1,11,304	5,98,703	1.0
Chandrapur	50,795	2,97,612	0.5
Dhule	92,718	3,41,473	0.9
Gondia	38,942	1,20,878	0.4
Greater Mumbai	5,823,510	11,914,398	54.6
Jalgaon	62,696	3,68,579	0.6
Jalna	56,157	2,35,529	0.5
Kamptee	78,854	84,340	0.7
Kolhapur	67,462	4,85,183	0.6
Latur	71,040	2,99,828	0.7
Malegaon	2,12,577	4,09,190	2.0
Nagpur	7,26,664	2,051,320	6.8
Nanded-Waghala	82,715	4,30,598	0.8
Nashik	1,42,234	1,076,967	1.3
Navi Mumbai	1,38,621	7,03,947	1.3
Parbhani	76,324	2,59,170	0.7
Pimpri Chinchwad	1,29,357	1,006,417	1.2
Pune	5,31,337	2,540,069	5.0
Solapur	2,31,420	8,73,037	2.2
Thane	4,20,276	1,261,517	3.9
Ulhasnagar	53,717	4,72,943	0.5
Yavatmal	43,232	1,22,906	0.4

Source: GoI (2001)

Housing Initiatives

There are some exemplary inititiatives by various government authorities and Urban Local Bodies (ULBs) to improve the housing infrastructure in the state. In this regard, the efforts of CIDCO in Aurangabad and Navi Mumbai are commendable. In Aurangabad, housing development is done systematically in the CIDCO area, whereas in the rest of the city it is haphazard, flouting the standard rules and regulations and therefore most of these areas are still termed as slums although they have good, pucca houses. Under the Gunthewari Scheme for housing, the Aurangabad Municipal Corporation (AuMC) proposed 600 projects, of which 60 are completed and Rs 30,000 was collected as development, administrative and other charges (AuMC 2004). The slum

redevelopment scheme initiated in Brihanmumbai is also an excellent example, which needs to be accelerated. In Navi Mumbai, out of 1,75,000 housing units, 1,10,646 units are built by CIDCO and 6,800 tenements are under construction. About 65 per cent of households are on ownership basis.

Urbanisation

The Census fugures for over last fifty years indicate that a large share of Maharashtra's population, compared to that of India, lived in urban areas. In 1961, barely 17.8 per cent of India's population and 28.2 per cent of that of the state lived in urban locations. Till 1991, Maharashtra was the most urbanised state among the 16 large states of India. In 2001, 27.8 per cent of India's and 42.4 per cent of Maharashtra's population was enumerated as urban, thus, showing an increase in the level of urbanisation for the state and the country. The urban population increased at 2.6 per cent a year and improved its share in the total, by merely 2 per cent, from 25.5 per cent to 27.2 per cent between 1991 and 2001. These urban dwellers lived in 5161 cities/towns and were estimated at 285 million. The urban population reported for 5151 cities/towns is 279.84 million. The population living in urban India is indeed large, considering that 281.4 million lived in USA in 2000 (Census, 2001).

In terms of the urban population, Maharashtra ranked second in the country with a share of 42.4 per cent, next to Tamil Nadu with a share of 43.9 per cent. Yet in absolute terms, Maharashtra's 41 million of urban population far exceeded Tamil Nadu's 27 million. These two states are closer to the World, with regard to the extent of urbanisation, than to India. In the year 2001, growing at 1.9 per cent per annum compound over the 1990s, India crossed the one billion mark and enumerated 1027 million persons. Thus, almost 17 per cent or one sixth of the global population lived in India. Maharashtra's total population grew at 2.0 per cent a year compound over the 1990s, while the urban population grew much faster at 2.9 per cent a year compound. The total population in the State increased by almost 19 million, from 78 million in 1991 to 97 million in 2001; around 10.5 million of this increase was in urban Maharashtra (Census 2001). The cities with million-plus population and their ranking are given in table 1.15.

Table 1.15: Urban Agglomerations/ Cities with Million-Plus Population

Rank in 2001	Cities	Population 2001		
		Persons	Males	Females
1	Greater Mumbai	16,368,084	8,979,172	7,388,912
8	Pune	3,755,525	1,980,941	1,774,584
13	Nagpur	2,122,965	1,097,723	1,025,242
26	Nashik	1,152,048	6,19,962	5,32,086

Source: Census, 2001

Patterns of Urbanisation

Barring the 1990s, since 1961, the number of urban units/settlements grew faster in India than in Maharashtra. Between 1961 and 2001, the share of settlements in the country as a whole, declined from 10 per cent to 7.3 per cent, however, Maharashtra retained its share of a little over 14 per cent in the total urban population in India (Table 1.16).

Table 1.16: Urban Units, Urban Population and their Annual Rates of Growth (1961-2001)

Year	Maharashtra		India	
	Number of Urban Units	Population In millions.	Number of Urban Units	Population In millions.
1961	266	11.2	2657	78.3
1971	289	15.7	3081	108.3
1981	307	22.0	3971	158.2
1991	336	30.5	4615	215.7
2001	378	41.1	5161	285.4
Rates of Growth (compound rates per annum)				
1961-71	0.8	3.4	1.5	3.2
1971-81	0.6	3.4	2.5	3.8
1981-91	0.9	3.3	1.5	3.1
1991-2001	1.2	2.9	1.1	2.8

Source: GoI (2001)

Till 1981, there were 26 districts in Maharashtra, which increased to 30 in 1991 and further to 35 in 2001. This increase in number of districts in the 1990s was due to bifurcation of the existing districts in the State. Data relating to levels of urbanisation in these 35 districts for the last three decades (1981-2001) indicates that Mumbai and Mumbai Suburban were fully urbanised districts during this period. Gadchiroli, with an urban population of 2.43 and 6.93 per cent in 1981 and 2001, respectively and Sindhudurg with that of 7.59 per cent in 1991 are the least urbanised ditricts of Maharashtra (MSDR, 2005).

Economic Profile

During 2003-04, the per capita National Income at current prices was Rs 20,989 whereas the per capita State Income was Rs 29,204. This higher per capita State Income was attributed to the predominance of the manufacturing and tertiary sector in the State. At constant (1993-94) prices, the National Income increased by 9 per cent while that State Income increased by 7.3 per cent over that of 2002-2003. Maharashtra contributes about 20 per cent to the country's industrial output and about 13 percent to India's GDP. The State's per capita income at current prices, of Rs. 26,291 in 2002-03 makes it the second richest state in India after Haryana (GoM, 2005).

The sectoral composition of the State Income has undergone considerable changes during 1960-61 to 2003-04. During this period the share of the primary sector has declined from 34.4 per cent to 13.4 per cent while that of the secondary sector has remained more or less constant at about 26 per cent; however, the share of tertiary sector has increased from 39.9 per cent to 60.8 per cent. For the year 1993-94 (which is base year for current national account series), however, the corresponding shares were 21.2 per cent, 31.2 per cent and 47.6 per cent, respectively. As per preliminary estimates, the GSDP of Maharashtra, at constant (1993-94) prices, is estimated at Rs. 1,90,151 crore during 2003-04, as against Rs. 1,77,138 crore in 2002-03, showing an increase of 7.3 per cent. The corresponding growth rate for all India was 8.5 per cent. The growth rates recorded for 2003-2004 were estimated as 5.5, 11.7 and 8.6 per cent for the primary, secondary and tertiary

sectors respectively (GoM, 2005). However, its fiscal situation does not reflect its relative income position. As a per cent of GSDP, its revenue deficit, fiscal deficit and debt stood at 2.7, 5.5 and 23.4, respectively, in 2003-04. Deteriorating revenue mobilisation and rising unproductive expenditure is responsible for this growing revenue and fiscal deficit. The most growing concern however, is that of indebtness of the State Government, which is expected to rise at a record level of Rs 1,10,211 crore in 2004-05 (GoM, 2005)

Growth of Economy

In the 10th Five Year Plan (2002-07), Maharashtra has set for itself a GDP growth rate of eight per cent through accelerated economic (infra-structural) development, with more private initiative in all possible sectors, ensuring high-speed industrial development and creating large-scale employment. Having experienced the growth rate of 8.9 per cent during the 8th Plan (1992-97), the target set for 10th Plan seems quite achievable but deceleration of the growth rate to 4.7 per cent per annum during the 9th Plan (1997-2002) and the deterioration in the fiscal situation of the state makes the task quite daunting. It may also be relevant to see the inter-state comparison of the growth rates during the last two Five Year Plans as indicated in Table 1.17. During the period from 1985-86 to 2000-01, while Maharashtra's economy grew at 7.3 per cent, Indonesia recorded a growth rate of 7.1 per cent, Malaysia 7.3 per cent, Singapore 7.8 per cent, Taiwan 8.0 per cent, Thailand 8.7 per cent and South Korea 8.7 per cent.

Sectoral Growth

Historically, economic development of the countries of the First World was accompanied by shifts in the shares of primary, secondary and tertiary sectors in their income and employment. The models incorporating the changes acquired prescriptive significance, though the historical experience was specific to the time and location. Development of East and South East Asia has been accompanied by the growth of tertiary sector ahead of the secondary sector. Globalisation and new technology have made predictions difficult; Maharashtra's experience in the last two decades suggests that the State may follow the East Asian rather than the Western path of sectoral change.

Table 1.17: Growth rates in SDP in the 8th and 9th Plans and those targeted in the 10th Plan (% per annum)

Major States	8th Plan 1992-97	9th Plan 1997-02	10th Plan (Targets) 2002-07
Andhra Pradesh	5.4	4.6	6.8
Assam	2.8	2.1	6.2
Bihar	2.2	4.0	6.2
Gujarat	12.4	4.0	10.2
Haryana	5.2	4.1	7.9
Himachal Pradesh	6.5	5.9	8.9
Karnataka	6.2	7.2	10.1
Kerala	6.5	5.7	6.5
Madhya Pradesh	6.3	4.0	7.0
Maharashtra	**8.9**	**4.7**	**7.4**
Orissa	2.1	5.1	6.2
Punjab	4.7	4.4	6.4
Rajasthan	7.5	3.5	8.3
Tamil Nadu	7.0	6.3	8.0
Uttar Pradesh	4.9	4.0	7.6
West Bengal	6.3	6.9	8.8

Source: GoI, 2002

The trend in growth rate of GSDP, at constant prices is given Table 1.18. The share of the primary sector in Maharashtra's income decreased from 28 per cent in 1980-81 to 17 per cent in 1999-00. The share of the secondary sector remained around 32-33 per cent, and that of the tertiary sector increased from about 40 per cent to 50 per cent (GoM, 2003). The output of the primary secondary and tertiary sectors increased at three, six and seven per cent per annum respectively (Table 1.19).

Table 1.18: Trends in Rates of Growth in Gross State Domestic Product at Constant Prices (% per annum)

State	Gross State Domestic Product (GSDP)		GSDP Per Capita	
	1980-81 to 1990-91	1993-94 to 1998-99	1980-81 to 1990-91	1993-94 to 1998-99
Karnataka	5.4	8.2	3.3	6.4
Gujarat	5.1	8.0	3.0	6.2
Tamil Nadu	5.4	6.8	3.9	5.8
Maharashtra	**6.0**	**7.1**	**3.6**	**5.4**
Rajasthan	5.9	7.7	3.8	5.3
West Bengal	4.8	6.8	2.6	5.0
All-India	**5.6**	**6.8**	**3.3**	**4.8**
Kerala	3.2	5.5	1.7	4.2
Himachal Pradesh	5.0	6.7	3.1	3.9
Haryana	6.2	5.8	3.9	3.6
Andhra Pradesh	4.3	4.9	2.1	3.5
Punjab	5.4	5.0	3.5	3.0
Orissa	5.0	4.3	3.1	2.9
Bihar	4.7	4.2	2.5	2.6
Madhya Pradesh	4.0	4.4	2.1	2.3
Uttar Pradesh	4.9	4.5	2.5	2.3
Assam	3.6	2.7	1.4	1.0

Source: GoI, 2002

Table 1.19: Growth in SDP at Factor Cost by Sector: 1980-81 to 1999-2000

Sectors	Share in SDP, Percentage			Growth, Percentage per annum		
	1980-1981	1990-1991	1999-2000	1981-1990	1990-2000	1999-2000
Primary	27.7	22.9	17.4	3.1	3.8	2.7
Secondary	32.6	32.9	32.1	5.9	6.3	5.1
Tertiary	39.8	44.2	50.5	6.4	7.6	5.8
Net State Domestic Product (NSDP)	100	100	100	5.4	6.4	4.7
Per capita SDP	-	-	-	3.1	4.6	2.4

Source: GoM, 2002

Export Potential

The State's share in the country's exports is estimated at 35 per cent. In 2000-2001, Maharashtra exported goods worth Rs. 506.27 billion, comprising largely of engineering, chemicals, apparels, leather and leather products, electronics and gems and jewellery. In Maharashtra, 562 Export-Oriented Units (EOUs) with an investment worth Rs. 75 billion were set up between 1991 and 2001. Maharashtra is one of the largest producers of mangoes, grapes and onions. The export promotion drive would have to be synchronised with the State's changing crop pattern in agriculture towards horticulture, floriculture, animal husbandry and food processing (MEDC, 2002).

Special Economic Zone (SEZ)

Maharashtra has been among leading states in attracting foreign direct investment (FDI). In 2001, the GoI has introduced the concept of Special Economic Zones (SEZs) through a revision in the Export-Import (Exim) Policy 1997-2002 to create a simple and transparent system and streamline the procedures for enhancing productivity and business. There are specifically delineated duty-free enclaves treated as foreign territory for the purpose of industrial, service and trade operations, with exemption from custom duties and a more liberal regime in respect of other levies, foreign investment and other transactions. Thus, the developers of SEZs, and industrial units and other establishments within the SEZs are exempted from all State and local taxes and levies, including Sales Tax, Purchase Tax, Octroi, Cess, etc. in respect of all transactions made between units/establishments within the SEZs, and in respect of the supply of goods and services from the domestic tariff area to units/establishments.

The SEZs as industrial townships are empowered by the state government to function as self-governing, autonomous municipal bodies. The powers of the Labour Commissioner, GoM, are delegated to the designated Development Commissioner or any other such authority in respect of the area within the SEZs. Domestic regulations, restrictions and infrastructure inadequacies are thus eliminated in the SEZs thereby creating a business-friendly environment. The SEZ authority ensures the provision of adequate water and power supply to these zones. The public sector enterprise(s) or joint ventures promoted by the GoI, can establish 'Independent Power Producers' (IPPs) and are permitted to establish dedicated provision of power to the these zones, including generation, transmission and distribution, besides fixing tariffs for the zone.

The Santacruz Electronics & Export Processing Zone (SEEPZ), Mumbai, has already been converted into a SEZ. The GoM has taken the lead to develop the SEZs near Navi Mumbai and has also decided to apply the GoI framework to the proposed SEZs at Navi Mumbai (Dronagiri), Aurangabad, Nagpur, Sinnar (Dist. Nashik), Kagal (Dist.Kolhapur), Guhagar (Dist.Ratnagiri) etc. In Maharashtra, the no objection certificates (NOC's), consents and other clearances for the units and activities within the state's SEZs, are granted by the empowered officer of the Maharashtra Pollution Control Board (MPCB) working under the administrative supervision and control of the designated Development Commissioner. Modalities are devised for the grant of various permissions required from the Directorate of Industrial Safety & Health and the Directorate of Steam Boilers within the SEZs themselves through the stationing of exclusive personnel for the purpose or through other means, so that clearances relating to various labour laws can be provided at a single point in the SEZs. The activities / projects, which fall within the ambit of the Environmental Impact Assessment Notification, 1994 need to obtain clearance from the Ministry of Environment and Forests (MoEF), GoI.

Infrastructure Sector

Growth of an economy is highly dependent on the adequacy and quality of infrastructure provided within the economy. Inadequate provision or poor quality of infrastructure by the public sector in most of the States in India is mainly due to lack of funds as priority for allocation of funds goes to development of social sector, which is the main responsibility of the states.

Modes of Transport

Transportation in Maharashtra is dominated by road and rail transport. Mumbai, the commercial capital of India, is relatively less transport energy-intensive in comparison to the other metropolitan cities, because of its well-developed rail network. The passenger transportation sector in Mumbai has a high share of public transport (rail and bus) and low share of private transport (cars and two-wheelers) relative to other urban centres in India. It is interesting to note that Mumbai is the only city in India where the share of passenger rail transport is equal to that of road transport. The road-based public sector undertaking, the Bombay Electric Supply and Transport Undertaking (BEST), operates passenger transport system without a subsidy from the government. It is felt that, with its well-developed transport network, Mumbai has good system. Maharashtra has 2408 vehicles per 100 square kilometres and 7653 vehicles per lakh of population during 2001-02, as per the data compiled from Maharashtra State Transport Information (MSTI, 2002). Upto the year 2001-02 in Maharashtra the length of national highways is 4176 kms and that of railway lines is 5459 kms. Table 1.20 gives the different modes of transport facilities in the state.

Road Development

Road network is one of the major infrastructural features for the growth of any region. Roads not only enable the masses to use the public road transport at economical prices but also help in smoothening inter-regional disparities in availability of goods, and hence, reduce dispersion of prices across regions. Development of a network of national highways is crucial to the development of a state. National highways provide connectivity to the states with other trading centres and ports of the country and constitute the first tier of road development plan (in a multimode transport system).

Table 1.20: Modes of Transport in Maharashtra

Road	**National highways**	4,176 km
	State highways	33,400 km
	Other Roads	1,80,000 km
	Bus routes	Daily buses from Mumbai to Bangalore, Aurangabad, Bijapur, Hyderabad, Indore, Kolhapur, Mahabaleshwar, Mangalore, Nashik, Pune, Ujjain and to all the districts of Maharashtra
Air	**Major airports**	Mumbai, Nagpur, Pune, Aurangabad, Nashik, Kolhapur
	Daily flights	To Aurangabad, Ahmedabad, Bhopal, Kolkata, Delhi, Jaipur, Jodhpur, Kolhapur, Chennai, Pune, Udaipur, Nagpur
Water	**Major ports**	Jawaharlal Nehru Port (Uran, outside Mumbai) and the Mumbai Port; 48 other minor ports
Rail	**Major junctions**	Mumbai, Kalyan, Pune, Miraj, Nagpur, Manmad, Jalgaon
	Major stations	Nashik, Kolhapur, Aurangabad, Wardha, Sangli, Solapur
	Daily trains	To Agra, Ahmedabad, Aurangabad, Bangalore, Bhopal, Kolkata, Calicut, Coimbatore, Delhi, Goa, Hyderabad, Indore, Jaipur, Kochi, Kolhapur, Chennai, Mangalore, Nagpur, Nashik, Pune, Thiruvananthapuram, Udaipur, Ujjain and Varanasi.

Source: MTSM (2002)

In December 1998, the Prime Minister's Taskforce approved the National Highways Development Project (NHDP). The Golden Quadrilateral (GQ), one of the components of NHDP, aims at connecting Mumbai, Delhi, Kolkata and Chennai. It involves construction of a road length of about 5846 kms. In February 2002, except for Allahabad Bypass, civil contracts were awarded for various parts of the GQ. Earlier a substantial part of the project was to be completed by the end of year 2004, which has now been advanced to the end of 2005. Along with this, the North-South (NS) corridor, connecting Srinagar to Kanyakumari and East-West (EW) Corridor, connecting Silchar to Porbandar, are also part of the NHDP. Four major sources of financing that have been identified for GQ and corridor projects are Imposition of cess on petrol, External assistance, Market borrowing and Contribution of private sector. The total estimated cost of the project is about Rs. 58,000 crores. The contribution of these four financing sources is expected to be approximately 34, 34, 21 and 10 per cent, respectively, of the total estimated project cost.

The National Highways passing through Maharashtra account for just about 6.2 per cent of the total length of these highways in the country. A large 'interior' triangular area in Maharashtra, bound by Dhule, Nagpur and Dharashiv, still remains uncovered by the national highway network. Maharashtra and Gujarat account for around 8.3 to 8.4 per cent of proposed laning under GQ. This is lower in comparison to the shares of Andhra Pradesh, Karnataka, Tamil Nadu, Rajasthan and Uttar Pradesh, which range between 10.7 and 17.4 per cent. Maharashtra accounts for just six per cent of the proposed laning of NS corridor while its main beneficiaries will be Andhra Pradesh, Jammu & Kashmir, Madhya Pradesh and Tamil Nadu. On the other hand, the EW corridor does not cover Maharashtra at all; its direct benefits will accrue mainly to Assam, Bihar, Gujarat, Rajasthan, Uttar Pradesh and West Bengal. The total share of Maharashtra in laning of both the corridors is just about 3.2 per cent, which is much lower than that for many other major states of India. In order to exploit the full connectivity potential of this minor share in four/six laning of national highways, Maharashtra will have to construct roads through its own initiatives to access the GQ and the NS corridor. NHDP will also help the state in providing connectivity to about 44 of its ports (NHDA, 2003).

The Pradhan Mantri Gram Sadak Yojana (PMGSY) was launched in December 2000. This scheme is dedicated solely to the construction of rural roads and aims at closing the gap between 'Urban India' and 'Rural Bharat'. The nodal agency for implementing the project in Maharashtra is the Ministry of Rural Development. The targets were to connect every unconnected habitation with a population of over 1000 persons through good, all-weather roads by the year 2003. Habitations with a population of more than 500 persons are to be connected by the end of the 10^{th} Plan, *i.e.*, by the year 2007. All habitations in the Hill states, Desert and Tribal areas (with a population of more than 250) are also to be provided connectivity through this scheme (PMGSY, 2003). Maharashtra accounts for about 6.3 per cent of the total habitations of the country. The state accounts for about 9.1 per cent of connected and 2.5 per cent of unconnected habitations of the country. In other words, rural road network in Maharashtra seems to be better as compared to other states. Table 1.21, indicates the share of Maharashtra in the PMGSY.

Table 1.21: Maharashtra's share in PMGSY (Per cent of All India Total)

Maharashtra's Share in PMGSY	Population				
	1000+	500-999	250-499	Below 250	Total
Habitations	7.8	6.1	5.0	6.1	6.3
Connected Habitations	10.7	9.9	7.1	8.0	9.1
Unconnected Habitations	0.9	1.0	2.6	4.4	2.5
Habitations covered under PMGSY Phase I (2000-01)	4.5	1.8	2.5	0.3	2.3
Habitations covered under PMGSY Phase II (2001-02)	4.8	9.9	1.1	0.1	5.4
Habitations to be covered under PMGSY Phase III (2003-04)	2.3	1.5	0.7	2.5	2.1

Source: GoI (2003:f)

The city of Mumbai has attracted migrants from all over the country and has emerged as a hub of industrial, commercial, entertainment and financial activity. About 2.49 million people have migrated to Mumbai between 1991-2001 (Census, 2001). There has been a phenomenal increase in the number of mechanical vehicles in the state over the years. Inadequacy of roads due to disproportionate growth between the number of vehicles and the growth of road length also has resulted in poor quality of roads in the state. The road length on the eve of the formation of the state was just 39,242 kms. At the end of March 2003, the road length in the state increased to 2.25 lakh kms, of which 1.65 per cent (3,710 kms) was National Highway (NH), 14.98 per cent (33,705 kms) State Highway (SH), 21.4 per cent (48,192 kms) Major District Roads (MDRs), 19.64 per cent (44,183 kms) Other District Roads (ODRs), and the rest 42.30 per cent (9,150 kms) Village Roads (VRs). At the end of March 2003, the road length per 100 sq. kms of geographical area in the state was 87.40 kms (provisional). As per the 1991 Census, the road availability per lakh of population was 277 kms. At the end of March 2003, out of 40412 inhabited villages in Maharashtra, 93 per cent were connected with all-weather roads and 4.77 per cent by fair weather roads. The remaining 2.23 villages (31 per cent in tribal and 69 per cent in non-tribal areas) did not have any road connectivity whatsoever.

Ports and Inland Water Transport

Maharashtra has a coastline of about 720 kms, which is about 10 per cent of the total coastline of the country. Out of 12 major ports in India, 2 belong to Maharashtra, *viz.*, and Mumbai Port Trust (MbPT) and Nhava-Sheva port. The state also has 48 minor ports, which fall into 5 groups, *viz.*, Bandra group (9 ports), Mora group (11 ports), Rajpuri Group (9 ports), Ratnagiri group (11 ports) and Vengurla group (8 ports). In order to provide the multi-user port facilities, the state government has decided to develop 7 of these minor ports, *viz.*, Rewas-Aware, Dighi, Raigad, Anjanwel (Dabhol), Alewadi, Ganeshgule, Vijaydurga, and Redi. Of these, development of the first three ports is in progress, whereas, the remaining ones are yet to be developed. Development of major ports comes under the jurisdiction of the Central Government, while that of, minor ports under the state list.

As per the Port Policy of GoM (Nalinakshan, 2002), development of the minor ports is to take place through Public Sector Participation (PSP) on the Build Own Operate and Transfer (BOOT) basis. These ports are to be developed for multiple uses, such as, for handling all types of cargo like, bulk and break bulk and hazardous cargo like petroleum and chemicals and for handling all types of equipments like containers etc. All property of the GoM in the port (to be taken up for development) is to be transferred on lease to the developer company, who also is to be exempted from payment of registration fee and stamp duty. The concession period is 50 years, including 5

years as the construction period. The state government can have equity participation of tonne the order of about 11 per cent. In order to operationalise these projects, Maharashtra Maritime Board (MMB) was established in 1996 to act as a nodal agency. The GoM decides the passenger tariffs and at present, levies a sum of Rs.3.00 per tonne of cargo handled by the port. This tariff can be increased up to 5 years, but at the end of 5 years it should not exceed twice the amount of the existing tariff. The developer is to be accorded full freedom to decide tariff rates for the various services provided at the port and is also expected to develop facilities required for passenger water transport.

A co-ordination committee comprising of officers from the concerned government departments under the Chairmanship of the Chief Executive Officer (CEO) of MMB, is to provide a single-window clearance to the investors. The investors will have to raise the required finance, develop the port, provide all services and manage the port as per the agreement entered with the GoM. They also will be responsible for the construction of roads within the port boundary and conservation of the port. However, the cost of construction of the approach roads and their maintenance are to be shared equally by the government and the investors. Table 1.22 summarises the cargo handled at various groups of minor ports in Maharashtra. The Bandra group basically handles coal and machinery and the Mora group, which accounts for almost 70 per cent of cargo of minor ports of Maharashtra, primarily handles minerals and iron in various forms. While the Rajapuri ports handle iron in various forms, the Ratnagiri port handles a diverse basket of commodities and Vengurla primarily caters to molasses cargo. With the development of Sindhudurg district as a tourist resort, it is quite likely that minor ports could also be used for transporting consumption goods.

Table 1.22: Cargo handled at minor ports in Maharashtra (2001-02)

Group of Minor Ports	Cargo handled in (MT)	(Per cent of Total)
Bandra group	3,50,058	7.6
Mora group	3,235,068	69.9
Rajpuri Group	7,87,604	17.0
Ratnagiri group	5,84,067	12.6
Vengurla group	20,132	0.4
Total	**4,627,015**	**100.0**

Source: Data provided by The Maharashtra Maritime Board and author's calculations

The GoM has also formulated a policy for captive jetties, which can facilitate the development of both, the port and the inland water transport. To encourage this the GoM will lease out the land and site for a jetty for a period of 30 years and the entire construction of the captive jetties and on the back up site will be on Build-Operate-Transfer (BOT) basis. The construction, repair, maintenance and management of the jetties will be the sole responsibility of the holder of these captive jetties. As per the port policy of the GoM, it will not recover any berthing dues from the vessels calling at the jetty. However, wharfage charges will have to be paid to the MMB as per the prescribed rate notified by the GoM through an official gazette. At the end of 30 years, the jetty and the super structure on the jetty will get transferred to the MMB.

Table 1.23 provides the relative position of Maharashtra's minor ports in relation to other selected states. Gujarat accounts for almost 80 per cent of the cargo of minor ports of India.

Maharashtra's share has been at best about 15 per cent in 1996-97 and in 2001-02 the provisional figure stood at about 5 per cent. Comparatively, Gujarat has an advantage over Maharashtra with regard to the geographic location. The former is more convenient for the movement of north, central and even eastbound cargo, while the latter's proximity is only to the south, which already has many ports. Besides, Gujarat being one of the most industrialised states also has the advantage of contributing to cargo handled at its own ports.

Table 1.23: Relative Position of Cargo Handled by Minor Ports of Selected States

Year	Maharashtra	Gujarat	Goa	India (Thousand Tonnes)
	As a percentage of India			
1991-92	4.0	77.7	0.1	13,258
1992-93	2.0	77.2	1.4	15,403
1993-94	3.3	80.9	1.1	19,470
1994-95	11.0	76.0	1.0	22,282
1995-96	13.5	71.9	0.4	25,710
1996-97	15.2	71.3	1.4	27,832
1997-98	12.1	71.8	2.6	38,607
1998-99	14.3	63.1	6.0	36,306
1999-00	9.5	73.7	3.9	63,383
2000-01	6.8	81.7	3.7	87,249
2001-02	5.2	83.8	3.0	95,126

Source: The Maharashtra Maritime Board, 2003

Due to the increasing load on the existing rail and road transportation system in Mumbai, the GoM has initiated development of inland water transport. Again, PSP is supposed to enable this, the inland water transport routes are to cover three routes, *viz.*, (i) Nariman Point to Borivali (western sea route) passing through Bandra, Juhu and Versova); (ii) The Eastern sea route (from South Mumbai/Gateway of India to Thane/Navi Mumbai; and (iii) the cross harbour route (from Gateway of India/ferry wharf/South Mumbai to Mandwa, Rewas, Jawaharlal Nehru Port Trust (JNPT), Elephanta, *etc.*). Their exact location has been finalised and the requirement of land has been worked out. Few issues, such as, promulgation of the navigational channel and details of infrastructure required, are being addressed. The commuter ferry system is already operational on the Eastern Sea route and cross-harbour route. However, better landing sites and infrastructure facilities are being planned so as to make the ferry system more attractive, convenient and safe.

Initiatives for Road Development

The Integrated Road Development Project (IRDP) has produced exemplary results and has introduced revolutionary changes in the state. As an outcome of IRDP several aspects of 'the quality of life' in the state have improved considerably. To meet the ever-increasing demand for better and wider road network in the state, two 20-year road development plans, *viz.*, 1961-81 Road Development Plan (Bombay Plan) and 1981-2001 Road Development Plan, have been implemented (Public Works Department, GoM, 2003:b). The details of targets and achievements during the Road Development Plans 1961-81 and 1981-2001 are given in Table 1.24. It can be seen from the table that the original target of NH was much higher in the Bombay Plan as compared to the revised target. These plans were preceded by the Nagpur plan, the targets of which were almost met when

the state of Maharashtra was formed in 1960. By the end of the seventies, the problem of deceleration in industrial growth had caught the attention of policy makers and the availability of infrastructure was considered to be one of the reasons for the same.

Table 1.24:Targets and Achievements During the Road Development Plans in Maharashtra

Category of Roads	1961-81 Plan				
	Length as on 1.4.61 (kms)	Target (kms)	Revised target (kms)	Length as on 1.4.81 (kms)	Achievement as a % of revised target
NH	2,312	5,007	2,956	2,945	-0.4
SH	9,804	13,468	20,374	18,949	-7.0
MDR	11,058	27,426	29,024	25,233	-13.1
ODR	6,954	32,681	35,714	25,404	-28.9
VR	9,114	35,100	44,230	28,105	-36.5
Total	39,242	1,13,682	1,32,298	1,00,636	-23.9
Un- classified	-	-	-	40,495	
Total	**39,242**	**1,13,682**	**1,32,298**	**1,41,131**	**6.7***
1981-2001 Plan					
Category of Roads	**Targeted length (kms)**	**Revised target (kms)**	**Total achievement (kms)**	**As a % of total achievement**	**Shortfall as a % of revised target**
				BT/ CC / **WBM** / **Unsurfaced**	
NH	3,924	3,112	2,972	98 / - / 2	-4.5
SH	28,282	35,831	32,380	95 / 4 / 1	-9.6
MDR	44,047	48,615	41,166	57 / 280 / 6	-15.3
ODR	50,794	51,396	41,701	26 / 58 / 16	-18.9
VR	76,602	1,31,304	72,834	10 / 63 / 27	-44.5
Total	**2,07,348**	**2,70,010**	**1,91,053**	**39 / 45 / 15**	**-29.2**

Note: (1) Abbreviations used: BT: Black Topped, CC: Cement Concrete, and WBM: Water Bound Mecadam (2) Over achievement of target (*) is due to the fact that there was no target fixed for the un-classified roads in 1961-81 plan.
Source: GoM (2003:a)

The GoI prepared a road development plan for the entire country for the period 1981-2001. Maharashtra finalised its own road development plan within the overall national road development plan framework. The basic objective of this plan was to connect all the villages having a population in excess of 500 in rural areas with at least one all-weather road. This plan also highlighted the problems of shortage of energy, environmental degradation and road safety. The main components of the Maharashtra's Road Development Plan 1981-2001 were:

- Expansion of National Highway (NH) network;
- Construction of expressways on major traffic corridors;
- Extension of State Highways (SH) to connect district headquarters, industrial centres and tourist centres;
- Construction of Major District Roads (MDRs) to connect villages with population of 1000-1500; and
- Construction of pedestrian footbridges (Sakavs) in hilly areas to serve the villagers living in remote areas by giving them access to their farms/other social amenities lying across rivers/creeks.

Given the uphill task of seeking resources for the implementation of this plan, the finances were raised from different sources, *viz.*, assistance from the World Bank (WB), National Bank for Agricultural and Rural Development (NABARD), private sector on BOT basis and plan and non-plan allocations from annual state budgets. The construction of roads was financed, to a large extent, by the non-plan expenditures. One of the major initiatives taken by the GoM towards development of road and road transport can be said to be the creation of Maharashtra State Road Development

Corporation (MSRDC). Established in July 1996, it is fully owned by the GoM and was created mainly to deal with properties and assets comprising of movables and immovables including land, road projects, flyover projects, toll collection rights and work under construction which were vested with the State Government and were under the control of the Public Works Department. Some of the projects undertaken by the MSRDC have been listed in Box 1.3. The Mumbai-Pune expressway is cited as one of the successful projects undertaken by the MSRDC, being the first 6-lane expressway in the country. The GoM awarded the project to MSRDC in March 1997 on BOT basis with a permission to collect toll for 30 years. The project was completed in record time, the full length of the route opened from 1st March 2002, though a part of it was opened a couple of years earlier.

Box 1.3: Projects undertaken by MSRDC

- Airoli Bridge Project
- 50 Flyovers (Mumbai Traffic Improvement Mega Project)
- Amravati City Integrated Road Development Project
- Aurangabad City Integrated Road Development Project
- Bandra Worli Sea Link Project
- Four laning of Satara - Kolhapur - Kagal section of NH4
- Improvements to Satara - Chalkewadi - Patan Road
- Mumbai - Aurangabad - Nagpur Highway Development to NH standards
- Mumbai Pune Expressway & Panvel - Bypass Project
- Nagpur City Integrated Road Development Program
- Pune Integrated Road Development Project
- Railway Over - Bridges Project
- Solapur City Integrated Road Development Project
- Construction of Railway Over Bridges under Vidarbha Scheme
- Widening of Thane Ghodbunder Road SH – 42
- BARAMATI - (Intergrated Road Development Project (IRDP)
- Light Rail Transit (LRT) for Pune and Nagpur
- Mumbai Trans Harbour Link (Nhava - Sewri sea link Project)
- Mass Rapid Transit System for Thane City
- Nanded City Integrated Road Development Project (Waghela Municipal Corporation)
- Nandurbar Integrated Road Development Project
- Western Freeway Sea Link Project
- Kolhapur City Integrated Road Development Project
- Inland Passenger Water Transport (IPWT) Project of Mumbai
- Widening of Existing Jogeshwari Vikroli Link Road
- Construction of Santacruz Chembur Link Road
- Mumbai- Ahmedabad Expressway

Source: MSRDC (2005)

Steps taken in MMR

The Mumbai Metropolitan Region (MMR) having a population of 18 million extends from Colaba in south Mumbai to Virar in the north, Kalyan Bhiwandi in the northeast and Alibaug in the south. It consists of seven Municipal Corporations (Greater Mumbai, Kalyan-Dombivili, Navi Mumbai, Thane, Ulhasnagar, Bhiwandi and Mira-Bhayandar) and 13 Municipal Councils (Alibaug, Ambernath, Karjat, Khopoli, Kulgaon-Badlapur, Matheran, Nallsopara, Navghar-Manikpur, Panvel,

Pen, Uran, Vasai, Virar). The Environmental Improvement Society (EIS) set up in 1997, provides funds for innovative projects in solid-waste management, afforestation, installation of toilet blocks etc. that help improve the quality of life in the MMR. Some activities of the MMR - Environment Improvement Society are as follows:

- Creating a critical awareness and promoting best practices on solid waste management in selected areas in the western and central suburbs in Greater Mumbai
- Environmental management plan for Sanjay Gandhi National Park, Borivali
- Conservation and beautification of lakes in Thane Municipal Corporation limits

Installation of toilet complexes attached with night soil based biogas plants in Municipal Corporations and Councils under jurisdiction of Mumbai Metropolitan Region Development Authority (MMRDA)

Projects Undertaken by MMRDA

MMRDA was established in 1975 (under the MMRDA Act, 1974) by the GoM as an apex body for planning and co-ordination of development activities in the MMR. When a project is of particular significance, the MMRDA takes up the responsibility for its implementation. Some of its major projects include:

i) *Bombay Urban Transport Project (BUTP):*

The project achievements are:

- Procurement of 700 buses for (Bombay Electric Supply and Transport Undertaking (BEST)
- Construction / improvement of five bus depots and part of major workshop for BEST
- Provision of new bus shelters and terminals.
- Construction of five fly-overs on the main arteries of Mumbai
- Installation of new micro processor based integrated traffic signals at 77 junctions
- Construction of pedestrian bridges and underpasses at important junctions, road/bridge widening/extensions and channelisation

ii) Mumbai Urban Development Project (MUDP):

The World Bank-assisted MUDP successfully implemented during 1985-94, was formulated, coordinated and monitored by the MMRDA and implemented through Maharashtra Housing and Area Development Authority (MHADA), Municipal Corporation of Greater Mumbai (MCGM), City and Industrial Development Corporation (CIDCO), Thane Municipal Corporation (TMC) and Kalyan Municipal Corporation (KMC). Some of its major projects include:

- Under the Land Infrastructure Servicing Programme (LISP), development of 88,000 serviced sites in Greater Mumbai, Thane and Navi Mumbai was undertaken.
- Upgradation of 35,000 slum households in Greater Mumbai was taken up under the Slum Upgradation Programme (SUP)
- Some major infrastructure works such as water supply and storm water drainage were also undertaken in Greater Mumbai and Navi Mumbai

iii) *Shifting of Wholesale Markets from South Mumbai:*

In order to reduce the congestion in South Mumbai, the State Government and the MMRDA decided to shift the wholesale markets located therein. In pursuance of this policy decision, the wholesale markets for onions, potatoes, sugar, spices, condiments, and dry fruits and for iron & steel markets have already been shifted to Navi Mumbai. Similarly, the wholesale agricultural, fruits and vegetable markets are also relocated in Turbhe in Navi Mumbai recently, while those for groundnuts, pulses and edible oil are to be relocated in Navi Mumbai.

iv) *Wadala Truck Terminal:*

This truck terminal (on 80 ha of land) is being developed at Wadala in four phases and will be a centralised facility for the transport of goods in Mumbai. The first phase on about 25 ha of land, with all the basic infrastructure facilities consisting of the construction of four buildings accommodating godowns, shops and offices and an Amenity Building having provisions for Police Station, MTNL, Fire Station, Post & Telegraph Office and staff quarters and dormitories, for their essential staff is already completed. The work of providing infrastructure facilities in Phase-II will be taken up shortly. Construction of link roads like Wadala-Anik Road and Sion-Koliwada Connector is in an advanced stage.

v) Mahim Nature Park:

The MMRDA has converted 15 ha of land in 'H' block of Bandra-Kurla Complex, which earlier was a garbage dump, into a nature park in close association with the World Wide Fund for Nature (WWF). For the development and management of the Park, MMRDA has promoted a society, known as Maharashtra Nature Park society, which is responsible for its day-to-day management and activities.

vi) Mumbai Urban Transport Project (MUTP):

The MMRDA with WB assistance has formulated this multi modal project to improve the traffic and transportation situation in the MMR. As a sequel to the BUTP, it envisages the investment in suburban railway projects, local bus transport, new roads, bridges, pedestrian subways and traffic management activities (MMRDA 2005).

The Mumbai Rail Development Corporation (MRDC) has been set up to execute rail projects in MUTP II area; to augment the suburban commercial rail infrastructure and for exploitation of railway land. Railways and Government of Maharashtra fund the projects undertaken by the MRDC on a 50:50 basis. The outlay for Ninth Five Year Plan, and anticipated expenditure for Annual Plan 2001-02, Annual Plan 2002-03 and Tenth Five Year Plan 2002-2007 in the Transport Sector are given in table 1.25.

Table 1.25: Various Outlay Plans for Transport Sector from 1997 onwards

Sectors	Annual Plan Year Plan 1997-2002 Outlay	Annual Plan 2001-02 Outlay	Annual Plan 2001-02 Anticipated Expenditure	Tenth Five Year Plan 2002-2003 Outlay	Year plan 2002-2007 Outlay
Roads & Bridges	217200	187806.41	57430	79032.31	257121
Mumbai Road (PWD)	10000	1200	520.92	700	11352
Prime Minister Gram Sadak	-	-	-	12102	45000

Yojana					
Ports & Light Houses	8500	1134.82	914.79	3951.44	9650
Inland Water Transport	255	293.01	98.65	215	289
MSRTC	146300	24856	8916	5826	5826
Motor vehicles	900	150	108.53	100	1022
Civil Aviation	800	-	-	4762	5908
State Participation in Railway Project	4400	500	361.75	400	4995
Urban Transport	30000	44700	2500	28600	34000
Total	418355	260640.24	70851.62	135688.75	375163

Source: Tenth Plan, GoM (2005)

Agriculture and Allied Sectors

Sectoral Contribution to SDP

The contribution of different sectors in SDP and NDP is changing over time and the share of the agriculture and allied services (primary sector) is declining as shown in Table 1.26. Taking into consideration the three decades, the contribution of this sector was highest for All-India in 1980-81, but declined to 26 per cent in 2000-01. In Maharashtra, the contribution of the primary sector to SDP was much lower and declined to 14 per cent in 2000-01, while that of the tertiary sector rapidly increased to 52 per cent. At the All-India level also, the tertiary sector played the major role in terms of contribution to NDP.

Table 1.26: Sector-wise Share in SDP and (per cent)

Sector	Maharashtra			India		
	1980-81	1990-91	2000-01	1980-81	1990-91	2000-01
Primary	28	21.4	14.2	41.2	35	26
Secondary	35	36.6	33.5	22.9	25	26
Tertiary	36.8	42	52.3	35.6	40	48

Source: Computed from Economic Survey of Maharashtra (Various issues)

Since agriculture is one of the main sectors of the State's economy, it is necessary to observe how this sector is growing and how it compares with other sectors in terms of growth rates. It can be observed from Table 1.28 that Maharashtra's SDP grew faster than the All-India NDP average. Agriculture in Maharashtra is heavily dependent on monsoons as barely 15 per cent of the Gross Cropped Area (GCA) is irrigated. This is much below and even less than half the national average where 38.7 per cent of gross cropped area is irrigated.

Table 1.28: Sector-wise Growth Rates in SDP and NDP (at constant prices in percent per annum)

Sector	1980-81 to 1989-90		1990-91 to 2000-01		1980-81 to 2000-01	
	Maharashtra	All India	Maharashtra	All India	Maharashtra	All India
Agriculture	2.2	3.3*	3.3*	3.0*	4.0*	3.3*
Allied	1.9	1.0*	0.7*	3.4*	2.1	2.6*

Primary	2.2	3.0*	3.1*	3.0*	3.8*	3.2*
Secondary	6.2*	6.4*	6.0*	6.2*	6.7*	6.3*
Tertiary	6.6*	6.7*	8.5*	8.0*	8.4*	7.2*
SDP/NDP	5.3*	5.0*	6.7*	6.0*	6.8*	5.6*

Source: Computed from data in Economic Survey; Note: * significant at 1 per cent.

Agricultural Workforce

Agriculture emerges as a key sector in the state, especially with respect to workforce barring a few districts, (Mumbai, Thane, Nagpur and Pune). A comparison of the state with the national figures shows that at the all- India level, 59 per cent and at the state level 55 percent of the workforce is employed in agriculture (Table 1.27). Although the share of workers in agriculture is lower in Maharashtra as compared to India, a district-wise analysis presents a different picture. First of all, excluding the workforce Mumbai from the total of that in the state, the share of workers in the agricultural sector increases by 7 to 8 per cent for the years that the data is presented. Further, in 2000-01, almost 20 out of 35 districts had more than 70 per cent of their workforce in the agricultural sector while 29 districts had more than 60 per cent workforce in agriculture. These percentages are more than those of the national average.

Table 1.27: Share of Workforce in Agriculture percentage

Year	Maharashtra			India		
	Cultivators	Agri. Lab.	Total	Cultivators	Agri. Lab.	Total
1981	35	26.6	61.6	41	25	66
1991	32.8	26.8	59.6	38	26	64
2001	28.5	26.8	55.3	32	27	59

Source: GoI (2001)

Land Use and Cropping Pattern

Table 1.29 shows the statistics of land utilisation for agricultural and non-agricultural uses. The GCA shows an increase and this may be due to the initiatives of the Government's to convert wastelands into cultivable areas. Also it is seen that the land under non-agricultural uses has also increased, which is due to the growing urbanisation. The yield of Kharif food grain is 986 kg per hectare and yield of Rabi food grain is 707 kg/hectare in year 2001-02.

Table 1.29: Statistical Data of Land under Agricultural and Non-agricultural Uses (area in 100 ha)

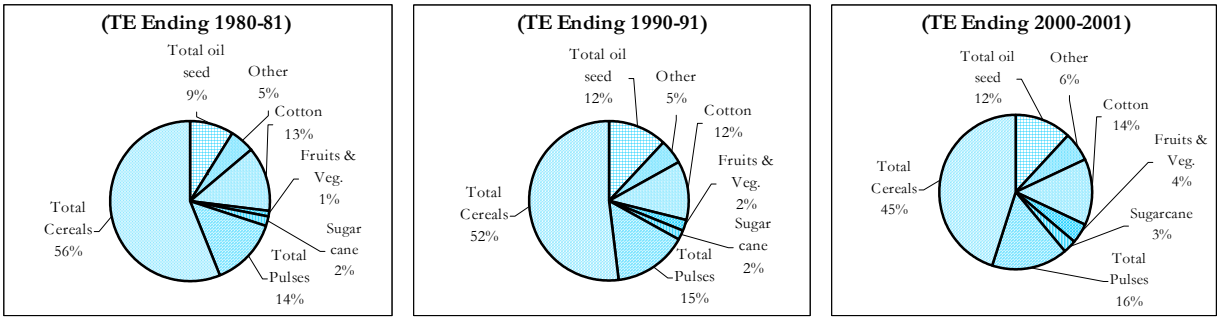
Year	Land Put to Non-Agricultural Uses	Barren and Uncultivable Land	Cultivable Waste Land	Permanent Pastures and Grazing Land	Land under Miscellaneous Tree Crops and Groves	Fallow	Net Area Sown	Area Sown more than Once	GCA
1991-92	11656	16354	9666	11377	2832	25409	178948	22386	201334
1992-93	11866	15906	9479	11803	2874	24005	180203	31683	211886
1993-94	12811	15624	9430	11726	2728	21923	181881	32209	214090
1994-95	13170	15423	9475	11733	2795	22986	180530	33046	213576
1995-96	13486	15435	9596	11663	2921	23202	179800	35240	215040
1996-97	13501	15435	9577	11737	3080	24284	178483	39876	218359
1997-98	13504	15438	9632	11798	3304	25211	177215	36624	213839
1998-99	12387	17015	8882	13405	2219	22704	177316	44231	221547

1999-00	12448	16979	8894	13405	2241	23053	176912	46600	223512
2000-01	13010	16957	9029	13410	2256	23499	176364	46194	222558
2001-02	13726	17222	9149	12504	2454	24170	176190	47621	223811

Source: GoM (2003)

State's cropping pattern is shifting towards commercial crops. Figure 1.3 shows the cropping pattern of the state. The share of oilseeds increased from 9 per cent in 1980-81 to 12 per cent in the later decades. Cotton also showed an increase and its share went up from 12.4 per cent in 1990-91 to 14.3 per cent in 2000-01. Area under sugarcane also gradually moved up from 0.3 million hectares in Triennium Ending (TE) 1980-81 to 0.6 million hectares in 2000-01. The increase in area was more marked in case of fruits and vegetables and increased rapidly from 0.27 million hectares in 1980-81 to 1.26 million hectares in 2000-01. It may be mentioned here and will be elaborated later that government policies have been instrumental in inducing cropping pattern changes. The growth rates of major crops of the state are given in table 1.30.

Figure 1.3: Cropping Pattern in Maharashtra



Source: Season and Crop Reports, various issues (GoM)

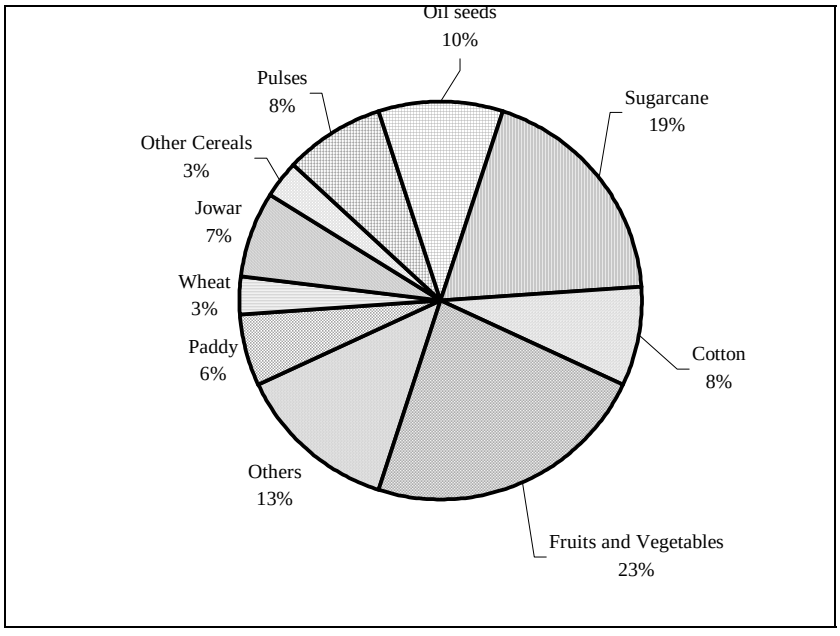
Table 1.30: Growth Rates by Area of Major Crops in Maharashtra (per cent per annum)

Crop	1980-81 to 1989-90	1990-91 to 2000-01	1980-81 to 2000-01
Rice	0.6	-0.7*	0.2
Wheat	-2.3*	3.5**	-0.8
Bajra	2.4*	-0.8	0.5**
Jowar	-0.4	-1.7**	-1.4*
Total Cereals	0.1	-0.7	-0.7*
Total Pulses	2.7*	0.9	1.7*
Total Food grains	-0.3	0.6*	-0.2
Sugarcane	1.7**	2.4**	3.8*
Cotton	0.4	2.6*	1.1*
Oilseeds	6.7*	0.6	2.7*
Fruits & Vegetables	6.2*	8.0*	6.5*

Source: Season and Crop Reports, various issues (GoM); Note: * significant at 1per cent, ** significant at 5 per cent

A look at the commodity-wise composition of agricultural SDP (Figure 1.4) indicates that in 2000-2001, although the share of food grains in total area was 60 per cent, its contribution to state domestic product was only 25.5 per cent. This can partly be explained by the fact that Maharashtra's food grain economy is dominated by low value coarse cereals such as jowar, which accounted for 52 per cent area under cereals and 23 per cent of GCA in 2000-01. Sugarcane, which barely constitutes 3 per cent of GCA, contributed to 19.3 per cent of state domestic product. Fruits and vegetables, which account for only 5.6 per cent of the GCA, accounted for as much as 24 per cent of agricultural state domestic product. The growth rates of production of major crops are given in Table 1.31.

Figure 1.4: Commodity-wise Composition of Agricultural SDP (1993-94 prices)



Source: Directorate of Economic and Statistics, 2001

Table 1.31: Growth Rate of Production of Major Crops in Maharashtra (per cent per/annum)

Crop	1980-81 to 1989-90	1990-91 to 2000-01	1980-81 to 2000-01
Cereals	1.2	-0.5	1.1
Pulses	7.2*	3.2	3.9
Foodgrains	1.9	-0.01	1.5*
Total oilseeds	9.2*	4.3**	6.1*
Cotton	3.3	3.8	4.2*
Sugarcane	0.6	4.2*	3.6*

Source: MSDR (2005); Note: * significant at 1 per cent; ** significant at 5 per cent

Horticulture Sector

Agriculture in Maharashtra is diversifying into high value crops of which horticultural crops are a major component. The state utilises the largest area and has the highest production in the country devoted to fruits and fifth largest area under vegetables. It had a 20 per cent share in the country's fruit production and 5 per cent share in the vegetable production in 1999-2000. Maharashtra, renowned for its exclusive production of the Alphonso mangoes, ranks first in the country for grape, cashew nut, pomegranate, orange and banana production and also has the highest share in onion production (MSDR 2005).

Fertilisers and Pesticides

Like seeds, the fertiliser consumption in Maharashtra has been rising continuously. In fact, it is one of the major fertiliser-consuming states in India with a share of around 10 per cent in the country's total fertiliser consumption. Annually around 3.8-4.0 million tonnes of fertilisers are consumed in terms of material and 1.8 to 2.0 million tonnes in terms of nutrients such as nitrogen, phosphate and potassium (N, P, K). In 1995, per hectare consumption was highest in Punjab (167kg/ha.). Comparatively, in Maharashtra, it was around 65 kg for the same year. However, it has increased from just 14 kg /ha in 1970-71 to currently around 75 kg/ ha thus registering a fivefold growth and a growth rate of 7.4 per cent per annum. As far as the level of NPK ratio is concerned, it was distorted from the normal level (4:2:1) to 8.1:2.3:1 due to the decontrol of phosphatic and potash fertilisers in 1992. It subsequently improved to 5.4:2.4:1, after the government introduced the Concessional Scheme of fertilisers to increase the consumption after 1992. The estimated consumption of fertiliser during the year 1999-2000 and 2000-2001 is 88.8 and 75.7 kg, respectively (Agricultural Statistics at a Glance 2002, Ministry of Agriculture, Govt. of India). With increasing area under horticultural and other high value export crops (which have significant nutrition requirement), fertiliser consumption might increase further. Application of fertilisers is governed by their prices.

At the regional level, in districts of Western Maharashtra, per hectare usage of fertilisers is very high (as compared to other districts) and this has adversely affected soil fertility. Among various crops grown in the state, sugarcane consumes very high quantity of fertilisers; its was reported that the per hectare consumption of fertilisers for this crop moved up from 226 kg per hectare in 1972-73 to 501 kg per hectare in 1990-91 (Sawant et al, 1999).

Bio-fertilisers are economical and pollution-free sources of plant nutrients. The state has about 41 production units of bio-fertilisers with capacity of 5000-6000 tonnes (www.agri.mah.nic.in). Under the integrated approach, implemented by the GoI, balanced use of chemical fertilisers and bio-fertilisers / organic manure is suggested to maintain the soil health. The state hardly uses 1500 tonnes of these fertilisers as against the potential of 85000 tonnes. On the other hand, the state consumes around 4 million tonnes of the chemical fertilisers.

In the case of pesticides, the consumption in Maharashtra has come down to 173 kg/ha from 320 kg/ha during VII plan due to Integrated Pest Management (IPM). However, there is irrational distribution of pesticide use with maximum use on cotton at about 54 per cent (GoI, 2003). Table 1.32 gives the demand/consumption and production of different fertiliser nutrients.

Table 1.32: Demand/Consumption and Production of Different Fertiliser Nutrients (in '000' MT)

Year	Demand/Consumption			Production	
	N	P	K	N	P
1998-99	1025	458	178	918	220
1999-00	1144	552	235	981	255
2000-01	993	402	205	878	204

Source: MSDR (2005)

Livestock

Technological changes in agriculture associated with the green revolution have brought about significant changes in the size, composition and productivity of livestock in Maharashtra as well as in several other areas of the country. Out of the 36404 total livestock population (1992-2000) of Maharashtra, 17446 are cattle, 5448 buffalos, 3077 sheep, 9943 goats, 41 horses and 73 donkeys. The dynamics of change in size and composition of the livestock population in Maharashtra vis-à-vis India since 1956 are shown in Table 1.31.

It is also clearly evident from this table that except for milk, the growth rate for the all other products from livestock species in this state has been slower during the period between 1985 and 2000 as compared to that of the nation as a whole. The growth rates for egg and wool production in the state have been marginally lower than the national average. The latter may be due to the predominantly, migratory nature of sheep flocks in the state. With regard to meat production it is important to mention that the state consists of both authorised and unauthorised slaughterhouses. It is difficult to arrive at a realistic estimate of total meat production in Maharashtra, as official estimates of the meat produced in unofficial slaughterhouses are unavailable. This may be one of the reasons why the state's share in India's total meet production has declined at the rate of 11 per cent per year during the period 1992-2000 (Table 1.33). Nonetheless, insofar as the meat production is concerned, the productivity levels of various species of animals in the state showed an upward trend during this period. This is also corroborated from the fact that the number of animals slaughtered in the state has shown a decline over time. However, there still exists vast scope for increasing livestock productivity in the state by following improved animal husbandry practices.

Table 1.33: Changing Structure of Livestock Production in Maharashtra vis-à-vis India

Production	Triennium Ending			85-2000
	87-88	91-92	99-00	CGR (%)
Milk Production (million tonnes)				
Maharashtra	2.5	4.1	5.4	7.1*
India	45.6	58.1	74.5	4.2
Share in India (per cent)	5.4	7.1	7.3	2.7
Wool Production (metric tonnes)				
Maharashtra	-	1487.5	1595.8	1.2*
India	-	40100	45500	2.0*
Share in India (per cent)		3.7	3.5	-0.9
Egg Production (billion)				
Maharashtra	-	2.3	2.9	4.3*
India	-	23.0	30.1	4.5*
Share in India (per cent)		9.8	9.7	-0.2
Meat Production@ (in '000' MT)				
Maharashtra	159.3	151.2	203.1	2.3*
India	993.3	3420.7	3895.0	11.4*
Share in India (per cent)	16.03	4.4	5.2	-8.1*
Meat Production Per Animal (in kgs.)				
Maharashtra	**21.6**	**24.1**	**27.9**	**2.8***

Notes: * - implies significance of growth rates at 1 per cent level of probability; CGR = Annual Compound Growth; @ - excluding poultry meat
Source: The estimates are based on figures obtained from various issues of 'Report on Milk, Egg, Wool, Meat Production and Livestock and Poultry Keeping Practices in Maharashtra State, Department of Animal Husbandry, Maharashtra State, Pune'.

Fisheries Development

Maharashtra, having a coastline of 720 km, accounts for a significant share (around 16 per cent) so far as marine fish production in the country is concerned. The estimates relating to fisheries development in Maharashtra encompassing the period from 1979 and 1999 are provided in Table 1.34. The state produces or harvests as many as 32 varieties of fish such as shrimps, prawns, harpodon neherias, ribbon fish, otalithes, pomfrets, anchoviella, mackerel and cattle fish which put together account for over 70 per cent share in total fish production of the state. As for various regions, Brihanmumbai and Thane alone account for about 60 per cent of the total fish catch of Maharashtra. Though, over the course of time, it has declined marginally.

Similarly Maharashtra's share in total fish production of India has also steadily declined over the past two decades mainly due to a sharp decline in its share in total marine fish production of India. However, over time, the state has shown considerable increase in the quantum strength of marine-fishing villages/hamlets, boats engaged in fishing, fish brought for curing, salt issued, cured fish removed, besides in the number of fish cooperative societies and their membership, etc (Table 1.34).

Another disquieting feature of fisheries sector of Maharashtra is the decline in the number of fish curing yards, which have come down by 45 per cent during the period under consideration. The number of fishery schools in the state has stagnated at nine over the last two decades. The declining trends in inland water spread area, numerical strength of fish curing yards and stagnant number of fishery schools are certainly disturbing features of the fisheries sector of Maharashtra. However, order to develop fisheries sector, the Department of fisheries in the state is conducting various

training programmes relating to carp fish seed production, fresh water prawn culture, integrated fish farming and management of aquarium, etc to remedy the situation.

Table 1.34: Fisheries Development in Maharashtra

Particulars	Triennium Ending			CGR 1979-99
	1981-82	1991-92	1998-99	
Total Coastline of State (in Kms).	720	720	720	-
Number of marine fishing villages	375	386	391	Neg.
Number of boats engaged in fishing	12503	15712	18345	2.2*
Boats above one tonne	6834	9061	13005	4.2*
Number of mechanised boats- Departmental	3058	3939	4544	2.1*
- Existing	4072	7047	8734	4.4*
Quantity of fish brought for curing (in tonnes)	8384	3083	15093	8.4
Quantity of salt issued (in tonnes)	1732	697	2885	8.1
Quantity of cured fish removed (in tonnes)	6420	2140	10820	8.2
Fish production (in '000' tonnes)- Marine	340	372	436	1.4*
- Inland	25	61	112	7.4*
- Total	365	433	548	1.9**
All India (in '000' tonnes)				
Fish Production - Marine	1498	2347	2662	3.9*
- Inland	912	1549	2381	6.1*
- Total	2410	3896	5043	4.8*
Share of Maharashtra in India (per cent)- Marine	22.7	15.9	16.4	-2.4*
- Inland	2.7	3.9	4.7	1.3
- Total	15.2	11.1	10.9	-2.8*
Number of fish cooperative societies	535	1547	2202	8.9*
Membership of cooperatives	177	190	221	2.3*
Total inland water spread area (in '000' tonnes)	310	301	300	-
Fish curing yards	20	7	11	-2.0*
Fishing schools	9	9	9	-
Disposition of fish catch (in tonnes)	-	473344	536303	3.9*

Source: Handbook of Basic Statistics of Maharashtra, 2000; DFDO (2005)

Energy Sector

Maharashtra has a total installed capacity of 15580 MW (including Central sector share) of centralised power plants. Maharashtra accounts for about 12 per cent of India's total installed capacity in power sector. Table 1.35 indicates the installed generating capacity in the State for the year 2001-2002. The sector-wise break-up of energy sales in Maharashtra is given in Figure 1.5

Conventional Energy

Until early June 2003, three power utilities, *viz.*, Tata Electric Companies (TEC), Bombay Suburban Electric Supply (BSES) and Bombay Electric Supply & Transport (BEST) served the Mumbai area. BSES Ltd was fully inducted into the Reliance conglomerate in early June 2003 and was renamed as Reliance Energy Ltd (REL). TECs and REL are private companies, whereas, BEST is municipality-

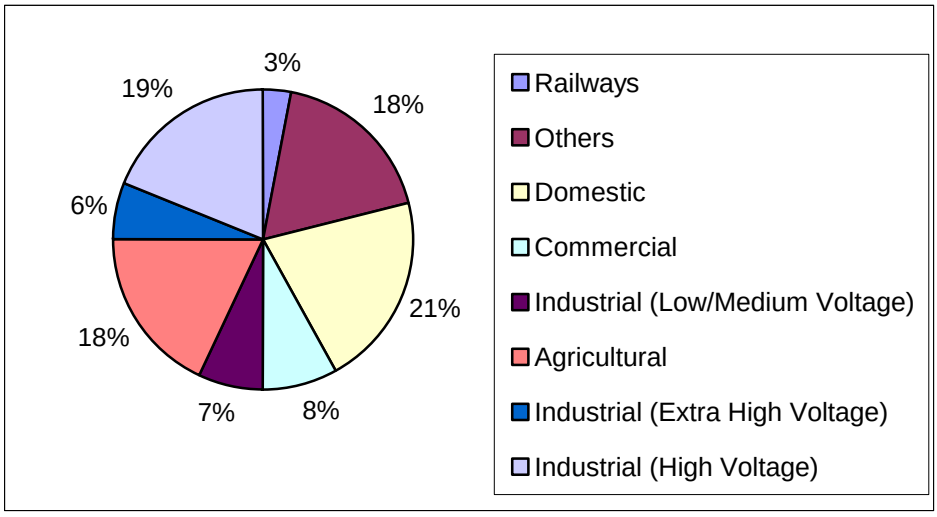
owned. The remaining area of the state is served by the Maharashtra State Electricity Board (MSEB) which is a public utility created under the Electric Supply Act (1948).

Table 1.35: Installed Generating Capacity in Maharashtra

Type of Power	Board/License	Capacity in MW		
		Installed	Derated	Total installed (source-wise)
Hydro	MSEB Tata Electric	2430 444	2430 444	2874
Thermal	MSEB Tata Electric BSES	6425 1150 500	6396 1150 500	8075
Gas	MSEB Tata Electric DPC	672 180 728	672 180 728	1580
Waste heat recovery	MSEB Uran	240	240	240
Atomic	NPC- Tarapur	190	160	190
Central Sector Share		2185	2185	2185
Non-Conventional sources	Bagasse Wind Energy Biogas	32 395 9	32 395 9	32 395 9
Total		**15580**	**15521**	**15580**

Source: MERC (2003)

Figure 1.5: Sector-wise Energy Sales in the State



Source: MREC (2003); Others include Tata Power Sales to Licensees

In 2005, the MSEB has been bifurcated into four companies namely, MSEB Holding Company Ltd, MS Power Generation Co. Ltd., MS Transmission Co. Ltd and MS Distribution Co. Ltd. MSEB has an installed capacity of 9771 MW, while Tata Power Company Ltd. and BSES have an installed capacity of 1774 MW and 500 MW, respectively. The generation capacity of MSEB has grown from 760 MW in 1960-61 to 9771 MW in 2001-02. The number of consumers has grown from 1,07,833 to 1,40,09,089 during the same period.

Maharashtra was ranked as one of the best states of the country in terms of production and consumption of electricty (MSDR 2005). About 80 per cent of the population in the state has access to electricity. Table 1.36 and figure 1.6 shows that a large number of households have electricity

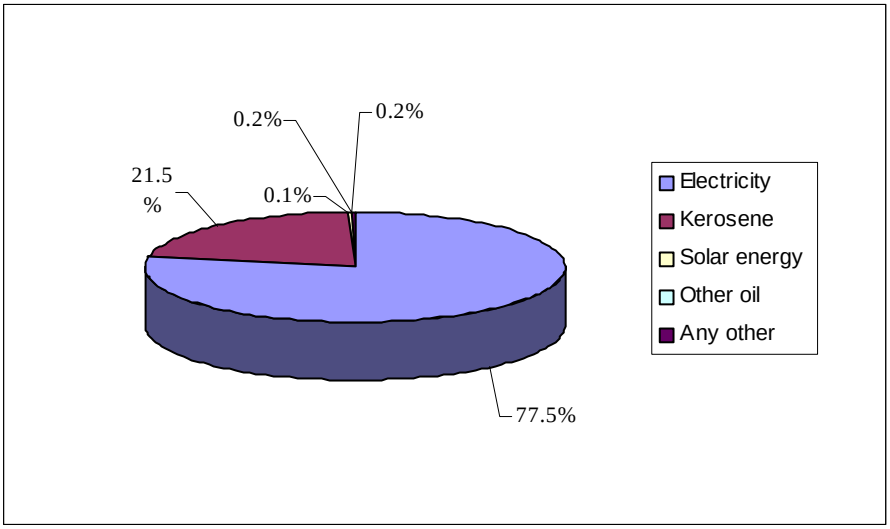
supply. Though almost all households in cities and towns have access to electricity, this is not true for all the rural households. The contribution of MSEB in 1997 was more than 4 times that of the private sector which deceares over, thus, indicating a greater role played by the private sector in the recent years as regards capacity installation in Maharashtra's power sector.

Table 1.36: Energy Sources of Rural and Urban Households

Source of Energy	Rural	%	Urban	%	Total	%
Electricity	7,164,057	65.2	7,608,033	94.3	14,772,090	77.5
Kerosene	3,695,381	33.6	408,445	5.1	4,103,826	21.5
Solar energy	14,823	0.1	9,831	0.1	24,654	0.1
Other oil	26,919	0.2	4,700	0.1	31,619	0.2
Any other	29,825	0.3	10,355	0.1	40,180	0.2
Total	**10,993,623**	**100.0**	**8,069,526**	**100.0**	**19,063,149**	**100.0**

Source: Census 2001.

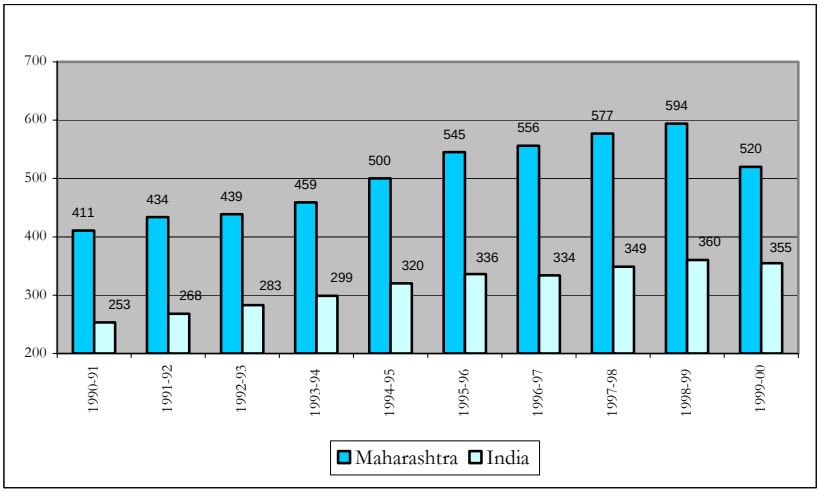
Figure 1.6: Energy Sources of Different Households



Source: Census, 2001

Though Maharashtra has ample power for the base load, it does face shortage of both energy and peaking capacity. The quality of supply is poor due to voltage drops, frequency fluctuations and load shedding. The Per capita consumption of electricity from 1999-00 was 520 KWh in comparison to national average of 355 KWh (Figure 1.7). Electricity consumption by different user groups in Maharashtra is given in Table 1.37. The annual plant load factor was 74.5 per cent from 2001-02. The length of Transmission and Distribution (T&D) lines in circuit KM for distribution lines upto 400 KV was 681374. The transmission of energy was 5,846,303,590 KWh. Energy Loss was 2,751,201,690 KWh; T&D losses were 32 per cent (Calculation from data in MSEB website for Oct-03 to Mar-04 and TEDDY 2002-03). Table 1.38 enlists the major power projects in the state.

Figure 1.7: Per Capita Consumption of Electricity (KWh)



Source: GoI (2002:c)

Table 1.37: Electricity Consumption by Different User Groups in Maharashtra

Year	(Per cent of Total)				Total (Mn KWh)
	Domestic	Commercial	Industry	Agriculture	
1960-61	9.6	7.3	68.1	0.6	2722
1970-71	9.6	7.2	69.4	4.7	7650
1980-81	12.7	6.8	57.9	12.3	14034
1990-91	16.9	6.9	49.1	22.0	29971
2000-01	18.1	15.0	40.6	26.3	41598
2001-02	25.7	9.5	37.6	18.8	46338
2002-03	24.6	9.3	36.4	21.3	49945

Source: GoI (2002c), MEDC (2000), GoM (2004)

Table 1.38: Major New Energy Projects

Project	Capacity
Thermal Generation Projects of MSEB	
Parli TPS Extension Unit 1 (1 x 250 MW)	250 MW (synchronisation by July 2006)
Paras TPS Expansion Unit 1 (1 x 250 MW)	250 MW (synchronisation in year 2006 – 07)
Khandwa 400kv, sub-stn: 400, 120 ckm by 2005	
Parli TPS Extension Unit 2 (1 x 250 MW)	250 MW (synchronisation by July 2006)
Paras TPS Expansion Unit 2 (1 x 250 MW)	250 MW (synchronisation in year 2006 – 07)
Khaperkheda TPS Expansion (1 x 500 MW)	500 MW
Bhusawal TPS Expansion (2 x 500 MW)	1000 MW
Umred TPS (2 x 250 MW	500 MW
Wani TPS (2 x 500 MW)	1000 MW
Nashik TPS Expansion (1 x 500 MW)	500 MW
Gas	
Uran Gas Turbine Power Station Expansion	400 MW (synchronisation in year 2006 – 07)
Others	
Tarapur atomic power	2500 MW (synchronisation by 2006-07)

Source: MSEB (2003)

Non-Conventional Energy

Maharashtra ranks second in the country in production of power from renewables having around 638.7 MW installed capacity (including Small Hydro), which is 4.43 per cent of total installed capacity in the state. There is a large potential in the non-conventional energy sources sector, which can be tapped, biomass being one such major source. Maharashtra has agricultural or agro-industrial surplus biomass with a potential of about 781 MW distributed through the state which in turn can be harnessed to meet the increasing power demand and to improve the techno-economic scenario. A variety of renewable energy technologies have been developed and implemented during the last two decades. The Ministry of non-conventional energy sources, GoI, provides an exclusive department of financial assistance for such projects and schemes. Work on renewable energy focussed mainly on the rural areas while energy conservation practices were taken up in 379 industries in the state. Maharashtra Energy Development Agency (MEDA) implements the programmes covered under the non-conventional energy source with excellent participation of the private sector, it has been able to facilitate establishment of about 401 MW of installed capacity in wind power generation at nine different locations in the state. In the last two years, MEDA has also initiated projects with other renewable sources of energy. Bagasse based co-generation and power projects with other agricultural waste like rice husk, generation of power from industrial and urban waste etc. are other areas in which significant advancements have been made.

Energy Conservation Programme

Energy conservation programme includes energy audits of various industrial establishments to identify inefficient use of energy and to suggest ways and means to conserve energy. Seven energy audits were conducted which resulted in saving energy in the post audit period. The performance with regard to other important schemes implemented by MEDA is shown in Table 1.39.

Table 1.39: Performance with regard to schemes implemented by MEDA

Items		During 2003-2004	Since inception upto the end of March, 2003
Installed capacity of power generation from Renewables (MW)	1.Wind Energy Power Projects	2.0	401.4
	2.Biomass Power Project	-	6.0
	3.Bagasse Co-generation	11.5	32.5
	4.Industrial waste	6.1	6.1
Solar Thermal Programme	1.No. of solar cookers sold	1000	46,287
	2.Total capacity of solar cookers (Lakh litres per day)	2.0	50.5
	3.No. of solar desalination systems installed	-	954
	4.No. of solar photovoltaic lanterns installed	300	8,677
	5.No. of solar photovoltaic battery charges distributed	-	310
	6.No. of solar photovoltaic sprayers supplied	-	179
Bio-gas programme	1.No. of community bio-gas plants installed	-	72
	2.No. of institutional bio-gas plants installed	3	35
	3.No. of night-soil based bio-gas plants installed	27	351
Bio-mass Gasifier Programme	1.No. of improved crematoria	208	1021

Source: GoM (2004)

Some of other conservation measures are as follows:

- Restricting and limiting the usage of electricity between 17.00 hours and 23.00 hours of cinema house, major commercial establishments and commercial complexes for at least 2 days in a week on a rotational basis.
- Restricting the timings of industrial units operating on single or double shift basis so as to avoid usage of electricity between 17.00 and 23.00 hours.
- Restricting electricity supply to shops only upto 5 pm.
- Banning use of neon-signs and heavy lighting, illuminated hoardings and flood lightings
- Change of timings into single and double shift operating industries so as to restrict the use of power by such industries (GoM, 2005).

Industrial Sector

Maharashtra, occupies a significant position as far as the manufacturing sector in the country is concerned. The major manufacturing industries located in Maharashtra includes refined petroleum products, other chemical products, and basic chemicals, manufacturing of Jewellery, musical instruments, sports goods, games & toys etc., spinning, weaving and finishing of textiles, other food products, sugar, cocoa, chocolates, noodles etc., basic iron & steel and motor vehicles. The principal industrial zone in Maharashtra is the Mumbai-Thane-Pune belt, accounting for almost 60 per cent of the State's output. Efforts are being made to promote other industrial areas like Nagpur, Nashik, Aurangabad, Solapur, Jalgaon, Raigad, Amravati and Ratnagiri, by building the necessary infrastructure and creating an environment conducive to industrial development. Table 1.40 gives the district-wise information on industries.

The state is grouped into seven industrial regions, namely, such as Greater Mumbai, Konkan, Pune, Nashik, Aurangabad, Amravati and Nagpur.

- The Greater Mumbai and Peripheries of the Suburbs in Thane and Raigad Districts.

This is one of the most important industrial zones of India because it is located near the Gateway of India-commercial and economic capital of India. More than fifty per cent of the factories and manpower are concentrated in this region. Textile w as the largest group in the initial stage of development of industries but now engineering, chemical, transport, software and electronics are also other leading groups. Industries have dispersed from Mumbai to Thane, Kalyan, Ambernath, Badlapur and Panvel complex. On the Western railway line this belt stretches up to Tarapur, Dahanu and touches the border of Gujarat state.

- Mumbai-Pune Corridor and Greater Pune

Outside Mumbai -Thane industrial region, Panvel is the main industrial centre on Mumbai Bangalore and Mumbai-Panaji national highways. Khopoli has developed at the base of Sahyadri as the complex of engineering, chemical, paper pulp and many small-scale industries. Tata hydroelectric power generation station supplies ample electricity to the neighbouring region. A new industrial complex is coming/has come up at Pimpri-Chinchwad near Pune extending up to Talegaon. Large factories producing machines, automobiles, electrical and electronic goods, plastics and pharmaceuticals are located along the Pune-Ahmednagar, Pune-Solapur and Pune-Satara roads. All these have spread out from the fringe of the old city.

- Solapur Textile Zone

Solapur and Barsi are cotton textiles centres in S E Maharashtra. They have specialised in power looms. Maharashtra Industrial Development Corporation has developed many centres in Sangli, Kolhapur, Ichalkaranji, Madhavnagar and Miraj in Southern Maharashtra.

- Western Tapi Valley Industrial Zone

Agro-based industries have developed in the Tapi valley. Cotton, groundnuts, banana and sugarcane are the agricultural raw materials in Khandesh (Dhule and Jalgaon districts). Recently MIDC areas are developed near Dhule and Jalgaon.

- Eastern Tapi Valley Industrial Zone

This is the cotton-producing zone. Berarsi, Achalpur and Badnera are the leading industrial centres situated near the central railway line in the districts Amravati, Akola, Wardha, Chandrapur and Nagpur. Near Kamptee-Nagpur mineral based industries are well developed due to local coal, limestone and manganese mines. Here, engineering, transport equipment, cement and metal product manufacturing industries are located.

- Krishna –Panchganga Basin Industrial Region

This is a unique triangular agro based region in Maharashtra. The region has industries like sugar and cotton textiles in Kolhapur and Ichalkaranji. Units producing agricultural implements, oil engines, spare parts of engines and transport vehicles have developed near Jaysingpur and Miraj.

- Pravara-Nira Valley Region

This is a prosperous belt of sugar industries with Baramati, Phaltan, Koparagaon, Sangamner and Belapur as main centres. MIDC has developed small-scale industries and infrastructure.

- Upper Godavari Valley Industrial Belt

This is the extension of Pune industrial region. Many industrial plants mostly electronics and agro based are predominant in and around Nashik have developed.

- Konkan Industrial Region

After the establishment of MIDC industrial activities took place in Raigad, Ratnagiri and Sindhudurg districts. Taloja, Roha, Patalganga, Mahad, Nagothane and Nanore in Raigad district; Chiplun, Loteparshuram, Ratnagiri, Dapoli and Sangameshwar in Ratnagiri and Kudal in Sindhudurg district have developed near Mumbai-Goa national highway and Konkan railway line.

Table 1.40: District-wise information on Industries

Districts	Major Industries
Ahmednagar	Handloom, & power loom, engines, pharmaceuticals, sugar factories
Akola	Ginning and pressing, handlooms, textiles, weaving, edible oils, thermal power station
Amravati	Chemicals, fertilisers, pulse mills, sugar factories, handlooms, oil mills, pharmaceuticals, edible oils
Aurangabad	Himru shawls, silk sarees, Paithani sarees, bedsheets, sugar factories, scooters
Beed	Oil mills, sugar factories, handlooms, clay ware
Bhandara	Beedi-making, handloom, woodcutting, purification of manganese
Buldhana	Ginning and pressing, handloom, oil mills
Chandrapur	Rice mills, handlooms, woodcutting, plywood, ginning and processing, glass, paper, cement, manganese
Dhule	Vegetable oils, brass and copper utensils, woodcutting, sugar factories, textile mills
Gadchiroli	Handlooms, rice mills, Kosa sarees, paper mills, Manglori sheets
Jalgaon	Silk, sugar industries, vegetable oil, ginning and pressing
Jalna	Seed production, ginning and pressing, pulse mills, sugar factories, Beedi-making
Kolhapur	Kolhapuri chappals (footwear), silver jewellery, powerloom, film production
Latur	Oil mills, nutcrackers, locks, stoves, brassware, milk powder, ginning and pressing
Mumbai	Automobiles, computers, motor cars, electrical goods, chemicals, pharmaceuticals, film industry, salt pans
Nagpur	Textile mills, weaving and spinning, ferro-manganese, cement pipes, medicines, handlooms, offset

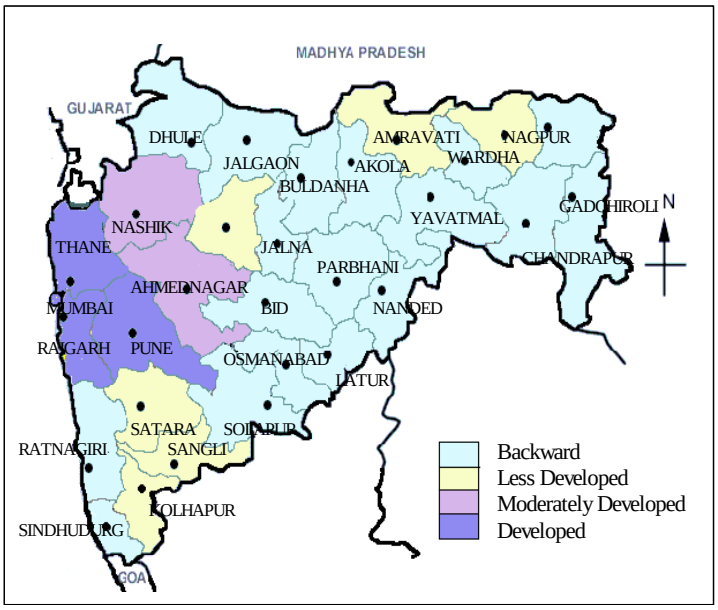
	printing
Nanded	Woodcutting, ginning and pressing, oil mills, sugar industries
Nashik	MIG planes, sugar factories, Beedi-making, currency notes, toffees
Dharashiv	Oil mills, sugar industries, handlooms, clayware
Parbhani	Handloom, ginning and pressing, weaving
Pune	Automobiles, radio, television, pharmaceuticals, glassware, sugar factories
Yavatmal	Ginning and pressing, handmade paper, weaving, oil mills, nylon ropes
Wardha	Textile mills, weaving, ginning and pressing, handloom, leather tanning, explosives, urea
Thane	Textiles, chemicals, oil refining, plastic, radio, matches, salt pans
Solapur	Textile, sugar factories, handlooms, vermillion
Sindhudurg	Salt pans, glass, wooden toys, stainless steel, cashewnut, mango processing
Satara	Scooters, medicines, honey collection, sugar industries, suitcases
Sangli	Textile mills, diamond cutting, sugar industries, turmeric godown, nutcrackers, musical instruments
Ratnagiri	Heavy industries, chemicals, ship-building, medicines, fruit and fish canning
Raigarh	Salt pans, fertilisers, chemicals, corn
Washim	-
Gondia	-
Hingoli	-
Nandurbar	2 Spinning mills, 3 Sugar factories, 346 Registered and running factories

Source: Infochange, 2005

Spread of Industrialisation

The geographical spread of industrialisation is assessed on the basis of the nature and extent of facilities and incentives provided by the state government. Figure 1.8 shows the level of industrialisation, which is categorised into four types viz: Backward, Less Developed, Moderately developed and Developed. It is noticed that industrialisation has happened in and around Mumbai. The districts of Pune, Thane and Raigad are the developed districts with a few less developed pockets. Nashik and Ahmednagar are moderately developed while Satara, Sangli, Kolhapur, Aurangabad, Amravati and Nagpur are less developed. The rest of Maharashtra is categorised as backward.

Figure 1.8: Spread of Industrialisation



Source: MSDR, 2005

Clusters of Industries

Maharashtra has the highest number of industrial clusters (66 including 55 modern ones) of which the important ones are:

- Auto components in Pune and Aurangabad.
- Basic Drugs in Mumbai, Thane-Belapur, Pune- Tarapur.
- Cashew Processing in Sindhudurg, Vaugurla Ratnagiri.
- Chappals in Kolhapur.
- Cottonseed oil in Akola Amravati.
- Electronics in Pune and Mumbai.
- Raisins in Nashik and Solapur.
- Pharmaceuticals in Aurangabad.
- Powerloom in Bewandi Malegaon, Bhivandi and Nagpur.
- Readymade garments in Pune, Nagpur, Mumbai.
- Rice Milling in Bhandara, Chandrapur and Gadchiroli.
- Steel Furniture in Nagpur and Nashik.

There are 226 functioning industrial areas in MIDC, of which 8 are five star units, 74 major, 61 minor industrial areas and 39 growth centres. *Five star* industrial areas have high quality infrastructure and amenities including external and social infrastructure and comprehensive waste management. *Major* industrial areas have a land area of 20 hectares or more. *Minor* industrial areas have a land area of upto 20 hectares. *Growth centres* are so declared by the government in order to give a higher priority for development of these locations and are eligible for higher incentives.

The five star industrial areas in Maharashtra include Nandgaon Peth (Amravati), Nanded (CGGC) Kushnur, Shendre and Waluj (Aurangabad), Kagal Hatkanangale (Kolhapur), Butibori (Nagpur), and Additional Sinnar (Musalgaon) near Nashik. Category–wise distribution of these areas is given in Table 1.41.

Table 1.41: Category wise Distribution of Industrial Areas at Different Locations in the State

Locations	Categories of Industrial Areas			
	Five Star	Major	Minor	Growth Centres
Amravati	1	6	24	8
Aurangabad	3	11	13	5
Kolhapur	1	13	9	4
Mumbai	-	17	-	1
Nagpur	1	8	11	8
Nashik	1	6	3	6
Pune	1	13	1	6
Total	**8**	**74**	**61**	**39**

Source: MIDC (2005)

Information Technology (IT) Parks

In order to promote an all-round growth of the IT industry and to tap the potential of abundant and varied IT skills available throughout the state, the GoM has undertaken several key initiatives. Several IT parks and facilities have been developed throughout the state in Aurangabad, Ahmednagar, Nagpur, Latur, Kolhapur, Nashik, Sangli, Solapur (Figure 1.9).

Kalyan	32	38	938	3	5	352	5	7	1043	2423
Kolhapur	62	97	545	18	7	939	1	3	5927	7599
Mumbai	57	32	634	21	26	351	3	19	3806	4949
Nagpur	108	111	738	8	36	1842	3	5	3104	5955
Nashik	146	65	571	12	19	487	13	21	7258	8592
Navi-Mumbai	106	31	768	8	12	358	2	4	1101	2390
Pune	206	129	1067	32	87	1426	40	82	3436	6505
Raigad	75	68	130	11	22	222	1	8	400	937
Thane	32	82	961	34	9	333	4	6	3686	5147
Total	**979**	**766**	**6867**	**157**	**279**	**8418**	**77**	**163**	**35364**	**53070**

Source: MPCB (2004)

Maharashtra's coast has a well-developed petroleum industry, which attracts different chemical units. In fact, the state accounts for one-fourth of the national annual turnover of the chemicals sector. As industrialisation started resulting in high GDP and revenues, the state began paying a heavy cost in terms of environmental degradation, particularly due to the massive concentration of the chemicals industry and blatant dumping of hazardous chemical wastes into the sea. Further, according to the reports of MPCB, almost every major town in the state is plagued by problems of air pollution, making the quality of air unsuitable for breathing and ever increasing the health costs, which run into several crores. The state has been reporting the highest number of accidents related to chemicals since 1985, followed by Gujarat, according to the MoEF. The MPCB indicates that 80 per cent of the units in the state pollute water, while 15 per cent pollute the air. Of the 83,000 industrial units in the state, 50 percent are in the chemicals, fertilisers and textiles sectors (Down to Earth, 2000).

Dombivli is an industrial township in Thane district of Maharashtra. This small town with a big industrial estate, comprising some 50 chemical units manufacturing dye intermediaries, is perpetually engulfed in smog. The residents are the most affected and complain that the factories emit gases at night and discharge effluents openly into the drain passing through their colonies. In fact, the people residing in areas surrounding the industrial estates keep their windows and doors bolted at night, for the fear that factories may discharge poisonous gases. Though the MIDC is supposed to establish a Common Effluent Treatment Plant (CETP) and the industrial units have to treat their effluents, visits to at least 15 units showed that they discharge effluents in open drains. Hazardous wastes in the shape of sludge are dumped in open fields besides residential colonies and during the monsoons, the rainwater often brings these chemicals into the houses. The most common health problems among the residents here are respiratory and skin disorders. The MPCB says the air quality here is as poor as Chembur and central Mumbai, but the pollution here is solely due to industries. "The town has become a huge dumping ground for chemical units operating on obsolete technology," says director of the International Institute for Sustainable Future, Mumbai, who conducted a survey in the area (Down to Earth 2000).

There are 165 total industries (large & medium) in the state, which generate different types of waste including industrial effluents (0.08 million m^3/d) and industrial solid waste (about 2628 tpd)(MSDR, 2005). In Maharashtra, by March 2003,out of a total of 335 polluting industrial units, 24 units were shut down due to violations of pollution norms. Among the 311 industrial units operating 5 units do not possess the infrastructure for complying with standards (MSDR, 2005).

Figure 1.9: IT Parks of Maharashtra

Source: MITP (2005)

Industrial Pollution

Industries are essential for the economic development of the state, however, the resultant industrial pollution is responsible for health hazards and environmental degradation. In terms of pollution, there are three main categories of industries as explained below.

Green: Only those industries that are non-obnoxious and non-hazardous and that do not discharge industrial effluents of a polluting nature.

Orange: Industries with proper Environmental Assessment and adequate Pollution Control Measures in sites that have been approved by the Ministry of Environment & Forests, Government of India.

Red: Industries that are highly polluting.

Around 8,612 are categorised under Red industries, 8,854 under Orange and 35,604 are Green industries as assessed by MPCB in 2003-04. District-wise classification of industries in the state, based on the level of pollution generated by them is given in Table 1.42. In Thane most industrial areas fall within the residential ones and this has a direct impact on the health of the residents. About 25 per cent of the industries are of chemical type. Wagle Industrial Estate is the only planned Industrial estate in this city (TMC, 2003-04). Due to this, environmentalists are threatening with complaints and PIL to shut down the polluting industries to protect the environment. From the said facts the economy cannot afford to shut down these industries on environmental reasons. Neither the present level of environment can tolerate further pollution due to these industries. The only choice, therefore left, is to rigorously pursue the pollution abatement measures in such polluting industries.

Table 1.42: Region-wise Classification of Industry by Red, Orange and Green in Maharashtra (2003-04)

	Red			Orange			Green			Grand
Region	**LSI**	**MSI**	**SSI**	**LSI**	**MSI**	**SSI**	**LSI**	**MSI**	**SSI**	**Total**
Amravati	41	27	224	3	10	1265	1	-	1955	3526
Aurangabad	114	86	291	7	46	843	4	8	3648	5047

Steps by MPCB

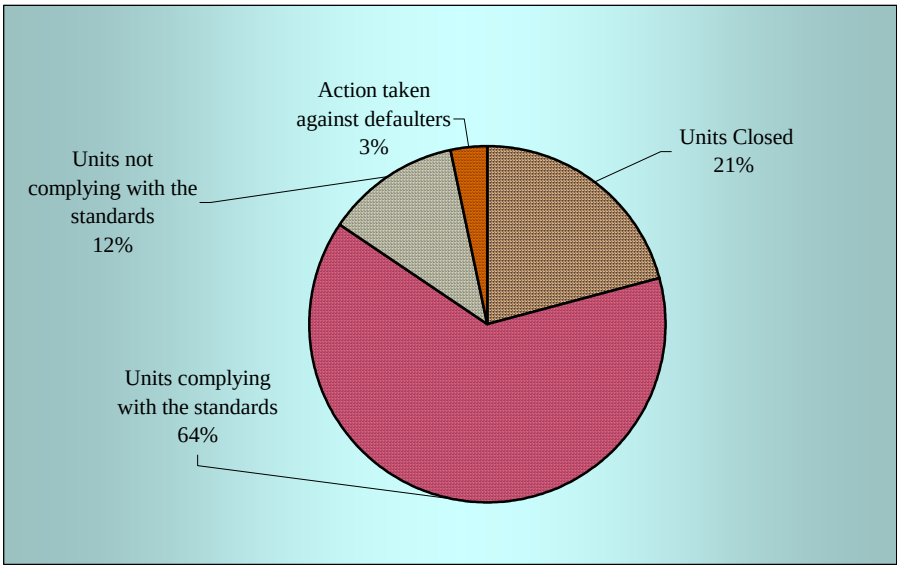
Despite strict enforcement of regulations, by the concerned authorities against defaulting industries there are still some industries, which are not complying with the standards. As reported by the MPCB out of total 866 investigated about 64% were complying with the standards, 21% defaulting units were closed, 12% were not complying with the standard and some action initiated against 3% of them as shown in Figure 1.10. The region-wise status of Industrial units in Maharashtra is given in Table 1.43.

Table 1.43: Region-wise Status of Industrial Units in Maharashtra

Region	Total Units	Units Closed	Compliant Units	Non-Compliant Units	Action taken against defaulters
Mumbai	19	6	13	-	-
Navi - Mumbai	48	13	35	-	-
Thane	54	14	38	2	1
Raigad	69	3	40	26	-
Kalyan	19	4	15	-	-
Pune	79	10	43	26	15
Nashik	135	38	96	1	1
Nagpur	49	2	10	37	7
Amravati	27	6	19	2	1
Aurangabad	83	16	58	9	4
Kolhapur	284	75	203	6	1
Total	**866**	**187**	**570**	**109**	**30**

Source: MPCB (2005)

Figure 1.10: Status of Industries in Terms of Enforcement of Regulations



Source: MPCB (2005)

Regulation of Consent

Industries, local bodies, hospitals, development projects etc. covered under the environment protection regulation are required to obtain NOC/Consent/Authorisation from the MPCB before commencement of projects. In order to facilitate project proponents, the MPCB has introduced the *"fast track system"* for disposal of applications in an expeditious manner. The MPCB is taking action on consent applications at a much faster rate. Quick disposal of applications for consent and friendly regulatory system are the important factors in attracting investment in the State. Recent data shown in Box 1.2 shows the enormity of task handled by the MPCB

Box 1.2: Consent on Applications by MPCB

Consents / Authorisation to the industries	50,000
Authorisation to local bodies	250
Authorisation for bio-medical wastes	10,394
Assessment under Water Cess Act	5,600

Source: MPCB, 2005

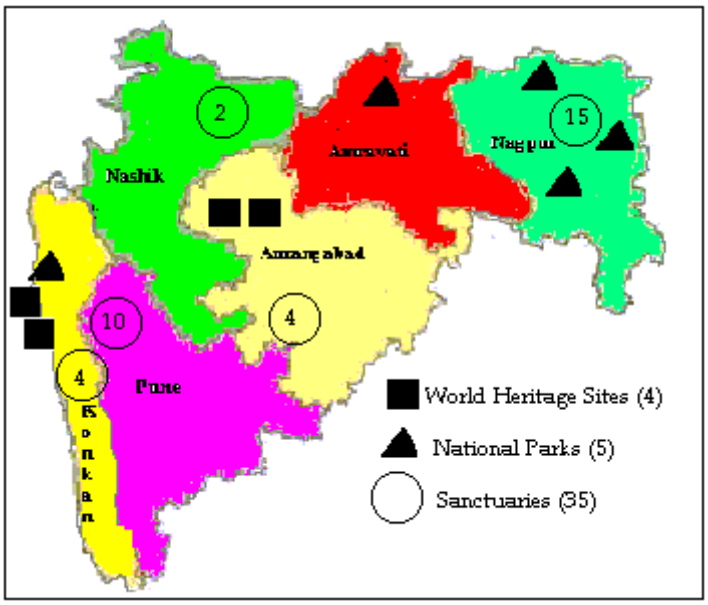
Tourism and Heritage

Maharashtra has recognised tourism as a major thrust area for economic growth in the state. The Budget 2002-03 for Tourism and Investment Incentive Package 1999 gives clear indications that the GoM realises the potential of tourism for wealth creation and employment generation. In 2001, Maharashtra received the highest numbers of international tourists and emerged as India's second most used port of entry. At the same time in the domestic tourist arrivals, the state ranked fourth amongst other Indian states. The Travel and Tourism Industry including transport, storage & communication, trade, hotels and restaurants accounted for around 20-22 per cent of the GSDP and 3.5 per cent of the state's employment. The government's promotion and development initiatives to harness Maharashtra tourism potential reflect the state's commitment to this industry.

In Maharashtra, the three world heritage sites located in the Sahyadri Mountain Range are the Ajanta and Ellora caves (Aurangabad) which were built more than 2000 years ago and the Elephanta caves (Mumbai) built more than 1300 years ago. The Konkan coast consists of scenic beaches like Ganpatipule and Guhaghar. Other fascinating tourist spots include the Bassein fort, Gateway of India, Afghan Church and the University with the Rajabai clock tower, the shrine of Haji Ali, Bibi Ka Makbara. Daulatabad, near Aurangabad, has an impressive medieval fortress on a pyramid-shaped hill. In it's the capital city of Mumbai, few of the main beaches are Alibaug, Aksa, Chowpaty, Erangal, Gorai, Juhu, Madh, Marve, Elephanta, Manori and Versova. Nashik on the banks of river Godavari is one of the ancient holy cities consisting of temples built in the 11th century by the Chalukyas.

Paradoxically however, along with the growing recognition of the importance of Travel & Tourism by the GoM, there seems to be a lack of appreciation of its scope, complexity and dynamism. This industry works beyond the local boundaries at a global level bringing together diverse industries and stakeholders. It encompasses the development of other areas of economic activity, as well as growth in the social and environmental context. Figure 1.11 shows the World heritage sites (3), National parks (5) and sanctuaries (35) in Maharashtra. The number within circle represents the number of sanctuaries in the corresponding region (MFD, 2005).

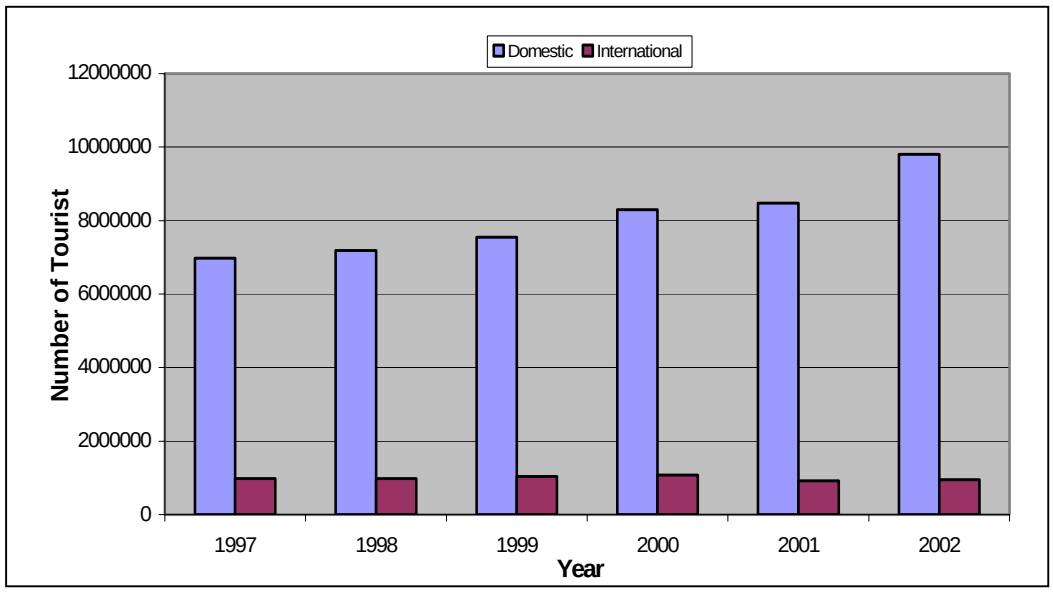
Figure 1.11: World heritage Sites, National Parks and Sanctuaries



Source: Compiled by IGIDR (Data source: Various Depts of GoM)

Mumbai's CSIA is the second most utilised international airport in India catering to 26 per cent of foreign tourists, after Delhi. The government of Maharashtra realises that out of the 1.08 million tourists visiting Maharashtra, only 5-6 per cent of foreign tourists move on to other tourist destinations in the state. Out of the total tourists visiting tourist destinations in Maharashtra, only 10-12 per cent are of foreign origin and not many of the 26 per cent of all foreign tourists who enter the country through Mumbai, spend time or money in the State. Maharashtra's share in total domestic tourist arrivals in India is 3.6 per cent. Out of the total tourist visiting Maharashtra, about 15-20 per cent from other Indian states. The majority in Maharashtra contains domestic tourists from within the state. Figure 1.12 indicates the total number of tourist arrivals between 1997-2000.

Figure 1.12: Tourist Arrivals in Maharashtra (1997-2002)



Source: GoM, (2003b)

Major national and international hotel chains – including Taj, Oberoi, Le Méridien, Best Western, Hyatt and ITC have already established hotels and resorts in the state. The latest year for which a detailed breakdown of hotel accommodation supply is available is 2000. As shown in the Table 1.44 most development has been in the one- to three-star categories.

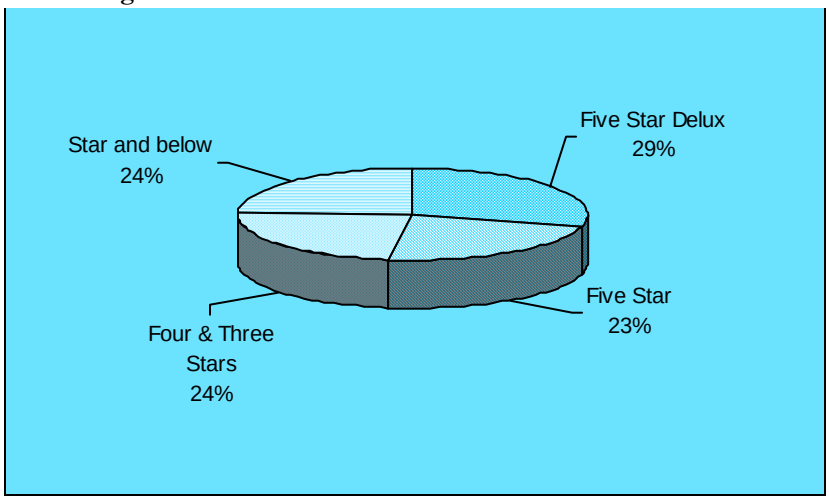
Table 1.44: Maharashtra's Classified Hotel and Room Capacity, 2000

Category	No. of Hotels	No. of Rooms
5-star deluxe	13	4064
5-star	14	1795
4-star	15	1097
3-star	50	2295
2-star	83	2564
1-star	47	1368
Heritage resorts	1	22
Unclassified	19	667
Total	**242**	**13854**

Source: IHR, 2000

Mumbai, Maharashtra's most prominent destination had 93 government-registered hotel establishments comprising 7,003 rooms, as of March 2000. Figure 1.13 indicates the percentage of rooms in different categories of hotels in Mumbai. Table 1.45 shows the average occupancy of hotels in major cities of Maharashtra compared to that of India.

Figure 1.13: Hotel Accommodation Available in Mumbai



Source: IHR, 2000

The role of tour operators in Maharashtra has been limited. According to statistics available till 2000, there were 24 tourist transport operators, 78 travel agents and 24 tour operators approved by the Ministry of Tourism in Maharashtra. International tour operators like Cox and Kings, Thomas Cook and national leading operators like Sita Travels, Raj Travels, Raja Rani tours have offices in Mumbai, though they mostly cater to outbound market and national market. Niche tour operators

for Maharashtra are very local and offer basic packages for travelling to religious and heritage destinations here. Recently, with a view to increase the role of the private sector, a joint task force, focusing on private-public sector partnership, is being set up with major industry players and other stakeholders as members, to act as advisors to the state government with regard to tourism development activities (Fig 1.14).

Table 1.45: Major City-wise Average Occupancy of Hotels in India (Per centage)from 1998-2002

City	Average Occupancy			
	1998-99	1999-00	2000-01	2001-02
India	52.4	51.7	55.6	53.2
Mumbai	62.0	59.5	66.1	63.8
Pune	61.6	58.3	58.1	58.0

Source: IHR (2003)

Table 1.46 shows a fairly stagnant number of domestic visitors to Ajanta, Ellora and Elephanta caves in Maharashtra, adding to the fact that Maharashtra attracts only 3.6 per cent of the domestic tourists in India.

Table 1.46: Number of Domestic Tourist Visits to World Heritage Monuments from 1999 to 2002 (In Lakhs)

World Heritage Monuments	1999	2000	2001	2002 (upto May)
Ajanta Caves, Maharashtra	2.7	3.0	2.9	1
Ellora Caves, Maharashtra	5.2	5.9	4.8	1.5
Elephanta Caves, Maharashtra	2.6	2.8	2.7	1.2

Source: IHR (2003)

Sustainable tourism is an approach that has found much favour recently, both in the academic and the business world. The WTO, WTTC, IH&RA amongst others, have taken a keen interest in harnessing its use in tourism. The National Action Plan for Tourism has identified 21 travel circuits, 12 destinations and 33 pilgrim centres which include destinations/places of tourism potential in remote/hilly areas for intensive development through the joint efforts of Central and State Governments and the private sector in order to strengthen infrastructure facilities. From Maharashtra, the travel circuit of Raigad Fort -Janjira Fort-Kuda Caves, Sirivardhan, Harihareshwar, Sindhudurg, the destination of Ajanta-Ellora (Aurangabad) and Pilgrim Centres of Shirdi, Nanded and Jyotiba have been identified. The government has played a central role in tourism for Maharashtra, while that of the private sector has been more than supportive.

In Maharashtra, the primary government agency responsible for the growth and development of tourism is Maharashtra Tourism Development Corporation (MTDC), which since its inception is working to boost the tourism industry in the state undertaken with the main thrust, to market Maharashtra as a premier global tourism destination, thereby generating employment and enhancing productivity through tourism, the award-winning promotion campaign - 'Maharashtra...Unlimited', has been created by MTDC to highlight the unlimited potential of the state.

It has also commissioned many master plans for various regions of Maharashtra such as Sindhudurg, Vidarbha, Ajanta-Ellora, and other forts. MTDC's budget outlay for tourism has increased ten-fold as compared to its previous budget. Its present budget of Rs. 101 crores has been segregated as – Rs. 55 crores has been allocated for Ajanta Ellora, Rs. 12 crores for Ashta Vinayak, Rs. 5 crores for the Konkan Riviera, Rs. 5 crores for wildlife and eco-tourism in the Vidarbha region and Rs. 10 crores for Shivneri. In addition, Rs. 7.95 crores has been sanctioned purely for publicity and promotion, a seven-fold increase over last year.

Major Tourism Projects

Ajanta -Ellora Project

Impressed by the successful completion of phase-I project on conservation and development of world heritage sites, Ajanta and Ellora, assisted by Japan Bank of International Cooperation (JBIC), the Bank has approved assistance for phase-II of this project. This phase of the project focuses on integrated development of infrastructure around the site and expected to be completed by the end of June 2008. The details of work on Ajanta-Ellora Development Project Phase-II are given in Table 1.47.

Table 1.47: Figure lay out of Ajanta -Ellora Conservation and Development Project Phase II

Scope of Work	Base Cost (Million Yen)	Deadlines	Implementing Agency
Monuments Conservation	901	December, 2007	ASI
Improvement of Aurangabad Airport	1,487	March, 2007	ASI
Afforestation	35	March, 2007	Forest Department
Improvements of roads	454	March, 2008	PWD
Water Supply at Tourist Attractions	120	March, 2005	Maharashtra Jeevan Pradhikaran
Tourist Complex	1,303	June, 2008	MTDC
Public Awareness Activities	739	March, 2008	MTDC
Human Resource Development	23	June, 2006	MTDC
Computerisation of Tourist Information	44	June, 2006	MTDC
Microcredit	12	June, 2008	MTDC
Lonar Conservation and Development	62	December, 2006	MTDC
State Archaeological Monuments	22	December, 2006	MTDC
Additional sub projects in vicinity of Buddhist caves circuit	580	June, 2007	MTDC
Contingency	661		
Consulting Services	413	June, 2008	MOT

Interest During Construction	475		

Source: PIB 2003

Luxury Tourist Train in Maharashtra (2002-03)

- The Department of Tourism has sanctioned an amount of Rs.8.49 crores for Luxury Train in Maharashtra under the scheme of Assistance for Large Revenue Generating Scheme. The aim of the scheme is to showcase the tourist assets of Maharashtra including the pristine beauty of the Konkan coast, Art, culture, heritage and local flavour of the region like Malvani cuisine, skills, and performing arts.

Tourism Projects sanctioned during 2003-04

- Development of Foot Hills at Ajanta Caves
- Development of Pandharpur, Dehu and Alandi (PIB 2003).

A study conducted on Tourism concludes that there is a greater awareness in the policy makers towards the revenue earning potential for their respective states. Thus, state of Maharashtra has increased its budgetary allocations for promoting tourism in the state by ten times from 10 crores in 2002-03 to 101 crores in 2003-04.(PHDCCI 2004).

Chapter 2: Water Resources and Sanitation

Introduction

More than 97 per cent of the world's water resources occurs in the form of oceans and only about 2.7 per cent as fresh water bodies including both surface and ground water resources. Thus, fresh water occupies a very small portion of the total water on the Earth in which rivers and lakes do not even get counted as they contribute to a negligible amount (0.014 percent) of all fresh water. Chemically, water is H_2O and since it is regarded as a universal solvent it never exists individually in nature. Nor it is desirable in its purest form as some components like minerals, salts, etc. are required from the health point of view. If any one or more components of water exceed the prescribed limits, it causes water contamination.

Acute shortage of drinking water is probably the most important issue in India. Millions of villages in the country have become water-scarce or no-source villages. The National Water Policy (NWP) gives highest priority to drinking water but despite more than five decades of planning, much lesser than the expected has been achieved. More than three-fourth of the rural population still does not have proper water supply systems. In the urban areas, quantities delivered are inadequate and the service is unreliable, mostly intermittent, resulting in wastage of water. Although, on an average, the country gets enough rainfall each year, it is unequally distributed. As a result, same region could be affected by drought in one year and by flood in another. Continuous droughts affect many parts of the country due to both natural and man-made reasons. Natural reasons of droughts are wide variations in rainfall and inequitable distribution of perennial rivers in various parts of the country. Man-made reasons are improper water management like excessive groundwater extraction, inefficient use and wastage of water, absence of rainwater harvesting, etc. This has resulted in a sharp decline in the ground water table, which in turn, has increased salinity in coastal areas. On the other hand, several regions in the country remain flood affected every year and measures for flood plan zoning and disaster preparedness are inadequate.

Broadly, there are two kinds of uses of water- abstractive use and in-stream use. The former includes domestic, industrial and agricultural uses while the latter refers to hydropower, fisheries, navigation, community bathing and washing and cattle bathing and watering. Ground water exploitation is divided into three categories. Category I consists of lesser than 65 per cent, Category II lies between 65 to 85 per cent and Category III consists of more than 85 per cent of exploitation of the annual utilisable groundwater resources. In respect of quantity, India has a precipitation of about 4000 km^3 but most of it is lost through evaporation, transpiration and surface flow and only 700 km^3 can be put to any beneficial use. Taking into consideration all inland resources (rivers, canals, reservoirs, tanks, lakes and ponds, derelict water and brackish water), Orissa has the largest area of water bodies followed by Andhra Pradesh. According to the Ministry of Water Resources (MoWR) in 2001-02, nearly 25 billion cubic meters (BCM) was used for domestic, 460 BCM for irrigation and 40 BCM for industry purposes, in the country. Inefficient use and misuse of water in all sectors are the major problems in the country.

Due to lack of education, awareness and civic sense and use of inefficient methods and technology, more than 50 per cent of water is wasted in domestic, agriculture and industrial sectors. Widespread water pollution and contamination is making much of the available water unsafe for consumption. Both negligence of authorities and lack of willingness of people are responsible for deteriorating quality of water resources. Due to inefficient work on operation and maintenance (O&M), inadequate quality and substantial leakage and unaccounted for water (UFW) levels are observed. While data on actual leakage levels do not exist in most cases, it is estimated to be in the range of 40 to 55 per cent. For example, as per studies by NEERI, the physical leakages in areas of Pune were found to be 43 per cent, while 6.2 km transmission lines in Kolhapur was found to be leaking at 17 locations, and Nagpur experiences 55 per cent of such leakage.

In addition to water scarcity, quality of water is also to be considered relative to the proposed use of water. The release of domestic wastewater, agricultural run-offs and industrial effluents promote excessive growth of algae in water bodies, which result in their eutrophication. Further, these wastewaters containing high organic matter use up the dissolved oxygen (DO) in water resulting in oxygen depletion thereby threatening the survival of aquatic life difficult. Pathogenic pollution or microbiological contamination of water due to mixing of untreated wastewater is the main cause of disease and even mortality in India. Groundwater quality is also a serious issue as about 85 per cent of India's population depends on it for drinking and other domestic uses. Leaching of toxic chemicals into the groundwater on account of contamination and over-exploitation is visible in many parts of the country.

Status of Water Resources

Safe and regular water supply is a necessary aspect of development process. Just as surface water is stored in the form of tanks, reservoirs, lakes within the river or drainage channels, groundwater is stored in the aquifers. This section describes the status of various surface and gound water bodies in the State.

Surface Water Resources

As shown in Table 2.1, the quantity of inland water resources in Maharashtra is about 3.39 lakh ha, which accounts for only 4.93 per cent of the total inland water resources in the country. Since the state has more than 9 per cent of the country's population, it indicates that the per capita water availability in the state is lower than the national average. Rivers and lakes are the main sources of surface water in the State. Table 2.2 gives details of some major and minor river basins in Maharashtra. The water flow of two major river basins (Krishna and Godavari) in the state is below the national average. While the average annual surface water potential for an Indian river is 1869 km^3/year, it is only 110.54 km^3/year for the Godavari basin and 78.12 km^3/year for the Krishna basin. With respect to the basin-wise ground water potential, total replenishable water resources are 40.65 km^3/year for Godavari and 26.41 km^3/year for Krishna (MoWR, 2003).

Table 2.1: Inland Water Resources in Maharashtra

Water Resource	Quantity
Rivers & Canals (Length in kms)	16000
Reservoir (In lakh ha)	2.79
Tanks, Lakes & Ponds (In lakh ha)	0.50
Beels, Oxbow Lakes & Derelict Water (ha)	NA
Brackish Water (In lakh ha)	0.10
Total Water Bodies (In lakh ha)	3.39

Source: GoI (2004)

Table 2.2: Major and Minor Rivers originating in Maharashtra

Major Rivers	Area	Length (km)	Catchment Area (km^2)
Godavari	Nashik	1465	312812
Krishna	Mahabaleshwar	1401	258948
Minor Rivers			
Vaitarna	Nashik	171	3637
Dammanganga	Nashik	143	2357
Ulhas	Raigad	145	3864
Savitri	Pune	99	2899
Sastri	Ratnagiri	64	2174
Washishthi	Ratnagiri	48	2239

Source: MSDR, 2005

Ground Water Resources

Ground Water is the major source of drinking water in both urban and rural Maharashtra and also an important source of water for the agricultural and the industrial sectors. Water utilisation projections for the year 2000 put the groundwater usage at about 50 per cent. Being an important and integral part of the hydrological cycle, its availability depends on the rainfall and recharge conditions.

Groundwater is used as an important supplementary source of water in certain parts of the MMR, such as Vasai, Virar, Bhiwandi, Kalyan, Ulhasnagar, Thane, Alibag, Pen and Panvel areas. The coastal areas of Vasai- Virar region have a large number of wells, which supply water for domestic as well as irrigation purposes. The rapid growth of urban development in this region and inadequacy of piped water supply has led to over abstraction of water from these wells. This has resulted in the intrusion of seawater into the underground reservoir affecting the quality of the well water. Apart from this, groundwater in certain parts of the region is polluted on account of microbial contamination and excess concentration of nitrates (MMRDA, 1995). The groundwater analysis of Mira-Bhayander Municipal Corporation (MBMC) showed that the water was contaminated or harmful to health, and hence, not potable (MBMC, 2004). In Navi Mumbai, the sampling revealed

organic pollution in well waters at Belapur and Shirvane necessitating frequent controlled chlorination (NMMC, 2004). Analysis of groundwater in Ichalkaranji indicates that the water at most places is hard. When compared with the WHO and ISI guidelines for drinking water, most of the tube well water is contaminated, hence, unsuitable for drinking. The groundwater in most of the industrial and residential areas of Ichalkaranji is highly polluted (INP, 2005)

Rainfall

Distribution of rainfall is highly uneven in the State. For example, while the Konkan region receives as high as 2500 mm; Marathwada receives lesser than 800 mm of rainfall, annually. The precipitation is concentrated between the months of June and September, particularly in the Konkan and Sahyadri regions. In Central Maharashtra, though the total precipitation is much lower, it is more widely spread over the months of June to October with a noticeable maximum in September. The total rainfall steadily increases towards the East under the influence of the Bay of Bengal monsoon pattern, and hence, Eastern Vidarbha receives maximum rainfall in the months of July, August and September. The percentage of rainfall received in various regions during the monsoon of 2003, is given below in Table 2.3.

Table 2.3: Percentage of Rainfall in various Regions

Percentage of rainfall to normal rainfall	No. of Talukas						
	Konkan	Nashik	Pune	Aurangabad	Amravati	Nagpur	Total
0-40	-	3	12	1	-	-	16 (4.5 per cent)
41-80	10	13	40	28	20	16	127 (36.0 per cent)
81-100	24	7	5	30	18	24	108 (30.6 per cent)
101-119	8	7	-	12	12	18	57 (16.2 per cent)
120 and above	5	24	-	5	6	5	45 (12.7 per cent)

Source: GoM (2004)

Mismanagement of Resources

Perennial water related problems in the State are due to several reasons. Firstly, there is an accelerated growth of sugarcane, a highly water intensive crop, cultivated in areas, which get lesser rainfall than even the desert part of Rajasthan. This crop is grown on only about three per cent of total irrigated area, but consumes about 70 per cent of the water. Secondly, mismanagement of the water resources is responsible for the water scarcity. Maharashtra has the largest number of the dams in the country yet only 17 per cent of its agricultural land is irrigated. Despite ample resources and water projects and schemes, government regulations and rules are such that problems do not have solutions. For example, there are 2.20 lakh borewells, 15000 mini-water supply schemes and 18000 big water supply schemes in the state. Yet, when a farmer wants to replace his defective pump for his borewell, the regulations require that replacement of the pump and borewell has to be done together (Martyris, 2003).

From Table 2.4, it is seen that most of the districts (19 out of 35) show a decline in groundwater level during the post monsoon period over 20 cm/year and it has continued for about 20 years (1981-2000). In 2001, drought affected about 20,000 villages in 23 districts; 28.4 million people, 4.5 million hectares of crops. Several districts including Ahmednagar, Dhule, Sangli, Satara, Solapur, Beed, Dharashiv, Latur, and Nashik have been affected by severe water scarcity. About 90 per cent of the land in the state has basaltic rock, which is non-porous and prevents rainwater percolation into the ground and makes the area drought- prone (MoWR 2003; GoM, 2003).

Table 2.4: Districts showing fall in Water Table as per the Long Term Water Level Trends (1981-2000)

Fall in Water Level >4 Mts (@ > 20 Cm/Yr)	Names of Districts
Pre-Monsoon	Ahmednagar, Akola, Amravati, Aurangabad, Beed, Buldahana, Chandrapur, Dhule, Gadhchiroli, Jalgaon, Jalna, Kolhapur, Latur, Nagpur, Nashik, Dharashiv, Parbhani, Pune, Ratnagiri, Satara, Sangli, Solapur, Sindhudurg, Thane, Wardha, Yavatmal.
Post Monsoon	Ahmednagar, Amravati, Aurangabad, Bhandara, Buldhana, Chandrapur, Dhule, Gadchiroli, Jalgaon, Jalna, Kolhapur, Nagpur, Dharashiv, Parbhani, Pune, Satara, Solapur, Wardha, Yavatmal.

Source: MoWR (2003)

Water Supply Scenario

Wide disparities exist in the water supply in the urban and rural areas. As of 2000, the GoM has taken several steps to improve the water supply situation in both rural and urban Maharashtra and it is reported that more than 96 percent of urban and about 70% of rural population has been provided with public drinking water supply (GoM, 2003). As far as the urban population is concerned, more than 245 urban centres have piped water supply schemes for drinking, though the supply of water is not adequate as per the standards laid down by the GoI. The distribution of households by source of drinking water and its location is given in Table 2.5. It can be seen that in the state more than 53 percent of the households have water supply within their premises and about 64 per cent of the households get their water supply through taps (Figures 2.1 and 2.2).

Urban Situation

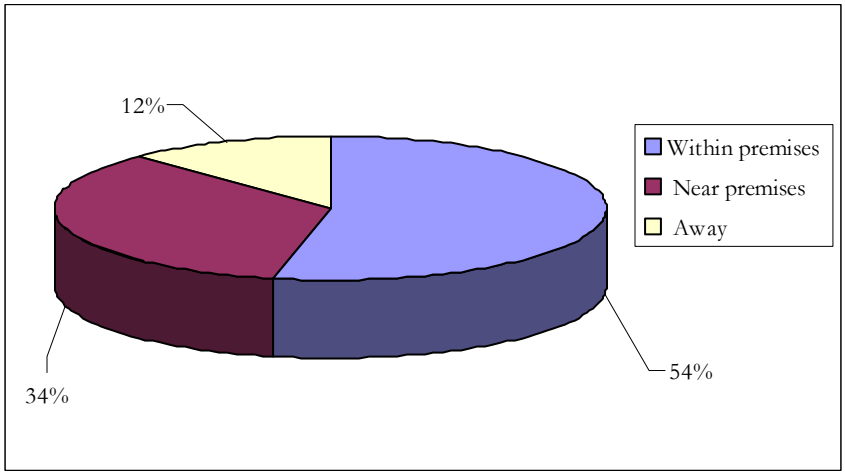
Maharashtra has about 250 urban agglomerations, comprising of 22 Municipal Corporations (MCs) and 222 Municipal Councils. The state's urban population is about 42.4 per cent, which is much more than the national average of 27.8 per cent (GoM, 2003). Mumbai, Thane, Pune, Nashik and Nagpur are among the 15 most populous agglomerations in India. Therefore, satisfying the basic needs of the urban population for water and sanitation poses a challenge for the authorities. Table 2.6 shows the water supply levels in selected urban areas of the extent to which they satisfy the standard per capita water consumption norms. Among all categories of urban local bodies only 15.3 per cent satisfied norms, thus, indicating inadequate availability of water. As can be seen from the Table 2.7, even within Class I cities, there is wide variation as the water supply is 272 litres per capita per day (lpcd) in Mumbai as against 158 lpcd in Nagpur (CPCB, 1997).

Table 2.5: Distribution of Households by Source of Drinking Water and its Location

Location	Rural	Per cent	Urban	Per cent	Total	Per cent
Within premises	4,271,679	38.9	5,910,714	73.2	10,182,393	53.4
Near premises	4,827,962	43.9	1,701,916	21.1	6,529,878	34.3
Away from premises	1,893,982	17.2	456,896	5.7	2,350,878	12.3
Total	**10,993,623**	**100.0**	**8,069,526**	**100.0**	**19,063,149**	**100.0**
Sources of drinking water						
Taps	5,006,729	45.5	7,196,763	89.2	12,203,492	64.0
Handpumps	2,096,754	19.1	362,071	4.5	2,458,825	12.9
Tubewells	417,923	3.8	136,039	1.7	553,962	2.9
Wells	3,129,153	28.5	260,615	3.2	3,389,768	17.8
Tanks, Ponds, Lakes	59,347	0.5	19,315	0.2	78,662	0.4
Rivers, Canals	117,305	1.1	5,026	0.1	122,331	0.6
Springs	90,649	0.8	4,309	0.1	94,958	0.5
Others	75,763	0.7	85,388	1.1	161,151	0.8
Total	**10,993,623**	**100.0**	**8,069,526**	**100.0**	**19,063,149**	**100.0**

Source: Census 2001.

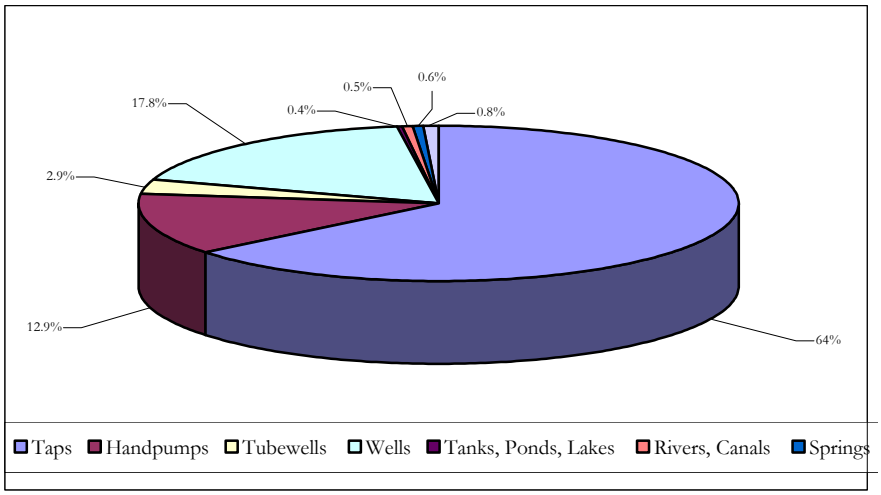
Figure 2.1: Distribution of Households by Location of Drinking Water



Source: Census 2001

Figure 2.2: Distribution of Households by Sources of Drinking Water

Source: Census 2001



Over the years, per capita water supply has changed considerably. The disparities in the amount of water supply in various urban centres as well as within different areas of a city are very striking. For example, though Mumbai has a maximum average water supply of 200 lpcd, on an average, the supply in different areas of the city is very much skewed. While slum areas of Mumbai are not getting even 90 lpcd, the well off areas receive as high as 300-350 lpcd (GoM, 2003:a). As far as water quality concerned, studies in 2000-01 have shown (NEERI), Mumbai showed the highest contamination at 15 per cent compared to Pune (1.3 per cent), Nashik (1.08 per cent), Navi Mumbai (9.26 per cent) and Thane (4 per cent). This may be due to the reason that water pipelines criss-cross with the sewerage lines and also due to the intermittent nature of supply, there may be contamination of drinking water mains leading to regular epidemics in various cities.

Over use and misuse of water can be observed in various activities. Due to intermittent/irregular water supply, it is the normal practice of every household to store more water than needed. When fresh water is to be stored for the next day, the old stock is just thrown away to empty the containers. Unnecessary wastage of water by keeping the water taps running, while bathing, shaving and so on, is also a common feature. Excessive use of water for gardening not only spoils the plants but also involves wastage. Leakage from water mains, feeder lines and public and private taps is a common and neglected phenomenon. It is estimated that for domestic use such as drinking, bathing, cooking, washing, cleaning and gardening about 16-25 per cent water is wasted. The quantity of overuse in industry and workshops is about 20 per cent, in construction and public works 25 per cent, in commercial establishments 10 per cent, in transportation including road, rail and air transport and storage 15-25 per cent, for public services like government offices, courts, police etc., 10-25 per cent and in community services such as theatres and clubs about 15-25 per cent (MSDR, 2005).

Table 2.6: Water Supply Levels in Selected Urban Areas of Maharashtra

Category of Local Body	GoI Norm (Gross lpcd including 15 per cent UFW)	Satisfying Norm	Below Norm	Range of Shortfall
MCs (14) (Mumbai not included)	177 lpcd	2	12	2 to 97 lpcd
A Class Municipal Councils (18)	83 lpcd –towns without sewers 159 lpcd –towns with sewers	3	15	3 to 109 lpcd
B Class Municipal Councils (48)	83 lpcd –towns without sewers159 lpcd –towns with sewers	9	39	3 to 94 lpcd
C Class Municipal Councils (96)	83 lpcd – towns without sewers 159 lpcd – towns with sewers	15	81	1 to 109 lpcd
C-1 Class Municipal Councils (66)	83 lpcd –towns without sewers 159 lpcd –towns with sewers	8	58	3 to 109 lpcd
Total		**37**	**205**	

Source: MJP, 2003

Table 2.7: Water Supply in Metro cities of Maharashtra

City	Ground Source (mld)	Surface Source (mld)	Total (mld)	Per capita Water Supply (lpcd)	Per cent Population covered by municipal water
Mumbai	-	3070	3070	272	92
Nagpur	-	256	256	158	100
Pune	-	540	540	241	100

Source: CPCB (1997)

Rural Situation

Availability of water supply in rural areas is shown in Table 2.8, as on April 1, 2000. It indicates that only about 55 per cent of villages and 64 percent halets had a per capita supply for more than 40 lpcd in the year 2000. The duration of supply in rural areas varies from one to three hours per day. In case of some of the regional schemes, the tail end villages do not receive any supply whatsoever. In accordance with the master plan of the GoM, by March 2000, 11322 villages and 7564 wadis were covered with regular water supply arrangements, with a service level of 55 lpcd, by incurring an expenditure of Rs. 2945 crores during the period from April 1996 to March 2000. Of total number of drinking water supplies- about 59489 are fully covered, about 24405 partially covered and 2036 are not covered.

Table 2.8: Availability of Safe Water Supply in Villages

Category	Villages		Hamlets	
	No.	Per cent	No.	Per cent
Total Number	40402	100	45528	100
FC – Villages fully covered (i.e. per capita supply more than 40 lpcd)	22209	54.97	29149	64.02
SS – Villages with safe source but inadequate supply (i.e. per capita supply between 10 and 40 lpcd)	13636	33.75	10311	22.65
NSS – Villages with no safe source (i.e. per capita supply of less than 10 lpcd)	3333	8.25	4362	9.58
NC – Villages not at all covered by a safe source	1224	3.03	1706	3.75

Source: Water Supply and Sanitation Department, (2002)

Table 2.9 shows the distribution of slums (per thousand), based on drinking water sources. The water supply availability, in terms of adequate and safe water, seems to have increased in the past two years. As of April 2002, safe groundwater supply was available to 64.3 per cent of the villages and 72.3 per cent of the hamlets (Table 2.10). Limited surveys conducted in rural areas show that bacteriological contamination was 39 per cent in Maharashtra in 1999 and as high as 66 per cent in some rural areas of Pune district. However, this figure has come down to about 32 per cent in the year 2002 as can be seen from the table. The main reasons for high contamination are the lack of appropriate sanitation, absence or inadequate dose of disinfectants and recontamination in the distribution networks.

Table 2.9: Distributions of slums (per thousand) based on drinking water sources.

Sources	Urban	Rural
Taps	956	540
Tube Wells/Hand pumps	27	260
Open Wells	17	0
Others	0	200

Source: MSDR (2005)

According to the water quality criteria given by MPCB the total coliform content in drinking water should be less than 50 MPN/100ml. The results of bacteriological analysis of drinking water in some districts of Maharashtra, from 1999 to August 2002 are shown in Table 2.11, which indicates that the results of analysis are within the limit. The water supply norms in rural areas and as per the urban municipality categories in the state are listed in Table 2.12.

Table 2.10: Progress of Drinking Water Supply (Groundwater) Programme as on April 2002

Village /hamlets	Progress of Drinking Water Supply			
	No. of Villages	Per cent	No. of Hamlets	Per cent
Total Number	40785		45528	
Number where successful and adequate GW source is created at 40 lpcd	26335	64.3	32925	72.3
Number where groundwater has been survey conducted but needs detailed studies for sitting of safe and reliable source	10511	25.7	8242	18.1
Number where groundwater source has been created but less than 40 lpcd especially during summer	2936	7.2	2987	6.6
Number where groundwater source could not be identified for various reasons viz. poor quality, difficult geology, no hydro-geological survey	74	1.8	1374	3.0
Number where supply source is surface water	377	0.92	0	0

Source: WSSD, GOM

Table 2.13 and 2.14 give the tarrifs fixed by the Maharashtra Jeevan Pradhikaran (MJP), effective 1st April 2003, for consumers in different organization (including hotels) being supplied water from the Pradhikaran water works. Estimated figures for the available supply and use of ground water have been shown in the Tables 2.15 and 2.16, respectively. It is seen that only 3.65 million hectares have ground water of quality that is fit for drinking or irrigation.

Status of Sanitation

To ensure delivery of safe and potable drinking water, sanitation and hygiene cannot be overlooked. Table 2.17 gives the details of houses with various sanitation facilities as per Census, 2001.

Rural Sanitation

As of 1999, only nine per cent of the rural population in India had access to sanitation facilities, which increased to about 20 per cent by 2002 (GoM and WSP-SA, 2002). However, according to the 54th round of the NSS (1998), only about 14 per cent of the rural population in Maharashtra had access to sanitation facilities. This is of serious concern as many water borne diseases, especially, diarrhoea are the major cause of mortality in rural areas. Despite a subsidy programme of the state government providing 87.5 per cent of the cost (Rs 4000) for the construction of toilets between 1997 and 2000 it was found that 57 per cent of the toilets constructed under this programme were not being used. Hence, mere provision of facilities has proved insufficient to solve the problems of rural sanitation. Thus, integrated water and sanitation projects must be formulated and it is necessary

to inculcate the concept of environmental sanitation and personal hygiene practices amongst the rural masses. Inexpensive ways of providing toilets at the household level is also necessary.

Table 2.11: Bacteriological Analysis of Drinking Water Samples in some districts

Districts	1999	2000	2001	2002 (Upto August)
Akola	49	42	43	45
Beed	36	27	21	30
Bhandara	55	44	37	31
Buldhana	31	32	41	41
Chandrapur	46	45	44	41
Gadchiroli	35	29		24
Jalgaon	64	18	18	19
Jalna	24	35	35	37
Kolhapur	31	30	25	25
Latur	23	44	37	35
Nagpur	24	28	22	27
Nashik	30	29	20	37
Dharashiv	37	36	45	43
Parbhani	39	35	28	36
Ratnagiri	44	47	22	34
Sangli	36	26	23	21
Satara	37	23	27	20
Sindhudurg	35	29	46	30
Solapur	33	45	46	39
Thane	39	31	27	26
Wardha	48	21	24	20
Yavatmal	52	45	38	34

Source: PHD, NEERI (2002)

Table 2.12: Water Supply Standards and Norms in Rural and Urban areas (lpcd)

Rural Areas		Urban Municipality	
Drinking	3	C class	70 lpcd
Cooking	5	B class	100 lpcd
Bathing	15	A class	125 lpcd
Ablution	10	Corporation	135/150 lpcd
Washing	7		

Source: NEERI, 2002.

Table 2.13: Water Tariff for Metered Supplies

Sr. No.	Description	Rates in (Rs. per 1000 litres)
1.	**Bulk Supply**	
A.	**Bulk Domestic**	
i)	Bulk supply to municipal councils/corporations who are required to pay electricity charges to MSEB directly.	4.00
ii)	Bulk supply to other municipal councils/corporations/local bodies	8.00
iii)	Other domestic consumers receiving more than 2 ML water per month at distribution mains of the board	8.00
iv)	Bulk supply to gram panchayats and zilla parishads.	4.00
B	**Bulk non-domestic**	40.00
i)	Bulk supply to non-domestic supply to gram panchayats and zilla parishads.	19.50
2.	**Retail Supply**	
A.	**Domestic Residential**	8.80
i)	Domestic retail supply to rural area	4.50
B)	**Non Domestic**	
i)	Non-domestic supplies in municipal councils other than 'C' class.	40.00
ii)	Non-domestic supply in 'C' Class Municipal Councils for consumers who consume upto 2 ML of water in a month (the Non-domestic consumers in 'C' class Municipal Councils who consume more than 2 ml of water in a month would be charged as an I-IB above (i.e. Bulk Non-domestic)	25.00
3.	**Institutions**	
	Supply to Institutions like schools colleges, Govt., Semi-Govt. Offices, Govt. hospitals, charitable trust and institutions not run for profit including Institutions at Hill stations.	17.00
4.	**Special Consumers**	
	Filtered water to ordnance factories at;	
a)	Ambazari	17.00
b)	Ozar	17.00
c)	Atomic power stations, Tarapur	17.00

Source: MJP, 2005

Table 2.14: Water Tariff for Hill Stations (Rs./1000 litres)

Domestic			9.75
Non-Domestic	2001-02 (1st year)	2002-03 (2nd year)	2003-04 (3rd year)
'A' class Hotel	75.00	75.00	75.00
'B' class Hotel	60.00	60.00	60.00
'C' class Hotel	44.00	50.00	50.00
Others	44.00	50.00	50.00

Source: MJP, 2005

Table 2.15: Ground water data (MCM/yr)

Total Groundwater resource that can be replenished	37867.32
Provision for Industrial/Domestic and other uses	12397.00
Available for ground water resource	25470.32
Net Draft	7740.09
Balance Ground Water	17730.23
Level of Ground Water Development (per cent)	30.39
Area with Quality Ground Water (quality fit for drinking or irrigation)(Mha)	3.65197

Source: GoI (2000)

Table 2.16: Use of Ground water (MHa-M/Yr)

Quantity of ground water for irrigation	3.78677
Available ground water for irrigation	2.54704
Utilisable ground water for irrigation	2.29233
Net ground water draft	0.8837

Source: MoWR (2003)

Table 2.17: Distribution of Households by Availability of Water and Drainage Eminities

	Rural	Percent	Urban	Percent	Total	Percent
Total number of households	10,993,623		8,069,526		19,063,149	
Number of households having bathroom facilities within the house	5,066,823	46.1	6,584,731	81.6	11,651,554	61.1
Type of Latrine within the house						
Pit latrine	1,124,458	10.2	571,036	7.1	1,695,494	8.9
Water closet	585,470	5.3	3,580,166	44.4	4,165,636	21.9
Other latrine	292,008	2.7	535,330	6.6	827,338	4.3
No latrine	8,991,687	81.8	3,382,994	41.9	12,374,681	64.9
Type of Drainage Connectivity for Waste Water Outlet						
Closed drainage	565,776	5.1	3,637,125	45.1	4,202,901	22.0
Open drainage	3,957,015	36.0	3,430,112	42.5	7,387,127	38.8
No drainage	6,470,832	58.9	1,002,289	12.4	7,473,121	39.2

Source: Census 2001.

Urban Sanitation

Table 2.18 gives the number of local bodies that have Under Ground Drains (UGD). While in Konkan and Western Maharashtra about 45 per cent of the local bodies have UGD, in Marathwada and Vidarbha this figure was only 23.52 per cent. Even if a particular local area has UGD, it may not be so for the entire area. In Sangli-Miraj-Kupwad MC (SMK-MC), for example, only 51 out of the 68 wards have UGD facilities with some wards being only partially covered. In many cases the Sewage Treatment Plants (STPs) were constructed for a much lesser capacity and are now overloaded causing untreated sewage to be directly released into the rivers thus polluting drinking water sources of many towns downstream. Ninety nine per cent of the sewage water generated by the Municipal Councils and over 50 per cent of sewage discharged by MCs goes untreated. The smaller towns and rural areas do not contribute significant amounts of sewage due to the low per capita water supply.

The problem of wastewater generation and disposal is a more serious issue in the case of larger cities and towns. A study by the Central Pollution Control Board (CPCB) in 2000 showed that though 83 per cent of wastewaters were collected in Maharashtra (Class I and Class II cities) only 13.3 per cent were actually treated (UNEP, 2001). From the Tables 2.18, 2.19 and 2.20, it can be seen that the domestic sector accounts for a predominant share of wastewater generation.

Table 2.18: Sewerage Facilities in Urban Maharashtra

Region/No. of Local Bodies	Corporations	Class A	Class B	Total
1 (Mumbai and Konkan)				
Total Local Bodies	4	3	6	13
Having UGD	3	2	1	6
Having > 110 lpcd water	3	3	1	7
Having > 110 lpcd water and UGD exists	3	2	1	6
Having > 110 lpcd water and UGD does not exists	0	1	0	1
I1 (Western Maharashtra)				
Total Local Bodies	6	8	17	31
Having UGD	3	5	6	14
Having > 110 lpcd water	6	4	8	18
Having > 110 lpcd water and UGD exists	3	3	4	10
Having > 110 lpcd water and UGD does not exists	3	1	4	8
II1 (Marathwada and Vidarbha)				
Total Local Bodies	3	9	22	34
Having UGD	3	2	3	8
Having > 110 lpcd water	2	1	4	7
Having > 110 lpcd water and UGD exists	2	0	1	3
Having > 110 lpcd water and UGD does not exists	0	1	3	4

Source: MMRDA (1998).

Table 2.19: Wastewater Generation, Collection, Treatment and Disposal in Some Cities of Maharashtra (Mld)

City	Volume of wastewater generated			Wastewater Collected		Capacity	Treatment		Mode of Disposal
	Domestic	Industrial	Total	Volume	Per cent		Primary	Secondary	
Mumbai	2228.1	227.9	2456	2210	90	109	Yes	Yes	Sea
Nagpur	204.8	-	204.8	163	79.6	45	Yes	Yes	Agriculture
Pune	432	-	432	367	85	170	Yes	Yes	River

Source: CPCB (2000)

Table 2.20: Quantity of Wastewater generated from some MC's in Maharashtra

Municipal Corporations	Sewage Generation (MLD)	Treatment
Akola	27	No treatment
Bhiwandi-Nizampur	64	17.5 MLD capacity
Brihan-Mumbai	2271	-
Jalgaon	48	-
Kalyan-Dombivli	184	30 MLD capacity
Kolhapur	105.6	43.5 MLD
Malegaon	15	15 MLD
Mira-Bhayandar	60	12 MLD
Nagpur	100	45 MLD
Nashik	160	-
Navi-Mumbai	190	161.5 MLD
Pimpri-Chinchwad	114	-
Pune	265	-
Sangli-Miraj-Kupwad	48.65	-
Thane	200	Primary treatment
Ulhasnagar	88	28 MLD capacity

Source: Environment Status Reports of Various MCs (2001-03)

Fresh-water Pollution

Discharge of untreated or partially treated waste water into fresh water bodies has detrimental effects on them. Data from regional offices of MPCB indicate that the aggregate domestic effluents discharged by 219 councils were 1,050 MLD (as on March 2000), out of which only 14 MLD was adequately treated and the remaining 1,036 MLD (almost 99 per cent) was discharged untreated. Only three municipal councils of Lonavala, Ahmednagar and Pandharpur undertook some treatment before discharging the effluents into the rivers (TOI, 2002). Recent data on industrial effluent show that more than 76 per cent having treatment facilities were able to treat their effluents despite the fact that very few districts had satisfactory Common Effluent Treatment Plants (CETP's) facilities. Region wise generation and treatment of industrial effluent is given in Table 2.21. Accordingly, out of 533 industries 410 (76.9 percent) have ETP facility in working condition.

River Pollution

There are about 21 notified rivers in Maharashtra as listed in Box 2.1 Out of the notified rivers, there are 8 main river basins in Maharashtra, which are listed alongwith their catchment area in Table 2.22. In the MMR, of the 9 major rivers, Tansa, Bhasta and Barvi are used as sources of drinking water, whereas Panvel, Bhogeshwari and Amba rivers are used for discharging effluents. The Ulhas and Patalganga are used for both purposes i.e. as a drinking water source in the upper reaches and for effluent discharge in the lower reaches. There is a wide variation in the quality of waters in these rivers. The waste from the Sheri and Haripur nullah in Sangli overflows in the monsoons into the river Krishna thereby polluting it (SMKMC, 2004). The sewage from different parts of Jalgaon Municipal Corporation (JMC) is conveyed through four nullahs and is discharged

into the Tapi and Grina rivers untreated. As a result the water in these rivers is polluted severly due to increased BOD load (JMC, 1999).

Table 2.21: Region-wise Industrial Effluent Generation and Treatment in Maharashtra

Region	Total Effluent (m3/day)	Total No. of Industries	Total no. of Industries with ETP	Percent
Kalyan	70394.5	19	15	78.9
Pune	72421.3	68	57	83.8
Thane	4565.6	57	46	80.7
Navi Mumbai	20956.4	30	28	93.3
Nashik	15408.5	27	4	14.8
Nagpur	254382.9	33	29	87.8
Mumbai	4,578,985	13	11	84.6
Aurangabad	56056.3	80	68	85.0
Amravati	11170	15	6	40.0
Raigad	67987.4	76	62	81.5
Kolhapur	61531.2	115	84	73.0
Total	**5213859.1**	**533**	**410**	**76.9**

Source: MPCB (2005)

Box 2.1: Notified Rivers of Maharashtra

- Agrani River Basin
- Bombay Island River Basin
- Ghataprabha River Basin
- Konkan Coastal Basin
- Krishna River Basin
- Kundalika River Basin
- Lower Bhima River Basin
- Lower Godavari River Basin
- Nag River Basin
- Narmada River Basin
- Nira River Basin
- North and New Bombay Basin
- Patalganga River Basin
- Satpati Coastal Basin
- Sukna River Basin
- Tapi River Basin
- Ulhas River Basin
- Upper Bhima River Basin
- Upper Godavari River Basin
- Wainganga, Wardha, Penganga River Basin

Source: DoE, GoM (2005)

Table 2.22: River Basins in Maharashtra

Name of River Basins	Type	Catchment Area (Ha)
Godavari	Major	312812
Krishna	Major	258948
Purna	Medium	2431
Ambika	Medium	2715
Vaitarna	Medium	3637
Dammanganga	Medium	2357
Ulhas	Medium	3864
Savitri	Medium	2899
Sastri	Medium	2174
Washishthi	Medium	2239

Source: CPCB (2002)

The water quality criteria, as given by the DoE, GoM and the CPCB and given in Tables 2.23 and Table 2.24, respectively. The results obtained from respective regional offices of the MPCB in respect of river water, indicate that out of 98 stations, 40 stations show deterioration in river water quality. No station in A-I class (State classification of rivers) was adhering to the prescribed standards i.e. "drinking water source without conventional treatment but after disinfection." Bacterial pollution was observed in river Godavari and Bhima, while the water quality of Krishna River is said to be improving. The overall water quality of rivers observed in the state is more or less well within the limits of A-II class of river water i.e. water to be used only after conventional treatment. Analysis of recent data (2003-04) obtained from sub-regional offices of MPCB and Department of Environment (DoE), GoM, indicate that many industries in Thane and Sangli have lower levels of BOD loads but Raigad shows highest level. Whereas a large number of power-looms, textile processing units and sugar factories in the Kolhapur district discharge high levels of BOD comparatively. Out of 9135 industries, only 4657 (about 50.97 per cent) were providing wastewater treatment facilities. Table 2.25 gives the details of industrial effluent treatment in some districts and major water quality parameters for some important rivers in Maharashtra are shown in Table 2.26.

Table 2.23: Water Quality criteria as per Environment Department of GoM

Designated Best Use	Class of Water	Major Criteria
Unfiltered public water supply after approved disinfection	AI	BOD 5 days at 20° 2 mg/l DO: Not less than 5 mg/l Bacteriological standards (MPN/100) 250
Public water supply with approved treatment equal to coagulation, sedimentation and disinfection.	AII	BOD 5 days at 20° 5 mg/l DO: Not less than 4 mg/l Bacteriological standards (MPN/100): not greater than 5000
Not Fit for Human Consumption, Fish and wild life propagation	AIII	BOD 5 days at 20° 10 mg/l DO: Not less than 3 mg/l
Agriculture, Industrial Cooling and process water	AIV	BOD 5 days at 20° 30 mg/l DO: Not less than 2 mg/l

Source: DoE, GoM (2005)

Table 2.24: Primary Water Quality Parameters according to the CPCB

Designated Best Use	Class of Water		Criteria
Drinking water source without Conventional treatment but after disinfection	A	1	Total coliforms Organised MPN/100ml
			Shall be 50 or less
		2	PH between 6.5 & 8.5
		3	Dissolved Oxygen 6mg/l or more
		4	Biochemical Oxygen Demand 5 days
			20°C 2mg/l or less
Outdoor bathing (organised)	B	1	Total coliforms Organism MPN/100ml
			Shall be 500 or less
		2	PH between 6.5 & 8.5
		3	Dissolved Oxygen 5mg/l or more
		4	Biochemical Oxygen Demand 5 days
			20°C 3mg/l or less
Drinking Water Source	C	1	Total coliforms Organism MPN/100ml
			Shall be 5000 or less
		2	pH between 6 & 9
		3	Dissolved Oxygen 4mg/l or more
		4	Biochemical Oxygen Demand 5 days
			20°C 3mg/l or less
Propagation of Wildlife	D	1	pH between 6.5 & 8.5 Fisheries
		2	Dissolved Oxygen 4mg/l or more
		3	Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial cooling, Controlled Waste	E	1	pH between 6.0 or 8.5
		2	Electrical conductivity at 25°C
			Micro mhos/cm Max 2250.
		3	Sodium absorption Ratio, Max 26
		4	Boron, Max 2mg/l

Source: CSO (2001)

About 35 km long stretch of river Panchganga between Kolhapur and its confluence with Krishna river at Narsinhawadi in Kolhapur district is polluted due to the discharge of effluents from the nullahs and the industries mainly sugar and distilleries upstream of the Kolhapur city. The National River Conservation Directorate (NRCD), MoEF has evolved a programme called the NRAP under which the state government can claim grant to meet a part of the cost in the river conservation. The Kolhapur Municipal Corporation (KMC) has also prepared a plan for the project (KMC, 2002).

Mithi River in Mumbai, which due to recent floods in the city, came into limelight, has very high BOD and COD loads and low DO levels. This is due to unchecked discharge of sewage, industrial waste and garbage into Mithi river from domestic and industrial sources situated along the river bank has deteriorated its water quality. Polluted river flow is also responsible for polluting the Mahim creek and destruction of the spawning ground of marine life There are several major

nullahs, which discharge polluted water into the river. These nullahs originate in MIDC area and carry industrial effluent from industries in MIDC. Many of nullahs are connected to slums in MIDC and hence these carry wastewater from slum residences also.

Table 2.25: Industrial Effluent Treatment in some districts

District	No of industries			Industries providing treatment		Total Pollution Load/BOD Load	Amount of Wastewater Treated		CETP Provided
	Large	Medium	Small	Number	Per cent	Kg/day	(M^3)/day	Per cent	
Nashik	40	26	2162	46	2.06	72	1200	-	NA
Yavatmal and Washim	2		7	6	66.7	289	1512.9	99.8	None
Nagpur	3	4	270	23	8.3	BOD: 2.2-160	1640	95	NA
Ratnagiri	12	26	84	122	100.0	1230	1400	-	For 4MLD
Ratnagiri & Sindhudurg	1	5	328	334	100.0	293.5	778	-	None
Akola	1	4	413	16	3.8	39467	68.2	100	NA
Buldhana	1	7	173	13	7.2	48.8	488	98	NA
Sangli		9	890	899	100.0	2018	2278	98	For 2 MLD
Raigad	34	54	65	72	47.1	118589	45387	100	To be commissioned
Kolhapur	7	23	1702	1733	100.0	2263.4	4357.5	100	Not Provided
Satara	6	9	514	529	100.0	0.1	All	100	None
Thane **	14	7	293	314	100.0	2817.9	13146.5	100	8 MLD, 250CMD
Thane	4	5	22	31	100.0	69.8	2075.7	100	NA
Thane	14	54	808	310	35.4	-	18000	100	2MLD
Thane	2	11	965	150	15.3	-	1995036	100	NA
Amravati	1		53	59	100.0	227.3	64.5 km2	100	None

Source: Compiled form MPCB Records (GOM, 2003)

Scenario of pollution levels of three major rivers in the State is given as follows.

Godavari Basin: There are over 60 Class I and Class II towns releasing wastes into the Godavari river basin of which 28 towns are located in Maharashtra and the remaining in Andhra Pradesh. The population, solid waste and wastewater generation of these towns is given in the Table 2.27. Of the total wastewaters and solid wastes released into Godavari, Maharashtra's share is 40.58 per cent and 42.02 per cent, respectively. The river stretch downstream Nashik and Nanded is polluted due to waste discharges from sugar industries, distilleries and food processing industries (Table 2.25). Most of the industrial activities in Maharashtra are located in Aurangabad and Nashik and distillery units are the largest polluters in the state followed by pharmaceuticals, leather and paper. Accordingly, Nashik is the most polluting city in terms of both wastewater and solid waste generation. Hingoli is a major contributor of wastewater while Ahmednagar accounts for about 17 per cent of solid waste generation.

Table 2.26: Water Quality of some important Rivers and Creeks of Maharashtra (2003-2004)

ivers/ Creek	pH		DO		BOD		COD		Total Coliform	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
odavari	7.1	8.5	4.0	7.2	2.9	34.2	14.9	59.3	130.	316
rishna	7.0	8.3	5.2	7.0	2.9	8.7	16.0	73.7	65.3	325
api	7.3	8.9	5.0	7.3	3	8.5	16	32	110	283
irna	7.6	8.6	5.9	7	3.2	7.5	16	26	150	187
alu	7.3	7.7	5.5	6.5	5	7	16	96	140	350
hatsa	7	7.6	5.4	6	5	8.5	16	40	175	275
ardha	7.5	8.4	5	6.8	4.8	10.2	20	64	102	225
ira	6.8	8.6	4.7	7.3	4	13	16	48	70	250
hima	6.9	11.3	2.6	5.4	7.7	28	21.6	56.8	147	255
lhas	6.3	8.2	5.3	7.5	3	7.9	16	28	102.5	275
atalganga	6.6	7.9	4.7	7.1	3	9.8	16	28	110	312.5
anchganga	6.9	7.7	3.2	6.2	7.8	10	24	36	250	350
undalika	7.3	8.6	5.9	6	4.8	9	16	28	150	275
ithi	6.8	8.2	0.4	3.9	2	290	36	1248	-	-
ahim Creek	6.8	7.3	3.5	4.9	6	60	144	376	175	275
hane Creek	7	7.8	3.4	5.2	5	32	172	364	120	275
asin Creek	6.5	7.9	2.5	6	6	38	56	352	95	200

Krishna basin: There are about 50 Class I and Class II cities releasing wastes into the Krishna basin of which only five are from Maharashtra. Thus, Maharashtra's share in the total wastewater and solid waste released into the Krishna forms only about two per cent and three per cent, respectively. However, within these five cities Satara accounts for the largest share of wastewater and solid waste released at 32.54 per cent and 22.94 per cent, respectively followed by Karad. Correspondingly, the Karad to Sangli stretch of the river is highly polluted due to the location of sugar industries and distilleries. The wastewater and solid waste generated by these towns is given in Table 2.28.

Tapi basin: Tapi River Basin within Maharashtra receives about 46.3 per cent and 42.4 per cent of total wastewater and solid waste discharged into it, respectively. Jalgaon and Dhule account for the largest share of wastes released into Tapi within the state (Table 2.29). Industrial effluents coupled with sewage make the river highly polluted during the summer months when river flow is the least. Kolhapur city discharges about 81 MLD of municipal wastewater into the *Panchaganga River*. The municipal STP set up in 1976 has a capacity of 29.8 MLD and is grossly inadequate. As a result, the remaining wastewater gets discharged into the river without any treatment. Moreover, only primary treatment is given, which is insufficient for satisfying prevailing river water standards.

Thane Creek is one of the major inland water bodies in the country, which stretches over a length of 26 kms to join the Arabian Sea and is connected with river Ulhas in the north by a narrow connection. Over the decades, this creek has been subjected to a lot of pollution. The creek has been receiving significant amounts of untreated or partially treated sewage from Thane and Navi Mumbai urban areas and industrial wastewater from the Thane Trans Creek Industrial area. The problem is further aggravated by the unrestrained dumping of solid waste, construction debris and other wastes into the creek. The Pollution Control Cell of Thane Municipal Corporation (TMC) has been

conducting extensive surveys and sampling of the creek water and the sediments. According to the results of the analysis, the water quality is observed to be deteriorating more and more (TMC, 2004).

Table 2.27: Pollution Load Generation from Class I and Class II Cities of Godavari River Basin

City	Wastewater Generation (mld)	Solid waste Generation (t/d)	Per cent of Total wastewater Generation	Per cent of Total Solid Waste Generation
Latur	20	120	6.47	10.29
Kamptee	2.9	14	0.94	1.20
Ahmadnagar	22	95	7.12	8.15
Parbhani	13	46	4.21	3.95
Aurangabad	12.5	200	4.05	17.15
Wardha	4.8	20	1.55	1.72
Bid	10.5	23	3.40	1.97
Nashik	60	213	19.42	18.27
Chandrapur	8.2	62	2.65	5.32
Jalna	13.2	44	4.27	3.77
Nanded	25.6	76	8.29	6.52
Yavatmal	7.7	22	2.49	1.89
Gondia	8.3	21	2.69	1.80
Amalner	4.89	17	1.58	1.46
Ambejogai	4.40	12	1.42	1.03
Ballarpur	3.92	19	1.27	1.63
Bhandara	8.80	20	2.85	1.72
Buldhana	3.12	12	1.01	1.03
Chalisgaon	4.33	16	1.40	1.37
Higanghat	3.12	14	1.01	1.20
Hingoli	45	10	14.56	0.86
Manmad	2	11	0.65	0.94
Nandurbar	2.74	16	0.89	1.37
Dharashiv	4.80	14	1.55	1.20
Parli	3.76	11	1.22	0.94
Pusad	4.92	10	1.59	0.86
Shrirampur	2.80	16	0.91	1.37
Udgir	1.69	12	0.55	1.03
Total	**308.99**	**1166**	**100.00**	**100.00**

Source: Compiled and calculated from CPCB (2002:d)

Table 2.28: Pollution load generation from Class I and Class II Cities of Krishna River Basin

City	Wastewater Generation (mld)	Solid waste Generation (t/d)	Per cent of total wastewater Generation	Per cent of Total Solid Waste Generation
Barshi	5.04	22	13.67	20.18
Karad	6.00	25	16.27	22.94
Pandharpur	9.60	17	26.03	15.60
Panvel	4.24	20	11.50	18.35
Satara	12.00	25	32.54	22.94
Total	**36.88**	**109**	**100.00**	**100.00**

Source: Compiled and calculated from CPCB (2002:d)

Table 2.29: Pollution load generation from Class I and Class II Cities of the Tapi River Basin

City	Wastewater Generation (mld)	Solid waste Generation (t/d)	Per cent of Total wastewater Generation	Per cent of Total Solid Waste Generation
Akola	21	100	15.45	14.35
Malegaon	23	102	16.93	14.63
Bhusawal	11	20	8.10	2.87
Jalgaon	25.6	225	18.84	32.28
Amravati	22	100	16.19	14.35
Dhule	17.3	80	12.73	11.48
Achalpur	5.2	31	3.83	4.45
Akot	2.62	15	1.93	2.15
Khamgaon	5.28	15	3.89	2.15
Malkapur	2.88	9	2.12	1.29
Total	**135.88**	**697**	**100.00**	**100.00**

Source: Compiled and calculated from CPCB (2002:d)

Table 2.30: Water Quality of some Important Rivers in the State

Rivers	pH	DO	BOD	COD	Total Coliform
Basin Creek	7.5	4.48	20.25	212	153.75
Bhatsa	7.45	5.78	6.73	25	206
Bhima	7.6	4.2	14.3	37.56	184
Girna	8	6.42	5.74	20.8	169
Godavari	7.8	5.9	8.3	26	202
Kalu	7.53	6.07	6.33	45.3	238
Krishna	7.6	6.3	5.4	23	198
Kundalika	7.8	5.97	7.1	22.67	198
Mahim Creek	7.07	4.2	31.33	234.67	208
Mithi	7.1	1.6	58.2	208	NA
Nira	7.55	6.1	6.53	24	137
Panchganga	7.2	4.77	8.6	30.67	291
Patalganga	7.3	6.43	6.09	20.6	170
Tapi	8.3	6.3	5.5	22.8	173
Thane Creek	7.5	4.23	24.33	246.67	198
Ulhas	7.5	6.67	5.19	18.8	173
Wardha	8	5.85	8.76	31.8	152

Source: Calculated from MPCB 2004

Table 2.31: Polluted Stretches of Rivers in Maharashtra

Rivers	Polluted Stretches	Sources/Towns	Critical Parameter (BOD in mg/l)
Godavari	Nashik to (Raher) Nanded	Sewage from Nashik, Chandrapur, Nanded, Raher	6-66
Kalu	Atale village to Confluence with Ulhas	---	6-10
Ulhas	Mohane to Badlapur	Industrial & Domestic runoff Ulhasnagar	6-8
Wainganga	D/S Ashti	Ashti town	6-7
Panchganga	Along Ichalkaranji	Ichalkaranji	7-25
Wardha	Along Rajura village	Paper mill waste	6-8
Bhima	Pargaon to Confluence with river Daund	Pune - Sewage Nira – discharge	6.5
Mula & Mutha	D/s Pune city	City Sewage of Pune	6.7
Bhatsa	D/S of Shahpur Industrial township.	Industrial township – Shahpur	
Patalganga	Khopoli to Estuarine region	Industrial & Municipal sewage from Khopoli, Rasayani &	6
Kundalika	Along Roha city	Roha city sewage	6-6.5
Krishna	Dhom dam to Sangli	Sewage & Industrial waste from Karnal & Sangli	6-8
Tapi	M.P. Border to Bhusawal	Bhusawal Sewage	6-9
Girna	Malegaon to Confluence with Tapi	Malegaon Sewage	6-12
Nira	Along Pulgaon	Pulgaon Cotton Mill	6-21

Source: CPCB (2002)

As a result of large-scale development activities in many cities of the State, the present capacity of the storm water drains is inadequate. The example of Mithi River in Mumbai city, turning from a natural storm water drain, into the Nullah (waste water stream) is enough to explain this. Similarly, the banks and the mouth of many other water streams are encroached upon by unauthorised constructions and this has reduced the width of these streams and their water carrying capacity and turned them into nullahs. Further, the scrap dealers and slum dwellers throw the garbage into these nullahs, causing heavy siltation and obstruction to the flow of rainwater through them.

Lake Pollution

Many lakes in the State are used for recreation purposes. Water quality criteria of CPCB for recreational purposes are shown in Table 2.32 and the water quality of some of the lakes in the State is given in Table 2.33. Many lakes in the State are polluted due to the excessive flow of sewage and other waste into them. The Lonar salt-water lake in Buldhana, which is located in the world's oldest meteoric crater, is coming under threat as a result of unchecked sewage flow. There has been an increase in the water level in the lake, decreasing its salinity levels. Such changes could also affect the ecosystem, which is unique to the area; for example, it is a home to three rare spider species and two scorpion species (Gokhale, 2003). Mumbai's Powai Lake has been adversely affected as a result of sewage flowing from nearby slums, industrial wastewater, and residential complexes and silting problems. It has been included along with 21 other urban lakes in the National Lake Conservation Programme (NLCP) of MoEF started in 1995. Similarly, the lakes in Thane and Kalyan high are also highly contaminated and have high BOD levels.

Table 2.32: Water Quality Criteria for recreational purpose

Sr.No.	Parameter	Standards
1	pH range	6.5-8.5
2	Dissolved Oxygen	4.0 mg/l or 50 percent saturation value, which ever is higher.
3	Colour and Odour	No noticeable colour or offensive odour.
4	Floating Matters	Nothing obnoxious or detrimental for use purpose.
5	Turbidity	30 NTU (Nephelo Tur- bidity Unit)
6	Fecal Coliform	100/100 ml (MPN)
7	Biochemical Oxygen Demand (BOD) 3 days, 27 ° C	3 mg/l

Source: CPCB, 2005

Marine Pollution

The coastal ecosystems in the State are encountering various problems like pollution, siltation, erosion, flooding, saltwater intrusion, storm surges, etc. due to the increasing population and the subsequent expansion of human settlements in coastal areas. The GoI, under the Environment (Protection) Act, 1986, issued the Coastal Regulation Zone Notification 1991 classifying the coastal areas into four categories as follows.

i) CRZ-I consists of the ecologically sensitive areas and areas of extraordinary natural beauty, where no activity is allowed.

ii) CRZ-II consists of the coastal stretches of urban and developed areas where construction of buildings is permitted on the landward side of the existing structures.

iii) CRZ-III consists of the areas, which do not come under CRZ-I and II where no construction is permitted up to 200 m from the high tide line.

iv) CRZ-IV consists of the Lakshadweep, Andaman and Nicobar Islands and other small islands.

Table 2.33: Lake Water Quality in Maharashtra

Stations	Parameters										
	pH	BOD	COD	DO	Total Coliform	Sulphate	SS	Total Hardness	Alkalinity	Chloride	E. Coli
Panvel (2003)											
Krishna Lake	6.7	36	23			31.7	13	327	366	191	
Ballaleshwar Lake	6.7	65	25			9.4	28	195	166	111	
Satara (2002)											
Venna Lake	8.6	8.6	24	4.4		12	14	120	124	22.5	
Kaas Lake	8.2	8.8	28	6.25		6.8	12	158	148	25	
Kolhapur (2003)											
Rankala Lake	8.1	48	104	4.45			1524				
Kotitirth Lake	7.9	64	168				276				
Hanuman Lake	7.9	80	180	4.79			418				
Kalyan (2004)											
Kala Lake	9.2	62.8	149.6		>2400		240	286			Present
Wadeghar Lake	7.2	62.8	149.6		>2400		676	218			Present
Umberde Lake	7.2	34.8	85.24		>2400		790	390			Present
Saparde Lake	7.9	232	572		>2400		514	420			Present
Gauripada Lake	7.4	65.4	158		>2400		92	162			Present
Adharwadi lake	7.9	45.2	88		>2400		174	128			Present
Bhatale Lake	9.1	25.1	52.8		>2400		128	282			Present
Titwala Lake	8.5	55	132		>2400		552	292			Present
Sangli Miraj (2004)											
Kali Khad Lake	8	14.5	33	2.6	1800				140	390	500
Ganesh Lake	7.5	21	88.5	3.15	126				201.5	387.5	250
Thane (2003)											
Khidkali Lake	7.8	44.5	76	2							
Kausa Lake	7.6	56	183	9.8							
Kharegaon Lake	7.7	78	137	4.1							
Upvan Lake		56	92	4.5							
Jail Lake	7.9	56	129	5.6							
Makhmali Lake	7.7	66	184	4.6							
Kasarwadavali Lake	7.6	36	150	2.65							
Rewale Lake	7.2	66	260	5.8							
Narr Lake	7.1	57	136	2.6							
Mumbai (2004)											
Tulsi Lake	7.9				900			51.5	44	14.5	140
Vihar Lake	8.0				3500			59	44	14	2750
Panjrapur Lake	7.3				2400			49	35	9.5	121
Nagpur (2003)											
Ambazari Lake	7.2	8	60	6.3							
Telankhadi Lake	7	10	60	6.3							
Shukrawari Lake	7.2	8	70	4							
Lendi Lake	6.5	12	70	1.8							
Dob Lake	5.8	15	65	Nil							
Solapur (2003)											
Siddeshwar Lake	8.1	21.5	48	5.05		164.1	23	291	312	582.97	
Kambar Lake	7.7	14.5	32	5.75		337.1	17.33	211.33	203	211.33	

Source: Compiled from the ESRs of various MCs

To implement the CRZ notification, the Ecologically Important Areas are identified based on the occurrence of the following criteria:

- Specialised ecosystems or habitats such as mangroves, coral reefs, Sea grasses, seaweed beds, salt marshes etc.
- Breeding or nesting sites of marine animals such turtles.
- Uninhabited and unexplored islands.
- Endemic or endangered marine fauna or flora.

The coastal areas of Maharashtra consists of many ecologically important features such as rocky cliffs of Deccan basalt; estuaries and patches of mangroves. Maharashtra state has about 720 km long indented coastline, which is marked by the presence of major estuaries and narrow creeks. It comprises the coastal districts of Thane, Raigad, Greater Bombay, Ratnagiri and Sindhudurg. The Maharashtra coast popularly known as Konkan coast is an important sector on the West coast of India, because of its physical distinctiveness, biota and marine resources. Some of the major problems faced by the littoral zone and the shore front areas of Maharashtra coast are related to coastal erosion, siltation, pollution and destruction of mangrove. The Institute of Ocean Management has identified Malwan and Ratnagiri on the Konkan coast as ecologically important areas in the state of Maharashtra as given in Table 2.34.

Table 2.34: Various Sites of Ecological Importance

District	Site	Ecological Importance	Area in Km2	Coast Length (km)
Ratnagiri	Ratnagiri	Mangrove	0.36	1.20
	Malvan	Coral Reef	0.43	0.99
		Mangrove	0.04	

Source: Anna University (2005)

There are patchy reefs near Ratnagiri and the satellite imagery indicates the presence of corals in the inter-tidal areas and occasionally at sub tidal depths. However, mangroves, coral reefs and sea grasses are absent within 10 km range. Malwan on the other hand, consists of rocky, dissected mainland with rias and lava promontories and an occasional presence of overhanging cliffs, projecting headlands, stacks and erosion platforms, rocky shoals, several submerged reefs and boulders in a rias type coast particularly towards south. The most striking feature of North Malwan is the 'littoral concrete' or 'beach rock' which occurs as a rocky beach either directly attached to the mainland or separated from the latter by a zone of sandy beach or muddy and marshy area. It has often afforded protection against the force of waves and helped the formation of sandy beach or muddy swamps between the rocky beach and the main land. Coastal erosion of narrow dunes is evident at many places along the coastal from Dahanu (Thane district) to Vengurla (Sindhudurg district). Due to erosion the coastal areas of Vengurla get flooded. The important wetland classes in Malwan and Ratnagiri are described in given Table 2.35.

Table 2.35: Wetland classes and its Areal Extent (km2) in Ratnagiri and Malwan

Wetland classes	Ratnagiri	Malwan
Mangroves	0.36	0.04
Coral Reefs	-	0.4
Mud Flats	5.6	1.54
Sandy Areas	5.9	1.13
Rocky Coasts	0.27	-
Salt Marshes	0.87	0.58
Other Vegetations	0.64	-

Source: Anna University (2005)

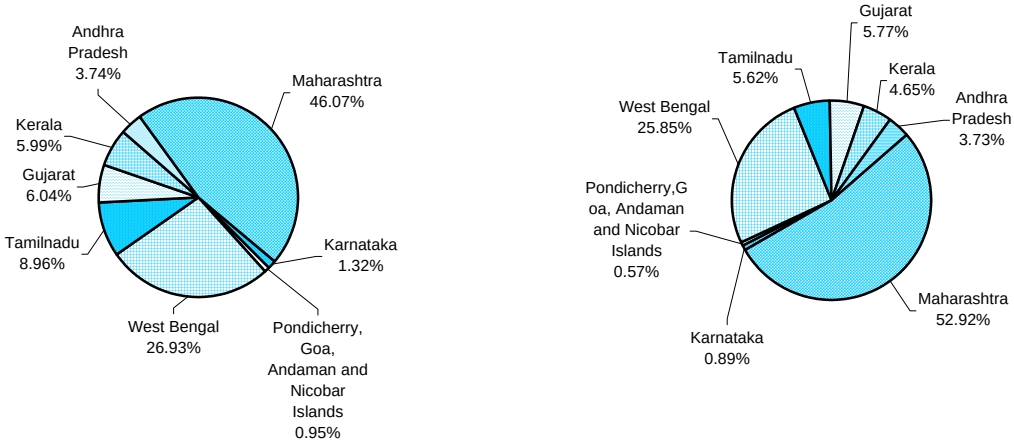
Degradation of the Marine Environment

In Maharashtra, 7 Municipal Corporations, 17 Municipal councils and about 1060 villages fall under coastal area. These areas are densely populated because of their natural beauty and availability of livelihood resources. Thus, waste generation from residential, industrial, commercial, agriculture, aquaculture and many other activities is much higher in these areas. The disposal of waste in the sea is considered a better option than disposal on land for coastal cities. It has been established that in an effectively designed waste disposal system into the sea, the benefits outweigh the losses. However, people perceive the ocean as a bottomless pit, which can accumulate and assimilate unlimited quantities of pollutants. Thus, indiscriminate and large scale dumping of waste into the sea causes marine pollution. Municipal wastewater is a major cause of coastal pollution. About 87 coastal cities and towns generate as much as 33 per cent of the total quantity of wastewater generated by Class I and Class II towns in the State. As can be seen from the Figure 2. 3, the state of Maharashtra contributes to about 46 per cent of the total wastewater generated by coastal cities in India, followed by West Bengal. However, with regard to wastewater collection also, Maharashtra leads other states as it collects 52.9 per cent of its wastewaters followed by West Bengal at 25.33 per cent (Figure 2.3).

Only about 9.38 per cent of total waste water, generated by coastal cities in India, gets any kind of treatment while the remaining 90.62 per cent finds its way to the sea. Among all the coastal states, Maharashtra releases the maximum amount of untreated wastewater (2382.64 mld) into the seas followed by West Bengal. Despite the fact that population is almost equal in the east and west coasts the water supply as well as per capita water consumption is much lower in the east as compared to the West. While the per capita water supply in Maharashtra is the highest at 208.50 lpcd it is as low as 68.41 lpcd in Andhra Pradesh and 80.76 lpcd in Tamil Nadu. Thus, in terms of supply of water, wastewater generation, wastewater disposal both treated as well as untreated, Maharashtra leads all the coastal states in the country as of 1999 (Table 2.36).

Figure 2.3: Generation and Collection of Wastewater (mld) from important Coastal States in India

Generation **Collection**



Source: CPCB (2002:a)

Table 2.36: State and Union Territory Wise Distribution of Population, Water Supply, Wastewater Generation, Treatment and Disposal in Coastal Cities

State/Union Territory	Population Estimated	Water Supply (mld)	Per capita Water Supply (lpcd)	Wastewater Generation (mld)	Treatment Capacity (mld)	Wastewater Disposal (mld)
Andhra Pradesh	3793720	259.95	68.41	203.90	-	203.9
Goa	248379	64.6	260.08	17.00	38.50	-
Gujarat	3881653	414.70	106.84	329.06	76.00	253.06
Karnataka	503258	90.00	178.83	72.00	27.50	44.50
Kerala	3687595	425.63	115.42	326.45	27.50	298.95
Maharashtra	15011211	3129.90	208.50	2508.64	126	2382.64
Orissa	93065	141	151.51	114.9	-	114.90
Tamil Nadu	7549913	609.7	80.76	488.02	226.01	262.01
West Bengal	12124438	1775.7	146.46	1466.08	-	1466.08
Andaman and Nicobar`Islands	109359	7.5	68.58	6	-	6
Pondicherry	327219	36.2	110.63	28.94	-	28.94
Total	**48167370**	**6954.78**	**144.39**	**5560.99**	**521.51**	**5060.68**

Source: CPCB (2002:b)

The ship breaking activity in Maharashtra is carried out at Lakri Bunder and Powder Works Bunder at Darukhana in Mumbai Port Trust (MbPT) area. In Mumbai, there are 27 authorised ship-breakers where, generally, smaller ships arrive for breaking. As per the findings of the MPCB team, deputed to study ship breaking activity at Alang Ship Breaking Yard, Gujarat, the process of issuing

authorisations to ship breakers in Maharashtra has been further refined to suit to the local conditions. Mumbai Port Trust has been directed to adhere to the directives of the Apex Court while permitting the ship breaking activity. It has been reported by Maharashtra Maritime Board that ship-breaking activities are carried out only in the area under MbPT. Coastal Ocean Monitoring and Prediction System (COMAPS) is a continuing programme since 1991 for monitoring the health of our seas. Data collected through this programme are essential to formulate remedial measures to protect health of our marine environment. In Maharashtra, monitoring is done at Trombay, Bassein, Mahim, Thane, Bombay Harbour, Versova, Ulhas creek, Murud, Ratnagiri and Redi. Depending upon the level and source of pollutants, 77 sampling stations have been identified of which 32 have been classified as "Hot spot" stations. Data on 25 environmental parameters including heavy metals and pesticide residues are being monitored.

Oil Pollution

Oil spills from ships have adverse effect on the flora and fauna. Depending on the characteristics of the oil spill, they may clog the gills of fishes and kill them. It could also lead to contamination of fishes, which may be later consumed by humans. Sea birds are most adversely affected by oil spills as the oil mats their feathers, making flight impossible eventually leading to their death. In the case of mammals like dolphins, whales etc., the oil breaks down their insulation thereby leading to death. Hence, the entire coastal eco-system surrounding the oil spill gets adversely affected.

Table 2.38: Incidence of oil spills in Mumbai coastal waters

Year	Quantity of Oil Spilled (Tonnes -T)	Environmental Impact
1984	Less than one tonne	Unaesthetic appearance of beach
1989	5500T beyond EEZ off Mumbai and 2 tonnes in Mumbai Port	Oil sank into the sea and no surface reappearance. However oil spilled in Mumbai shores gave unaesthetic appearance.
1991	40000T Crude oil, Mumbai	No report is available
1992	300T	No report is available
1993	110T	No report is available
1993	3000-6000T Rupture of ONGC offshore pipeline	Mortality of planktonic organisms, 3km.Long Murud beach contaminated with deposits of 1000 T of oil leading to mortality of inter tidal fauna.
1993	5460T	No report is available
1994	100T	No report is available
1996	Not estimated (Heavy Fuel Oil), Off Prongs, Mumbai	No report is available
1996	Not estimated (Heavy Fuel Oil), Off Bandra, Mumbai	No report is available
1996	Not estimated (Heavy Fuel Oil), Off Karanja, Mumbai	No report is available
1996	Not estimated (Heavy Fuel Oil), Off Worli, Mumbai	No report is available
1997	Not estimated (Heavy Oil and Diesel), Off Prongs, Mumbai	No report is available
1998	Not estimated (Mumbai Crude Oil), Bombay High	No report is available

Source: CPCB (2002:e)

In Maharashtra, Mumbai being a major port with refineries, oil spills are an obvious danger. There have been 48 oil spills in India between 1973 and 1998 of which 14 were in Maharashtra and all of them took place in and around Mumbai harbour. In one case the quantity of spill ranged between 100 tonnes to as much as 40,000 tonnes. Only three out of the 14 oil spills were recorded/reported mainly because most of these were considered minor as the quantity spilt was regarded as insignificant. The concentration of petroleum hydrocarbons, monitored in Indian coastal waters, varied between 0.20 µg/l and 3.55 µg/l (from the year 1996-2000), which is much lower than that recorded at other monitoring points like Bedi, Vadinar, and Phoenix Harbour etc. Table 2.38 gives the detail of oils spills occurred in Mumbai during 1984-98.

Impact of Water Pollution

Polluted water, depending upon the level and type of pollutant, causes various health and other effects. Several water borne ailments are the result of bacteriological pollution. Water with chemical pollutants used for industrial processing corrodes the equipment and reduces its life. Toxic water when used for irrigation damages the quality of the crops. Contaminated waters due to reduced levels of DO threaten the aquatic life. Further, water bodies, which are polluted, loose their aesthetic appeal and cannot be used for recreational activities such as swimming, boating etc.

The State has many areas with deficient water quality in terms of physico-chemical as well as bacteriological parameters. In 1183 villages spread over 28 districts, out of 2,33,217 sources of water, about seven per cent are contaminated due to fluorides, eight per cent due to nitrates and three per cent due to iron. A majority of these villages are located in Sindhudurg, Ratnagiri, Raigad, Thane, Solapur, Nagpur, Nanded, Yavatmal and Chandrapur districts. Table 2.39 lists pollution affected regions and districts and Table 2.41 shows water quality parameters for some water resources in selected districts. Nitrate pollution is most prevalent in four of the five divisions and arsenic pollution, which was prevalent in Nagpur division has been controlled. As observed in Table 2.40 Nashik division seems to be the least polluted.

Table 2.39: Water Quality affected Regions and Districts in Maharashtra

Regions	Parameters of Water Quality				
	Fluoride	Nitrate	Salinity	Arsenic	Iron
Konkan		Thane	Thane, Ratnagiri, Sindhudurg		Ratnagiri, Sindhudurg
Pune	Satara, Solapur	Sangli, Solapur, Satara			Solapur, Kolhapur
Nashik	Nashik				
Aurangabad	Beed	Beed, Parbhani, Dharashiv			
Amravati	Yavatmal	Yavatmal	Amravati, Akola, Buldhana		
Nagpur		Nagpur, Bhandara		Nagpur (2001), Gadchiroli (2001)	Nagpur, Gadchiroli, Chandrapur, Bhandara.

Source: Compiled from data of GOM (2002)

Table 2.40: Quality of Water Resources in Some Districts

Parameters	Wells/Borewells				Lakes				Coast	
	Navi Mumbai	Thane	Pune (ppm)	Nashik	Mumbai	Navi Mumbai	Thane	Pune (ppm)	Mumbai	Thane Creek
Total PO_4	N.D	1.40-6.05	N.A	N.A	N.A	N.D	0.09-14.322	N.A	N.A	N.A
Sulphate	N.D-78	30.23-146.04	N.A	N.A	N.A	200-681	12.09-112	N.A	N.A	N.A
Chloride	N.A	36.21-156.91	25-230	N.A	8—16	N.A	27-154	95	N.A	2449-23714
Hardness	N.A	108-535	90-680	120-452	N.A	N.A	126-407	295	N.A	N.A
Alkalinity	189-420	95-11368	100-410	32-138	11--70	126-242	9.09-307	340	N.A	N.A
PH	7.3-7.6	7-8.5	7.33-8.34	7.3-7.9	6.5-8.8	7.4-8.5	7.5-11	8.36	N.A	6.5-7.7
SS	N.A.	10—40	N.A.	N.A.	N.A.	N.A.	5.6-210	N.A	N.A	N.A
DO	4.8-6.7	4.2-8	N.A.	N.A.	N.A.	N.D-4.4	1.6-9.2	N.A	2.5-25	3.2-7.2
BOD	4—12	2.5 – 50	N.A.	0.4-2.8	N.A.	10--35	4.8-78	N.A	0-25	1—18
COD	8—48	8-132	N.A.	3.976-11.9	N.A.	43-188	40-272	N.A	N.A	N.A
Nitrite	N.D	Traces-0.191	Nil	N.D -23.89	N.A.	N.D – 0.46	Traces-0.529	N.A	N.A	N.A
Nitrate	N.D-4	0.27-6.68	1-1.2	1.3-19.8	N.A.	N.D - 2.3	BDL-0.092	N.A	N.A	N.A
MPN	<2	12-1600	N.A.	Nil - 1600	N.A.	2-1600	140-4500	N.A	N.A	N.A
F.Coli	N.A.	0-350	N.A.	N.A.	N.A.	N.A.	12-550	N.A	5--30	N.A
E.Coli	N.A.	0-120	N.A.	Absent /Present	2-550	N.A.	4-120	25	N.A	N.A
TKN	7—61	N.A	N.A	N.A	N.A	11--15	1.88-19.52	N.A	N.A	0.4-20.35
Zinc	N.D	N.A	N.A	N.A	N.A	N.D.	0.1035-0.4752	N.A	N.A	N.A
Chromium	N.D	N.A	N.A	N.A	N.A	N.D-0.15	BDL - 0.11	N.A	N.A	N.A
Lead	N.D	N.A	N.A	N.A	N.A	N.D	BDL -0.1	N.A	N.A	N.A
Copper	N.D	N.A	N.A	N.A	N.A	N.D	0.006-1.5	N.A	N.A	N.A
Total Dissolved Solids	N.A.	N.A	N.A	306-736	N.A	N.A	N.A	N.A	N.A	N.A
Turbidity	N.A.	N.A	1.8-2.1	N.A	N.A	N.A	N.A	N.A	N.A	N.A
Phosphorous	N.A.	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A
Nitrate-Nitrogen	N.A.	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A

Source: Compiled from Environment Reports of various MCs; NA- Not available

Sampling of drinking water sources by the Public Health Department (PHD) across the state shows that a large number of contaminated water sources are resulting into various health hazards. On an average, 1.2 million people are affected every year and about 350 people die of bacteriological contamination of drinking water. Chemical and bacteriological contamination of ground water has severe and serious health hazards and number of cases on Gastro, Diarrhoea, infective Hepatitis, Typhoid, and Cholera ailments were reported from rural areas during 1999-2002 (Tables 2.41). Time series data on water borne health problems in Maharashtra are compared with other states in Table 2.43. The trend analysis of attacks and deaths due to water borne diseases between 1997 and 2002

indicate a progressive decline. This is due to increased availability of clean drinking water and health services provided by the GoM under various programmes.

Table 2.41: Year wise Attacks and Deaths Due to Waterborne Diseases in Rural Areas

Disease	1999-2000		2000-2001		2001-2002	
	Attacks	Deaths	Attacks	Deaths	Attacks	Deaths
Gastro	65067	68	82479	128	67295	119
Diarrhoea	1023194	18	1146395	31	1104841	16
Inf. Hepatitis	16159	289	13343	197	12066	142
Typhoid	13079	3	15438	5	13320	7
Cholera	348	1	1043	4	1326	3
Total	1117847	379	1258662	365	1198848	287

Source: PHD, GOM (2002)

Table 2.42: Year-wise deaths due to waterborne diseases in Maharashtra and its neighbouring States

Diseases	States						
	Cases/ Deaths	Andhra Pradesh	Goa	Gujarat	Karnataka	Madhya Pradesh	Maharashtra
Cholera							
1997	Cases	107	0	31	725	16	737
	Deaths	1	0	0	9	2	1
1998	Cases	43	10	113	388	0	2423
	Deaths	0	0	0	2	0	8
1999	Cases	0	2	80	118	N.A	240
	Deaths	0	0	0	3	N.A	2
Diarrhoea							
1997	Cases	1450994	7583	212230	600889	540265	802093
	Deaths	273	4	50	355	203	179
1998	Cases	185264	11175	207027	674805	479073	109875
	Deaths	674	3	50	366	260	556
1999	Cases	1432084	10265	209868	895619	193344	708933
	Deaths	349	2	12	409	71	73
Malaria							
1997	Cases	129577	21025	159652	181450	451552	204969
	Deaths	14	57	37	7	58	98
1998	Cases	118800	25975	106825	118712	475098	165985
	Deaths	12	19	3	3	26	32
1999	Cases	124806	15380	64130	97274	527510	137712
	Deaths	11	17	7	11	50	46

Source: CBHI, 2002

Some examples of water borne health hazards in the State are described as follows. The records during 1995-2002 in a hospital in Mumbai show that, on an average, about 50 per cent of the cases are related to water borne diseases like Diarrhoea (Gastro), Enteric Fever (Typhoid) and Hepatitis B (Jaundice). The effects of these diseases are more prevalent in the children below 12 years of age. Seasonal variation of incidence of diarrhoea remains constant over the years or stable during the pre-

monsoon and post-monsoon periods, but there is a sharp increase in the cases during the monsoon season. Male children are recorded more vulnerable to diseases. This may be due to a gender-bias where if a male child is sick, he will be given more attention and more likely to be taken to the hospital for treatment, whereas for the female child, either the disease could be overlooked or she maybe treated using some home-remedy. The prevalence of diarrhoea for children under one year suggests possibility of dependency on external feeds to infants (Sharma, 2002; MSDR, 2005). The nullahs, which convey the sewage in Jalgaon MC, pass through the centre of the city where there are the maximum slum settlements. Being a potent breeding ground for disease carrying vectors like mosquitoes, flies etc. the slum dwellers are likely to be most affected. Further, health problems due to polluted river water may also increase the chances of epidemics. Severe cases of cholera in Jalgaon city have claimed the lives of hundreds of people in 1992 (JMC, 1999).

Response and Strategy

Maharashtra is one of the foremost states to undertake reforms in water resources sector including water supply and sewerage services. Due to highly erratic nature of the rainfall, water supply in rural areas of Maharashtra becomes a priority issue. The State government has been giving both grants and loan guarantees to Urban Local Bodies (ULBs) for new water projects. Efforts are also being made to tackle the problems of poor operations and maintenance (O&M), inefficient customer service, water leakage, unauthorised connections, theft, and low energy conservation of existing systems. There are several programmes based on the new policy of community led demand-driven principles, such as GoI sponsored Sector Reform Programme, Swajaldhara Programme, PMGY Programme, World Bank aided Jalswarajya Project and even any new schemes in ARWSP and MNP are planned and implemented at Gram Panchayat level. Thus, planning, implementation, operation and maintenance of such programmes are now entrusted to the villages. In addition to the GoM, various other agencies such as MPCB, ULBs, International organisations, etc. are also making efforts to improve this sector.

Efforts of the GoM

The fast decline in the availability of water for irrigation purpose coupled with the increasing demand for water from different sectors has forced the policy makers to introduce strategies to conserve water. Among various water conservation measures, Water Users' Association (WUAs) and Watershed Development Programmes (WDPs) have proved to be important in conserving water resources. While WUAs help to improve the overall performance of the irrigation sector besides increasing the water use efficiency, WDPs improve the water and moisture availability in the rain fed areas, where poverty is widespread because of the slow growth of agriculture (MSDR, 2005).

The details of irrigated area through canal and well irrigation is given in Table 2.43. It is seen from the Table that the irrigated area through canals and wells during 2003-04 is 1.676 Mha. (43.39%) as against the potential created of 3.863 Mha. It is further revealed from the figures that the irrigated area for the year 2003-04 has decreased by about 10% as compared to 1999-2000. The main reason for this decrease in irrigated area is due to less storage in the reservoir and more

reservation of water for drinking. Further, while the water used for irrigation from canal in the year 2003-04 (10569 Mm3) was comparatively less than the year 1997-98 (10639 Mm3), the irrigated area in the year 2003-04 is more by 33 thousand ha than that of the year 1997-98 (1.202 Mha). It shows an improvement in the water use efficiency.

Irrigation Development Corporations

In order to accelerate the completion of irrigation projects in Maharashtra, the State Government has established five Irrigation Development Corporations (IDC's), each headed by an Executive Director who is the officer in the rank of Secretary to Govt. IDC's raise the funds by a centralised procedure for the construction activities through Maharashtra Irrigation Finance Corporation (MIFC). Projects not covered by IDC jurisdiction rest with Water Resources Department of GoM. The IDC's are responsible for survey, planning, design, construction and management of major, medium and minor irrigation projects are as follows (DoI, GoM, 2005).

- Godavari Marathwada Irrigation Development Corporation (GMIDC) for the Godavari Basin
- Konkan Irrigation Development Corporation (KIDC) for the Konkan Region
- Maharashtra Krishna Valley Development Corporation (MKVDC) for the Krishna Basin
- Tapi Irrigation Development Corporation (TIDC) for the Tapi BasinVidarbha Irrigation Development Corporation (VIDC) for the Vidarbha Region

Table 2.43: Irrigation Potential Created and Area Irrigated (Mha) under State Sector Projects

Sr.No.	Year	Irrigation Potential created by end of June	Area Irrigated			Percent of area irrigated to potential created.
			Canal	Wells	Total	
1	1997-98	3.228	1.202	0.475	1.677	51.95
2	1998-99	3.416	1.225	0.471	1.696	49.65
3	1999-00	3.500	1.286	0.584	1.870	53.43
4	2000-01	3.706	1.298	0.466	1.764	47.60
5	2001-02	3.769	1.250	0.458	1.708	45.32
6	2002-03	3.812	1.318	0.524	1.842	48.32
7	2003-04	3.863	1.235	0.441	1.676	43.39

Considering the need for sectoral reforms, in January 2000, the GoM established the Sukthankar Committee to prepare a roadmap for improved provision of water and sewerage services in rural and urban areas. In the recent past, with the inputs from the Committee, the GoM has undertaken several positive steps, which include extensive consultation workshops for improving the rural water supply, improved groundwater management and private sector participation (PSP) in the urban water supply sector. The GoM has also introduced a sectoral reforms package for rural water supply along the lines of GoI guidelines and restructured the urban capital grants programme to provide incentives for efficiency improvements. In order to achieve substantial and far reaching reforms in

the water sector within the state, the Committee strongly recommended the establishment of an independent Maharashtra Water and Wastewater Regulatory Commission (MWRC), which would be responsible for regulating both water supply and wastewater disposal services. Sanitation aspects such as solid waste management and low cost latrines are excluded from the purview of the MWRC.

Maharashtra was the first states to prepare a white paper on Water and Sanitation in June 1995, based on which the GoM established a separate Department for Water Supply and Sanitation (WSSD) for better coordination of the sector. As per the policy approved by the State Government, the WSSD implements the programmes for provisions of drinking water supply services through the Maharashtra Jeevan Pradhikaran (MJP), the Groundwater Survey and Development Agency (GSDA), and the Zilla Parishads (ZPs). The GoM implements the rural water schemes to provide safe drinking water to all rural habitations through two main programmes, namely, the Accelerated Rural Water Supply Programme (ARWSP) funded by the GoI, launched in 1972-73 and revamped in 1999-2000; and the Minimum Needs Programme (MNP) funded through budgetary support and raising of bonds and loans from the open market. Specific projects are also funded with the financial assistance made available by the World Bank and by bi-lateral funding agencies. It is obligatory on the part of the state to provide, under MNP, funds at least on a matching basis in relation to the Central allocation for the ARWSP. There are many rural and urban water supply and sanitation schemes that are in operation in Maharashtra which are given in Table 2.44 and Table 2.45, respectively.

The government has long managed water resources at highly subsidised prices. Tariff levels are uniformly low in almost all MCs and municipal councils in Maharashtra. To break-even in terms of just the maintenance expenses and staff salaries, the urban local bodies will probably need to charge 2 to 2.5 times their current tariffs. It must be highlighted that MCs like Mumbai, historically have healthy surpluses in water and sewerage account. However, in other MCs, the recovery is less than the operation and maintenance expenditure. Deficits of local bodies on the water supply and sewerage account have been as high as 95 per cent in Nagpur and as low as 17 per cent in SMK-MC as per the information given in Table 2.46 for the year 1999-2000.

In order to improve the efficiency of water and sewerage services the state government asked the municipalities to conduct leak detection surveys, water audits and energy audits. Due to the leakages, the total availability of water to the consumers gets reduced and secondly there is also loss of revenue. To handle this problem a Leak Detection Scheme is being propounded. Pune recently abolished metered user charges for the domestic sector and moved to water tax based on property value. The Maharashtra government restructured the capital grants system. Previously, ULBs were responsible only for O&M activities whereas under the new system they were accountable for both capital works as well as O&M. The release of funds will be subjected to performance of ULBs .The Urban Development Department of Government of Maharashtra issued tariff guidelines for A, B and C class municipal councils in 1998.

It has been realised that the government does not have the capacity to invest in huge infrastructure projects and that are necessary to sustain the increasing population, especially in the urban regions. Hence, there is a growing trend in support of privatisation of water resources and

Private Sector Participation (PSP) is being actively encouraged in services such as water supply, sewerage and solid waste management. For instance, as a part of the reform process in the SMK-MC, PSP is being undertaken in the area of water and sewerage, accounting reforms, energy/water/leak detection audits, solid waste management, resource mobilisation and improved service access to the poor (FIRE:D, 2002).

However, there are no success stories of PSP and therefore, many opinions against it. For example, of the first generation privatisation projects taken up in six major cities, four have been grounded or abandoned. Pune, which was the first city to undertake PSP in its water and sewerage project, had to cancel it in 1998 as a result of political pressure (Das, 2002). Since private participation is for a profit motive it is bound to push up water tariffs, which will create social inequities since water is a necessity of life. Further, private companies are prompt to cut connections on non-payment of bills, which would be a crucial issue in a developing country like India. Privatisation efforts have not been very successful in some other developing countries. For example, in Bolivia, the high water rates lead to riots and in Manila, the company with same objectives had to shut down. The main motives for bringing in PSP in water sector is for investment purposes but this need not necessarily happen, as is the case of all infrastructure projects (Dharmadhikary, 2003).

To a certain extent, City and Industrial Development Corporation (CIDCO) in Navi Mumbai has been successful in privatising the urban infrastructure. This includes maintenance of sewerage pump, water pumps, meter reading and billing, maintenance of parks and gardens, collection of CIDCO's service charges and so on (Suresh, 2002). In order to ensure the commercial viability of these infrastructure projects, the Housing and Urban Development Corporation Limited (HUDCO) has promoted some innovative instruments, which are outlined in the Table 2.47.

The GoM has launched *Sant Gadgebaba Urban Cleanliness Drive and Jawaharlal Nehru Clean City Campaign*, which is one of its revolutionary programmes. The former was initially implemented in rural areas and received wide popularity in a very short span, which resulted in its espousal in urban areas from November 2002 onwards. Many organisations participate in this campaign and the best performers are suitably rewarded. However, the main hurdle in continuation of campaign is the paucity of funds. The campaign needs an estimated amount of Rs.10 crores that includes prize distribution costs of Rs. 731 lakhs and other expenses including publicity and propaganda costs of Rs. 269 lakhs. Maharashtra Housing and Area Development Authority (MHADA) was to provide Rs10 crores per year to the state government for this purpose. But, as of November 2002, MHADA has been able to provide only 10 per cent of the total amount (GoM, 2003 b).

Table 2.44: Rural Water Supply and Sanitation Schemes in Maharashtra

Name of the Scheme/Plan	Area Covered	Investment	Year of Implementation	Implementing Agency	Objectives
ARSWP	Rural Maharashtra	Central Budgetary Allocation	1972-73 Ongoing	GoI	
MNP	Rural Maharashtra	State Budgetary allocation	Ongoing	GoM	
Rural Water Supply and Environmental Sanitation Project	560 villages over ten districts	Rs 504 Crores	1991-1998	GoM and WB	Delivering rural water supply, environmental sanitation and health education in an integrated manner.
Rural Water Supply and Sanitation project	187 villages in Jalgaon, Nashik and Dhule districts	Rs 58 crores	1991-1997	GoM and DFID	Overall management of drinking water as well as O&M of the schemes through Water Management Units
Rural Water Supply and Sanitation Project	Districts of Ahmednagar, Aurangabad and Pune	Rs 153 Crores	2001-2007	GoM and KfW	Provision of sustainable rural drinking water supply, environmental sanitation, health and hygiene promotion, and watershed interventions and human resource development.
Sector Reform Pilot Projects	Districts of Dhule, Amravati, Nanded and Raigad	Rs 140 Crores (estimated)	2000 to 2003	GoI and GoM	

Source: Compiled from Kumar et al (2003)

Table 2.45: Budget Provision for Urban Water Supply & Sanitation Program for the year 2003-2004

Sr.No	Head	Marathwada	Vidarbha		Rest of Maharashtra			Total
			Amravati	Nagpur	Konkan	Nashik	Pune	
1	GIA No Backlog	994.65	609.23	405.22	674.23	942.20	337.20	3962.73
2	GIA Backlog	1213.00	0.00	0.00	0.00	0.00	0.00	1213.00
3	AUWSP							
	GOM Share	160.00	0.00	120.00	14.00	70.00	36.00	400.00
	GOI Share	160.00	0.00	120.00	14.00	70.00	36.00	400.00
4	11th Finance Comm. Sch.	317.00	800.00	50.00	0.00	250.00	583.00	2000.00
		1 Sch.	1 sch.	1 sch.		1 sch.	5 sch.	9 sch.
5	Bond GIA	1250.00	0.00	1060.00	116.00	61.00	213.00	2700.00
		7 sch.		5 sch.	3 sch.	1 sch.	2 sch.	18 sch.
	Total	**4094.65**	**1409.23**	**1755.22**	**818.23**	**1393.20**	**1205.20**	**10675.73**

Source: MJP (2005)

Table 2.46: Domestic Tariffs and Cost Recovery in 1999-2000

City	Tariffs	Unit	Tariffs Last Revised in	Cost recovery with respect to operation and maintenance costs (per cent)
Pune	3.00	Rs/KL	1999	50
Kolhapur	5	Rs/KL	1999	79
Nagpur	1	Rs/KL	1989	5
Nashik	2.25	Rs/KL	1997	56
Sangli-Miraj-Kupwad	4.5	Rs/KL		83
Ambernath	4	Rs/KL		17
Ichalkaranji	40	Rs/month/conn	1998	67
Desaiganj	360	Rs/yr/conn		45
Bhusaval	1.5	Rs/KL	1996	63
Sindi	365	Rs/yr/conn		40
Vaijapur	360	Rs/yr/conn		

Source: Compiled from information from individual municipal authorities obtained by MJP for Sukthankar Committee, 2000.

Table 2.47: Some Innovative Instruments Promoted by HUDCO.

Infrastructure Type	Innovative User Pay Instruments
Water Supply	Advance registration charges, Connection charges, Enhancement of water tariff, Water Benefit tax/water tax, Betterment charges, Development charges, Utilisation from other sources such as octroi, property tax, sale of plots etc. and charges from water Kiosks
Sewerage	Connection charges, Sewerage Cess Tax, Conservancy Tax, Sale of renewable waste, Sale of sludge and nutrient rich wastewater.

Source: Suresh (2002)

Steps by MPCB

To use water effectively and discourage the mis-use, provisions of Water Cess Act are applied in the State. The details about the water cess in Maharashtra have been enlisted in Table 2.48.

Table 2.48: Water Cess in the State

Purpose for which water is consumed	Maximum rate under sub-section (2) of section 3	Maximum rate under sub-section (2A) of section 3
Industrial cooling, spraying in mine pits or boiler feeds	Five paise per kilo litre	Ten paise per kilolitre.
Domestic purpose	Two paise per kilo litre	Three paise per kilo litre
Processing whereby water gets polluted and the pollutants are easily bio- degradable and are toxic.	Ten paise per kilo litre	Twenty paise per kilolitre.
Processing whereby water polluted and the pollutants are not easily bio- degradable and are toxic.	Ten paise per kilo litre	Twenty paise per kilolitre.

Source: MPCB

MSCZMA

Maharashtra State Coastal Zone Management Authority (MSCZMA) was constituted in November 1998. The purpose of constitution of this Authority was to protect and improve the quality of coastal environment of the State. The Authority since its inception has held 25 meetings and dealt with complaints /applications received from individuals, non-governmental organizations etc. The Authority has also examined projects falling in CRZ area and has forwarded these proposals to MoEF, GoI, and National Coastal Zone Management Authority for consideration. Besides this, the Authority has also been dealing with cases referred to it by Hon'ble High Court of Judicature at Mumbai and matters in which Petitioners are given liberty to approach the Authority for redressal of their grievances (MPCB, 2005).

Provision of CETPs

This scheme is implemented for the clusters of industries in MIDC areas as a part of the common environmental infrastructure for environment protection. Common Effluent Treatment Plants (CETPs) are being promoted by the Central Government since 1990, for management of industrial effluents, especially from small and medium enterprises. For the construction of the CETPs, the Central Govt. gives a 25 per cent subsidy, MIDC 20 per cent; MPCB five per cent; the user industries 15 per cent and 35 per cent is a loan from the financial institutions. The first CETP in Maharashtra came up at Tarapur, followed by others at TTC, Navi Mumbai, Dombivali, Taloja, Mahad, and Lote Parshuram etc. However, the past history shows that most of these plants do not comply with the prescribed standards, in terms of effluent quality of treated wastewater at the outlet. As a result, there have been several complaints from various people in the area and is a common issue for many debates/questions in the legislative assemblies.

A concerted effort was made by MPCB in July 2004 to ensure compliance by the CETPs and implementation of the directions of the Hon'ble Supreme Court regarding the management of hazardous wastes. The MPCB took action against the defaulters and held intensive discussions and meetings with industry. Time-bound action plans were prepared for each CETP and strengthening and upgradation of treatment units at CETPs is now in progress. Primary standards are complied by all CETPs and they are expected to have achieved all standards prescribed by the MPCB by June 2005. CETPs at TTC, Navi Mumbai, Mahad, Badlapur and Roha have completed the work and final commissioning is in progress, while those at Taloja, Dombivali and Tarapur with additional capacity expansion, would be ready by June 2005. MPCB has obtained bank guarantees from most of the CETPs as a proof of their commitment for complying with the standards and completing the work within the agreed time period, failing which, the bank guarantees are liable to be forfeited. Various industries and MIDC are working earnestly towards setting up of such CETP's. Status of CETPs, as of March 2005, is given in Table 2.49.

The MPCB has taken legal action against the industries that flout the rules for setting up of CETP's. Some examples of punitive action of MPCB are as follows.

Tarapur: 75 industries were closed for one week and their water supply was also disconnected. Permission to restart operations was given only after obtaining a commitment from industries to set up a CETP by June 2005 and also taking a bank guarantee of about Rs.75 lakh as proof of their commitment.

Mahad: The Industry Association, had to give the Board a Bank Guarantee of Rs.25 lakh, to ensure setting up of a CETP by February 2005. The work for this high-tech CETP is now completed and commissioning is in progress.

Taloja: Around 58 defaulting industries were identified and show cause notices were issued. Industries have started the work of up gradation of wastewater treatment plant and it is due to be completed by June 2005. Once completed, the water quality of the River Kasadi will improve considerably.

Table 2.49: Status of CETPs in Maharashtra

Sr. No.	Name of CETP and Location	Status	Capacity MLD	Cost in Lakhs	Subsidy Released in Lakhs
1	ACMA CETP Ambernath	In Operation	0.25	40	17.06
2	CETP Additional Ambernath	Not in Operation	7.5	650	Nil
3	Chikholi Morivali CETP Ambernath	Under Construction	0.8	130	Nil
4	CETP Badlapur	Partly in Operation	8	450	176.17
5	CETP Dombivli (Chemical)	In Operation	1.5	260	112.5
6	CETP Dombivli (Textile)	In Operation	14	667	253.21
7	CETP Saravali MIDC	Proposed	2.5	178.50	Nil
8	CETP Taloja (Phase I)	In Operation	12.5	616	206
9	CETP Taloja (Phase II)	Not commissioned	10	1200	Nil
10	CETP Rasayani	Under Stabilization	15	700	295
11	CETP RIA, Roha	Under Stabilization	10	1250	362.7
12	CETP Mahad	Partly in Operation	7.5	744	241.34
13	CETP Sangli - Miraj	Ready for Commissioning	1.5	200	90
14	CETP Jaysingpur	Operational	0.8	35.70	16.34
15	CETP Lote Parshuram	In Operation	4.5	425	181.96
16	CETP Tarapur	In operation	2.0	306	65
17	CETP Additional Tarapur	-	20	2200	Nil
18	CETP Solapur	Trial run Started	1.5	250	21.11
19	CETP MIDC Kurkumb	In Operation	1.0	120	Nil
20	CETP Ranjangaon	In Operation	11.50	300	Nil
21	CETP Buti Bori Nagpur	Not Commissioned	5	700	35.38
22	CETP Khairane	Operating	12	400	100
23	CETP Additional Khairane	Under Construction	15	825	163.22

Source: MPCB (2005)

Dombivali: Around 287 industrial units were fined and closed down for three days in entire industrial estate of Dombivali phase II and I due to non-compliance of the environmental standards by the CETPs. As a result of this exemplary action by the Board, things are rapidly improving at Dombivali. Upgradation to CETP to comply with effluent standards will be completed by June 2005(MPCB 2005). The Ministry of Environment and Forests has undertaken a Centrally Sponsored Scheme for enabling the Small Scale Industries (SSI) to set-up Common Effluent Treatment Plants (CETP) in the country. The SSIs are polluting the environment through their effluents but some of them are unable to afford installation of pollution control equipment. In order to encourage use of new technologies for CETPs for existing SSI clusters of units a scheme for financial assistance has been formulated. This promotional scheme is being instituted and will be implemented during the Tenth Five Year Plan.

The Criteria for Consideration for Assistance to SSI units are encouraged with CETPs

- Central Assistance will be available only for clusters of SSIs
- Projects for assistance will be given on the basis of Toxicity of pollutants, Pollution load being generated and to be treated and Number of units covered
- The CETPs are to be set up and managed by the State Industrial Infrastructure Corporation or through cooperative body of the units may be decided by the State Government/SPCBs.
- The project should be self-supporting for repayment of the loan and meeting operation and maintenance costs
- The project must formulate adequate institutional arrangements for cost sharing, recovery of dues and management.
- The scheme must have the technical recommendation of the State Pollution Control Boards, etc.

All hazardous waste facilities associated with these CETPs should obtain clearance from the concerned State Pollution Control Board and documented in the CETP project. There are financial institutions like IDBI, ICICI or any other nationalised Banks, State Industrial Financial Corporation etc., funding for different projects for various issues. The pattern for assistance is given in Table 2.50.

Table 2.50: Financial Assistance Pattern for CETPs

Pattern of Subsidy	Percentage
State subsidy	25 percent of the total project cost
Central subsidy	25 percent of total project cost
Loan from financial institutions	30 percent of total project cost

Source: CPCB, 2004

Revenue Generation

The MPCB for the last several years hasn't taken any financial contribution from the state government even though there is provision under the Water (P&CP) Act, 1974 for Government support for efficient working of the Board. Thus, MPCB has become self-sufficient on its own revenue collection, which are arising from water cess, consent fees, analysis charges, etc. In February 2004, revenue generation activities were reviewed and it was decided to increase the consent fees at 0.01 per cent for the industries/development projects involving capital investment of Rs 100 crore or above. In case of laboratory analysis charges, which were not revised in last ten years, have been revised upwards by 40 percent. Further, intensive campaign was undertaken to cover as much as industries and also efforts were made to collect the old dues from various agencies on account of cess to be paid to MPCB. The target of Rs.20 crore set up for the year 2004-05 was achieved. Revenue generation of the MPCB has gone up from Rs.22 crores in the year 2003-04 to Rs.34.7 crore in 2004-05 (MPCB 2005).

Plans at Religious Places

There are various pilgrimage spots in the State where huge conglomeration of people takes place. Several environmental problems are created at these spots, which adversely affect human health and property. Activities such as mass bathing, washing etc. cause pollution of rivers/lakes and contamination of drinking water. Improper disposal of municipal solid waste, air and noise pollution resulting from anthropogenic activities are also responsible for deterioration of the environment and ecology. These problems are further aggravated due to lack of basic civic amenities.

In order to address these issues the MPCB has decided to undertake environment-improvement project at select religious places, providing technical and financial assistance with the cooperation of local authorities. This project is based on the concept of eco-city project being implemented by MoEF/CPCB at places like Mathura and Vrindavan. The MPCB has approved several religious places, namely, Shirdi / Shani-Shingnapur, Alandi, Bhima Shankar, Ashta Vinayak (Temples of Lord Ganesh at eight different places), Jejuri (Khandoba), Pandharpur, Mahoor, and Shegaon for upgradation. Shani Shinganapur is a unique pilgrim centre famous for the temple of Lord Shani. The offerings of leaves and flowers generate about 1.5 to 2 tonnes of solid waste per day, the disposal of which has been a problem for the local Gram Panchayat and the temple authorities. MPCB was approached by the latter, along with a Pune based NGO "Conservation Education & Research Institute", with a proposal for financial assistance for the project of vermin composting of this solid waste at the site 2 kms away from the temple. MPCB has considered the proposal for extending technical and financial assistance for this project.

Kumbh Mela

Nashik attracts a large number of tourists and pilgrims during the Kumbh mela when people take a holy dip in the Godavari river on the Simhasthan day. In fact, lakhs of devotees attended the mela, which was last held here in 2003. The authorities had taken adequate measures to prevent the spread of diseases such as dengue and malaria by regular spraying of disinfectants (NMC, 2003). During

Kumbh Mela at Nashik and Trimbakeshwar, the CPCB carried out monitoring of water quality at upstream and downstream of the bathing places and at the place of bathing to assess the impact on the river water quality and the suitability of the river water for bathing purpose. The study revealed that river Godavari had advantage of good self-assimilation and self-cleaning capacity, due to heavy flow in the river during Kumbh Mela period. The local authorities also made extensive arrangements for discharge of sewage of the town in the extreme downstream of holy bathing place. The river water quality was found fit for bathing purpose during the Kumbh Mela period (CPCB, 2003).

Godavari Action Plan.

The following measures are to be undertaken for abatement of pollution of Godavari River along the Holy stretch.

- Diversion of Waghadi Nullah
- Land Acquisition for STP at Tapovan (32 Hectares)
- Interception and Diversion of all Nullahs Joining Godavari River
- Construction of Storm Water Drain from Indrakund to Devi- Sandwa (Culvert)
- Construction of Outfall Sewer from Talkuteshwar Temple to New Ganeshwadi Pumping Station
- Construction of Box Culvert for Saraswati Nullah from Gadge Maharaj to Talkuteshwar Temple
- Augmentation of Ganeshwadi Pumping Station and Renovation of the Existing Unit.
- Providing and laying of rising main of 700 mm from Ganeshwadi pumping Station to STP site.
- Construction of STP at Tapovan.

Steps by MCs

Resources Conservation Programmes

Many projects on conservation of lakes and rivers in the State have been initiated in collaboration of MCs and other ULBs. For Example, in Mumbai, the Powai Lake has been incorporated under NLCP of MoEF. In Pune, three lakes namely Katraj, Pashan and Model Colony lakes are included in the 10th Five-Year Plan of NLCP. In 1997, the TMC undertook "Lake Beautification" programme to study their water quality and identify the sources of pollutants. Based on these findings many steps were undertaken to clean and beautify the lakes such as changing the wastewater ways, constructing storm water drains, growing plantations around the lake area, etc. The restoration of Kachrali Lake was carried out and its water quality was improved by the use of biotechnology. In the year 2002, TMC received a grant of Rs 1.85 crores for the treatment and revival of lakes. A project has been initiated to dredge and treat the Railadevi Lake in Thane. Bioremediation programmes have been undertaken in Kolshet, Makhmali, Hariyali, Kausa, Upvan, Kharegaon, Rewale and Jail lakes of TMC (TMC, 2004). The Nagpur Municipal Corporation (NPMC) has undertaken a project to rejuvenate and beautify the lakes in the city. The project involves removal of encroachment on the

banks of the lakes, desilting of the lake, purification of water, landscaping and beautification of the lake (NPMC, 2003).

The Mira-Bhayander Municipal Corporation (MBMC) has undertaken a project called "Roof Rainwater Harvesting" to harvest the terrace rainwater of the corporation's head office building. Also, within the corporation region some such projects are successfully running where 80,000 to 1,00,000 litres of water is made available everyday (MBMC, 2004). In Kolhapur MC, of the 132 MLD of water supplied, only 55 MLD is actually metered and billed. Therefore, it is necessary to conduct a water audit and reduce such unaccounted for water (UFW). The Water Supply and Sanitation Dept (WSSD), GoM, has passed a resolution to give financial support to conduct such studies. The KMC with the USAID group has undertaken the work for energy audit of water supply schemes with a view to investigate opportunities to save energy in water pumping operation (KMC, 2002).

The AuMC had planned a water supply scheme for Pundalikanagar, where the residents were to pay 25 per cent of the cost of the project. However, hardly 10 percent of this amount could be collected, putting a huge burden on the AuMC to provide water to the people through tankers. An important issue in this region was the provision of a parallel water supply system to the industrial area of Waluj, through an independent water supply line, which may invariably decrease the water supply to the rest of the city at a later stage. The AuMC is taking several steps to increase water supply to all users (AuMC, 2004). There have been efforts by external agencies like the Department For International Development (DFID) and United States Agency for International development (USAID) in collaboration with Urban local bodies (ULBs) and rural communities to establish a set up for water management which makes the system sustainable. A study conducted by USAID in Kolhapur revealed that water could be saved up to 12,414 m3/day, and electrical energy consumption up to 666,029 units/year, leading to an estimated revenue savings up to Rs.231 million with a payback of approximately one-year (USAID, 2001).

Sewage Disposal Project of MCGM

Mumbai Sewage Disposal Project (MSDP) was designed for a population of 9.4 million with an average dry flow of sewage of 2671 MLD including wastewater flow upto 240 MLD. The sewage from Colaba, Worli and Bandra is disposed into the sea through marine outfall with a capacity of 41.1 MLD, 756.90 MLD and 796.80 MLD, respectively. The work of marine outfalls at Colaba and Worli were completed in the year 1998 and 1999, respectively. The Worli outfall consists of RCC lined tunnel and passes at about 65mts below the ground level and about 53 metre below the seabed. The sewage flows through the tunnel and disperses into the seawater through the risers at the end of the tunnel A preliminary treatment and aerated degritting is imparted to the sewage before it is let into the tunnel. The Bandra outfall system and the aerated lagoons at Versova (90 MLD), Bhandup (280 MLD) and Ghatkopar (285 MLD) are also completed and commissioned. The aerated lagoons reduce the BOD of wastewater by 75-90 percent in 1.5 days and the effluent is discharged into the adjacent Creek. The Sewerage master plan prepared in 1979 for Mumbai had 2 phases, of which the first phase was upto 2005 and the works under this will be completed soon. The Mumbai sewerage stage II feasibility study covers wastewater management plan for the year 2006 upto 2025. It includes

recommendations on sewage treatment options, planning for additional works necessary to meet the future environmental standards, determine operation and management and requirements and training for adequate technology transfer (BMC, 2004).

Storm Water Drain

Brihanmumbai Stormwater Drain is a project undertaken for the rehabilitation and improvement of Mumbai's storm water drain system. The main objective of the project is to mitigate the hardships faced by the people during monsoons. The major aspects of the project include, laying of new drains to augment the carrying capacity of the existing drains, draining of the watercourse and deepening and widening of the nullahs. Project work worth Rs.225 crores has been completed and the remaining work costing about Rs.800 crores is being undertaken, phase-wise based on the availability of funds (BMC, 2004).

Storm water management of Navi Mumbai has been planned on the basis of the 'Dutch method' used in the Netherlands, which is a country located below sea level. This method is used to control ingress of seawater during high tide and allowing the wastewater/rainwater to flow into sea during low tide naturally or by pumping with the help of high capacity pumps during high tide. The high tide levels and low tide levels difference has been used to control the ingress of sea water during high tide and disposal of wastewater/rainwater during low tide. Essential parts of the system are Storm water holding pond, retaining wall, flap gates and storm water pumping station. As Navi Mumbal is located below high tide level, CIDCO used this system of flood control to optimise the reclamation levels. For disposal of rainwater, holding ponds have been constructed in Belapur, Vashi, Turbhe, Koparkhairane and Airoli nodes with high capacity storm water pumping stations Belapur and Vashi. These holding ponds are useful for monsoon season and to utilize its recreational potential during balance 8 months, NMMC has started work of beautification of holding pond at Nerul to provide jogging track, boating and other facilities. NMMC has intentions to lease the other holding ponds for fishing purpose (NMMC, 2004).

NGOs' and Private Initiatives

There is some success stories on people's participation and small-scale private initiatives (SSPI), at least in rural areas. In Kolhapur, the water Mandal of four villages has maintained its own multi-village piped water supply scheme for 19 years and has an operating revenue surplus of Rs.37000, mainly due to able leadership and transparency in operations (WSP and DFID, 2000). Further, even people who could not afford a private connection were able to access public stand posts where water was provided free of cost. Despite the fact that the spread effect of this concept has been non-existent, the lessons to be learned from this experience are many. Such a system of management could help to overcome the fiscal problems of government organisations as well as provide sustainable management of water resources.

Ralegaon Siddhi: A Success Story

Ralegaon Siddhi, a village in Ahmednagar district, was a drought prone area of the State. In 1975 under the leadership of noted social worker Anna Hazare the village began to conserve water through construction of storage ponds, reservoirs and gully plugs. Due to this there was a steady

percolation of water and the groundwater table began to rise. Because of this increased availability of irrigation water, fallow land came under cultivation and the total area under farming thereby increased. The average yield of the crops also increased. The water conservation efforts have resulted in increased availability of groundwater that in turn has facilitated the development of the community wells. Now, the village has two percolation tanks, 30 nullah bunds, about 90 wells and 10 borewells that are viable all through the year (MSDR, 2005).

Water of life: The rebirth of Surodi

Surodi is situated in a drought-prone area between Pune and Ahmednagar in the Western Maharashtra. With the help of some individuals and NGOs a watershed development project was initiated. Bunds were constructed along the stream using either earthen, concrete, a mix of concrete and stone, or composed of loose boulders. Due to this, the flow of water in the stream is slowed, preventing precious topsoil from being washed away and also allowing the impounded water to percolate into the earth and recharge groundwater. Of the 42 bunds in Surodi, the villagers constructed 21 bunds in four years. The impact of the water conservation effort has spread to other areas such as dairy farming. Due to increased water availability there is enough grass to feed the cattle. Consequently, milk production has more than doubled since work on the project started, leaping from 450 to 1,000 litres every day. There has been indirect assistance from the State in administration matters as well as transportation to and from the village (Infochange, 2005).

Ground water conservation System: Formation of Pani Panchayats

Under the Pani Panchayat, water is not only conserved but also properly managed through stringent regulations. Several water conservation techniques were employed by the state to replenish the groundwater, which could be used for irrigation and domestic purposes. In Naigaon village, equitable distribution was a key step in this process where water was treated as a common property resource with all the villagers including the landless enjoying equal rights and access to it. Five basic principles of the Pani Panchayat or Gram Gaurav Pratishtan were evolved. A family of five was given water rights for irrigation over one hectare of land. Cropping was restricted to seasonal crops with low water requirements. As water rights were not attached to land rights, if land was sold, the water rights reverted back to the farmers' collective. The beneficiaries were required to plan, administer, manage the scheme and ensure equitable distribution of water The farmers paid 20 per cent of the cost of lift irrigation; the government provided another 50 per cent while the Pani Panchayat provided the remaining 30 per cent as an interest-free loan.

This system has resulted in even landless farmers buying or leasing land for cultivation. The Pani Panchayat now operates in 25 villages having a total of 52 lift irrigation schemes, covering 2,000 families. Apart from Purandar taluka, it also operates in the Ambegaon, Maval and Phaltan talukas of Pune district, and in Yavatmal district. As a result, there has been a reversal in migration trends in Mahur village, as the farmers now earn more than those who migrated out to the cities in search of employment. Farmers who once earned Rs 2,500-Rs 4,000 annually now get Rs 10,000-Rs 1 lakh from the same land. In addition to the traditional cereals, they grow wheat, onions, vegetables and a variety of flowers and fruit. They practise organic farming and are also generating employment.

Chapter 3: Air and Noise Pollution

Introduction

India has many metropolitan cities, a large number of urban areas and vast rural regions. The deterioration of air quality, particularly in the urban areas, is a matter of serious concern in the country. Both natural and anthropogenic activities release several air pollutants in the atmosphere. Naturally occurring processes, like dust storms, volcanic eruptions etc., contribute to air pollution significantly but they are out of our control. Major anthropogenic sources of air pollution are power plants, industrial plants, vehicular traffic, domestic burning, etc. in urban areas, and chullahs (traditional cooking stoves), agricultural emissions, pollen, biomass burning, etc., in rural areas. Main pollutants include Suspended Particulate Matter (SPM), Respirable Suspended Particulate matter (RSPM/PM10), Sulphur dioxide (SO_2), oxides of Nitrogen (NO_x), Carbon Monoxide (CO), Hydrocarbons (HCs), Volatile Organic Compounds (VOC), Methane (CH_4), Benzene (C_6H_6), etc. All these pollutants are released as primary pollutants from various sources but atmospheric and metereological processes may transform them to secondary pollutants such as Ozone (O_3), which is generated as a result of photochemical reactions in the lower atmosphere.

Similar to other countries, in India, ambient air quality standards, have been developed to define the permissible pollutant concentration, which can be present in the atmosphere without causing adverse effects on the human health and environmental impacts on vegetation, crops, animals, visibility etc. Central Pollution Control Board (CPCB), under the MoEF, the apex environment regulatory agencies in India, has stipulated National Ambient Air Quality Standards (NAAQS), presented in Table 3.1. The methods used for measuring different air pollutants are as per WHO guidelines. The CPCB standards are comparable with other countries, except for NO_2, which is considered to be a more stringent standard for Indian conditions.

Based on the annual mean concentration in microgram per cubic metre of ambient air ($\mu g/m^3$) levels of SO_2, NO_2, SPM have been described as Low (L), Moderate (M), High (H) and Critical (C) for various regions such as Industrial (I), Residential and mixed use (R) areas as shown in Table 3.2.

Table 3.1: National Ambient Air Quality Standards of CPCB and WHO Guidelines

Pollutant	Averaging Time	Standards ($\mu g/m^3$)			Method of Measurement	WHO Guidelines
		Industrial	Residential	Sensitive		
SPM	Annual 24 hrs	360 500	140 200	70 100	HV Sampling (Gravimetric)	60-90 100-150
PM10	Annual 24 hrs	120 150	60 100	50 75	HV Sampling (Gravimetric)	40 70
SO_2	Annual 24 hrs	80 120	60 80	15 30	West & Gaeke (pararosaniline)	40-60 100-150
NO_2	Annual 24 hrs	80 120	60 80	15 30	Modified Jacob & Hochheiser	150
Lead (Pb)	Annual 24 hrs	1.0 1.5	0.75 1.00	0.50 0.75	AAS after sampling using EPM 2000	0.5-1.0
Ammonia (NH_3)	Annual 24 hrs	--	100 400	--	Spectroscopy	--
CO	8 hrs 1 hr	5000 10000	2000 4000	1000 2000	NDIR Spectroscopy	10000-30000

Source: CPCB (2005)

Table 3.2: Classification of Air Quality based upon the Concentration of Pollutants (µg/m³)

Air Quality	Industrial		Residential	
	SO_2 and NO_x	SPM	SO_2 and NO_x	SPM
Low (L)	0-40	0-180	0-30	0-70
Moderate (M)	40-80	80-360	30-60	70-14-
High (H)	80-120	360-54	60-90	140-210
Critical (C)	>120	>540	>90	>210

Source: CPCB (2005)

Status of Air Quality in Maharashtra

Being a highly industrialised state, urban areas of Maharashtra have numerous air pollution sources, which have deteriorated air quality of many cities. For example, based upon the observations of air quality of the seven major cities by CPCB (Table 3.3), it is indicated that the air quality in Mumbai is critical in terms of RSPM and SPM. The Table also compares air quality of various cities for residential (R) and industrial (I) area in 2001-02.

Table 3.3: Ambient Air Quality in Seven Major Indian Cities

CITY	SO_2				NO_2				RSPM				SPM			
	2001		2002		2001		2002		2001		2002		2001		2002	
Category	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R
Hyderabad	L	L	L	L	M	M	L	M	M	H	M	H	M	H	M	H
Delhi	L	L	L	L	L	M	L	M	C	C	C	C	H	C	H	C
Ahmedabad	L	L	L	L	M	M	M	M	C	C	C	C	H	C	M	C
Bangalore	L	L	L	L	L	L	L	M	H	C	M	H	L	H	L	H
Mumbai	L	L	L	L	L	L	L	L	M	H	M	H	M	C	M	C
Chennai	L	L	M	L	L	L	L	L	M	H	M	M	L	M	M	M
Kolkata	L	L	L	L	H	H	H	H	H	C	H	C	M	C	M	C

Source: CPCB (2005)

Monitoring of Air Quality

Air quality sampling and analysis in the State is carried out by MPCB at State level, by MCs their jurisdiction and at some places by research organisations such as NEERI, IITB, IITM Pune etc. As reported for 2003-2004, there are 89 NAAQM stations in Maharashtra monitored by Maharashtra Pollution Control Board (MPCB). Out of which 7 monitoring stations are in Amravati, 3 in Aurangabad, 5 in Thane, 12 in Kalyan, 9 in Kolhapur, 4 in Mumbai, 17 in Nagpur, 11 in Nashik, 3 in Navi Mumbai, 11 in Pune and 7 in Raigad as shown in Table 3.4 (MPCB, 2005). These stations have been selected on the basis of their land-use pattern and were classified under industrial, residential, commercial and sensitive area categories. At least three such stations are operated (one under each

category) in each identified city where the air pollutants are monitored twice a week for 24 hours, thus, in a year, 104 days' observations are taken. SPM is monitored every 8 hours and SO_2 and NO_2 every 4 hours. Data from a number of large-scale industries which monitor air quality in their premises, mainly for compliance purpose, was procured from the MPCB website and analysed. The annual average levels of SPM, SO_2 and NO_2 in Mumbai and Nagpur for the years 1991 to 2003 and for other cities (after 1997-1998) were analysed to establish the trend variations in their representative activity zones. PM10 data has been analysed for 2001-2003 for Mumbai, Nagpur and Pune (CPCB, 2004).

The Brihanmumbai Municipal Corporation (BMC) initially commissioned an Air Quality Monitoring Network (AQMN) consisting of 9 AQM stations in 1978, which gradually expanded to cover 20 fixed AQM stations in 1982. These stations were operated manually using high-volume samplers once a week and also recorded wind direction and speed. Over a period of time, BMC had to relocate some of these stations due to various operational difficulties and also discontinued a few e.g. Sewri station in 1998 and Mahul in 1996-97. After January 2000, the AQMN was restricted to only 6 fixed AQM stations (Khar, Worli, Tilaknagar, Maravali, Andheri and Borivali) with a bi-weekly sampling frequency as per the CPCB standards. The AQM station at Khar also collected PM10 samples.

The AQMN was supported with a mobile laboratory (monitoring van) from January 1997 equipped with the necessary instrumentation to monitor additional parameters such as PM10, HC (methane/non-methane), O_3 and H_2S as well as to record meteorological measurements such as wind speed, wind direction, temperature and relative humidity. For the first three years, this van was primarily used to respond to complaints arising from different areas of the city and to monitor traffic pollution at various locations. However, since January 2000, it was used on a regular basis to monitor the kerbside air quality at three locations (traffic junctions at Andheri, Wadala and Mahim) twice a week, as per the directive of the Hon'ble High Court. Automatic. AQM is done to check the air quality levels at various junctions using mobile monitoring vans in Mumbai.

A study was undertaken by NEERI (2003) to address the problem of particulate matter in Greater Mumbai region and to draw action plans for its control/mitigation. Primary data was collected from December 2001 through to January 2002. Sixteen representative sampling sites were selected to monitor SPM and PM10 levels which were measured using the standard gravimetric technique. The samples were collected twice a week, every 8-hours starting from 14:00 hours on a 24-hour basis for a minimum period of 8 days. The average SPM and PM10 concentrations at control sites (background concentration) were observed to be marginally below permissible limits, around 194 $\mu g/m^3$ and 82 $\mu g/m^3$, respectively. Ambient air quality in normal activity areas showed that the average SPM was 334 $\mu g/m^3$ and PM10 was 128 $\mu g/m^3$. The average concentrations of SPM and PM10 were found to be highest at the kerbside sites with an average level of 496 $\mu g/m^3$ and 181 $\mu g/m^3$, respectively. The CPCB standard for mixed-use area was exceeded at all the sampling locations representing ambient air quality.

Air pollution levels of some important cities of Maharashtra are compared with those of India in Table 3.4. Among these cities Calcutta recorded the highest NOx levels followed by Solapur and Ahmedabad. The SPM levels in Solapur exceeded the standard limit, while the SPM and RSPM levels recorded in Delhi were higher than the prescribed level. The RSPM levels in almost all places, at all times, are higher the standard limits. In terms of these levels, which are responsible for health damages, Maharashtra towns are better than northern cities like Delhi, Calcutta and Ahmedabad, but

worse than southern cities like Chennai, Bangalore and Hyderabad. The RSPM constitutes a major fraction of SPM in residential areas of Nagpur and Chennai and industrial areas of Hyderabad and Chennai. In both Mumbai and Solapur, its share is reasonably less, both in residential and industrial areas (Table 3.5).

Table 3.4: Air Quality Levels in Some Important Indian Cities (2000-04)

City	Combined Site Average of Mean of Annual Averages (µg/m³)															
	SO_2				NO_x				SPM				RSPM			
	2000-01	2001-02	2002-03	2003-04	2000-01	2001-02	2002-03	2003-04	2000-01	2001-02	2002-03	2003-04	2000-01	2001-02	2002-03	2003-04
Delhi	16.5	13.3	13.2	10.6	41.5	28.9	35.1	39	312	334.5	41.5	374	123.4*	519#	-	-
Kolkata	25.3	21.9	13.3	18.1	44.2	86.7	96.4	83.3	285	319	320		149.5	145.3	-	-
Chennai	15.1	20.7	40	19.8	14.1	21	20.7	34.5	85.7	96.8	156	70.8	71.6	83	-	-
Bangalore	18.9	19.6	14.6	12.8	32.4	22.4	23.1	29.7	120	121	126	146	-	89.66	-	-
Ahmedabad	9	11.2	10	18.7	35.2	45.9	42.1	28	-	366	344	311	163.3	229.5	-	-
Hyderabad	12	11.7	6.7	5.4	29.3	32.5	27	29.5	199	159.3	187	81.3	127.1	98	-	-
Mumbai	11.8	12.9	9.7	7.4	31.1	27.3	17.8	22.5	-	220	226	227	249	277	314	254
Nagpur	9.3	8.8	8.7	6.5	21.1	14.7	12.9	20.8	-	133	233	219	178	121	-	-
Solapur	18.9	19.4	20.1	19.9	45.8	46.4	47.3	45.3	390	403	407	396	177.5	192	-	-

Source: CPCB (2000, 2001:a, 2005)

Table 3.5: Percentage of RSPM in SPM for Various Cities

City	Percentage of RSPM = (RSPM/SPM)*100	
	Residential Areas	Industrial Areas
Delhi	43	58
Kolkata	47	38
Chennai	79	68
Bangalore	45	35
Ahmedabad	49	58
Hyderabad	54	63
Mumbai	51	37
Nagpur	67	-
Solapur	42	44

Source: CPCB (2001:b)

The ambient air quality status in some cities of the State (Table 3.6 and 3.7) shows that air pollution in the residential areas is mostly moderate or low, except for the SPM levels in Solapur. Mumbai, Nashik, Nagpur and Solapur have shown an increase in SPM levels between 1997 and 2001. Thane is the only city, which has shown some decline in the SPM levels during the same period but these levels are still above prescribed standards. The reasons for decline in Thane are introduction of new vehicles with low emissions, overall improvement in road conditions, reduction in congestion, etc.

Table 3.6: Ambient Air Quality Status of Some Residential Areas in Maharashtra

Area	SO_2	NO_x	SPM
Mumbai (Bandra)	8.00(L)	19.00(L)	219(M)
Mumbai (Kalbadevi)	8.00(L)	23.00(L)	224(M)
Thane (Terrace of Maternity Hospital, Thane East)	8.00(L)	15.00(L)	Not Available
Thane (Terrace of Shahu Market, Thane East)	9.00(L)	19.00(L)	Not Available
Solapur (Chitale Clinic, Solapur)	20.00(L)	46.00(M)	398(H)

Source: CPCB (2003)

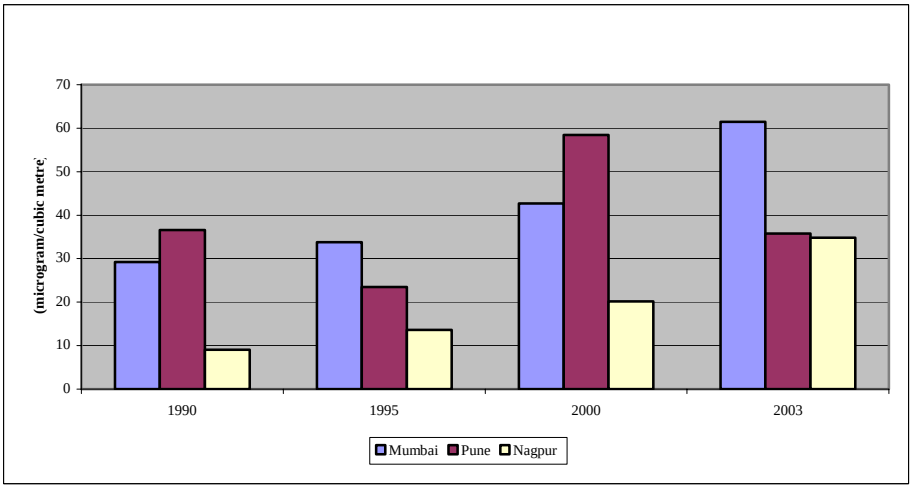
Table 3.7: Major Air Quality Parameters for Selected Locations in Maharashtra during 1997-2004 (µg/m ^{3})

Parameter	Year	Location									
		Thane	Nashik	Nagpur	Chandrapur	Solapur	Mumbai	Dombivili	Aurangabad	Ambernath	Pune
SO_2	1997-98	13-40	5-24	4-40	18-43	16-21	6-51	29	12.62	28	49.15
	1998-99	9-35	7—38	6-48	24-54	13-17	12-46	24	-	49	-
	1999-00	10.8-14.5	6.5-37.4	5.5-31.8	16-33	17.9	9-43	34	-		43.46
	2000-01						7-26			37.27	
	2001-02	19.2-22.4	11.1-29.8	9.5-10.1	-	19.5-46.27	7-25	-	-	-	36.5-44.4
	2002-03						14-40			28.02	
	2003- 04	6- 70	17.1- 58.3	6.1- 29.3	-	-	11.2- 14.2	-	14.8- 15.1	-	8.4- 35
NO_x	1997-98	34-41	15-34	16-55	29-53	35-47	22-80	66	8.71	20	58.1
	1998-99	23-32	9-37	9-52	29-53	25-45	19-49	31	-	36	-
	1999-00	20.1-25.9	13.8-21.9	12.4-52.8	28.2-54.2	45-45.6	18-46	37.4	-	40.5	58.43
	2000-01						14-69			75.73	
	2001-02	50.2-75.6	58-94.3	169.7-194.7	174.8-214	179.5-200.7	16-57	94.3	-	66.49	48.4-101.7
	2002-03						24-96			159.8	
	2003- 04	6.5- 27	16.7- 55.8	18.4- 69.6	-	-	45.8- 107	-	14.8- 15.8	-	11.8- 47.5
SPM	1997-98	150-343	159-199	114-133	116-132	229-314	166-441	211	673	203	310.5
	1998-99	141-179	143-190	146-161	172-181	222-247	162-356	124	-	217	-
	1999-00	-	-	163.83	-	-	108-424	-	-	-	199
	2000-01						148-373			252.15	
	2001-02	-	-	-	-	-	120-390			185.33	61-27.37
	2002-03						172-463			190.48	
	2003- 04	201.6-3621 *	163.19-839#	80.1-1114.3♦	-	-	-	-	40.5- 181.7	-	102.7- 440.2

Note: 3621* indicates dumping site, 839# indicates commercial area, 1114.3♦ indicates industrial area
Source: MPCB (2005)

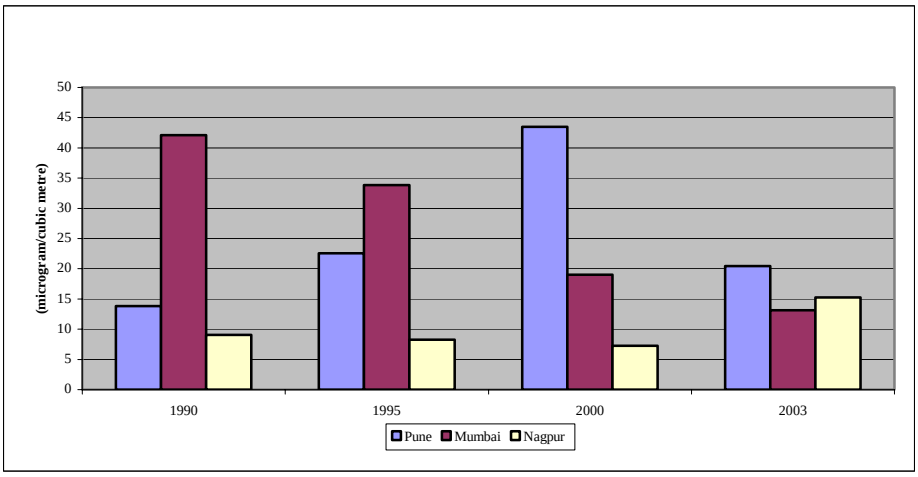
Time series data of major air quality parameters, for the last decade, is available only for Mumbai, Nagpur and Pune as shown in Figures 3.1 to 3.3 and Table 3.8. It is clear from the Figures and Table that the SO_2 levels have reduced considerably during 1990 to 2001. In Mumbai, reduction in SO_2 levels is due to the use of low sulphur content fuel by the industries. In Pune, surprisingly, SO_2 levels have increased substantially from 13.85 µg/m^3 to 49.15 µg/m^3, whereas in Nagpur they have remained more or less constant. With respect to NO_x all the three cities have shown a sharp increase from 1990 to 1998 mainly due to the rapid increase in vehicular population. This holds special context for Mumbai and its suburbs where although 80 per cent of the population uses public transportation, traffic congestion is still high due to higher traffic density. However, both SO_2, NO_x levels have remained within the prescribed limits despite the increase in their levels over the years.

Figure 3.1: Concentration of SO_2 in Mumbai, Pune and Nagpur



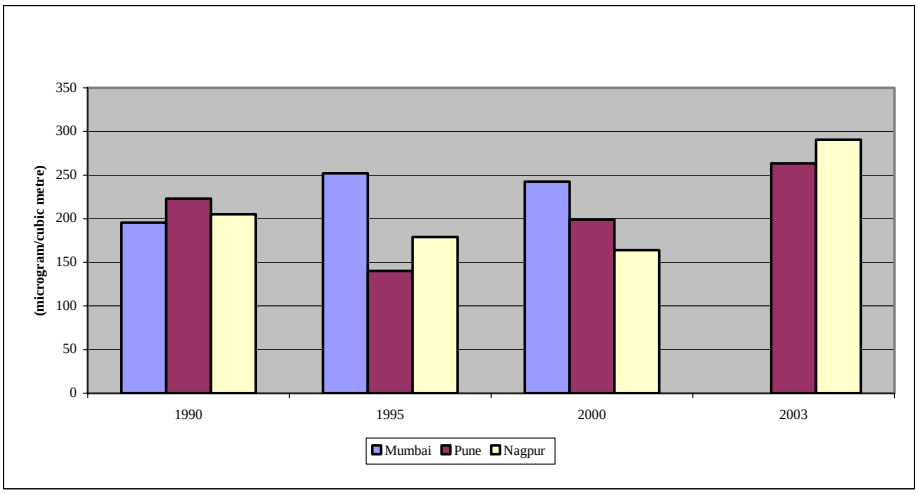
Source: CPCB (2005)

Figure 3.2: Concentration of NOx in Mumbai, Pune and Nagpur (µg/m³)



Source: CPCB (2005)

Figure 3.3: Concentration of SPM in Mumbai, Pune and Nagpur (µg/m³)



Source: CPCB (2005)

Mumbai's, SPM levels showed a high degree of variation; a rising trend was seen until 1995 after which they fluctuated sharply. Pune also showed a constant rise across the years reaching 310 μg/m^3 in 1998 and then a sudden decrease and increase in the years 2000 and 2003, respectively. Nagpur, on the other hand, has shown a declining trend, except in the year 2000. Thus, within these three cities, there are wide variations in SPM levels.

Table 3.8: Major Air Quality Parameters for Mumbai, Pune and Nagpur

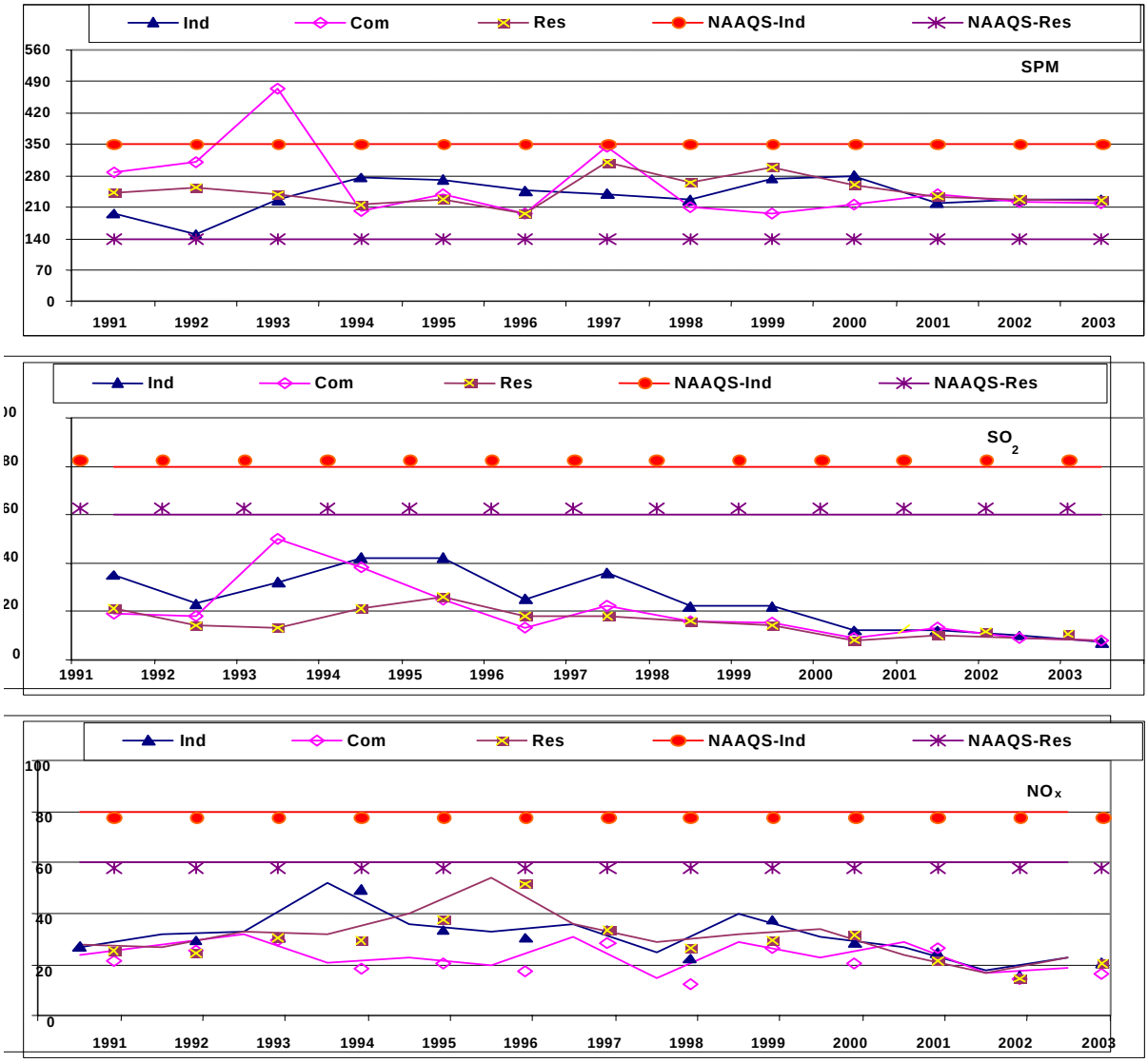
Year	Concentration in Annual Average (μg/m^3)								
	SO_2			NO_x			SPM		
	Mumbai	Pune	Nagpur	Mumbai	Pune	Nagpur	Mumbai	Pune	Nagpur
1990	42.1	13.85	9.05	29.2	36.6	9.05	195.5	223	205
1991	27.4	17.05	8.25	3.6	22.05	16.7	233	197.5	248.5
1992	19.65	-	9.4	29.85	17.1	20.7	216.5	-	186.5
1993	22.2	27.8	7.95	33	39	14.5	232.5	179.5	130.5
1994	36	-	6.1	41.9	-	12.6	242.5	-	184.5
1995	33.85	22.55	8.25	33.75	23.45	13.6	252	140	179
1996	19.5	41.5	7.75	34.5	41.5	16.9	221.5	210.5	181.5
1997	27.8	53.1	9.05	34.7	61.1	18.55	283.5	276.5	140
1998	18.9	49.15	7.2	23.5	58.1	15.45	164.5	310.5	143.5
1999	38	-	-	25	-	-	260	-	-
2000	19	43.46	7.23	42.7	58.43	20.16	242.5	199	163.83
2001	19	-	-	43	-	-	212	-	-
2002	28	-	-	57	-	-	245	-	-
2003	13.15	20.47	15.26	61.45	35.77	34.84	-	263.43	290.67

Source: Calculated from CPCB (2000), CPCB (2002:c), Phatak (2002) and MPCB (2004)

Monitoring at Mumbai

The monitoring of air quality parameters within Mumbai City is primarily the responsibility of the MCGM. Three stations are also monitored by NEERI, but the monitoring results of these stations were not available with the MPCB. Many a times, due to malfunctioning of the mobile monitoring vans, the 104 mandatory annual measurements to be taken as per the CPCB guidelines are rarely complied with. Hence, monitoring is not being conducted in a satisfactory manner (CAG, 2000-01). The annual average levels of SPM, SO_2 and NO_2 in Mumbai were analysed by NEERI, for the years 1991 to 2003, to establish the trend variations in the three representative activity zones. Annual air quality trends (in terms of SPM, SO_2 and NO_x) at the industrial, commercial and residential sites in Mumbai are presented through Figure 3.4, along with the applicable CPCB standards and WHO guidelines. Analysis of long-term SPM data indicates that, though the SPM levels were still much higher than the corresponding CPCB standards and also WHO guidelines of 60-90 μg/m^3, the SPM levels were decreasing and are stabilising at three locations during past 3-4 years. The SO_2 levels indicate that these levels have always been well within the CPCB limits, and the WHO guidelines of 40-60 μg/m^3 at all the locations. The values were found to decrease and stabilise around 10±2 μg/m^3 in Mumbai during the past 3-4 years. Levels of NO_x indicates that NO_x levels were always well within the CPCB limits and the WHO guidelines at all the locations. NO_x was found to decrease and stabilise around 20±3 μg/m^3 in Mumbai in the last 3-4 years.

Figure 3.4: Ambient Air Quality Trends for Mumbai (1991-2003)



X - axis : Year; Y - axis : Pollutant Concentration (µg/m^3)

Source: NEERI (2005a)

Some PAHs, which are known to be potent carcinogenic compounds are analysed from SPM and the annual average range found is presented in Table 3.9. The configuration of Mumbai is such that the industries are located in north/north-eastern part. The predominant wind direction is south/south-west in monsoon and north/north-east in winter. Stable atmospheric conditions and predominant wind direction in winter cause high pollution levels in Mumbai (BMC, 2004).

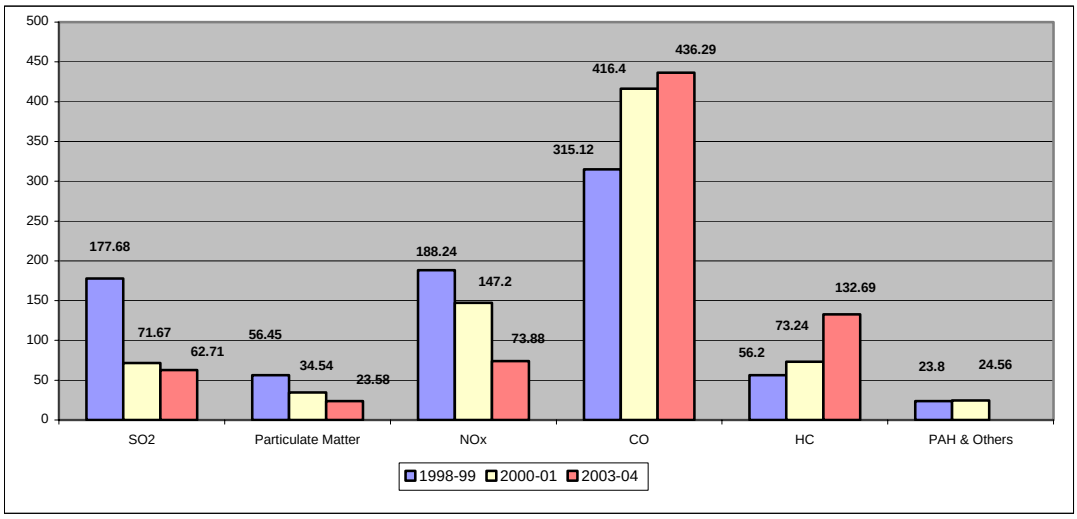
The time-series emission load for Mumbai city as represented in Figures 3.5 and 3.6, indicates that the CO and HC emission levels are steadily increasing over the years. There is a decrease in SO_2 and NO_X levels from 1998 to 2004. In case of NO_X levels, it is in contrast to the CPCB results shown in Figure 3.2, which can not be explained.

Table 3.9: Annual Average Range of PAHs (µg/1000m³)

PAHs	Annual Average Range (µg/1000m³)
Benzo (a) Pyrene	0.11 - 3.67
Phenanthrene	0.03 - 0.45
Anthracene	0.0 - 0.15
Fluoranthene	0.07 - 1.17
Pyrene	0.07 - 1.15
Chrysene	0.16 - 8.22
Benz (a) Anthracene	0.06 - 1.81

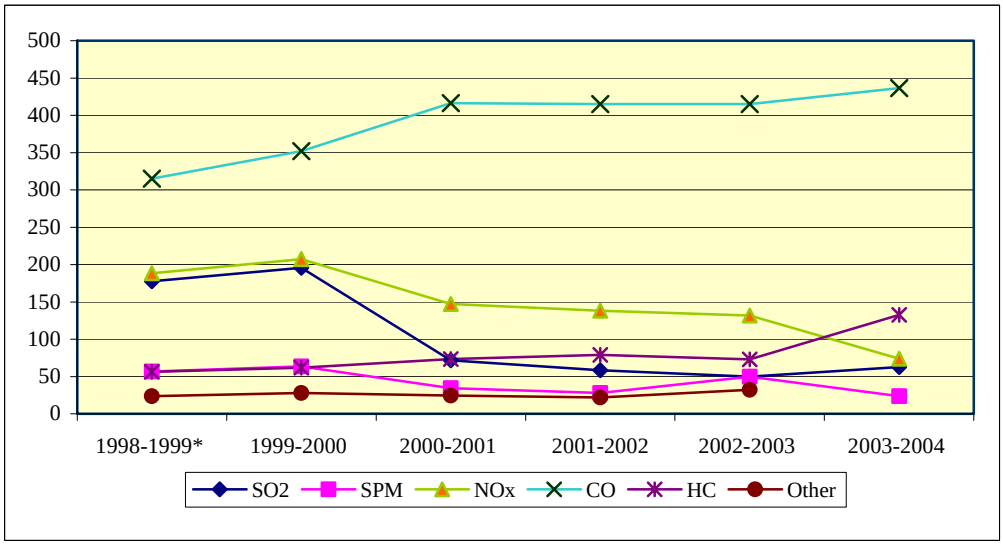
Source: BMC (2004)

Figure 3.5: Emission Load of Mumbai City (Tonnes/Day)



Source: Data from ESRs of BMC (2004)

Figure 3.6: Emission Load of Mumbai City (Tonnes/day)

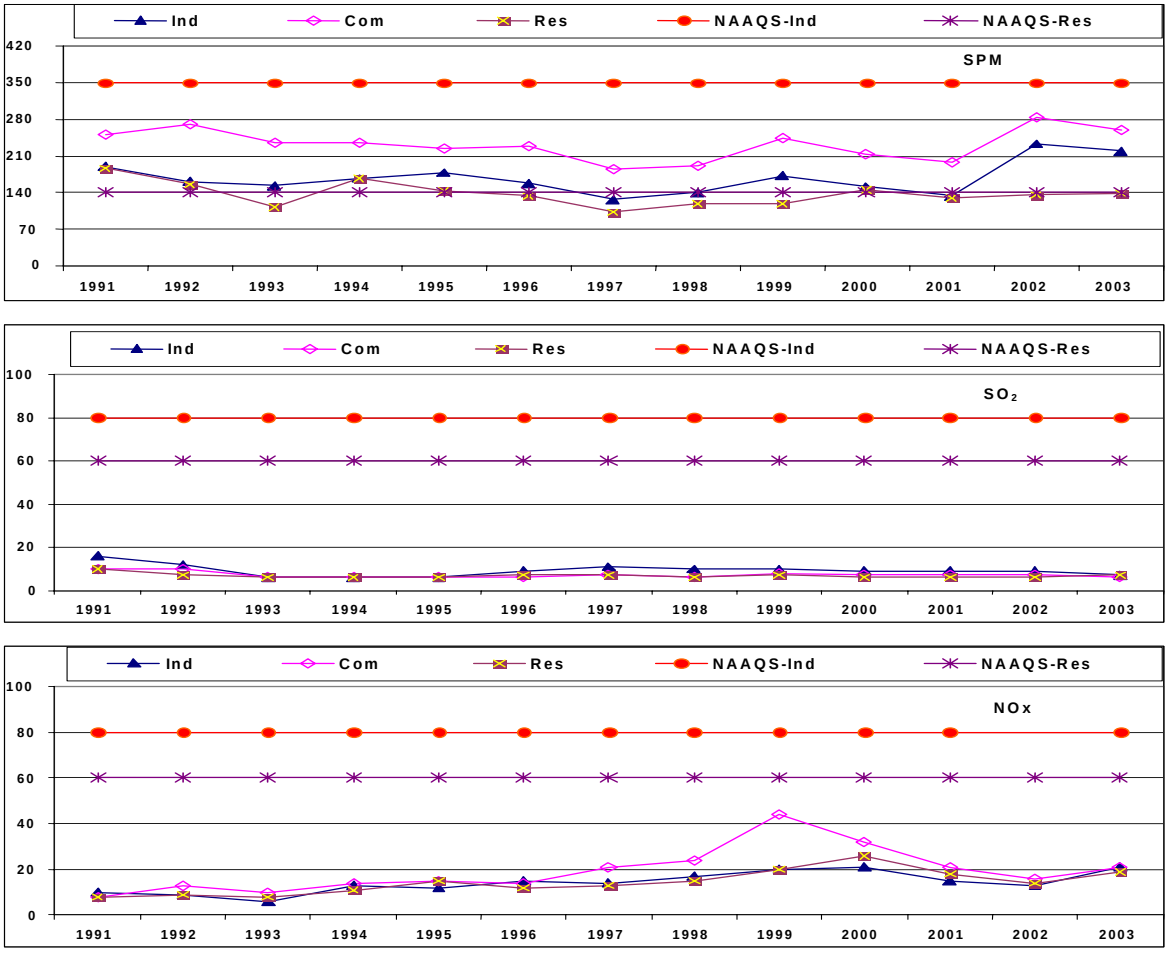


Source: Compiled from different ESRs of BMC.

Monitoring at Nagpur

The annual average levels of SPM, SO_2 and NO_x in Nagpur during the years 1991 to 2003 were analysed by NEERI to assess the trend variations in the three representative activity zones. Annual air quality trends (in terms of SPM, SO_2 and NO_x) at the industrial, commercial and residential sites in Nagpur are presented in Figure 3.7, along with the applicable CPCB standards and WHO guidelines. Analysis of SPM data indicates that the SPM levels were marginally higher than the corresponding CPCB standards. SPM levels were consistent between the years 1998-1999, then increased in the year 2000 and remained quite consistent (in the range 129-145 µg/m^3) during 2000-2003. Annual mean SO_2 levels remained more or less consistent at all the three sites, and were always much below the corresponding CPCB and WHO standards throughout the period. Annual mean NO_x levels were also much below the corresponding CPCB and WHO standards throughout the period.

Figure 3.7: Ambient Air Quality Trends for Nagpur (1991-2003)



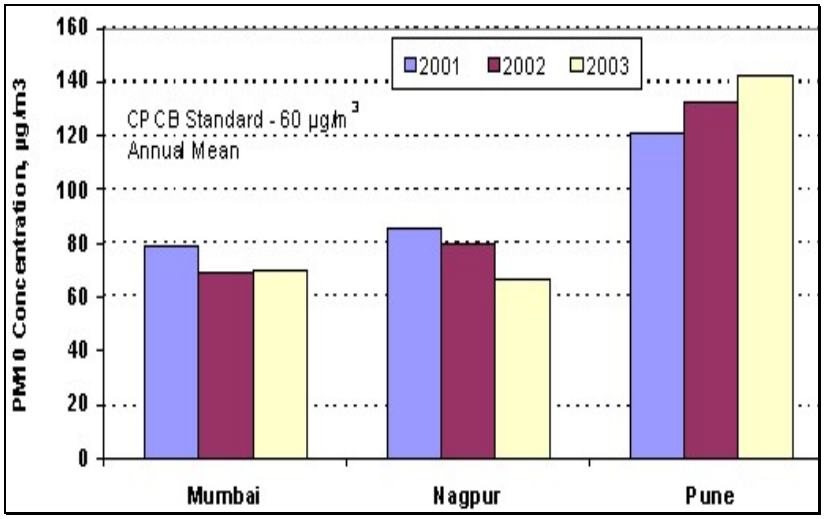
X - axis : Year; Y - axis : Pollutant Concentration (µg/m)

Source: NEERI (2005a)

Monitoring of PM 10 levels was included in CPCB stations during the year 2001. Annual mean levels of PM10 in Mumbai, Pune and Nagpur between the years 2001-2003 are presented in Figure 3.8. In general, PM10 levels exceeded the CPCB standard of 60 µg/m^3 in all the three cities during this period. A decreasing trend in PM10 concentrations was observed in Nagpur, Mumbai also

showed a decreasing/consistent trend, whereas Pune showed an increasing trend. Since PM10 has proven to adversely affect human health, proper control and mitigation of its emission requires urgent attention. Figure 3.9 shows AQ trend of various cities during 1997-2004.

Figure 3.8: Annual Mean Concentration of PM10 in Mumbai, Pune and Nagpur, (2001-03)



Source: NEERI (2005 a)

Monitoring by MPCB

NEERI also carried out the analysis of data for eight MPCB regions, namely, Thane, Nashik, Nagpur, Chandrapur, Solapur, Mumbai and Kalyan, the details of monitoring locations and agencies are given in Table 3.10 as per National Air Monitoring Programme (NAMP). Air quality parameters (SPM, SO_2 and NO_x) have been monitored at various locations in each city for a period of 1997-98 to 2003-04, covering all types of areas i.e. residential (R), commercial (C) and industrial (I). The resultant data was analysed as average of the monitoring locations in each city and the averaged data are presented through Figure 3.10. However, the data for some of the years/locations was either not available or not properly reported.

SPM levels, in general, were in the range 140-280 µg/m^3, except high levels (up to 420 µg/m^3 at Solapur and low levels at Thane and Kalyan during 1999-2001). SPM levels exceeded the CPCB standard of 140 µg/m^3 (for residential area), in almost all the regions/cities during most of the years. With regards to SO_2 levels, a decreasing trend was observed and the levels were well within the CPCB standard of 60 µg/m^3. Similarly, NO_2 levels were always well within the CPCB standard of 60 µg/m^3. A decreasing trend in all the regions, except at Kalyan and Nagpur was observed.

Monitoring by Industries

Air quality data monitored by various industries in different regions of Maharashtra for the year 2003-2004 was analysed for different regions, viz. Amravati, Aurangabad, Thane, Mumbai, Kolhapur, Kalyan, Navi Mumbai, Nashik, Nagpur, Pune, and Raigad. The data was available for 91 monitoring locations, falling under Residential (10), Commercial (28) and Industrial (53) activity zones. Details of the monitoring locations, number of monitoring stations and air quality parameters (SPM, PM10, SO_2 and NO_x) for each city/town are presented in Table 3.11.

Table 3.10: Details of Air Monitoring Stations of MPCB under NAMP

Sr. No.	Region	Monitoring Agency	Monitoring Location	Type of Location	Data Availability
1.	Thane	Thane Municipal Corporation	Dhobi Ghat, Kopri	R	1997-98, 1998-99, 1999-2000, 2000-01, 2001-02, 2002-03, 2003-04
			Balkum& Koshet	I	
			Shahu Market, Naupada	C	
2.	Nashik	KTHM Science College	RTO	R	1997-98, 1998-99, 1999-2000, 2000-01, 2001-02, 2002-03, 2003-04
			VIP	I	
			NMC	C	
3.	Nagpur	Visvesvaraya National Institute of	Institution of Engineers	R	1997-98, 1998-99, 1999-2000, 2000-01, 2001-02, 2002-03, 2003-04
			Govt. Polytechnic College,	I	
			MIDC, Himgna	C	
4.	Chandrapur	MPCB	Admn. Bldg. DIC	R	1997-98, 1998-99, 1999-2000, 2000-01, 2002-03, 2003-04
			MPCB Office Bldg.	C	
5.	Solapur	Walchand Institute of Technology	Sat Rasta	R	1997-98, 1998-99, 1999-2000, 2000-01, 2001-02, 2002-03, 2003-04
			MIDC	I	
			WIT Campus	C	
6.	Mumbai	NEERI	Kalbadevi	R	1997-98, 1998-99, 2002-03, 2003-04
			Parel	I	
			Bandra	C	
7.	Kalyan	MPCB	Ambernath	R	1997-98, 1998-99, 1999-2000, 2000-01, 2001-02
			Dombivili	I	
8.	Pune	Pune University	Nal Stop	R	2001-02, 2003-04
			Bhosari	I	
			Swargate	C	

Source: MPCB (2004:c)

In most of the cities/towns the SPM and PM10 levels are found to exceed CPCB standard of 200 μg/m^3 and 100 μg/m^3, respectively. Concentration levels of SO_2 and NO_x are well within the CPCB standard of 80 μg/m^3.Analysis of long-term as well as short term air quality data available for the different cities/towns/regions of the Maharashtra indicate that SO_2 and NO_x are well within the permissible limit of CPCB. However, a higher level of SPM/PM10 is observed in almost all the cities/towns. Air quality data of some MCs for different years is given in Table 3.12.

Relative Pollution Levels

Pollution levels in terms of Excedence Factor (EF) during the period 1997-2004 are presented for major cities of Maharashtra in Table 3.13. EF is the ratio of measured annual mean concentration of a pollutant to the annual standard for that pollutant. Extent of pollution in a city is presented in relative terms of pollution levels (low, moderate, high or critical), which is defined on the basis of EF. The four air quality categories are:

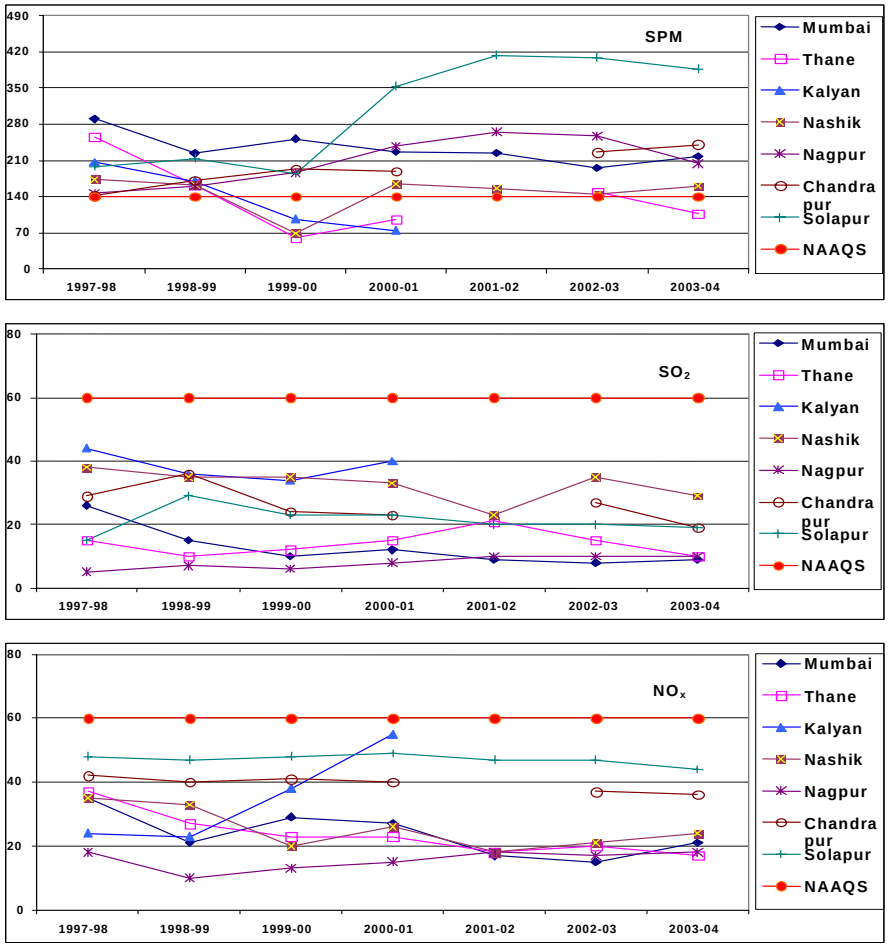
(i) EF > 1.5 - critical pollution;

(ii) EF between 1 and 1.5 - high pollution;

(iii) EF between 0.5 and 1.0 - moderate pollution; and

(iv) EF < 0.5 - low pollution.

Figure 3.9: Ambient Air Quality for Major Cities of Maharashtra: 1997-2004



X - axis : Year; Y - axis : Pollutant Concentration (µg/m)

Source: NEERI (2005)

Based on this analysis, it may be concluded that air quality in all the cities can be classified as high to critical in terms of SPM during all the years 1997-2004. Pollution due to SO_2 was mostly low for all the cities, except for Nashik, which was moderately polluted. With regard to NO_x, Thane, Nashik, and Nagpur have low pollution levels, whereas Solapur and Mumbai were moderately polluted. Kalyan was low to moderate, and Pune was moderate to high and sometimes critically polluted too.

Table 3.11: Region-wise Ambient Air Quality data of Maharashtra (2003-2004)

Region	No. of Stations / Classification	SPM	PM10	RSPM	SO_2	NO_x
Amravati Region						
Amravati	5, I -3; C-1; R-1	232	90	90.32	17	33
Akola	2, I-2	248	-	-	23	56
Aurangabad Region	3, I –3	167	-	-	15	15
Thane Region						
Thane	4, I-2; C-1; R-1	-	-	-	30	18
Tarapur	1, I-1	202	96	96.32	49	20
Mumbai Region						
Chembur	4, I-2; R-2	-	185	174.38	13	68
Kolhapur Region						
Kolhapur	1, C-1	-	46	45.8	2	7
Sangli	3, I-1; C-2	929	269	268.83	3	12
Ratnagiri	4, I-4	106	-	-	8	12
Chiplun	1, I-1	205	-	-	68	32
Kalyan Region						
Kalyan-I	3, I-2; R-1	381	-	-	28	114
Kalyan-II	3, I-3	81	-	44	14	13
Kalyan-III	4, I-3; R-1-	-	223	199.63	24	25
Dombivili	2, I-1; R-1	-	142	189	28	12
Navi Mumbai-Region	3, I-3	181	83	83.03	9	63
Nashik Region						
Jalgaon	1, I-1	-	37	37.16	49	34
Dhule	10, C-10	474	-	-	42	33
Nagpur Region						
SRO-I	2, C-2	202	128	128.25	6	29
SRO-II	5, I-5	692	-	-	17	38
SRO-III	8, I-8	278	-	104.46	18	40
Chandrapur	2, C-2	139	98	98.77	19	36
Pune Region						
SRO-I&II	2, C-1; R-1	262	170	169.6	19	31
Pimpri-Chinchwad	1, I-1	103	114	113.6	35	44
Satara	3, C-3	-	185	185.3	13	23
Solapur	5, I-1; C-3; R-1	490	264	263.78	19	37
Raigad Region	7, I-7	100	97	83.11	13	28

Source: MPCB (2004:c)

Table 3.12: Air Quality data of some Municipal Corporations/Councils for different years (µg/m³)

MCs		SPM	SO2	NOx	RSPM / PM10
Ahmednagar	2000	611	17	39.83	232.5
	2003	250	24.25	36.75	NA
	2004	240	31	44.33	NA
Ambernath	2000	99.81	40.5	54.37	NA
Aurangabad	1998	727.86	13.33	9.8	NA
	2004	578.57	14.43	13.29	NA
Bhiwandi-Nizampur,	(summer) 2001	391.48	29.4	59.1	125.28
	(Winter) 2001	506.8	12	47.4	NA
	2002	391.48	12	47.4	125.28
	2003	438.14	14.2	62.2	163.14
Bhusawal	2000	379	13.83	59.33	145
	2001	379	13.83	59.33	145
Dhule	2003	494.12	44.42	33.36	NA
Ichalkaranji	(Monsoon) 2004	82.81	19.64	14.78	25.06
	(Post-Monsoon) 2004	107.04	22.86	18.49	32.25
Jalgaon	1998	356.21	24.2	20.46	NA
Kalyan-Dombivili	2003	87.59	20.05	20.63	54.94
	2004	82.06	26.73	23.47	43.37
Kolhapur	2000	457.33	82.83	76.33	319
	2002	473.63	NA	NA	323.97
	2003	480.41	NA	NA	331.3
Mumbai	2001	226.5	17.33	35.5	NA
	2002	258.5	27.83	57.5	NA
	2003	258.5	27.83	57.5	NA
	2004	260.8	25.8	53.2	NA
Nanded	1998	415.83	35.4	22.8	NA
	2004	289.74	18.21	26	123.53
Nashik	2002	224.63	15.37	48.38	147.91
	2003	131	18.2	39.9	100.3
Navi Mumbai	1998	538.25	106.4	65.17	NA
	2002	308.25	19.767	39.33	93.38
Panvel	2003	37	31.54	27.18	NA
	2004	45.07	35.75	33.63	68.9
Pune	2000	404.91	56.9	93.62	187.29
	2002	203.49	NA	NA	127.01
	2003	NA	NA	NA	153.76
Sangli	2001	681.75	22.37	98.36	NA
Satara	2003	130.82	12.08	38.33	NA
Thane	2001	NA	21	18	54
	2002	NA	17.73	19.87	61.3
	2003	116.8	9.93	22.71	53.09
	2004	93.33	8.63	15.5	47.79
Ulhasnagar	2004	200.68	15.02	57.86	108.2
Mira-Bhayandar	2004	NA	70.6	65.31	96.85
Beed	2000	208.5	45.25	32.25	106.5
Pimpri-Chinchwad	2000	482.8	68.4	65	NA
	2002	486.2	68.3	65.5	NA
Nagpur	2003	247.7	8.87	11.4	72.73
Solapur	2001	443	19.6	46.8	NA
	2002	414	19.6	46.7	NA
	2003	409	19.85	46.8	NA

Source: Compiled from various ESRs of Municipal Corporations/Councils.

Table 3.13: Relative Pollution Levels of Major Cities: 1997-2003

Parameters/City	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
SPM							
Thane	C	H	L	M	-	H	M
Nashik	H	H	L	H	H	H	H
Nagpur	H	H	H	C	C	C	H
Chandrapur	H	H	H	H	-	C	C
Solapur	H	C	H	C	C	C	C
Mumbai	C	C	-	-	-	H	C
Kalyan	H	H	M	M	-	-	-
Pune	C	H	H	C	C	-	C
SO_2							
Thane	L	L	L	L	L	L	L
Nashik	M	M	M	M	L	M	L
Nagpur	L	L	L	L	L	L	L
Chandrapur	L	M	L	L	L	L	L
Solapur	L	L	L	L	L	L	L
Mumbai	L	L	L	L	L	L	L
Kalyan	L	L	L	-	-	-	-
Pune	-	-	-	-	L	-	L
NO_2							
Thane	M	L	L	L	L	L	L
Nashik	M	M	L	L	L	L	L
Nagpur	L	L	L	L	L	L	L
Chandrapur	M	M	M	M	-	M	M
Solapur	M	M	M	M	M	M	M
Mumbai	M	L	-	-	-	L	L
Kalyan	L	L	M	M	-	-	-
Pune	M	H	H	H	C	-	M

C - Critical; H - High; M - Medium; L – Low.
Source: MPCB (2004)

Indoor Air Pollution

High levels of pollution within houses and premises have severe repercussions on the health of women, children and aged people. The use of traditional fuels in rural areas of India is as high as 80 per cent, giving rise to various health problems such as Acute Respiratory Infections (ARI) in children, chronic obstructive lung diseases (such as asthma and chronic bronchitis), lung cancer and pregnancy-related problems. It is estimated that premature deaths on account of indoor air pollution in the country could be as high as 2.78 million annually. As seen in Table 3.14 the about 73 per cent of households in rural Maharashtra still use firewood as cooking fuel.

Table 3.14: Distribution of Households by Availability of Separate Kitchen and Type of Fuel Used for Cooking in Rural and Urban Areas

Kitchen within the house	Rural	%	Urban	%	Total	%
Available	8,487,453	77.2	6,645,419	82.4	15,132,872	79.4
Not available	2,033,872	18.5	1,288,771	16.0	3,322,643	17.4
Cooking in open	449,765	4.1	81,276	1.0	531,041	2.8
No cooking	22,533	0.2	54,060	0.7	76,593	0.4
Total	10,993,623	100.0	8,069,526	100.0	19,063,149	100.0
Type of fuel used for cooking						
Fire-wood	8,076,135	73.5	802,354	9.9	8,878,489	46.6
Crop residue	842,437	7.7	96,804	1.2	939,241	4.9
Cowdung cake	372,440	3.4	27,785	0.3	400,225	2.1
Coal, lignite, charcoal	13,494	0.1	39,550	0.5	53,044	0.3
Kerosene	472,291	4.3	2,424,717	30.0	2,897,008	15.2
LPG	1,055,083	9.6	4,601,342	57.0	5,656,425	29.7
Electricity	13,307	0.1	4,093	0.1	17,400	0.1
Biogas	113,658	1.0	11,970	0.1	125,628	0.7
Any other	12,245	0.1	6,851	0.1	19,096	0.1
No cooking	22,533	0.2	54,060	0.7	76,593	0.4
Total	10,993,623	100.0	8,069,526	100.0	19,063,149	100.0

Source: Census (2001)

A study conducted in Chennai indicated that the RPM levels were alarmingly high, about 2000 µg/m3, where biofuels were being used (World Bank, 2001). Besides having adverse health impacts on humans, use of biofuels also leads to unsustainable consumption of fuel wood causing desertification and deforestation. Thus, there is a need for a stove in rural households that has the following characteristics: a) low cost; b) easy to build and operate; c) meets general and specific cooking needs of households in different regions; d) burns a variety of biomass fuels efficiently; and e) causes less pollution. In order to ensure that cleaner fuels such as LPG are made easily accessible to the rural regions and thereby reduce health hazards the World Bank gives the following guidelines (World Bank, 2001).

- Facilitating access to modern fuels and electricity.
- Reducing the cost and improving the quality of energy supplied to low-income households.
- Ensuring that energy subsidies are targeted at and are accessible to the poor.
- Promoting energy efficient/less polluting end-use technologies.

Studies on human exposure to air pollution in Mumbai, conducted by CPCB and Indian Institute of Technology Bombay (IITB), concluded that the personal exposure to RSPM exceeds the NAAQS, almost uniformly for all respondents. The standard for PM10 is exceeded by a factor of

approximately 3.3 of CPCB standards, whereas that of the WHO is exceeded by a factor of 4.6. The NAAQS, for NO_2 is 80 mg/m^3 or 43 ppb for 24 hrs. The personal exposure level for NOx for winter season was slightly above the standard value, while for summer it was lower. It is noted that the ambient air quality value, measured at a monitoring station nearby, during this period was much below the standard. The CO exposure is highly dependent upon the proximity of the receptor location to the source. Its concentration very near to the road during peak traffic hours far exceeds the prescribed standard. However, a few meters away from the road, it decreases rapidly, and reaches below detection limit. Similarly, inside residences during cooking period, CO concentration is very high. Hence, a traffic policemen or a housewife can be exposed to very dangerous concentration of CO during some periods in a day, though their daily-integrated exposure can be below the standard (CPCB 2002:g).

Industrial Sources

Table 3.15 shows that Kolhapur, Nashik, Raigad, Thane, Navi Mumbai, Aurangabad and Nagpur regions account for the major number of industries located in the state (as of March 2004). Table 3.16 show that the main industries in Maharashtra include Integrated Iron and Steel, Pharmaceuticals and Bulk Drugs, Distilleries, Dyes and Drug Intermediates, Sugar, Pulp & Paper, etc. present the details relating to compliance with standards and the actions taken against defaulters. Most of the industrial estates in Konkan and Pune (90 to 100 per cent) and in the Amravati region (between 75 to 100 per cent) have provided air pollution abatement facilities. In Nagpur and Nashik regions, the provision of these facilities is not satisfactory possibly because only a few local industries have an air polluting potential.

Table 3.15: Regional Distribution of Industries

Region	Total No. of Units	Total No. of units Closed	Total No. of units complying with the standards	Total No. of units not complying with the standards	Action taken against defaulters
Mumbai	19	6	13	-	-
Navi - Mumbai	48	13	35	-	-
Thane	54	14	38	2	1
Raigad	69	3	40	26	-
Kalyan	19	4	15	-	-
Pune	79	10	43	26	15
Nashik	135	38	96	1	1
Nagpur	49	2	10	37	7
Amravati	27	6	19	2	1
Aurangabad	83	16	58	9	4
Kolhapur	284	75	203	6	1
Total	**866**	**187**	**570**	**109**	**30**

Source: MPCB (2004:c)

Table 3.16: Status of Air Pollution Abatement by Industries

Industry Type	Total No. of Industries	No. of. Industries Closed	Industries Complying with Standards	Industries Not Complied with Standards	Action taken against defaulters
Aluminium Smelter	9	2	4	3	-
Chlor Alkali	4	-	4	-	-
Cement	17	3	13	1	1
Copper Smelter	2	-	1	1	-
Distillery	63	7	46	10	6
Dyes and D.I.	98	31	57	10	2
Fertilisers	17	5	11	1	-
Intg. Iron and Steel	157	27	121	9	-
Tanneries	51	32	12	7	4
Pesticides	34	6	22	6	-
Petrochemicals	37	7	28	2	1
Pharmaceuticals and Bulk Drugs	128	12	98	18	5
Pulp and Paper	57	21	23	13	1
Oil Refinery	12	4	7	1	1
Sugar	166	28	116	22	7
Thermal Power Plant	10	-	6	4	1
Zinc Smelter	4	2	1	1	1
Total	**866**	**187**	**570**	**109**	**30**

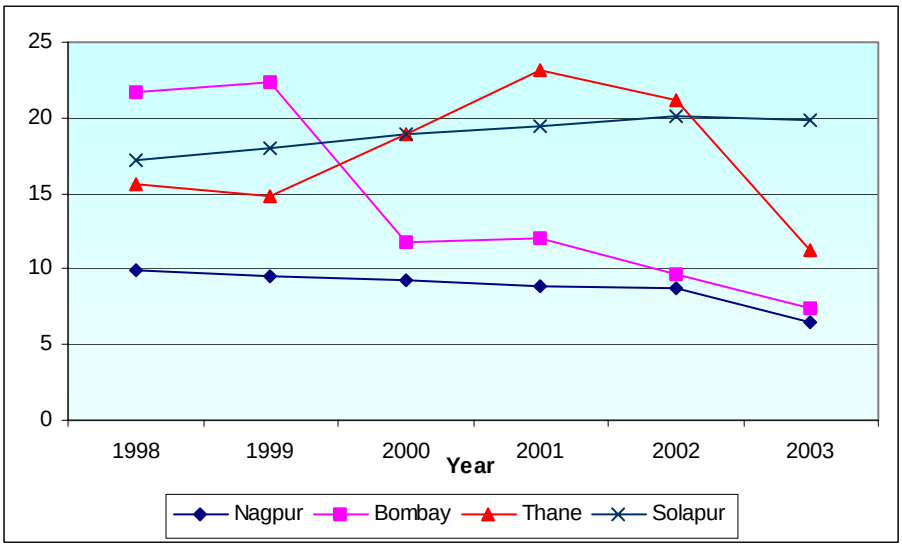
Source: MPCB (2004:c)

Figures 3.11, 3.12 and 3.13 represent the change in industrial pollution level of SO_2, NOx and SPM, respectively, in some major cities of the State during 1998-2003. Although the SO_2 and NOx levels show an increase in Solapur, they are well below prescribed limits. However, the SPM levels in Solapur show an increase during the period and are above the NAAQ Standards.

Greater Mumbai

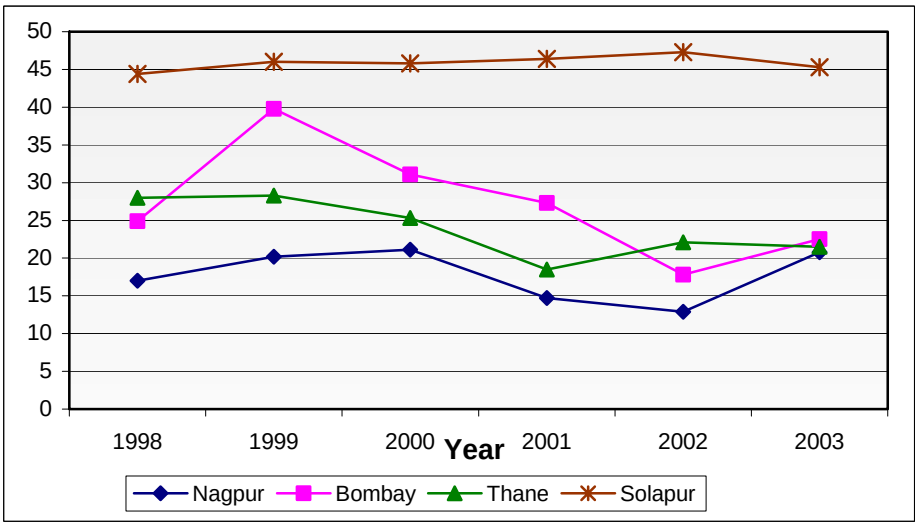
The emission inventory for the entire Greater Mumbai Region necessitates assessing the load of pollutants from all the existing sources, which could be categorised into three major sources viz. Point sources (industries), Area sources (domestic, bakeries, construction, re-suspended dust etc.) and Mobile sources (transport) sector. Chemical, petrochemical fuel-based power plant, textiles, fertiliser and other industries are the major point sources of emissions in Brihanmumbai region. These industries are located mainly in the eastern and northeastern corridor of the region. While large industrial areas are mainly concentrated in Parel, Worli, Chembur, and Sion and along LBS Marg from Kanjurmarg to Mulund, the western region also has some industries, which are potential sources of air pollution. Manufacturing processes of large and medium scale industries were studied in order to quantify the emissions from stacks. Fossil fuel used by the industries for boilers and manufacturing processes remain the single potential source discharging emissions into the atmosphere from their stacks.

Figure 3.11: Industrial Pollution Levels of SO_2 in some Cities of Maharashtra



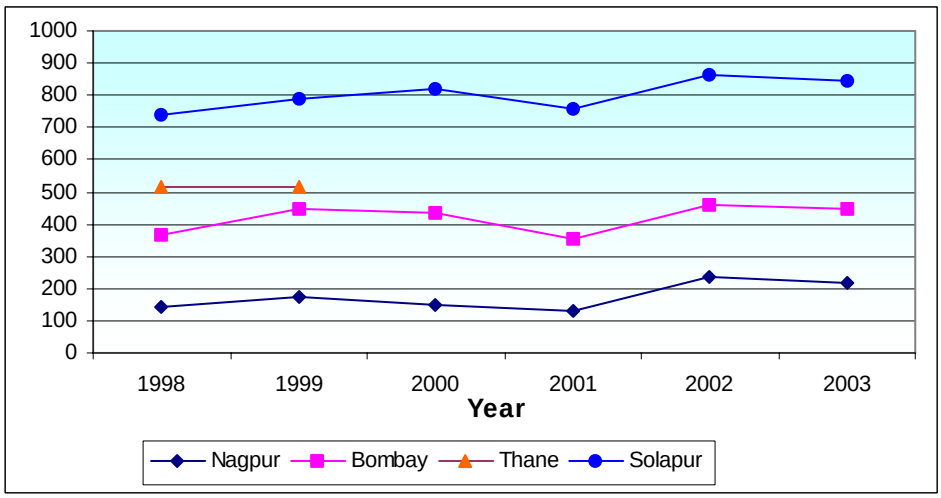
Source: MPCB (2004:c)

Figure 3.12: Industrial Pollution Level of NOx in some Cities of Maharashtra



Source: MPCB (2004:c)

Figure 3.13: Industrial Pollution Level of SPM in some Cities of Maharashtra



Source: MPCB (2004:c)

A total of 183 industries apart from stone crushers were identified as being the air polluting type. These industries use Furnace Oil (FO), Light Diesel Oil (LDO), Low Sulphur Heavy Stock (LSHS), High Speed Diesel (HSD), Compressed Natural Gas (CNG) Liquefied Petroleum Gas (LPG), Liquefied Flammable Gas (LFG) Natural Gas (NG) and coal. Information relating to industrial fuel consumption in the Municipal Corporation of Brihanmumbai (MCBM) area has been obtained from Maharashtra Pollution Control Board (MPCB). According to MPCB presently, there are totally 32 stone crushers in Mumbai, out of which 20 are located in Kandivali, 9 in Chandivali, 2 in Dahisar and 1 in Powai. The gross emissions are estimated for all types of industries viz. power plant (1), chemical and other industries (183) and stone crushers (32) with the help of published emission factors.

To arrive at the spatial distribution of industrial emissions, the entire study area was divided into grids. Total emissions were calculated and distributed into various grids in accordance with the actual location of emission sources. For grid wise emissions estimation, the whole region of Brihanmumbai was divided into equal grids of 2 km x 2 km size and the wards were overlaid on these grids. The grid-wise emissions from various industries in these wards were estimated. The available information on 183 industries was categorised with respect to their products, power, pharmaceutical, chemicals/petrochemicals, textile and food/beverages and others as presented in Table 3.17 and their distribution as per their geographic locations in various wards of MCBM is shown in Table 3.18. It was observed that industries under category "others", most of the engineering type of industries form the largest group. The wards K, S, R, P, M & N form the predominant industrial wards.

Table 3.17: Category-wise Distribution of Air Polluting Industries

Sr. No.	Category	Number
1.	Power	1
2.	Chemical/Petrochemical	19
3.	Pharmaceutical	26
4.	Textile / Printing	41
5.	Food & Beverages	13
6.	Others (Engg. Rubber, Paints, Oil, Misc.)	83
Industries		183
7.	Stone Crushers	32
	Total	**215**

Source: NEERI (2003)

The data on fuel used in power plants obtained from Tata Power Company Ltd. (TPCL), Chembur Reveals that the LSHS consumed by them is more than the total quantity used in 183 industries. It was observed that there is a wide variation in 'sulphur' and 'ash' content in the fuel used in the industry and hence an average value was taken for emission load estimation. The emissions from existing 183 industries and power plant as estimated are given in Table 3.19 and 3.20. Details of industries already using LNG as fuel are given in Table 3.21.

Table 3.18: Ward-wise Distribution of Air Polluting Industries

Sr. No.	Ward	Number
Industries		
1	A	2
2	E	9
3	F	12
4	G	15
5	K	34
6	L	1
7	M	13
8	N	8
9	P	25
10	R	24
11	S	33
12	T	7
		183
Stone Crushers		
13.	R	31
14.	S	1
	Total	**215**

Source: NEERI (2003)

Table 3.19: Emission Scenario for 183 industries

Sr. No.	Fuel type	Quantity (KLPD/MTPD/ SCMD)	Emissions (kg/day)				
			TSP	SO_2	NO_x	HC	CO
1.	LSHS	287.84	271.3	2493.4	2158.8	34.5	181.3
2.	LDO	538.752	134.7	16728.2	1481.6	64.6	339.4
3.	FO	1161.145	6246.9	89408.2	8708.6	139.3	731.5
4.	LPG	1294.78	271.9	0.3	1877.4	46.6	246.0
5.	HSD	32.7	8.2	564.1	89.9	3.9	20.6
6.	NG	927351	148.4	8.9	2596.6	44.5	252.2
7.	Coal	65.3	4775.1	620.4	489.8	32.6	65.3
Total (kg/day)			**11856.4**	**109823.4**	**17402.6**	**366.2**	**1836.4**
Total (TPD)			**11.9**	**109.8**	**17.4**	**0.37**	**1.8**

Source: NEERI (2003)

Table 3.20: Emission scenario for power plants

Sr. No.	Fuel type	Quantity (KLPD/ MTPD/SCMD)	Emissions (kg/day)				
			TSP	SO_2	NO_x	HC	CO
1.	LSHS	4768	4493.84	41302.80	35760.00	572.16	3003.84
2.	NG	1800	0.29	0.02	5.04	0.09	0.49
3.	Coal	2940	573.30	83.79	22050.00	1470.00	2940.00
Total (kg/day)			**5067.43**	**41386.61**	**57815.04**	**2042.25**	**5944.33**
Total (TPD)			**5.07**	**41.39**	**57.82**	**2.04**	**5.94**

Liquid Fuel – KLPD (kilo litre per day) Solid Fuel – MTPD (Metric tons per day) Gaseous Fuel – SCMD (Standard cubic meter per day)
Note: Air pollution control system and their efficiency considered for calculation of emissions where applicable
Source: NEERI (2003)

Table 3.21: List of Industries using LNG as Fuel

Sr. No.	Name of the Consumer	Quantity (SCMD) *
1	Pepsico	1,450
2	Ujagar Prints	1,000
3	Borosil	6,000
4	Victory	3,400
5	L&T	4,100
6	Ujagar Textiles	1,200
7	Empire	20,000
8	Star Metal	1,000
9	Jolly Board	12,000
10	Parle Products	12,000
11	Just Textiles	2,800
12	Metal Tube	1,000
13	Hindustan Composites	5,750
14	Premier	2,800
15	Haldyn	20,000
16	Shakti	1,200
17	Girish Dye	2,400
18	Radha Dyeing	7,000
19	Godrej Soaps	18,300
20	Amforge	6,500
21	Godrej-GE	1,010
22	Indian Smelting	3,900
23	Mahindra & Mahindra	4,500
24	Universal Knitting	3,000
25	Vandana Dyeing	3,250
26	Valson Dyeing	2,800
27	Tata SSL	10,000
28	Merind Ltd.	8,800
29	Godrej & Boyce	4,500
30	Golden Chemicals	30,000
31	Asian Paints	2,000
	Total	**2,03,660**

*SCMD: Standard cubic meter per day Source: MGL (2002)

Thermal power plants (TPP's) account for a major share of industrial emissions in the region. However, as the major units in these plants are equipped with high efficiency control equipments, viz. Electrostatic precipitator (ESP) & Flue Gas Desulphurisation (FGD) and also due to use of clean (imported) coal, its contribution to air pollution has reduced in comparison to 1992 emissions as reported in World Bank sponsored URBAIR project report. Earlier, a study conducted by NEERI (1991) also showed that the power plants and chemical industries were the major sources of

industrial emissions. The contribution of power plant to the industrial TSP, SO_2 and NOx emissions was reported as 63, 21 and 46 per cent, respectively. At present, the contribution of power plant to the industrial TSP (excluding stone crushers) has reduced to 30 per cent and SO_2 and NOx values have now increased to 27 & 77 per cent, respectively (Tables 3.19 and 3.20). Chemicals and petrochemicals are another group of air polluting industries in the region. Among this group, the major air polluting industries are HPCL, BPCL, RCF, VVF and APAR located in M ward.

The total emission scenario (Table 3.22) includes contribution from the power plants, 183 industries as well as from stone crushers. The industries were the major sources of emissions in the region with 44.2 per cent share towards TSP. Stone crushers and power plants contributed the remaining 36.9 and 18.9 per cent of TSP, respectively. The total estimated emissions from point sources were 26.82, 151.21, 75.21, 2.4 and 7.78 TPD in respect of TSP, SO_2, NOx, HC & CO, respectively as presented in Table 3.22.

Table 3.22: Total Industrial Emissions in Brihanmumbai

Sr. No.	Sector	Emissions (tpd)				
		TSP	SO_2	NO_x	HC	CO
1.	Power Plant	5.07	41.39	57.81	2.04	5.94
2.	183 Industries	11.86	109.82	17.40	0.37	1.84
3.	Stone Crushers**	9.90	--	--	--	--
Total		**26.82**	**151.21**	**75.21**	**2.41**	**7.78**

** According to MSPCB, the existing stone crushers were to be relocated from Mumbai suburbs by June 2002.
Source: NEERI (2003)

Vehicular Pollution

Corresponding to the overall rise in the population, there has been an increase in the total number of vehicles leading to increased vehicular pollution. The problem becomes severe at traffic junctions in urban areas, particularly during the peak traffic hours. In a study conducted by WHO on urban air pollution in 24 mega cities in India (1992), alarmingly high levels of SPM were reported in Mumbai, Calcutta and Delhi, ranking them third, sixth and seventh city, in terms of air pollution levels, respectively. However, over the time, the situation has changed to relatively less pollution.

Vehicle Population

Category wise total number of registered vehicles in the State (as on March 31, 1971 to 2004) is given in Table 3.23. Total number of vehicles in 1971 was 307030, which increased to 8968733 in 2004. The average annual growth rate of on-road vehicles in Maharashtra during 1971 to 1981 was 10.7 per cent, and recently it was 9.88 per cent in 2001 to 2004. As per 2004 data, two wheelers constitute the major share (69.3 per cent) with respect to total number of vehicles. With regard to the two wheelers, motorcycles constitute about 56 per cent, scooters 25 per cent and mopeds 19 per cent. The share of other major category vehicles in the State is shown in Figure 3.9.

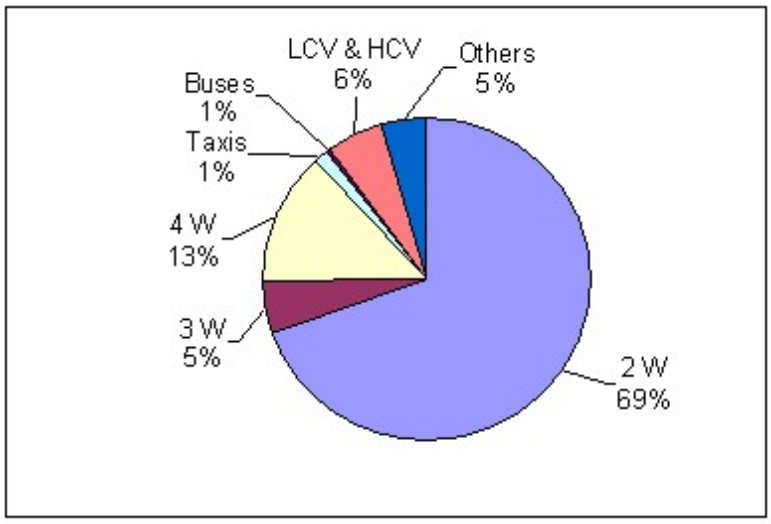
In Maharashtra, Greater Mumbai, accounts for about 13 per cent of the total vehicles in the State. Total number of vehicles (as on March 31, 2004) in the State as well as in Greater Mumbai is given in Table 3.24**,** along with the percentage share of each category of vehicles. The share of major categories of vehicles in Greater Mumbai is shown in Figure 3.10. Two wheelers (48.7 per cent) and 4 wheelers (except taxis) constitute about 81 per cent of the total vehicle population in Greater Mumbai.

Table 3.23: Motor Vehicles on Road in Maharashtra State (As on March 1971 to 2004)

Sr. No.	Category	Number of Vehicles as on March 31				
		1971	1981	1991	2001	2004
1.	Two Wheelers	86749	363624	1735870	4519351	6216794
2.	Cars/Jeeps/Stn. Wagons	118808	227386	430762	921928	1199356
3.	Taxis/Cabs	17970	32240	43400	89308	102475
4.	Auto Rickshaws	3888	31895	130614	413828	493142
5.	Stage/Contract Carriages	7561	15771	22566	41248	40480
6.	School Buses	478	598	1032	1741	2251
7.	Private Service Vehicles	953	2192	4727	6248	6361
8.	Ambulances	423	933	2274	4052	4894
9.	Trucks & Lorries, Tankers & Delivery Vans	53403	108124	199935	4069	499195
10.	Tractors	8335	25474	63668	176421	201940
11.	Trailors	7376	24651	63295	171222	190628
12.	Others	1086	1411	5212	10058	11217
	Total	**307030**	**834299**	**2703355**	**6759474**	**8968733**
	Annual Growth (%)		**17.2**	**22.4**	**15.0**	**10.9**

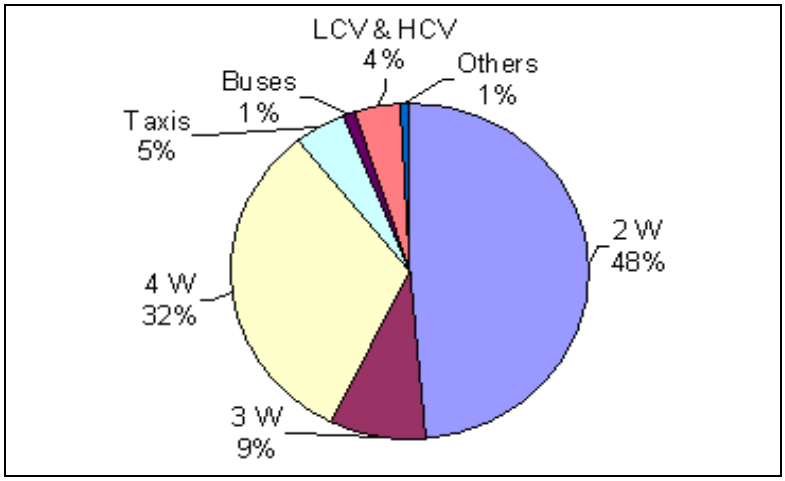
Source: GoM (2004:a)

Figure 3.9: Share of different categories of vehicles in Maharashtra



Source: NEERI (2005a)

Figure 3.10: Per cent Share of different categories of vehicles in Mumbai



Source: NEERI (2005a)

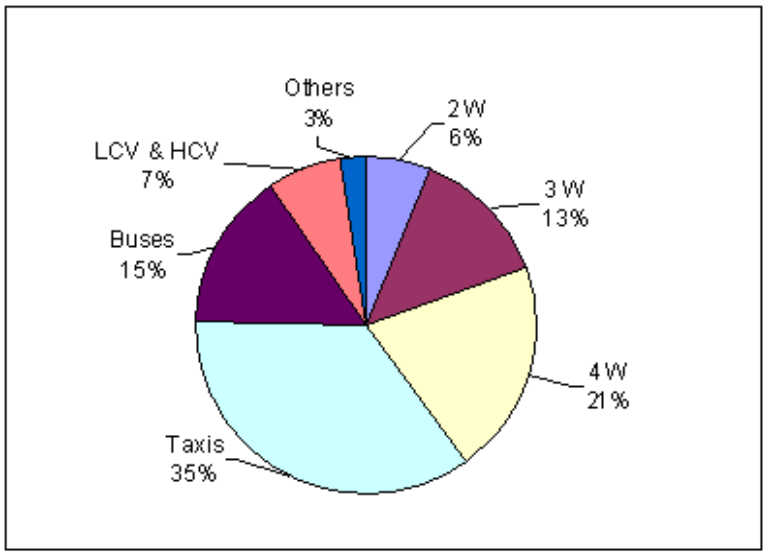
Table 3.24: Motor Vehicles Population in Maharashtra State and Greater Mumbai (As on March 31, 2004)

Sr. No.	Category	Vehicle Population				
		State	Per cent of Total	Greater Mumbai	Per cent of Total	Per cent of Mumbai to State
1.	Motor Cycles	3493322	38.95	318191	26.53	9.11
2.	Scooters	1562353	17.42	233156	19.44	14.92
3.	Mopeds	1160554	12.94	32833	2.74	2.83
	Total - 2 Wheelers	6217126	69.32	584180	48.71	9.40
4.	3 Wheelers/Autos	493280	5.50	102224	8.52	20.73
5.	Cars/Jeeps/Stn.Wagons	1199120	13.37	384258	32.04	32.04
6.	Taxis	102244	1.14	56459	4.71	55.10
7.	Buses	49328	0.55	11662	0.97	23.76
8.	Goods vehicles	499558	5.57	52243	4.37	10.47
9.	Tractors	201796	2.25	1403	0.12	0.69
10.	Others (Ambulance/ Trailors etc.)	207178	2.31	6987	0.58	3.38
	Total	**8968733**	**100.0**	**1199416**	**100.0**	**13.37**

Source: GoM 2004 (2004:a)

With respect to the total vehicle population of State, per cent share of different categories of vehicles in Greater Mumbai is presented in Figure 3.11. Mumbai accounts for nearly 55 per cent of the total taxis, 32 per cent of four-wheelers (4W), 21 per cent three-wheelers (3W), 24 per cent buses, 10.5 per cent Goods vehicles, 9.4 per cent two-wheelers (2W) and 4 per cent other vehicles registered in the State (as on March 31, 2004).

Figure 3.11: Percentage of vehicles in Mumbai vis-à-vis Maharashtra



Source: NEERI (2005a)

Major cities of the State, having population more than 1 million are Gr. Mumbai, Nagpur, Pune, Kalyan- Dombivili, Thane, Nashik and Pimpri- Chinchwad. As on March 31, 2003 the total number of vehicles in these cities was about 11.2, 5.0, 7.0, 3.9, 1.4, 0.6 and 1.6 lakhs, respectively. Category wise distribution of vehicles in these cities is given in Table 3.25. Vehicles in Mumbai include cars (passenger taxis and light duty vehicles), trucks and buses, motorcycles and auto rickshaws.

Table 3.25: Category wise Motor Vehicles Population in Major Cities

City	2 W	3 W	4 W	Taxis	Buses	Goods Vehicles	Other Vehicles	Total
Gr. Mumbai	527108	98527	366805	54809	11812	56130	8371	1123562
Nagpur	424379	10180	38697	711	2546	17983	8078	502580
Pune	517137	44960	85559	3896	7051	34845	3545	696993
Kalyan	27866	5728	2944	253	85	2445	26	39347
Thane	68417	24760	25914	978	1149	21579	1226	144023
Nashik	35620	5418	7941	976	232	4305	8333	62825
Pimpri-Chinchwad	126055	2617	14765	304	820	13150	1466	159177

Source: GoM (2004:a)

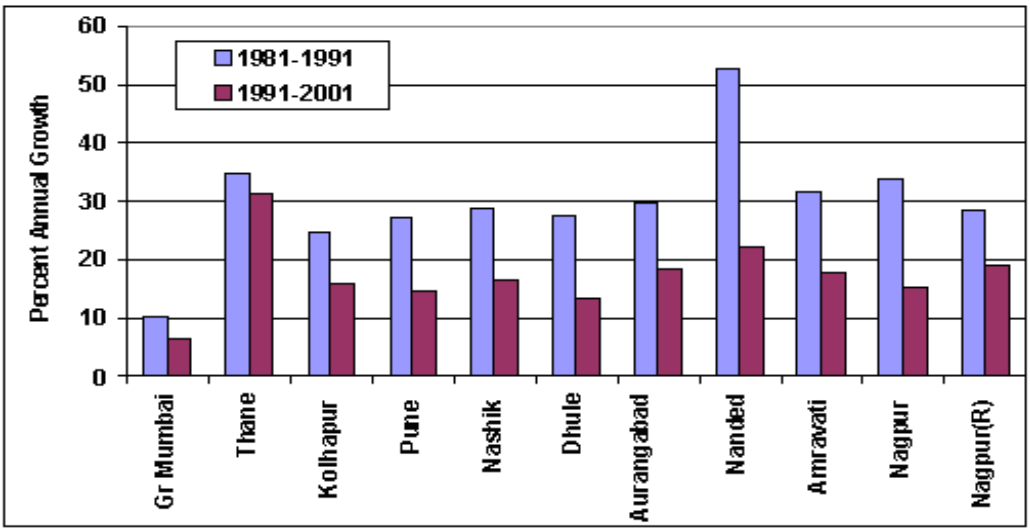
As per the classification of Motor Vehicles Department of Maharashtra, the state was divided into eight regions upto 2003 and three more regions were created in 2004. Region wise growth of total number of vehicles in Maharashtra during 1981 to 2004 is given in Table 3.26. Region wise growth during 1981-91, 1991-01 and 2001-04 is depicted in Figure 3.12. In the last decade (1991-2001), total number of vehicles increased by 311 per cent in Thane, 158 per cent in Kolhapur and 150 per cent in Pune, whereas it was 150 per cent for the whole State.

Table 3.26: Region wise Motor Vehicles in the State

Sr. No.	Region	1981	1991	2001	2004
1.	Greater Mumbai	308881	628488	1029563	1199416
2.	Thane	50639	225662	927277	1321435
3.	Kolhapur	74957	261892	677457	884269
4.	Pune	146709	547911	1353237	1764677
5.	Nashik	65635	253820	672402	907529
6.	Dhule	35928	135619	317360	428161
7.	Aurangabad	33427	132959	377514	527383
8.	Nanded	9375	58779	188897	279477
9.	Amravati	36261	150379	415977	577715
10.	Nagpur	55258	241494	607413	795777
11.	Nagpur(R)	17229	66352	192377	282894
	Total	**834299**	**2703355**	**6759474**	**8968733**

Source: GoM (2004: a)

Figure 3.12: Region wise Annual Growth in Vehicles in Maharashtra



Source: NEERI (2005a)

As on March 31, 2004, category wise per cent distribution along with the total number of vehicles in different regions of the state is given in Table 3.27. Percentage share of 2-W, 3-W and 4-W in different regions vary between 49 per cent (Greater Mumbai) and 84 per cent (Nagpur), 2.3 per cent (Nagpur, Rural) and 12.6 per cent (Thane), 6 per cent (Nagpur Rural) and 37 per cent (Greater Mumbai) respectively. Percentage share of LCV, HCV and others vary between 1.1 per cent (Nagpur Rural) to 4.0 per cent (Thane), 1.6 per cent (Greater Mumbai) to 6.7 per cent (Thane) and 0.6 per cent (Greater Mumbai) to 10 per cent (Dhule) among the different regions of the state respectively. among the different categories of vehicles in the state, 2 wheelers account for about 69.3 per cent, 3-wheelers 6.7 per cent, 4 wheelers 14.5 per cent, LCV 2.2 per cent, HCVs 2.8 per cent and others 4.5 per cent.

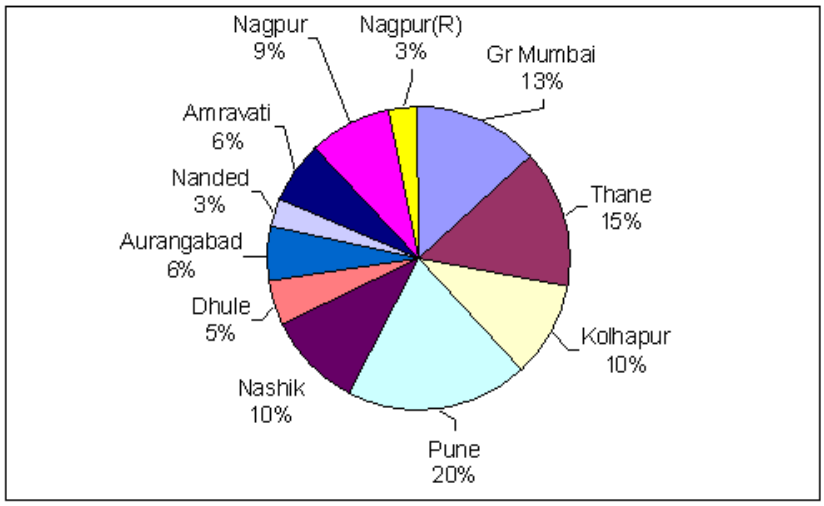
Table 3.27: Region & Category-wise Percentage of total Vehicle Population

Region	2 W	3 W	4 W	LCV	HCV	Others	Total No. of Vehicles	Per cent of Region to State
Gr. Mumbai	48.9	10.2	36.9	2.0	1.6	0.4	1195616	13.3
Thane	54.2	12.7	21.6	4.0	6.7	0.8	1321435	14.7
Kolhapur	75.0	3.8	9.0	2.0	2.1	8.1	884273	9.9
Pune	77.0	5.2	11.2	1.9	2.2	2.5	1764681	19.7
Nashik	73.5	4.3	9.0	1.9	1.8	9.5	907529	10.1
Dhule	73.1	6.1	6.6	2.0	2.2	10.0	428161	4.8
Aurangabad	71.8	6.5	9.1	2.5	2.7	7.4	527383	5.9
Nanded	70.0	8.1	9.0	2.0	4.0	6.9	279477	3.1
Amravati	78.0	6.2	6.3	1.3	1.9	6.3	577715	6.4
Nagpur	84.5	2.7	7.8	1.7	1.8	1.5	795777	8.9
Nagpur (R)	81.1	2.3	6.1	1.1	2.2	7.2	282894	3.2
State Total (%)	**69.4**	**6.7**	**14.5**	**2.2**	**2.8**	**4.4**	**-**	**100.0**
State Total	**6216794**	**599312**	**1301831**	**196108**	**247107**	**403785**	**8964937**	**-**

Source: GoM (2004:a)

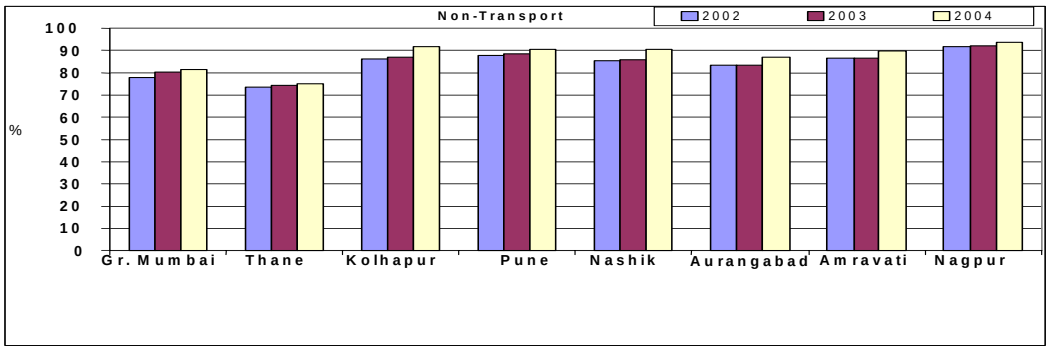
Based on the total number of vehicles, Pune region has highest number of vehicles (19.7 per cent) followed by Thane region (14.7 per cent), Greater Mumbai region (13.3 per cent) and Nashik region (10.1 per cent). Region wise share of total vehicles in Maharashtra is presented in Figure 3.13. Region wise distribution of non-transport and transport vehicles in Maharashtra as on March 31, 2002 to 2004 is presented in Figure 3.14. The share of non-transport vehicles (private/non-commercial) varied between 73-94 per cent and in almost all the regions, their share was steady during the year 2002-2003, but in 2004 it grew marginally. As a result, a decline in the growth of transport vehicles was observed during 2002 to 2004. All the regions have more number of non-transport vehicles except Gr. Mumbai and Thane, which have more number of transport vehicles.

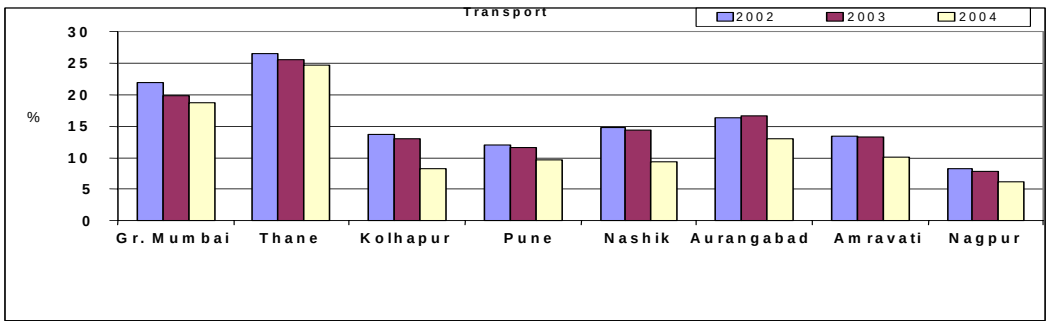
Figure 3.13: Region wise share of Total Vehicles in the State (percentage)



Source: NEERI (2005a)

Figure 3.14: Region wise Share of Non-Transport and Transport Vehicles (percentage)





Source: NEERI (2005a)

Emissions from Vehicles

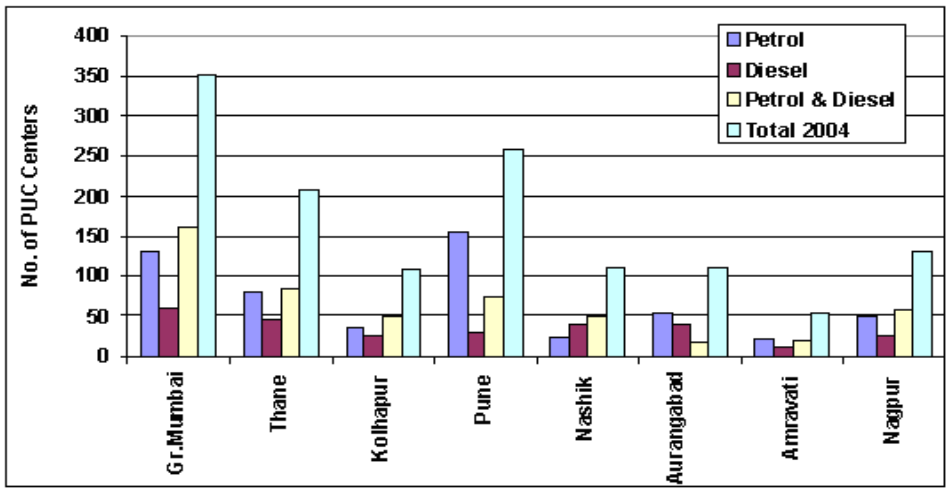
A study conducted by Central Road Research Institute (CRRI), New Delhi, in 2002, the total emission load from the transport sector in Mumbai was estimated in terms of four key pollutants (CO, NOx, HC and PM). As per the estimates, vehicles in Mumbai contributed about 190 MT of CO, 46.4 MT of NOx, 90 MT of HC and 10.6 MT of SPM during 2001. For such emission inventory for other districts/cities of the Maharashtra need to be carried out to determine the contribution of sector-specific emission loads to enable delineation of effective pollution control strategies. In general, contribution of vehicular emissions at traffic junctions is more than other sites of urban regions.

Status of PUC Centres

In order to maintain the emission levels within the standards, pollution under control certificates (PUC) are required to be obtained for each type of vehicle. To cater to this requirement, a number of PUC centres having emission testing facilities for petrol as well as diesel vehicles were opened in the state. Total number of PUC centres in the Maharashtra was 1327, out of which 544 had petrol vehicle emission testing facilities, 271 had diesel vehicle emission-testing facilities and 512 centres had emission testing facilities for both the type of vehicles. As on March 31, 2004, region-wise distribution of these PUC centres is given in Figure 3.15**.** PUC centres having petrol vehicle emission testing facility are highest in Pune (155), followed by Greater Mumbai (131). Greater Mumbai region has more than 320 approved PUC centres (the highest in all regions) followed by Pune and Thane regions.

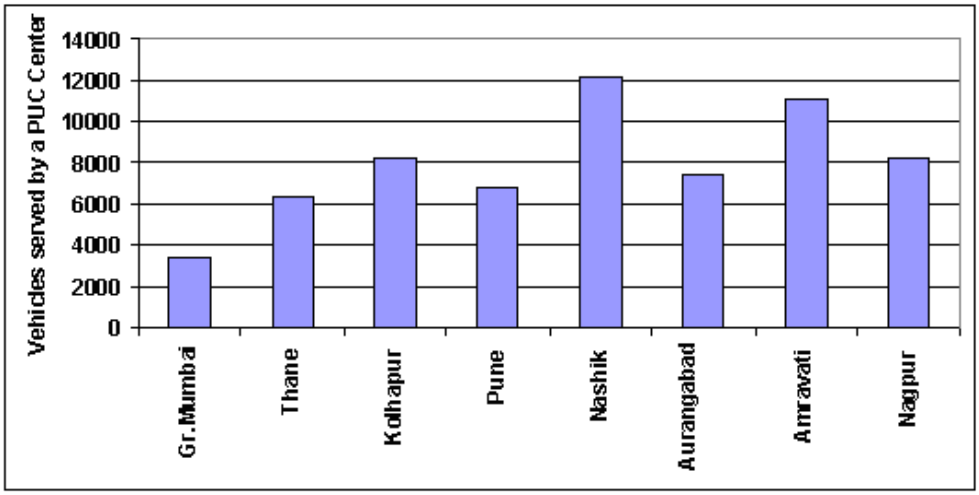
Region-wise average number of vehicles that can be tested by one PUC centre are projected in Figure 3.16**.** The highest number of vehicles can be tested annually by one PUC centre in Nashik region (12254) followed by Nagpur region (8234) and Kolhapur region (8188).

Figure 3.15: Region-wise Number of Approved P.U.C. Centres



Source: NEERI (2005a)

Figure 3.16: Region-wise Number of vehicles served by a PUC Centre



Source: NEERI (2005a)

Effects of Air Pollution

Air pollution has serious implications for health and the environment when it increases beyond certain critical limits. Due to lack of authentic data and information, estimating the total damage caused by air pollution is difficult though some micro-level studies in the State have shown that both health and non-health damages could cost substantially. The RSPM are especially dangerous as they have many adverse health effects for humans. They cause respiratory diseases like Chronic Obstructive Pulmonary Disease (COPD), bronchitis etc., emphysema, asthma, systemic poisoning, cancer and pneumoconiosis. Some of the harmful effects of various air pollutants are given in Table 3.28 (Sharma, 1994).

Air Borne Diseases

Studies on health impacts of air pollution, have shown that high levels of SPM, NOx and HC were causing an increased incidence of respiratory diseases like tuberculosis, cardiovascular diseases and asthma. The SPM levels have high percentage of RSPM, which is responsible for various health problems in the State. Major cities like Mumbai, Thane, Pune etc. have higher incidences of chronic respiratory problems. A study by the KEM hospital, Mumbai indicated that cases of interstitial lung disease (inflammation of capillaries) have increased from 1,479 in 2000 to 1,871 in 2004. Cases of bronchitis and allergic rhinitis have also increased. In a recent study by the Environmental Pollution Research Centre (EPRC) at KEM found that about 10 per cent of the population of Chembur suffers from bronchitis and respiratory distress as a result of air pollution. The study found that while the SO_2 levels have fallen in recent years, the NO_x levels have risen. Routine checks for the NO_x, SO_2 and RSPM levels are carried out at AQM stations of the BMC. However, the CO levels are not being monitored at these stations, which have very high levels from traffic exhausts (Bombay, 2000; BMC, 2004; TOI, March, 2005).

Another study of the health status of 78 traffic policemen in Mumbai, exposed to vehicular pollution at busy traffic junction, showed that they were exposed to high levels of CO and other pollutants at he traffic junctions. They often suffered from eye irritation, and dyspnoea and high incidences of colds and coughs. Pollutants from the traffic also have volatile organic compounds

(VOCs) including benzene, ozone and other toxics, which adversely affect blood and human nervous system causing anaemia, brain dysfunctions and kidney damage. At high concentration of CO (more than 50 ppm) for several hours causes headache, asthenia, giddiness and nausea. At low concentrations (corresponding to above 2.5 per cent carboxyhaemoglobin in blood or about 13 ppm CO in air for a long duration) individuals with weak hearts are placed under additional strain. Combustion oxidises both the nitrogen in the fuel and some of the nitrogen present in the air, producing several oxides of nitrogen. However, only NO and NO_2 are known to have adverse environmental or biological effects.

Table 3.28: Effects of Air Pollutants

Air Pollutants	Effects	
	Health	Other
Sulphur Dioxide (SO_2)	Eye irritation, Respiratory system	Damages trees & lakes, acid aerosols eat stone used in buildings statues, monuments
Nitrogen Oxides (NO_X)	Lung damage, illnesses of breathing passages and lungs. Pulmonary Oedema at very high levels (90 PPM)	Damages trees & lakes, acid aerosols eat stone used in buildings statues, monuments
Particulate Matter (Including SPM and RSPM)	Alone or in combination with other air pollutants can cause aggravated asthma, acute respiratory symptoms, chronic bronchitis and decreased lung function in human beings.	Affects materials, vegetation and animals. Reduces visibility by causing haze. Ashes, soot, smoke and dust can discolour property and other property
Ozone (O_3)	Breathing problems, reduced lung function, asthma and eye irritation	Affects materials, vegetation and animals. Reduces visibility by causing haze. Damages rubber and fabrics
Carbon Monoxide (CO)	Reduction in oxygen carrying capacity of blood, severe headache, nausea, vomiting, dizziness at high CO levels	---
Lead (Pb)	Brain and other nervous system damage and cause digestive and other health problems.	Can harm wild life

Source: Sharma (1994)

Other Effects

In addition to health effects, air pollution also has several other effects such as damage to animals, plants and vegetation, materials and property, historical monuments and cultural heritage, etc. Some micro-level studies in a small area of Mumbai indicate that for every 10 $\mu g/m^3$ increase in SO_2 concentration, the social costs could exceed Rs.100 million, which include only dyspnoea and mortality effects. The loss of rent not including property values, could amount to Rs. one million per year and the cumulative loss in property value due to each 100-unit increase in SPM concentration could be around Rs.2000 million. Other potential damages are due to visibility reduction and global effects of air pollutants. However, more detailed studies are required to estimate total economic damage of air pollution in the State (Sharma, 1994; IDR, 1999).

Noise Pollution

Noise pollution is caused by an unwanted sound that is produced by various natural or man-made sources such as oceans, construction, industrial, transportation etc. Noise can have many adverse affects such as hearing impairment; sleep disturbance, interference with speech communication, reduced performance, annoyance and harming physiological functions.

Noise pollution is regarded as a public nuisance under Sections 268, 290 and 291 of the Indian Penal Code. There are several other legislations relating to noise pollution such as The Factories Act, 1948 (under which 'noise induced hearing loss' is notified as a disease); Motor Vehicles Act, 1988 (which specifies rules for horns and silencers); Law of Torts (civil suits can be filed for claiming damages); The Air (Prevention and Control of Pollution) Act, 1981 (ambient noise standards have been given), The Environment (Protection) Act, 1986; Noise Pollution (Regulation and Control) Rules, 2000 and regulations in respect of Loudspeakers/Public Address System.

Further, there are standards and guidelines for ambient noise quality, automobiles, domestic appliances and construction equipment, generator sets, and firecrackers as notified under the Environment (Protection) Act, 1986. In general, continued exposure to noise levels above 85 dB would cause hearing loss over time. However, noise above 140 dB could cause aural damage after just one exposure. As a safeguard against harmful noise level, the CPCB has specified standards for various categories of areas as given in Table 3.29.

Table 3.29: CPCB Standards for Noise for Different Areas

Area Code	Category of Area/Zone	Limits in dB (A) L_{eq}*	
		Day Time (6.00 a.m. to 10.00 p.m.)	Night Time (10.00 p.m. to 6.00 am)
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone**	50	40

* DB (A) Leq denotes the time-weighted average of the level of sound in decibels on scale, which is related to human hearing. ; ** Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area, which is declared as such by the competent authority.; Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority. ; A 'decibel' is a unit in which noise is measured."A", in dB (A) Leq, denotes the frequency weighing 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 of time.
Source: CPCB (2001:a)

As evident from Table 3.30, in all major cities, noise pollution levels exceed the higher end of the range in almost all categories. Calcutta has very high noise pollution levels compared with other cities. Mumbai in Maharashtra shows increased level particularly at night, probably because of many activities in the city are conducted on a 24 hr basis. Thane had an average figure of 62 dB (A) while Navi Mumbai and Nashik were higher at 69.87 dB (A) and 81 dB (A), respectively in 2000-01, at slected residential locations (TMC, 2001; NMMC 2001; NMC, 2002). Aurangabad had a noise level of 67.96 dB (A) in 1998 (AuMC, 1998). As can be seen these figures are much above the prescribed limits for residential areas. The high noise pollution is mainly due to traffic congestion and vehicular noise. The noise levels are much higher during festival times like Ganpati and Navratri festivals. Aircraft noise during landing, take-off and ground operations is also a source of noise pollution, especially when the airport is located in the centre of the city like in Mumbai.

The Tables 3.30 and 3.31 indicate the noise levels recorded in Thane and Mumbai at key locations. Thane levels were measured during festivals. Accordingly, the average value of the noise levels for these cities were much beyond the prescribed limits.

Table 3.30: Ambient Noise Levels in Some Cities

Name of the City	Residential		Commercial		Sensitive		Industrial	
	Day	Night	Day	Night	Day	Night	Day	Night
Prescribed Standards	55	45	65	55	50	40	75	70
Bangalore	59-79	37-59	68-81	46-64	58-74	-	63-86	42-65
Calcutta	76-86	58-76	70-90	57-78	69-89	65-70	75-82	53-70
Chennai	57-84	45-50	74-80	69-71	46-70	47-50	69-76	63-69
Delhi	53-71	-	63-75	-	62-68	-	65-81	-
Hyderabad	56-73	40-50	67-84	58-73	62-78	51-67	44-77	42-70
Mumbai	45-81	45-68	63-81	60-75	58-77	46-66	73-79	56-72

Source: NIUF (2000)

Table 3.31: Noise Pollution Levels recorded at various places in Thane and Mumbai

Places in Thane*	Levels of Noise Pollution (dB)	Places in Mumbai	Levels of Noise Pollution (dB)
Manisha Nagar	91	Churchgate Subway	91
Kalwa Bridge	85	Outside CST	90
Tembhi Naka (Mela)	81	Flora Fountain	88
Prabhat Talkies	92	Mantralaya Junction	86
Samata Nagar	87	Marine Drive	85
Kanhaiya Nagar	87	Girgaum Chowpatty	72
Inside Dandiya Pandals (during Navratri)	115	Fashion Street	80

Source: Environmental Status Report, TMC, 2002-2003; Mumbai Mirror, Sep 2005; * Measured during festivals

Table 3.32 represents the region-wise noise levels recorded in the state. It can be noticed that in all places except for Bhiwandi- Nizampur the noise level exceed the permissible limits. Although the data show no significant variation for the different years, the noise levels have decreased slightly. The variation in the noise levels in some MCs (corporations and councils as well), for different years, is given in Table 3.33. As obvious, data for many MCs are not available and, wherever they are there, in most of the places, are observed above prescribed limits.

Table 3.32: Region-wise Noise Levels of Maharashtra (dB)

Districts	Industrial			Commercial			Residential			Silence		
	Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average
Mumbai	63	87	75	65	90	77.5	49	76	62.5	59	90	74.5
Navi Mumbai	62.6	68.9	66.3	73.2	115	92.6	58.6	120	83.27	NA	NA	NA
Raigad	NA	NA	NA	54	109	80.0143	50	98	69.336	NA	NA	NA
Thane	NA	NA	NA	80.4	90	85.2	46.2	101	69.4	NA	NA	NA
Kalyan	55	65	57.75	41.9	94.4	61.25	37.8	82.4	58.8	NA	NA	NA
Pimpri Cinchwad	NA	NA	NA	67.5	104.3	85.308	NA	NA	NA	NA	NA	NA
Satara	NA	NA	NA	67.4	77.19	71.89	NA	NA	NA	NA	NA	NA
Solapur	48.2	74	71.2	51.1	84.3	66.61	50.1	77.3	67.02	NA	NA	NA
Nashik	NA	NA	NA	56	110	76.107	NA	NA	NA	NA	NA	NA
Nagpur	NA	NA	NA	76	86	80.25	NA	NA	NA	NA	NA	NA
Kolhapur	NA	NA	NA	68.8	93.3	78.39	49.6	80.2	62.5	73.8	80.4	76.13

Source: MPCB (2004, c)

Table 3.33: Noise levels of some Municipal Corporations/Councils for Different Years

MCs		Noise Level (dBA) Industrial	Commercial	Residential	Silence
Ahmednagar	2000	59	60.9	55.1	53.1
	2003	NA	NA	NA	NA
	2004 Day	102	81	72	75
	Night	66	60	54	69
Aurangabad	1997	NA	NA	NA	NA
	1998	NA	NA	NA	NA
	2004	NA	NA	NA	NA
Bhiwandi-Nizampur	2000	49	45.1	39	38.3
	2004	45	47	42	36
Bhusawal	2000	NA	68.1	56.0	52.8
	2001	NA	69.0	53.3	55.4
Dhule	2003	NA	NA	NA	NA
Ichalkaranji	2004	78.2	71.5	61.3	54.3
Jalgaon	1998	63.9	70.9	58.1	58
Kalyan-Dombivili	2003	NA	NA	NA	NA
	2004	NA	NA	NA	NA
Kolhapur	2000	NA	NA	NA	NA
	2002	NA	78.4	62.5	76.1
Mumbai	1998	NA	76	69.5	57
	1999	NA	85.5	79.5	66.5
	2000	NA	85.5	79.5	66.5
	2001	NA	81.5	67.5	64.5
	2002	77	77	64.5	71.5
	2003	75	77.5	62.5	74.5
Nanded	1998	NA	NA	NA	NA
	2004	NA	NA	NA	NA
Nashik	2002	NA	NA	NA	NA
	2003	NA	NA	NA	NA
Navi Mumbai	1998	NA	NA	NA	NA
	2002	NA	NA	NA	NA
Panvel	2003	NA	NA	NA	NA
	2004	NA	NA	NA	NA
Pune	1996	NA	NA	NA	NA
	2000	NA	NA	NA	NA
	2002	NA	NA	NA	NA
	2003	NA	NA	NA	NA
	2004	NA	NA	NA	NA
Sangli	2001	NA	NA	NA	NA
Satara	2002	NA	NA	NA	NA
	2003	NA	NA	NA	NA
Thane	1997	77.6	78.7	68.6	NA
	1999	61.5	68	56.5	NA
	2001	66	64.5	60.5	NA
	2002	63.6	67.3	62	NA
Mira Bhayandar	2004	NA	NA	NA	NA
Beed	2001	NA	NA	NA	NA
Pimpri-Chinchwad	1999	86.6	79.3	71.2	70.8
	2000	86.4	82.0	74.2	73.3
	2002	87.7	83.7	78.3	76.8
Nagpur	2003	NA	NA	NA	NA

Source: Compiled from various ESRs of Municipal Corporations/Councils.

Response and Strategy

Increasing levels of air pollutants and their adverse impacts have forced various stakeholders to take mitigation measures for air pollution abatements. Efforts are being made by at international, national and local organisations to adopt strategies that minimise the damage due to air pollutants.

In early nineties two World Bank sponsored programmes titled "Metropolitan Environment Improvement Programme (MEIP) and Urban Air Quality Management Strategy in Asia (URBAIR) were initiated in Mumbai, which aimed at improving the air quality management in four Asian cities. These studies had assembled and analysed information on sources and quantity of emissions and had provided overall assessment of air quality. The findings of the studies indicated that SPM and PM10 levels were the most critical pollutants for Greater Mumbai (MMRDA, 1995).

In 1991 and 1994, the European Environment Council and European Commission regulated the permissible pollution limits for vehicles within the European Union, which consisted of a group of 15 European nations. Standards were set for the amount of carbon monoxide (CO), oxides of nitrogen (NOx), hydrocarbon (HC) and particulate matter a vehicle could emit. These emission norms are collectively known as *EURO I*. This norm was introduced in National Capital Region (NCR) Delhi in 1999 and in Mumbai in 2000 as per a Supreme Court Ruling. These were followed by stricter standards of *EURO II* in 1998, which was introduced in Delhi and Mumbai in 2000 (Table 3.34). The comparative statement of emission norms as given in Table 3.35, indicates the narrowing of time gap between their introductions in Europe vis-à-vis India

Table 3.34: Emission Levels of the EURO II & EURO I

Pollutants	Existing 1998	EURO I	EURO II
CO (Carbon monoxide gm/km)	4.34	2.75	2.20
Hydrocarbons and NOx Nitrous oxide	1.50	0.97	0.50

Source: Indiacar.com

Table 3.35: Comparison of Emission Norms for Europe and India

	Euro I	Euro I	Euro II	Euro III
European Norms	1983	1992	1996-97	2000-2001
Indian Norms	1996	1.4.2000	*2005	--

* Bharat Stage–II norms

Source: Dept of Road Transport & Highways

The *Bharat Stage–II norms*, which are akin to Euro-II norms and basically involve the supply of petrol and diesel with 0.05 per cent sulphur content. They have been introduced in Mumbai, Pune and Solapur in 2001, 2003 and 2004 respectively for all categories of vehicles. These norms have been extended to the entire country since April 2005. The *Bharat Stage–III norms* will be introduced by the end of October 2005.

Steps of GoI and CPCB

The GoI defines the emission norms, which are the prescribed as Carbon Monoxide (CO), Hydrocarbons (HC) and Nitrous oxide (NO_X) levels emitted by vehicles. All the manufacturers need to implement these for all vehicles being manufactured. The first State emission norms came into

force for petrol and diesel vehicles in 1991 and 1992, respectively. The fitting of catalytic converters in new petrol-driven passenger cars in the four Metros and introduction of unleaded petrol was mandated in 1995. Unleaded petrol was made available all over India from April 2000.

The MoEF has taken initiative to reduce pollution levels in the major metropolitan cities of the country. It is working closely with the Ministry of Petroleum and Natural Gas to explore possibilities for the introduction of fuel (diesel and petrol) additives having a dual benefit of economy and emission reduction. Low Sulphur diesel (diesel with a sulphur content of not more than 0.5 percent) was introduced in Delhi, Mumbai, Calcutta, Chennai after mid-nineties. In April 1998, sulphur content was reduced to 0.25 per cent in these cities and in September 1999, this was extended to the whole country. In January 2001, all vehicles in Mumbai were required to reduce their sulphur content in diesel to 0.05 per cent. MoEF has also introduced many other regulations such as use of two-stroke engine oil (2T), use of CNG, phasing out of old vehicles and guidelines for various industrial units to reduce air pollution.

Some other policy measures for abatement of vehicular pollution are as follows (CPCB, 2005):

Fuel Quality: The use of low sulphur diesel as vehicular fuel must be extended to the entire city of Mumbai to reduce air pollution. The content of sulphur in diesel could be reduced to 0.05 percent. Petrol quality has to be improved in respect of benzene and sulphur content.

Prevention of Adulteration: Adulterated fuel is one of the major causes of excess emissions of pollutants from vehicles. Environmental Pollution Control Authority (EPCA) has suggested that Ministry of Petroleum and Natural Gas may be issued directives to control/prevent such adulteration.

Improvement in Vehicle Technology: SPM is one of the major pollutants of the ambient environment. A substantial part of emitted from the vehicles making its level being higher than the NAAQS. And therefore, an urgent attention is required to improve the technology of vehicles to reduce the emissions pollutants including SPM.

Emission Warranty: The warranty period of the vehicles should be restricted and old vehicles should be phased out.

Indoor Air Pollution

The GoI has taken up several programmes to promulgate the use of the biogas plant and the improved smoke-free chullah. Comprising the National Project on Biogas Development (NPBD) catering to family type biogas plants, Community Biogas Plants (CBP), Institutional Biogas Plants (IBP) and Night Soil based Biogas Plants (NSBP) Programme, Research and Development on Biogas and National Programme on Improved Chullahs (NPIC). Besides these, pilot schemes on Rural Energy Entrepreneurship and Institutional Development (REEID) and Women and Renewable Energy Development (MNES, 2003). The Gram Yojanas play an important role in motivating the people in Maharashtra. MEDA is implementing the Biogas programme in Maharashtra. As of March 2002, there were 72 CBP's, 32 IBP's and 324 NSBP's installed, in the state. Maharashtra has installed biogas plants in most of its distilleries, amounting to 74 per cent of its estimated potential, which is the second highest in the country after Mizoram which is at 95 per cent (MEDA, 2005; MPCB, 2005).

The NPIC aims at satisfying the requirements of a good chullah. The state has achieved 37.4 per cent of its targets under the NPIC programme, which is lower than many other states like Tamil Nadu and West Bengal, which satisfied more than 100 per cent of there targets. A study by National

Council of Applied Economic Research (NCAER) in 2001-02 of the evaluation of the NPIC in various states revealed that in Maharashtra 56.2 per cent of the chullahs were working and in use, 11.8 per cent were working and not in use and 23 per cent were dismantled. Awards are being given to various states under the two programmes. Maharashtra received the first place under the NBPD programme for the year 2001-02. As part of the NPIC programme the Appropriate Rural Technology Institute, Pune (ARTI) is the Technical Back up Unit (TBU) for Maharashtra and designs improved stove technologies. It also conducts indoor air pollution assessment of traditional stoves vis-à-vis improved stoves. The ARTI has trained traditional potters to build these improved chullahs, which have been successful in Sangli, Satara and Kolhapur as they enable easier access of chullahs to rural areas. A study conducted by an NGO in a village in Raigad district in Maharashtra revealed that PM5 and CO levels reduced by 54 per cent in the kitchen as a result of improved chullahs.

Initiative of GoM and MPCB

The MPCB, as mentioned earlier, in order to check the levels of air pollution, has set up 89 AQM stations in different locations in the State. Further, it has seven "mobile air quality monitoring vans." It is reported that air quality parameters are regularly monitored on these stations as per prescribed norms. Educational institutes having environmental sciences departments will be involved for operation and maintenance of most of these stations. Data acquisition and coordination centres are proposed to be set up at the Pune University. Air quality data are published regularly and also placed on website of the MPCB, which could be useful for public information and also for students. It is proposed to spend about one crore Rupees per year for implementation of monitoring projects and the CPCB has approved the proposal (MPCB, 2005).

As per records of MPCB, abatement measures taken by industries are given in Table 3.36, which indicate that most of the industrial estates (90 to 100 per cent) in Konkan and Pune regions have provided air pollution abatement facilities. In Nagpur and Nashik regions, the provision of facilities for is not satisfactory possibly as very few industries here have air polluting potential. In Amravati region, about 75 to 100 per cent industries have abatement facilities.

Fly Ash Utilisation

In Maharashtra, about thirty thousand tons of fly ash is generated everyday by thermal power plants producing about 12,000 MW of power. In order to regulate the disposal and utilisation of fly, Govt. of India has issued notification making it mandatory for the brick manufacturers to use the fly ash. This is also aimed to reduce the exploitation of the precious natural topsoil layer. According to the MPCB, the fly ash, which causes air pollution and health and other impacts, is being utilised for manufacturing of bricks. MPCB has issued directions to more than 3800 brick manufactures for utilisation of the fly ash. Co-operation of District Collectors is also sought for implementation of the notification of MoEF (MPCB, 2005).

Table 3.36: Air Pollution Abatement Measures by Industries

Districts	No. of industries	Industries providing measures		Air Pollution Parameters				Noise dB	Total Pollution Load
		Number	Per cent	SO_2	NO_X	SPM	RSPM		kg/day
Nashik	2228	56	2.5	14.8	15.59	93.69	-	-	-
Amravati	17	17	100.0	19.62	24.97	232.2	-	-	-
Akola	14	11	78.6	17.9	27.6	5432	-	-	-
Buldhana	20	17	85.0	-	-	-	-	-	-
Yavatmal and Washim	8	8	100.0	60.5	57.4	971.9	150.57	-	-
Nagpur	121	48	39.7	25.28	15.7	359.2	-	71.35	646
Ratnagiri	131	131	100.0	19 kg/d		283.33 mg/Nm3	-	62	SO2: 6.7 T/d, 1140 kg/d, SPM: 1.5T/d, 385kg/d
Ratnagiri	19	19	100.0	Average	Average	Average		Average	615
Raigad	153	146	95.4	25	31.33	147	70.66	67	SO_2: 28318.68
Thane	158	158	100.0	31.14	129.24	208.28	89.64	57.18	-
Thane	91	91	100.0	6.4	12.9	57.6	83.11	63.3	-
Thane	372	372	100.0	15.46	25.59	100.54	307.36	-	-
Thane	124	124	100.0	-	-	-	-	245	-
Sangli	98	86	87.8	-	-	725.9 kg/d	6642.8 kg/d	-	2895.5 kg/d
Kolhapur	230	230	100.0	Average	-	-	-	Within limits	SO_2: 143.06
Satara	529	529	100.0	32.33	40	142.67	-	67.16	SO_2; 589.9

Source: MPCB (2004:c)

Action plan for Pune and Solapur

Maharashtra Pollution Control Board (MPCB), as per the Supreme Court order, has prepared a report on the various actions plans to be implemented to control air pollution in Pune and Solapur cities. A series of directions have been issued by MPCB to various authorities, which are responsible for their implementation. For Pune, these include-

- Use of Cleaner Fuel (CNG/ LPG) for the auto rickshaws; Use of CNG for buses and other vehicles; Prevention and control of adulteration of auto fuels
- Supply of Petrol with 1% Benzene and Diesel with 500-ppm sulphur for the vehicles in the city and to further achieve EURO-III compliance
- Implementation of new PUC norms
- Construction of a by-pass to divert outbound traffic from the city

- Establishment of a bus Terminal on the outskirts of city, for non-Pune bound buses in order to decongest the unwanted bus traffic in the city
- Paving the footpaths to control dust pollution

With regard to Solapur, these plans include banning of the supply of 2T oil, use of EURO III fuel, upgrading the action plan for Municipal Public Transport System and the PUC centres at petrol pumps.

MCs are also taking several measures to curb the air pollution, For example, in Nashik reverse countdown units are fixed at three signal intersections and to increase the awareness among vehicle drivers the display reads "please put off the ignition of your vehicle if you have to stop for more than 30 seconds". Such simple experiment have been successful and as a result the percent of RSPM and CO has come down (NMC, 2002).

Taking serious view of the traffic problems in the TMC area, several developmental plans were initiated and implemented under the Integrated Road Development Project (IRDP) scheme, which was funded by the World Bank (WB) and other organisations. The IRDP project in Thane city was initiated in 1997, which included several modifications in the road network such as construction of flyovers, widening of roads and development of alternative routes. Air monitoring was carried out before the initiation of the IRDP projects in 1997, during and after its implementation in 1999 and in 2000 respectively. The figures clearly show a reduction in air pollution levels ranging from 46–92 per cent at all intersections after the implementation of the IRDP scheme. There was a substantial decrease in concentrations of heavy metals, particularly lead. Although the noise levels at the traffic intersections were reduced after the implementation of the IRDP project, the levels recorded were still above the standards (TMC, 2001).

Role of Judiciary

Indian Judiciary has played a significant role in regulating the implementation and enforcement of various environmental regulations in the country. In many cases, the Honourable Supreme Court of India has issued directions to various Stakeholders to take care of their wrong doings with the nature. At State levels, Honourable High Courts have also been active in this regard.

The Bombay high court ordered the State government, the regional transport authority and the transport commissioner to ensure that all vehicles moving within the limits of greater Mumbai strictly comply with the emission norms stipulated by the State government under rule 115 of the Motor Vehicle Act. The court has directed NGOs to appoint volunteers to attend the PUC centres, which shall be designated by the transport commissioner to ensure that regular checks are conducted. The court has asked for 12 flying squads to be constituted to ensure compliance with vehicular emission norms. These mobile flying squads shall have the power to detain any vehicle not complying with the norms. Volunteers can also accompany such flying squads, which have the authority to impose fines, suspend or cancel registrations of offending vehicles. The authorities are required to ensure that petrol pumps do not supply fuel to those who do not possess valid PUC certificates and that the fuel is not adulterated. Petrol pumps should be checked regularly and those who are guilty of adulteration can be subject to action including suspension of license for a minimum of seven days. Any tanker found to be involved in adulteration can be impounded and its registration suspended for 12 weeks. Any PUC centre found to be issuing fake certificates could have its license revoked immediately and prosecuted.

Chapter 4: Solid Waste Management

Introduction

Solid waste refers to any solid or semi-solid substance or object resulting from human or animal activities, discarded as useless or unwanted. It is an extremely heterogeneous mass of wastes, which may originate from household, commercial, industrial or agricultural activities. Solid waste is a broad term, which encompasses all kinds of waste such as Municipal Solid Waste (MSW), Industrial Waste (IW), Hazardous Waste (HW) and Bio-Medical Waste (BMW). It consists of organic and inorganic constituents which may or may not be biodegradable. One one hand, the recyclable components of soild waste could be useful as secondary resource for production processes. On the other hand, some of its toxic and harmful constituents may pose a danger if not handled properly.

In India, the situation of Solid Waste Management (SWM) is grim, particularly in urban regions. The management of MSW is entrusted to civic bodies in the urban areas, which depending on their financial resources, spend on an average, about 5 to 25 per cent of their total budget on SWM. It is reported that in more than 40 Indian cities, the municipal agencies spend around Rs.50-150 per capita per year on SWM. Most of the ULBs, report shortage of funds as one of the main barriers for achieving a proper MSW Management. A lack of efficiency is evident at all stages of SWM i.e. collection, transportation, treatment and disposal. There is no concept of source separation and only mixed waste is collected in most of the cities. The workers handling waste do so in highly unhygienic and unhealthy conditions. Sanitary landfills are not practiced and waste is dumped unattended, in open sites, resulting in several hazards.

The state of SWM in Maharashtra, particularly in its major cities, is of serious concern. There are several environmental, economic and social issues attached with the SWM that are to be addressed by the state. Some of these issues have been highlighted in earlier studies undertaken for Maharashtra and Gujarat (Sharma et. al., 1997). Majority of cities and towns in the state adopt the community-bins system of collection and, except in few cities, the quantity of waste generated daily is not recorded. The quantity of recyclables collected by informal sector, involving lakhs of rag pickers, is not known. The waste is not suitable for thermal treatment due to its low calorific value and high moisture content. Biological processing methods such as composting, vermi-composting, biomethanation, etc., have been attempted with limited success. Table 4.1 and 4.2 show the statistics of MSW management and its composition, resepctively, in some cities of India inlcuding Mumbai and Nagpur in Maharashtra.

Table 4.1: Status of Municipal Solid Waste Management in Indian Metropolitan Cities

Item / City	Bangalore	Calcutta	Chennai	Delhi	Mumbai
Area (Sq. Km)	226.16	187.33	174.00	1484.5	437.71
Population(in millions)	5.31	6.00	5.00	12.20	12.50
MSW Generation (Tonnes/day)	2200	3100	3050	6000	6000
MSW per capita (Kg/day)	0.414	0.517	0.610	0.492	0.480
Garbage pressure (tones/sq.km)	9.728	16.548	17.529	4.042	13.708
Persons involved in MSWM	12600	12030	10130	40483	22128

Source: CSO (2001)

Table 4.2: Composition of Municipal Solid Waste in Some Indian Cities

City	Non-Biodegradable					Bio-degradable
	Paper	Plastics	Metal	Glass	Ash & Earth	
Calcutta	3.18	0.65	0.66	0.38	34.00	47.00
Delhi	6.29	0.85	1.21	0.57	36.00	35.00
Nagpur	1.88	1.35	1.33	1.34	41.42	34.81
Bangalore	4.00	2.00	-	1.00	15.00	78.00
Mumbai	10.00	2.00	3.60	0.20	44.20	40.00

Source: IDR (1997)

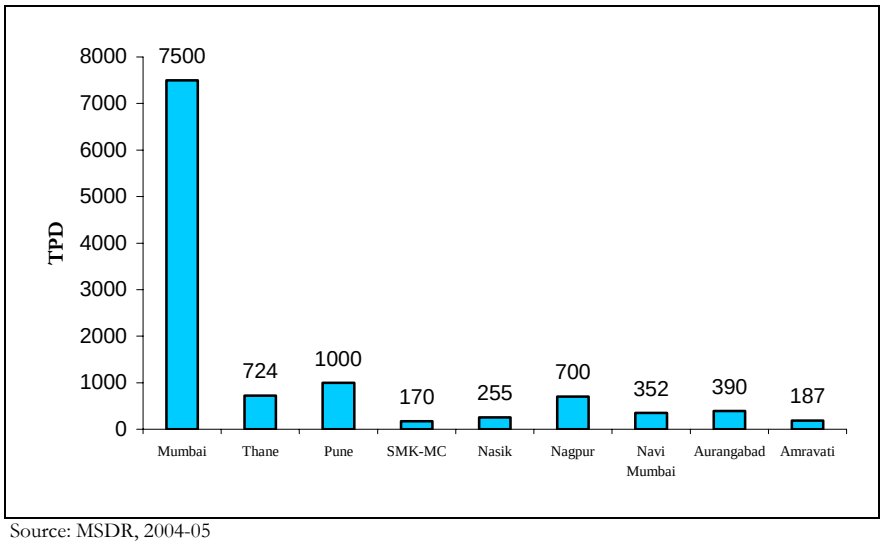
Solid Waste in Maharashtra

Following sections give the scenario of generation, impact and management of various types of wastes such as MSW, IW, HW, BMW etc. in the State of Maharashtra.

Generation of MSW

Per capita MSW generation in various towns of the state ranges between 100 and 600 gm per day. In total, over 16000 tonnes per day (TPD) of MSW is generated of which around 50 per cent is generated in three cities, namely Mumbai, Thane and Pune only (as in 2001-02). Compared to other metropolitan cities in India as well as in Maharashtra, amount of MSW generation is the highest in Mumbai and the city alone generates about 7500 TPD followed by Pune at 1000 TPD and Thane at 724 TPD as indicated in Figure 4.1 (TMC, 2001; TOI, 2003:b).

Figure 4.1: MSW generation in major regions of Maharashtra



Source: MSDR, 2004-05

In terms of composition of solid waste, authentic data and information are not available. Available data indicate that the waste generated in Mumbai contains about 60 per cent of non-biodegradable and 40 per cent biodegradable components. For Nagpur, these figures are about 65 per cent and 35 per cent, respectively. In Pune, about 95 per cent of solid waste is either biodegradable or recyclable, in Navi Mumbai it is almost 100 per cent and for Nashik about 72 per

cent. In Thane, mixed garbage accounted for 62 per cent, which could neither be classified as biodegradable nor as recyclable. Mumbai's clearing efficiency of MSW is about 86.2 per cent, which is the highest among all the major cities in Maharashtra, and that for Thane is about 57 per cent (CSO, 2001). The overall solid waste composition of Maharashtra includes 2.63 per cent paper, 0.96 per cent textiles, 0.33 per cent leather, 1.31 per cent plastics, 1.95 per cent glass, 62.28 per cent ashes and fines and 32 per cent compostable matter. Table 4.3 shows district-wise MSW generation is shown for the year 2001.

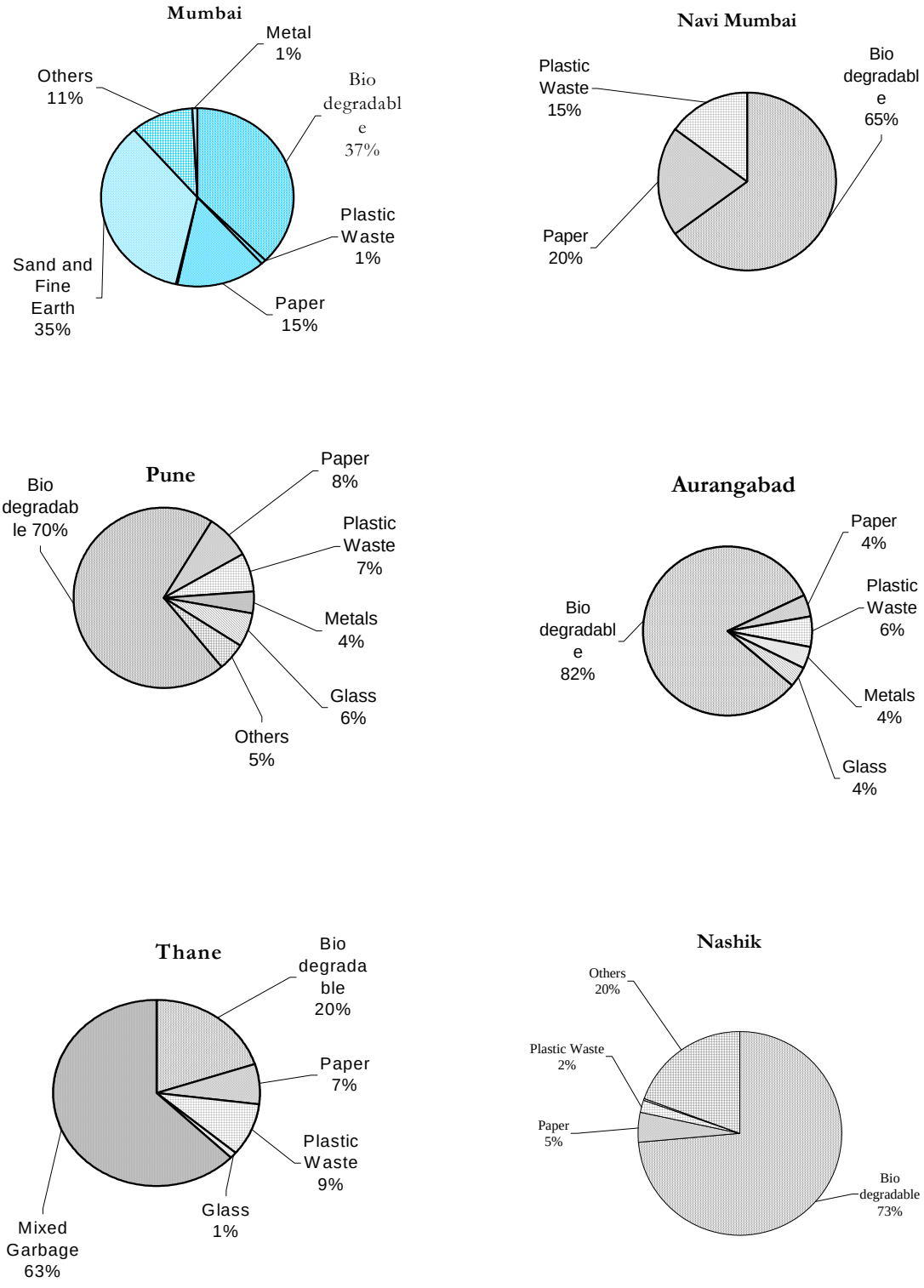
Table 4.3: District-wise MSW Generation

Districts	MSW Quantity TPD	Per Capita Per Day (kg)
Ahmednagar	147.08	0.04
Akola	142.62	0.09
Amravati	202.33	0.08
Aurangabad	290	0.10
Beed	64.18	0.03
Bhandara	23.81	0.02
Buldhana	57.14	0.03
Chandrapur	141.07	0.07
Dhule	83.27	0.05
Gadchiroli	-	-
Gondia	40	0.03
Hingoli	35.53	0.04
Jalgaon	339.16	0.09
Jalna	35	0.02
Kolhapur	262.08	0.07
Latur	145.73	0.07
Mumbai & Mumbai Suburb	7500	0.63
Nagpur	723.62	0.18
Nanded	149	0.05
Nandurbar	26.42	0.02
Nashik	315.28	0.06
Osmanabad	22.57	0.02
Parbhani	54	0.04
Pune	1339.96	0.19
Raigad	50.75	0.02
Ratnagiri	19.69	0.01
Sangli	160	0.06
Satara	79.73	0.03
Sindhudurg	-	-
Solapur	405.59	0.11
Thane	2683.18	0.33
Wardha	75.85	0.06
Washim	34.44	0.03
Yavatmal	42.8	0.02

Source: NEERI (2005 b)

Figure 4.2 gives percentage of various constituents of MSW in major cities of the State and indicates a high biodegradable content of the waste.

Figure 4.2: Composition of MSW in Major Cities of Maharashtra



Source: Compiled from Environment Reports of various MCs (1999-2003)

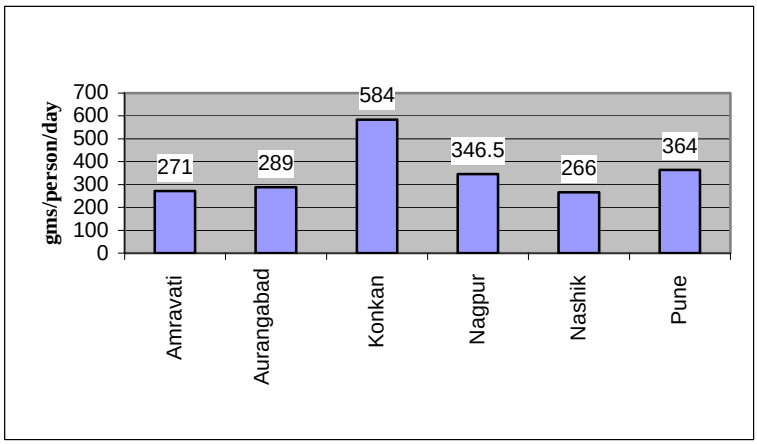
Table 4.4 indicates division-wise quantity of waste generated in the State, from different sources such as Domestic Solid Waste (DSW), Commercial Solid Waste (CSW), Industrial Solid Waste (ISW), Market Solid Waste (Mkt SW) and Hotels and Restaurant Solid Waste (H/RSW). Figure 4.3 shows per capita waste generation (in gm/day) for different divisions.

Table 4.4: Division-wise Quantity of Solid Waste from Various Sources

Division	DSW (MT)	CSW (MT)	ISW (MT)	Mkt SW (MT)	H/RSW (MT)	Total waste per day (MT)	Per capita waste generated (gm/ person-day)	Quantity of SW collected per day (MT)	Percentage of waste collected everyday
Amravati	86	25	N.A	49.5	8.5	319	271	276.5	86.7
Aurangabad	375	146	32	65	55	683	289	595	87.1
Konkan	6714	1226.6	709.7	910.8	618.8	10159	584	9974	98.2
Nagpur	705	62	8	86	29	890	346.5	880	98.9
Nashik	320.78	74	86.5	76.75	29.25	708.28	266	652.28	92.1
Pune	1133	375	123	141.25	292.75	2115	364	1658.5	78.4

Source: AIILSG, 2003

Figure 4.3: Division-wise Per Capita Waste Generation



Source: AIILSG, 2003

MSW in Class I and Class II Cities

For class I cities in Maharashtra, the waste generation rates reported are in the range of 0.14 to 0.63 kg per capita per day (pcpd), which includes Mumbai having the highest rate of 0.63 kg pcpd. The average waste generation rate for the state is estimated as 0.35 kg per caipta per day (AIILSG, 2003).

In class II towns, where population is semi-urban and agricultural based, the waste generation rate is smaller considering low standard of living and poor infrastructure facilities. District towns such as Bhandara, Buldhana, Hingoli, Nandurbar, Ratnagiri and Washim are included in class II towns based upon the population in year 2001. In absence of the data on SW quantity and generation rate for all the towns, it is assumed as 0.28 kg per caipta per day for year 2001. The past trend of increase in quantity of MSW is not known for each city and town. Hence, projections are

based on rates observed in other cities such as the studies carried out by NEERI for Kolkata indicated the per capita quantity increase at the rate of 1.33 per cent per year.

Tables 4.3. indicates the waste quantity and waste generation rate for all districts in the State. According to projections made by NEERI the waste quantities are estimated to increase from 6.18 million tonnes/yr in the year 2004 to 8.05 million tonnes/yr in 2011 and 11.77 million tonnes/yr in 2021. Based on the studies at national level, it is expected that characteristics of waste will change due to increased commercial activities, life style and standard of living. Paper and plastic contents would increase and ash and inert material is expected to decrease. However, the MSW will still have enough organic content and be amenable for composting along with other biological processing methods and calorific value of MSW may continue to remain unsuitable for incineration.

Comparison with India

A recent (2004) and elaborate study of 42 cities was carried out by NEERI for CPCB, Delhi.. The study involved preparation of national level database for MSW quantity, composition and generation rate in each city. The study by NEERI excluded metros like Mumbai, Delhi, Kolkata, Hyderabad and Chennai. In addition, NEERI studies have also been carried out for three cities of the State, namely, Pune, Nashik and Nagpur. AIILSG, Mumbai has also prepared a report, which included a wide range of MSW parameters such as waste quantity, generation rate, compostable organic matte, recyclables, carbon to nitrogen ratio, calorific value, etc. in the State (AIILSG, 2003). The reports of the AIILSG, Mumbai for all class I cities in the State are based on the inputs provided by the civic agencies of these cities and the data and information given in these reports are comparable in terms of parameters like compostable matter, waste quantity, generation rate, etc. with the National level values. However, the methodology for estimation of recyclable matter has not been indicated. The C/N ratio and calorific value have not been reported, which are essential for deciding appropriate processing and mode of disposal of waste and hence comparison in this regard cannot be made.

The comparison of various MSW parameters at national and state levels is presented in Table 4.4. At national level, the waste generation is in the range of 0.12-0.75 kg/capita/day and generally the smaller towns produce less MSW compared to metropolitan cities and some of the industrial townships. It has been observed that the otal waste generation is the lowest at Itanagar (11.8 tonnes/day) and highest (1302 tonnes/day) at Ahmedabad. The waste generation rate was lowest of 0.12 kg/c/day at Vadodara and highest of 0.75 kg/capita/day in coastal city i.e. Panji.

Table 4.4: Comparison of MSW Parameters at National and State Levels

Items	National level excluding Mumbai	Maharashtra State excluding Mumbai	NEERI's study in Maharashtra (3 Cities: Nagpur, Nashik, Pune)
Total quantity of waste (tonnes/day)	11.8 – 1302	18 – 1000	200 – 1175
Waste generation kg/person/day	0.12 – 0.75	0.14 – 0.63	0.19 – 0.46
Total compostable matter in per cent	29 – 71	10.8 – 84	39.5 – 62.44
Total recyclables in per cent	9 – 36	1.8 – 43.8	15.5 – 25.11
C/N ratio	14 – 52	-	26 – 37.20
Calorific value in Kcal/kg	590- 2736	-	1180 – 2632

Source: NEERI (2004); AIILSG (2003)

MSW Management

The SWM system comprises of four essential steps i.e. collection, transportation, processing and disposal. The MSW in each city of Maharashtra is managed by civic agencies, which adopt community bin system of waste collection and transport it to processing and disposal site. The status MSW management is described as follows.

Collection

In all the cities, except Mumbai, health officer, chief sanitary inspector or sanitary superintendent in the officer-in-charge of SWM, where separate departments of collection and transportation exist. It has been observed that around 2-3 workers per 1000 of population are provided in majority of class I cities and this figure is lesser in class II towns. Workers are allotted jobs in a shift of 8 hrs per day and their job involves cleaning of streets, collecting the refuse and garbage and transfering it to the waste bins. Moreover, households are supposed to transfer their solid waste from residential areas into the nearest waste bins.

Community bin system of waste collection is adopted, wherein the storage bins made of either RCC or MS, rectangular/circular type, having different capacities, are used. These bins are located at different locations along the roadside/street in residential, business and commercial areas. In most of the cities, the design, location and capacity of community bins is not appropriate both in terms of population they serve and quantity of waste generated in the area of their locattion. Further, the frequency of collection and transportation of wastes is not satisfactory.

House to house collection system has recently been started in some towns such as Nashik and Nagpur and some parts of Mumbai. In some cities like Pune, efforts have been made to collect source-segregated waste, separately. In few cities, private participation has been encouraged in waste collection.

Transportation

A variety of vehicles such as tricycles, bullock carts, tractor trailor systems, open body trucks, tippers, dumper placers, compactor vehicles, etc. are used for transporting the waste from community bins to the dump sites. These vehicles are highly capital cost intensive and due to inadequate financial budget provision, older vehicles are deployed for SW transportation. This results in an uneconomic operation of the system. In most of the cities, maintenance facilities for these vehicles are inadequate, which adversely affect operational schedule of transport of waste. In few cities, some wards/zones are privatised for the transportation of MSW where payment to private parties is made either on the basis of volume or weight of the waste transported.

In some cities like Mumbai and Pune, where the haul distance is more than 20-25 km, intermediate transfer stations have been established.. At these transfer stations, the small capacity vehicles (2-3 tonnes capacity) transfer the waste to large capacity vehicles (8-10 tonnes capacity) for further transportation of waste to the processing/disposal site.

Treatment or Processing

MSW in the State has a high content of biodegradable and recyclable waste. Such composition provides ample opportunities for more efficient and resourceful waste management. Aerobic and anaerobic composting has been practised at some places. Vermi-composting has also been tried at community level but it is yet to develop at commercial scale. Incineration of waste is a thermal process, which reduces the waste to 15-20 per cent. However, due to lower calorific value of waste,

this process has not been fully exploited. Similary, attempts are being made to produce energy from waste. A number of cities and towns have initiated installation of aerobic composting plants of different capacities which will reduce organic load to sanitary landfills and also the GHG emissions from landfills.

Disposal

In majority of the urban centres, MSW is being disposed of in low-lying areas. Location of various dump sites and their capacity (area) is given in Table 4.5. Compaction is not carried out and earth cover is not provided except in few metro cities like Mumbai, Pune and Nashik. In Mumbai, earlier there were four dumping grounds, namely Gorai, Mulund, Deonar, Chincholi. While the Chincholi dump has been closed due to health hazards, the Gorai dump may also be closed due to public protests. Mumbai neither has the space for dumping grounds nor does it have agricultural land to absorb the processed waste, thus, making solid waste disposal a serious issue. Despite efforts like composting and power generation, alternative solutions have not been very successful mainly due to their high cost. Some MCs are trying to promote eco-friendly methods of SW disposal. For example, in Mumbai, about 43 MTPD of market-waste is disposed off by vermi-composting, which is environment friendly natural process. At Nashik, sanitary landfill has been developed (NMC, 2002; BMC, 2004).

Table 4.5: MSW Sites and their Area

Sr.No.	Location	Area (in hectares)	Sr.No.	Location	Area (in hectares)
1	Deonar	111.00	1	Nala	2.7
2	Mulund	25.20	2	Turbe	40
3	Chincholi	19.22	3	Diaghar	18
4	Gorai	14.50	4	Khamba	47
5	Belkheda	1.37	5	Bhandewadi	52
6	Naigaon	4.5	6	Mirgavan	5.25
7	Bhatukuli	12.53	7	Halsavde	NA
8	Karodi	51	8	Punawde	20.4
9	Deolgaon	2	9	Urli-devachi	40
10	Maltekdi	11	10	Sangli & Miraj	3.2 &5.2
11	Dhar	4	11	Tuljapur	23

Source: MSM Cell, AIILSG, 2004

Shortcomings of SWM System

Existing SWM system in class I and class II towns in Maharashtra has several shortcomings.

Low removal frequency: In many cities, the waste stored at the various storage bins/containers is not removed at regular intervals. In some cities, population at the periphery of city, is not been provided with collection service. This results in the accumulation of waste in the form of unsighlty heaps and some waste finds its way to the drains and sewer lines, thereby blocking them.

Uncontrolled dumps: The prevailing method of open dumping not only causes anasthetic conditions but leaching of toxic chemicals also results in ground water pollution. Open sites are accessible to humans (informal waste-pickers) and animals resulting in health hazards to them. Moreover, lack of new sites for disposal is prevalent due to lengthy land acquisition procedure, public opposition, scarcity and high cost of land.

Obsolence: Both methods and manner by which the SWM is achieved is obsolete. Waste collection bins are short of proper design, capacity and placement. Workers and officers are not well trained and use unhygienic way of handling the waste.

Under-utilization of Potential

Bio-degradable organic matter of MSW can be biotechnologically processed to reduce the organic load on landfills. At the same time, this process would also result in prodcution of biogas which can be recovered for beneficial use. In Nineties, some studies carried out by NEERI on a small scale showed good results. However, appropriate energy recovery systems are yet to be established in the State.

The plastic waste, especially thin plastic bags, have become a nuisance in MSW management. These bags are not recycled and rejected by the informal rag pickers due to less economic value. In spite of the ban imposed by the State Government on thin plastic bags, its use has not stopped. While, ban on plastics may be a point of argument, authorities, have to evolve some more efficient methods for collection and disposal of plastics and other recyclables.

A committee appointed by the Hon'able Supreme Court of India in 1999 recommended source separation of `wet' biodegradables and `dry' recyclables with daily door to door collection of `wet' waste for composting and `dry' waste left to the informal sector, for recovery and reuse. However, its enforcement is still not observed.

Problems of slaughterhouse waste

The slaughtering of animals is occurring in an uncontrolled manner in several unlicensed slaughterhouses spread in various localities. It is observed that they are often located in the vicinity of residential areas and schools, which should not be permitted. Besides, slaughtering is carried out in unhygienic conditions and the waste is disposed off either on ground or in the nearest drains. To improve the situation the following actions could be taken.

- The licensed slaughterhouses should be shifted to alternate sites identified by the municipal authorities and MPCB.
- Encourage the slaughterhouses to join together in a cooperative to set up a modern slaughterhouse, which will ensure hygienic conditions.
- Actions should be taken to provide the facilities for treatment and safe disposal of waste from such facilities and the grants provided by GoI for this purpose should be utilised.

Some of the MCs in the state such as Pimpri-Chinchwad MC are making efforts to solve these problems. In PCMC, around 1.5 tonnes of waste is generated from the slaughterhouses is used to make good quality vermin-compost. The PCMC is also making efforts to allocate lands for slaughterhouses (PCMC, 2002).

Impact of MSW

As metnioned earlier, MSW's components include various toxic and hazardous chemicals which not only pollute land on which MSW is dumped but also affect nearby surface water resources, ground water resources, crops and if accessed by human and animals, their health.

Health Effects

Exposure to any kind of solid waste, whether agricultural, domestic, industrial or hazardous, affects human health, particularly children, who are more vulnerable to these pollutants. Waste dumped near a water source contaminates the water bodies both surface and underground. Disposal of hospital and other medical waste requires special attention as it poses a major health hazard. Similarly, waste treatment and disposal sites can also create health hazards for the neighbourhood. Improperly operated waste incineration plants cause air pollution and improperly managed and designed landfills attract all types of insects and rodents that spread disease. Recycling also poses health risks if proper precautions are not taken. Direct handling of solid waste can result in various types of infectious and chronic diseases, with the waste workers and the rag pickers being the most vulnerable.

There are several environmental and socio-economic implications associated with solid waste in the State. A health assessment survey of 174 people residing adjacent to Gorai dumping ground in Mumbai revealed that the incidence of asthama in the studied population was 9.2 per cent, which is higher than the noted prevalence of 3.5 per cent among the general population of the city. About 16.8 per cent and 47.3 per cent of the studied population suffered from allergic rhinitis and eye irritation and headache, respectively (BMC,2004). Thane-Belapur industrial belt in Navi Mumbai creates more than 100 TPD of solid waste, most of which is highly toxic. Possibility of unauthorised dumping of this waste in the rivers can not be ruled out. Plastic waste sorted out from MSW by rag pickers is recycled without proper technology giving rise to highly toxic fumes. It is reported that burning of waste at the Deonar dumping ground in Mumbai caused sickness among nearby residents, resulting in a public interest litigation (PIL) forcing BMC to make some improvements (ToI, 2003).

Socio-economic Dimension

Social dimension, in the form of the involvement of informal sector in SWM, is worth mentioning. Some studies have revealed that this system works very efficiently through a chain of waste (rag) pickers, waste buyers and wholesalers. Mumbai has several thousands of rag pickers having solid waste collection as their primary source of income. Most of these rag pickers have migrated from other places in Maharashtra and nearby states and adopted waste collection as their profession. Thus, rag picking has both positive and negative aspects. On the one hand, it is a source of income and employment for the migratory labour. Rag pickers form an important part of SWM in the city by segregating recyclables from the waste, which is not done by municipality workers. On the other hand, these rag pickers are exploited by the middlemen and get paid much less than the market rate, for their recyclable wastes. They are also not aware about the harmful effects of the toxic waste and unhygienic conditions in which they are working (Sharma et. al, 1997).

Among the non-health effects, the opportunity cost of the land used for dumping of waste is also important. The cost of land in cities like Mumbai, Thane and Pune is very high and a large chuck of land is used as dump sites. Furhter, the cost as well as the rental value of residential and commercial properties lcoated near dumpsites is reduced due to unsightly condistions, odour, and nuisance due to flies, rodents and mosquitoes.

Response for Better SWM

Various Central and State Level authorities have taken steps for an efficient SWM. All Urban Local Bodies (ULBs) in the State are trying to improve collection, treatment and disposal system for management of municipal solid wastes as per requirement given in the MSW Management Rules notified in the year 2000 under the Environment (Protection) Act, 1986.

Initiatives of MPCB

Until April 2003, most of the ULBs even did not obtain mandatory authorisation from the MPCB as per rules. Several of them were not in compliance of the rules and regulations. As a first step, the MPCB persuaded successfully all the ULBs to obtain mandatory authorisation, prepare action plan for management of MSW and identify/notify suitable land for setting up of facilities for treatment and disposal of waste generated in the city. In order to facilitate the implementation of the MSW rules, MPCB has taken demonstration projects in five cities, namely Ambad (Jalna), Sonpeth (Parbhani), Navapur (Nadurbar), Murud-Janjira (Raigad), and Baramati (Pune). In all these cities, technical and financial assistance is provided by the MPCB to set up MSW collection, transport, treatment and disposal facilities, as well as to augment the existing infrastructure. The project implementation is in full swing and is in advance stages of completion at Ambad, Sonpeth and Navapur. For other places, the respective local bodies are issuing orders shortly and work will commence soon. In addition, MPCB is also making efforts to support local bodies at Gandhinglaj, Pandharpur and Jalna (MPCB, 2005).

Efforts of MCs

Municipal authorities have made efforts to solve the problems associated with SWM. For example, in 1998, with the help of BrihanMumbai Municipal Corporation, 'Parisar Vikas', a project by an NGO, namely, Stree Mukti Sanghatna, was launched on an experimental basis. The unique feature of this project was that livelihood of poor, low skilled, low educated dalit women engaged in rag picking would be protected while solid waste would be disposed off in eco-friendly manner. Today, more than 2000 women are engaged in collecting garbage from houses, separating dry and wet garbage, selling the dry garbage (plastic, glass, metal), converting wet garbage into vermi-fertiliser and earn a living. Besides, they extend advisory services and training to people. This has saved the cost of transporting garbage to the dumping grounds, prevented pollution and generated resources by recycling the solid waste.

The MCGM has also taken technical measures for reducing nuisance at dumping grounds. It has provided water tankers on dumping grounds, to spray water mixed with disinfectants of ecofriendly quality, which has helped bring the hydrogen suphide levels within the limits. Refuse vehicles at the check post and empty vehicles leaving the dumping ground are also sprayed with these disinfectants (BMC, 2004). Security guards have been appointed to avoid stray dogs and unauthorised dumping. The BMC has also introduced "Mechanical Beach Cleaner" at Girgaon Chowpatty for improved beach cleaning. The BMCalso proposes to deploy beach-cleaning machines for other beaches in the city. It is expected that there will be great improvement in the level of cleanliness at beaches in the city.

In Mumbai, as a result of MCGM's efforts to ensure segregation of dry and wet waste, many residential societies are now segregating their garbage at source and 45 vermi-culture sites are converting the wet garbage in to compost (TOI, 2003:a). However, a pilot survey revealed that 60 per cent of the housing societies did not segregate waste because of the lack of willingness and

awareness of people and inability of BMC officials to provide the necessary infrastructure (Moitra and Ramachandran, 2003). To handle the solid waste in urban areas some of the projects have been put up for PSP and limit the role of government to that of a facilitator. Some projects available for PSP are given in Table 4.5. However, some incidences of mis-management by private contractors have been reported by BMC. While contracts were given for 4000 TPD, in reality only 2500 TPD waste was cleared, causing huge losses to the MCGM (Sen, 2003).

Table 4.5: Solid Waste Management Projects available for PSP

Name of the Project and Location	Agency	Project Cost	Description
Underground sewerage and surface water drainage scheme, for Akola City.	AMC	Rs. 650 Million (US $ 15 Million)	To construct underground sewerage scheme for Akola City to generate energy from the sewage and the biogas.
MSW based power projects	MEDA	Rs.80 Million per MW.	Generation of Power from the Municipal Solid Waste for MCs at Nagpur and Pune.
Solid Waste Management.	MCGM	Private sector participant will indicate the cost.	Privatisation of collection and disposal of municipal waste in Mumbai.

Source: MIS (2002)

NMMC is consiering an abandoned mine at Turbhe as an alternate site for MSW disposal (NMMC, 2004). Community groups have been involved in management of solid wastes in many cities. Treatment and disposal of solid waste by vermi-culture composting has become an important method. On the banks of the river Godavari, the Nashik MC has installed what is known as "Nirmalya Kund" to collect the garlands, flowers and other worshipping materials used daily and in religious events. This has helped in avoiding the solid waste disposal into the river (NMC, 2002).

Advance Locality Management

The MCGM is encouraging the co-operative housing societies in Mumbai to adopt Advance Locality Management (ALM) so that separation of solid waste is done at the source. This will help the BMC to receive only wet garbage, which can be vermicultured in the garden of that locality and the dry waste can be handed over to rag pickers. At present 584 ALM systems and 25 vermiculture locations have been developed at various locations in Mumbai (BMC, 2004). The concept of ALM has been well established as about 611 such groups registered in different parts of Greater Mumbai. The BMC and ALM groups work together to keep their respective areas/wards clean. The social organisations in Mumbai have formed an apex body called AGNI (Action for Good governance through Networking India) to involve all concerned in improving the city. The corporation has continuous interaction with AGNI to identify and solve the problems faced by Mumbai city like proper solid waste management, flooding, etc. The corporation has also involved an organisation of the senior citizens, namely, Dignity Foundation in its Solid Waste Management activities. About 600 senior citizens work as a watch dog in conservancy sections and motivate the conservancy staff and involve school children in propagating awareness about cleanliness amongst citizens.

The Pune Municipal Corporation (PMC) has was made MSW rules 2000 mandatory and based on the directives of the Supreme Court, segregation of MSW has been vigorously started by the PMC at three levels, namely, Domestic level, Transfer station level and at the land fill site. At the

domestic level, the PMC has provided 18 *Ghanta* trucks along with 2 rag pickers and 2 PMC employees, which go house to house. The dry waste is collected by the ragpickers directly and the wet waste is collected by the PMC. At the transfer station, it has appointed 4 to 5 ragpickers to collect the dry waste from the mixed waste, brought in from the various ward offices. The waste is collected at the transfer stations in bulk refuse carriers and is transported to the landfill site at Devachi Uruli. Here again, rag pickers segregate the dry recyclables. In this way maximum quantity of dry recycles are segregated by the rag pickers. The remaining waste is treated with the EM (Effective Micro-organisms) solution at the landfill site. Under the `Clean Pune Project' the PMC has proposed to start vermi-culture in all public gardens and, at open spaces at the Balgandharva Ranga Mandir.

PMC has undertaken special cleanliness drives since 1999, with its enforcement through the nuisance detection (ND) squad, consisting of 48 retired personnel from the police, army, navy, air force; home guards, etc. recruited on contract basis. The teams, each consisting of 3 personnel, are assigned to each ward office to implement this drive. The ND squad members penalise the erring citizens causing nuisance like throwing garbage on roads, spitting, passing urine on road side, etc. These members have been authorised to recover the administrative charges from the erring citizens on the spot under sections 3 (a) 4 and section 376 of BPMC Act, 1949. It is reported that the ND squad has so far collected the administrative charges of over Rs. Two Crores by penalising about two lakh citizens since its inception (PMC, 2004).

Steps by Government

The MoEF has provided financial assistance for setting up of one Common Treatment, Storage and Disposal Facility (CTSDF) in Maharashtra, two in Gujarat and one in Andhra Pradesh (MoEF 2005). The MoEF has announced financial assistance of Rs 20 lakhs for local bodies of small twons in Konkan. This assistance is in the form of zero interest loans returnable in 20 years at one lakh per year.

According to the directives of the Supreme Court and GoI Gazette Extra ordinary dated 3.10.2000 and provisions of Environment (Protection) Act 1986 and Municipal Solid Waste (M&H) Rules 2000, all the residents of houses, societies, bungalows, and row houses are directed to segregate the garbage generated by them at source, into dry and wet wastes, into green and white buckets/containers, respectively, within their premises.

The GoM has banned use of plastic carry bags below the thickness of 20 microns and there is a move for total ban on plastic carry bags. With six MCs in Maharashtra deciding to put up MSW power plants, the state has taken the lead among all other states of the country in adopting eco-friendly measures for the disposal of MSW. The nation's first MSW power plant using 500 TPD of waste and 5 MW generating capacity was set up in Nagpur in 2000. Power plants of varying capacity have been planned at Mumbai, Pune Kalyan, Solapur and Pimpri-Chinchwad. Almost all these plants were conceived on a Build-Own-Operate (BOO) basis wherein the MCs have agreed to provide garbage free of cost at the site of the power plant. The land for the privately owned power plant was provided on lease at a nominal charge of Rs.1 per km^2 per year. A number of incentives for these plants like interest subsidy, assured power purchase, 100 per cent income tax depreciation and protection from foreign exchange fluctuations have been provided by the GoM(Vaidya, 2000).

Hazardous Waste

Hazardous waste (HW), generated by industries, is highly toxic and can have serious repercussions on our health and cause environment pollution if it is treated properly and disposed off securely. In India, 12 states account for 97 per cent of total hazardous waste generation (Maharashtra, Gujarat, Tamil Nadu, Orissa, Madhya Pradesh, Assam, Uttar Pradesh, West Bengal, Kerala, Andhra Pradesh, Karnataka and Rajasthan). The top four HW generating states are Maharashtra, Gujarat, Andhra Pradesh and Tamil Nadu. On the other hand, states such as Himachal Pradesh, Jammu & Kashmir, and all the North Eastern States excepting Assam generate less than 20,000 MT per annum.

Maharashtra generates more than eight lakhs TPA of HW from more than 4000 industrial units. Major hazardous waste generating industries in the State include chemicals, petrochemicals, pharmaceuticals, agricultural chemicals and fertilizers, pulp and paper, paints, dyes and intermediates, petroleum, tanneries, caustic soda, textile processing, distilleries, electroplating and heavy metal industries. Thane, Ratnagiri and Raigad are generating the maximum solid hazardous waste. According to the Environmetnal Status of BMC, about one-fourth of the solid waste generated in Mumbai is toxic. There are about 40,000 small, medium and large-scale industrial units in Mumbai city of which 523 are in the chemicals sector, 531 in textiles sector and 9 in pesticides sector.

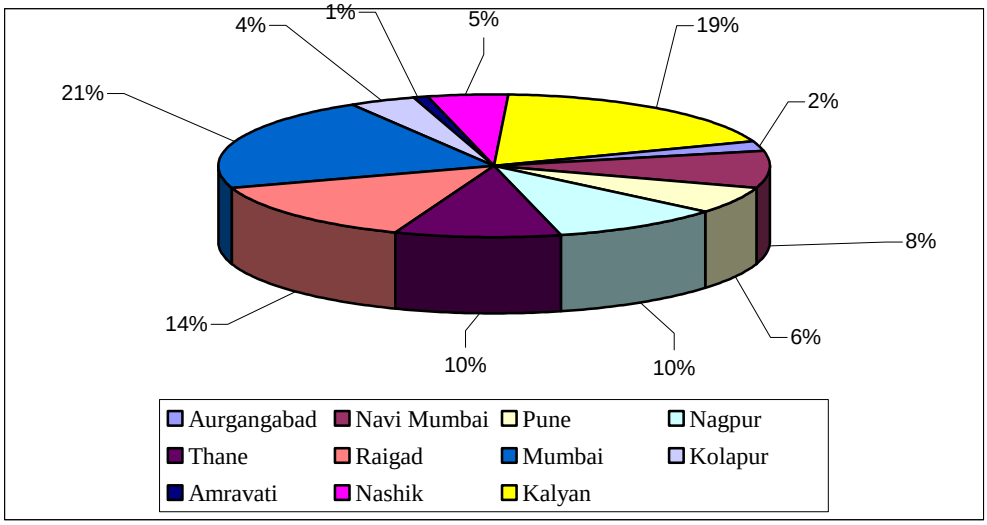
Region wise statistics of HW generation is given in Table 4.6 and percentage of HW generation is given in Figure 4.3. Accordingly, largest share (21%) of HW comes from Mumbai region followed by Kalyan (19%) and Raigad regions (14%) with least share is from Amravati region (1%).

Table 4.6: Region wise estimated quantity of HW generated in Maharashtra (as on 1st June, 2005)

Sr. No.	Regions	No. of Industries generating HW	Secure Landfill %	Incineration %	Scale / Recycling %	Total MT/Y
1	Navi Mumbai	517	39.7	46.7	13.6	108727
2	Pune	669	57.5	19.1	23.4	67129
3	Nagpur	273	50.5	10.1	39.4	110700
4	Thane	613	60.7	9.1	30.2	75168
5	Aurangabad	238	27.6	6.9	65.5	26749
6	Raigad	340	60.9	14.2	24.9	154478
7	Kalyan	652	48.8	7.4	43.8	107256
8	Amravati	91	76.9	2.9	20.2	12725
9	Nashik	451	37.7	13.5	48.8	56366
10	Kolhapur	293	40.0	26.3	33.7	48232
11	Mumbai	218	51.6	19.8	28.6	61164
Total		**4355**	**50.5**	**17.6**	**31.8**	**828694**

Source: Compiled from MPCB, 2005

Figure 4.3: Region wise Percentage of Quantity of HW generated



Source: MPCP, 2005

Hazardous Waste Management

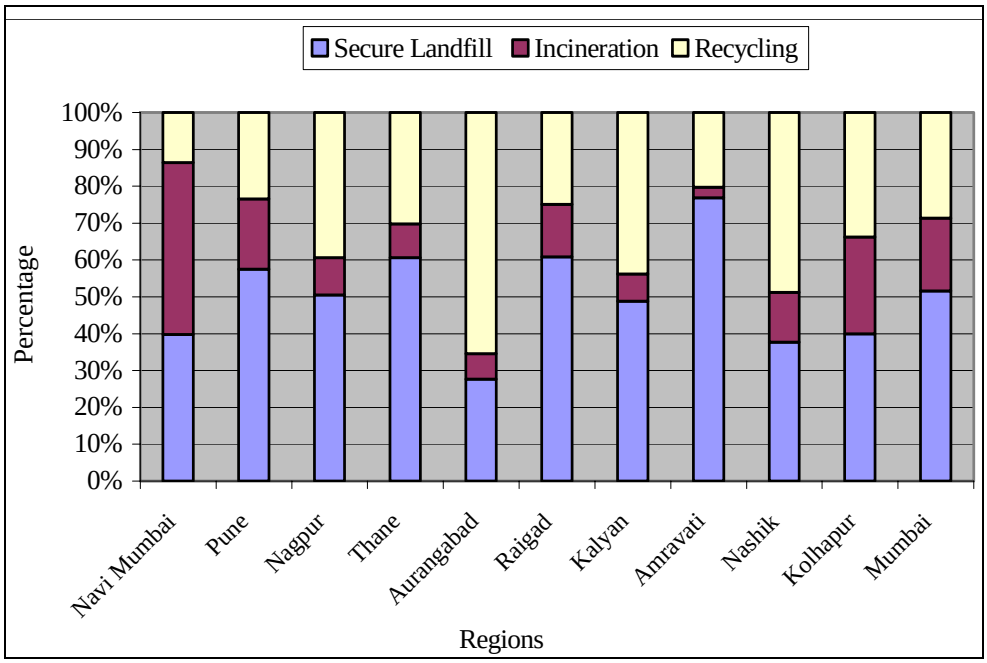
The GoI has reiterated its commitment to Waste Minimization and Control of Hazardous Wastes, both nationally and internationally. The Basel Convention on the control of Transboundary Movement of Hazardous Wastes and Disposal was signed by India on 15th March 1990 which was ratified and acceded to in 1992. A ratification of this convention obliges India to address the problem of Transboundary movement and disposal of dangerous hazardous wastes through international cooperation. As per the Basel Convention, India cannot import hazardous wastes listed in Annex VIII of the Convention from the countries that have ratified the agreement. However, the convention agreement does not restrict the import of such wastes from countries that have not ratified the Basel Convention. It is through the orders of the Honourbale Supreme Court of India that the import of such wastes is now totally banned in the country. The legal basis, therefore, is regulated in the "Hazardous Waste Management and Handling Rules (1989) amended in 2000 and 2003". This document also controls the import of hazardous waste from any part of the world into India.

According to the MoEF guidelines and as per the Hazardous Wastes (M&H) Rules, 1989 as amended in 2000 and 2003, all hazardous wastes are required to be treated and disposed off in a prescribed manner. Hazardous waste generated by industries has to be disposed in secured landfills and the toxic organic part of it needs to be incinerated. The country has more than 120 hazardous waste incinerators, and 11 hazardous waste landfills, the majority of which are located in western India (Maharashtra and Gujarat).

In Maharashtra, HW generated is treated and disposed off in different ways such as secure landfills, incineration and recyling. The task of proper management of HW is enormous but MPCB has made commendable efforts in this direction including the implementation of the Court orders. The Supreme Court Monitoring Committee (SCMC) has appreciated the exemplary work done by MPCB and MIDC in successful cleaning up operations, compliance of environmental standards by the industries, public awareness and stringent action taken against defaulters by way of levy of fines, prosecutions, etc. Two common facilities for management of hazardous wastes are set up at Taloja and Trans Thane Creek (T.T.C.) Industrial Areas of MIDC in Thane district. These facilities are

high tech and capital intensive. The Central Government through the Ministry of Environment & Forests, MPCB and MIDC have provided capital subsidy to these facilities so as to reduce the tariff and motivate the user industries for management of their waste in an environmentally sound manner. The state-of-the-art technology at these facilities is comparable with international standards. Efforts are also being made to develop such facilities at Butibori (Nagpur), Shendre (Aurangabad) and Ranjangaon (Pune) and environmental infrastructure for industries in Vidarbha, Marathwada and Western Maharashtra. The percentage of HW managed by these techniques in various regions is shown in Figure 4.4.

Figure 4.4: Region-wise hazardous waste management in Maharashtra



Source: Compiled from data available from MPCB

MPCB has been intensely involved in the activities for the environmental sound management of hazardous waste in the State of Maharashtra during the period of 2004-05. The Supreme Court Monitoring Committee (SCMC), after their visits to Maharashtra, to monitor overall performance of MPCB in managing the HW, has highly appreciated it. Thus, MPCB is instrumental in setting up world class CHWTSDF facilities at Taloja and TTC Thane-Belapur. The discrepancy of incineration facility at these TSDFs has also been removed and an incineration capable of destroying the Hazardous Wastes with adequate air pollution control measures has been now established at Taloja TSDF site. The SCMC directives on the maintenance of the quality of treated effluent in Tarapur have been complied with by setting up a new 22 MLD capacity CETP at MIDC, Tarapur. This was a landmark development, which has been completed, in a record time and the 1st phase of CETP has become ready now. The initiatives of MPCB to establish a Local Area Environment Committee have been lauded by SCMC especially the terms of reference of the committee to monitor the compliance of the SCMC directives. The committee is playing a very effective role in the pollution control at MIDC Tarapur. MPCB has also appointed a Local Area Environment Committee for Dombivali industrial area on the similar lines.

It is reported that despite the commissioning of a secure landfill and incineration facility at Taloja, some industries are unwilling to pay for the treatment cost (TOI, 2003:d). MPCB has issued directives to industries to send all hazardous waste to the Common Hazardous Wastes Treatment Storage Disposal Facility (CHWTSDF). As per records (DoE, GoM 2005), about 57000 MT of the hazardous wastes are received by the CHWTSDFs at Taloja and about 1400 MT, at TTC site. The sludge from CETPs) has been identified as one of the major sources of hazardous waste inside the MIDC area. MPCB has approached IRSA, Hyderabad for conducting surveys, using the satellite imaging technique, as per the advice of SCMC. As per the data collected by the SCMC, the details of HW in MIDC areas are given in Table 4.7. MPCB has also issued show cause notices to 18 industries and recovered as fine of Rs. 16.62 lakhs from two industries who did not comply with the directives of the MPCB regarding waste collection and its tarsportation to CHWTSDF.

Table 4.7: Hazardous Waste in MIDC areas

Sr. No.	MIDC area	Qty. of HW (MT) Approx.
1	Mahad	1747
2	Roha	200
3	Taloja	200
4	Badlapur	15
5	Ambernath	25
6	Dombivilli	210
7	TTC, Thane Belapur	200
8	Patalganga	200
Total		**2797**

Source: DoE, GoM 2005

Management and recycling of lead acid batteries was another task undertaken by the MPCB. As reported, the level of implementation done by MPCB, is one of the highest in the country in terms of collection of batteries from the dealers and also large consumers. The recovery rate in the State has been 65 per cent from dealers as against the target of 90 per cent given in the Rules.

The Supreme Court has directed that re-refining / recycling of used oil / waste oil shall be done only through application of clean technology. MPCB has issued public notices in the leading newspapers for the information of all concerned regarding provisions under the rules and the Apex Court's directives. MPCB has suspended all the authorizations of defaulting units and appointed an Expert Committee for verification of compliance in terms of adoption of environmentally sound technology (EST) in the process of re-refining and recycling. The committee consists of experts from University Department of Chemical Technology of Mumbai University, Central Pollution Control Boards, Industry Association and Members and Regional Officer (HQ) of MPCB. The Committee has completed the work and submitted its report to MPCB.

In order to stream-line the directions of the SCMC, MPCB is holding regular meetings with NGOs, Industry Associations and other stakeholders and using the services of print and electronic media for information dissemination on hazardous waste management.

Electronic Waste

Electronic waste or E-waste is the term used to describe old, end-of-life electronic appliances that are disposed off as junk, and include used computers, laptops, TVs, DVD players, mobile phones, MP3 players, etc. While there is no universally accepted definition of e-waste, in most cases, it comprises of relatively expensive and essentially durable products used for data processing, telecommunications or entertainment in private households and business. However, technically, electronic waste is only a subset of Waste of Electrical and Electronic Equipment (WEEE). According to the Office of Environmental Compliance and Documentation (OECD), any appliance using an electric power supply that has reached its end-of-life would come under WEEE. This web-based guide defines all redundant appliances running on electricity as E-waste.

Following are various categories of WEEE

- Large household appliances
- Small household appliances
- IT and telecommunications equipment
- Consumer equipment
- Lighting equipment
- Electrical and electronic tools (with the exception of large-scale stationary industrial tools)
- Toys, leisure and sports equipment
- Medical devices (with the exception of all implanted and infected products)
- Monitoring and control instruments
- Automatic dispensers

According to a survey carried out by IRG Systems South Asia (on behalf of GTZ), the total WEEE generated in India is estimated about 1,46,180 tonnes per year based on selected EEE tracer items. This figure does not include WEEE imports. Mumbai currently tops the list of major cities with e-waste. The country's financial hub has an estimated 11,017 tonnes of E-waste, followed by Delhi - 9,730 tonnes, Bangalore - 4,648 tonnes, Chennai - 4,132 tonnes and Kolkata - 4,025 tonnes. Even smaller cities such as Ahmedabad (3,287 tonnes), Hyderabad (2,833 tonnes), Pune (2,584 tonnes) and Surat (1,836 tonnes) figure in the list of high e-waste generating city in the country.

WEEE Hazards

Electrical and electronic equipment are made up of a variety of components. Some of them contain toxic substances that can have an adverse impact on human health and the environment, if not handled and disposed off properly. Often, these hazards arise due to the improper recycling and disposal processes used for E-Waste. For example, Cathode Ray Tubes (CRTs) have high content of carcinogens such as lead, barium, phosphorous and other heavy metals. When disposed off carefully in a controlled manner, they do not pose any serious health or environmental risk. However, breaking, recycling or disposing CRTs in an uncontrolled environment without the necessary safety precautions can result in harmful effects for the workers and release toxins into the soil, air and groundwater.

Recycling of components containing hazardous compounds such as halogenated chlorides and bromides used as flame-retardants in plastics is dangerious as they form persistent dioxins and furans on combustion at low temperatures (600-800°C). Copper, which is present in printed circuit

boards and cables, acts as a catalyst for dioxin formation when flame-retardants are incinerated. The PVC sheathing of wires is highly corrosive when burnt and also induces the formation of dioxins.

Land filling of E-waste, one of the most widely used methods of disposal, is prone to hazards because of leachate, which often contamintes ground water resources. Older landfill sites and uncontrolled dumps pose a much greater danger of releasing hazardous emissions. Mercury, Cadmium and Lead are among the most toxic leachates. Mercury, for example, will leach when certain electronic devices such as circuit breakers are destroyed. Lead has been found to leach from broken lead-containing glass, such as the cone glass of cathode ray tubes from TVs and monitors. When brominated flame retarded plastics or plastics containing cadmium are land filled, both Polybrominated Diphenyle Ether (PBDE) and cadmium may leach into soil and groundwater. In addition, landfills are also prone to uncontrolled fires, which can release toxic fumes.

In several Indian cities like New Delhi, Mumbai, and Chennai an unorganised and unmonitored reclycing industry exists that uses electronic junk to salvage re-saleable metal. In the process, workers who handle the waste without protective clothing and the neighbourhood residents have several hazards. A large amount of the E-waste is being imported from developed countries to India because it is cheaper to recycle it here. For example, while in the US the cost to recycle one computer is approximately $20, the companies make a profit by selling the scrap to an Indian trader for $5 (TIE, 2004 21 march).

Many NGOs have pointed out that it is not only businees houses but even household share in generation of E-waste is likely to increase in future. Despite that there is no specific legislation pertaining to the management of E-waste so far. However, computer manufacturers in India alongwith the are now coming together to find a workable solution, including prospsoing a draft legislation of E-waste management. Keeping in view that any legislation that is passed would have far reaching consequences on their business, the players have also decided to come out with a draft legislation prepared by the industry.

MPCB alongwith some NGOs have recently (September, 2005) lauched a rapid assessment survey of e-waste in Maharashtra, results of which would be known within six months period

Bio-Medical Waste

Bio-Medical Waste (BMW) is generated during the diagnosis, treatment or immunisation of human beings or animals, in research activities pertaining to them or in the production/testing of biologicals. BMW is also termed as hospital waste and includes sharp needles, soiled waste, disposables, anatomical waste, etc. It poses a serious threat to people handling it in an unscientific manne. Hospital waste management in India has received serious attention which led to the notification of Bio-Medical Waste (Handling and Management) Rules, 1998. According to these rules, hospital waste has to be segregated into various categories such as human anatomical waste, microbiology and bio-technology waste, waste sharps, discarded medicines and cytotoxic drugs, soiled waste, liquid waste, incineration ash and chemical waste, etc. Various categories of bio-medical wastes and their treatment and disposal techniques suggested by the MoEF are given in Table 4.8.

The campaign for medical waste management in India began in 1996 with the Supreme Court's order that all hospitals with more than 50 beds should have incinerators to dispose off their BMW. It is estimated that each hospital bed in India generates about 250 gm of waste per day, which is

much lower, than other countries (United States- 4.5 kg/day/bed, Netherlands-2.7 kg/day/bed and Latin America-2.63 to 3.8 kg/day/bed). In India, Delhi generates the highest BMW at about 1.5 kg /day/bed (Krishnamoorthy, 2001). Taking an average of 250 gm/day/bed, it can be estimated that India generates about 227 TPD of BMW.

Table 4.8: Categories of BMW and their Disposal Technique

Category of Waste	Composition	Treatment and Disposal
Human Anatomical Waste	Human tissues, organs, body parts	Incineration/deep burial
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
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
Waste Sharps	Needles, syringes, scalpels, blades, glass, etc. that may cause puncture and cuts. This includes both used and unused sharps	Disinfection (chemical treatment/autoclaving/microwaving and mutilation/shredding)
Discarded Medicines and Cytotoxic drugs	Wastes comprising of outdated, contaminated and discarded medicines.	Incineration/destruction and drugs disposal in secured landfills
Solid Waste	Items contaminated with blood, and body fluids including cotton, dressings, soiled plaster casts, lines, beddings, other material contaminated with blood. Wastes generated from disposable items other than the waste shaprssuch as tubings, catheters, intravenous sets etc.	Incineration, autoclaving/microwaving Disinfection by chemical treatment, autoclaving/microwaving and mutilation/shredding
Liquid Waste	Waste generated from laboratory and washing, cleaning, house-keeping and disinfecting activities	Disinfection by chemical treatment and discharge into drains
Incineration Ash	Ash from incineration of biomedical waste	Disposal in municipal landfill
Chemical Waste	Chemicals used in preparation of biologicals, disinfections, as insecticides.	Chemical treatment and discharge into drains for liquids and secured landfill for solids.

Source: MoEF, 1998

Comparison of Maharashtra with other parts of the country shows that in 1993, Maharashtra contributed the largest share of BMW among all states, which was about 19 TPD or about 13 per cent of that of India. During 1993-99, it grew almost by 60 per cent, which is more than the average increase for the country (52.3%). In 1999, Maharashtra contributed the largest amount of BMW in India at about 31.5 TPD (Table 4.9).

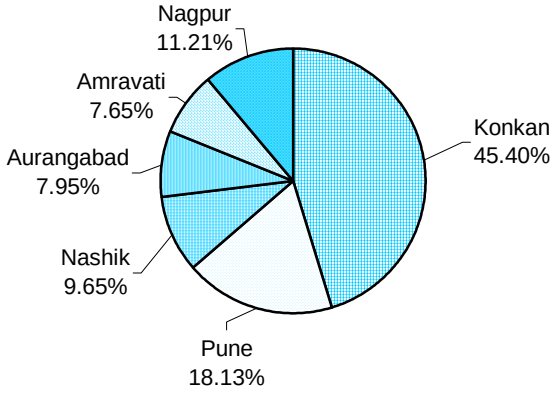
Table 4.9: State-wise estimated Quantity of Infectious Bio-medical Waste in India.

States/Union Territories	Total No: of Beds	Reference Period	% Share of each state in Waste Generation		Estimated quantity of infectious bio-medical waste generation (kg/day)		Increase from 1993 to 1999 (%)
			1993	1999	1993	1999	
Andhra Pradesh	75910	1998	4.5	8.4	6698	18977.5	183.3
Arunachal Pradesh	2476	1992	0.4	0.3	619	619	0.00
Assam	16000	1991	2.1	1.8	3164	4000	26.4
Bihar	44642	1992	4.9	4.9	7273	11160.5	53.5
Goa	4741	1999	0.6	0.5	911	1185.3	30.1
Gujarat	78664	1995	9.9	8.7	14746	19666	33.4
Haryana	11440	1999	1.2	1.3	1757	2860	62.8
Himachal Pradesh	9316	1999	0.7	1.03	963	2329	141.9
Jammu & Kashmir	5515	1999	1.4	0.6	2051 ('89)	1378.8	-32.8
Karnataka	56558	1998	6.4	6.2	9482.25	14139.5	49.1
Kerala	106967	1999	13.0	11.8	19300	26741.8	38.6
Madhya Pradesh	28724	1992	3.0	3.2	4534	7181	58.4
Maharashtra	**126378**	**1999**	**13.2**	**13.9**	**19730**	**31594.5**	**60.1**
Manipur	2532	1999	0.2	0.3	299	633	111.7
Meghalaya	3300	1999	0.3	0.4	467	825	76.7
Mizoram	1777	1998	0.2	0.2	326	444.3	36.3
Nagaland	1987	1999	0.2	0.2	263	496.8	88.9
Orissa	16780	1999	2.4	1.9	3624	4195	15.8
Punjab	26469	1999	2.5	2.9	3668	6617.3	80.4
Rajasthan	48259	1999	3.4	5.3	5115	12064.8	135.9
Sikkim	1400	1999	0.1	0.2	144	350	143.1
TamilNadu	61000	1990	8.2	6.7	12195('86)	15250	25.1
Tripura	2242	1998	0.3	0.3	433	560.5	29.5
Uttar Pradesh	74450	1986	7.9	8.2	11820(86)	18612.5	57.5
West Bengal	69256	1999	9.2	7.6	13692	17314	26.5
Andaman & Nicobar Islands	1119	1999	0.1	0.1	144	279.8	94.3
Chandigarh	2075	1999	0.1	0.2	125	518.8	315.0
Dadra and Nagar Haveli	187	1998	0.01	0.02	18	46.8	159.7
Daman and Diu	312	1999	0.03	0.03	38('92)	78	105.3
Delhi	24025	1997	3.2	2.7	4693	6006.3	28.0
Lakshwadeep	200	1999	0.01	0.02	18	50	177.8
Pondicherry	3579	1999	0.4	0.4	652('92)	894.8	37.2
India	**908280**	**1999**	**100.0**	**100.0**	**149051**	**227070**	**52.3**

Source: Compiled and calculated from CPCB (2001:c) and CBHI (2002)

Figure 4.4 shows division-wise generation of BMW in Maharashtra. The data for 2001 show that Konkan division accounts for 45.40 per cent of the BMW generated in the State while Pune and Nagpur account for 18.13 per cent and 11.21 per cent, respectively. Nashik accounts for 9.65 percent, Amravati for 7.65 percent and Aurangabad for 7.95 percent of BMW. However, as per latest data and information, region-wise (MPCB regions), generation and treatment of BMW is given in Table 4.10.

Figure 4.4: Division -wise Generation of BMW



Source: Calculated from MEDC (2001)

Table 4.10: The Region-wise Generation of Bio Medical Waste of the Maharashtra

Region	Name of the corporation	Estimated BMW generated	Quantity of BMW treated	Quantity of BMW & it's disposal mode
Amravati	Akola	447 Kg/M	154 Kg/M	293 Kg/D disposals on municipal dumping site
	Amravati	368 Kg/M	168 Kg/M	Nil
Aurangabad	Aurangabad	938 Kg/M	880 Kg/M	58 Kg/M
	Nanded	--	--	--
Pune	Pune	1500 Kg/D	1400 Kg/D	--
	Pimpri Chinchwad	545 Kg/D	545 Kg/D	--
	Solapur	677 Kg/D	677 Kg/D	--
Kalyan	Kalyan & Dombivilli	27600 Kg/M	26900 Kg/M	2600 Kg/M
	Bhiwandi	7670 Kg/M	--	--
	Ulhasnagar	12180 Kg/M	--	--
Nashik	Nashik	2200 Kg/D	1700 Kg/D	500 Kg/D
	Malegaon	450 Kg/D	Nil	450 Kg/D
	Jalgaon	400 Kg/D	Nil	400Kg/D - JMC
	Ahmednagar	584 Kg/D	513 Kg/D	71 Kg/D
	Dhule	361.6 Kg/D	361.6Kg/D	Nil
Navi-Mumbai	Navi-Mumbai	235.30 Kg/D	350 Kg/D	--
Thane	Thane	6692 Kg/M	4014 Kg/D	959 Kg/M
	Mira Bhayandar	1822 Kg/M	1265 Kg/M	585 Kg/M
Kolhapur	Kolhapur	5.5 MT/M	5.5 MT/M	Nil
	Sangli, Miraj & Kupwad	10.5 MT/M	10.5 MT/M	Nil
Raigad	--	--	--	--

Source: MPCB, 2005

Management of BMW

Various agencies including MPCB and MCs have taken steps for special handling of medical waste in different parts of the State. MPCB has asked hospitals and clinics to take care of their BMW either themselves or through the Common Biomedical Waste Treatment and Disposal Facility (CBMWTDF). The treatment and disposal sites for BMW in the state of Maharashtra are present in the cities given in Table 4.11.

Table 4.11: BMW Treatment and Disposal Sites

Ahmednagar	Amravati	Aurangabad	Chandrapur	Kalyan
Kolhapur	Miraj	Mumbai	Nagpur	Nasik
Pimpri Chinchwad	Pune	Sangli	Taloja	Thane

Source: MPCB website

The MPCB appointed a committee to assess the BMW treatment facility in the state. The committee concluded that BMW was not segregated properly at the source, because of lack of training and control. Hospitals do not generally send the non-incinerable / autoclavable waste to the CBMWTDF. This waste is directly sold (to be recycled), without any treatment, thus, flouting the BMW rules. Most of the hospitals do not have one fixed point of collection where from the waste can be transported. The hospitals also complained that the BMW is not collected on a regular basis and this is due to inadequate number of vehicles used to collect and transport the waste.

In 2002, MPCB served notices to 62 hospitals, generating 75 per cent of the total medical waste in the state, under the Bio-Medical Waste (Management and Handling-II Amendment) Rules, 2000. These hospitals have to now comply with the requirements of these rules, else, will have to face prosecution (Dutta, 2002:b). The MPCB has also taken proactive measures in facilitating development of about 22 common facilities for management of BMW in different cities of Maharashtra. The MPCB has issued directions under BMW rules to these common facilities for strictly maintaining the compliance of environmental standards. A bank guarantee of Rs.50,000 is required to be submitted by the common BMW management facilities to MPCB as a proof of their intent to comply with the standards and upgrade the system wherever necessary within the time-bound action plan as submitted to the MPCB (MPCB, 2005).

It was observed that some facilities like at Pune and Nagpur had only incineration facility and no proper arrangement for ash disposal. The fact sheets revealed that none of the BMW treatment facilities were properly maintained and the compliance level was unsatisfactory. The report of the committee gave suggestions for proper management of BMW and prepared an action plan for a time frame of 24 months, in which training and awareness programmes are to be conducted (MPCB, 2004:d).

As a result of the BMW rules notification in 1998, the BMC allotted one acre of land near Deonar to handle BMW, which will be inaccessible to rag pickers and guarded from foraging animals. Many of the hospitals have set up their own incinerators and hospitals were advised to have shared treatment facilities. CBMWTDF such as that at G. B. Hospital, Sewree have been also provided. But, there have been several complaints from people living in the vicinity of CBMWTDF, and as a result, the MCGM started dumping the collected BMW in Deonar dumping ground, violating the BMW Rules. Faced with the growing problem of how to dispose of the piles of bio-medical waste, the BMC has short listed seven sites in the city to set up three or four waste disposal

centres. The short-listed sites are- Vaikunthdham Cemetery at Mazgaon, The Hindu Cemetries at E-Moses Road, Cheetah Camp and Marve Road; a recreational ground plot at Anik Village at the Malad Lagoons, Deonar dumping ground and Centenary Hospital at Govandi. The Western and Eastern suburbs will get one centre each, while the city may get two centres. Each centre will cater to between eighty thousands to one-lakh beds (TOI, 2 April 2005).

The PCMC had made mandatory for hospitals with more than 30 beds, to install their own incinerator for disposing BMW. However, due to unavailability and high cost of land, the owners expressed their inability to set up private incinerators. Thus, the PCMC set up an incinerator at Yashwantra Chavan Hospital to dispose BMW from hospitals. Around 500-600 kg of BMW per day is disposed here (PCMC, 2002).

It is reported by the hospitals that the cost to be incurred for disposal and treatment of BMW is too high. A 100-bed hospital generating about 25 kgs per day of waste has to incur a cost of Rs.1,67,000 with additional costs for plastic bags. The BMC requires that human wastes should be disposed off in yellow-coloured plastic bags; pathological wastes in red, blue, or white bags; and general waste in black-coloured plastic bags. This is an improvement over the WHO recommended system of using black bags for general waste and yellow ones for both human and pathological wastes. The yellow and red bags have to be bought from BMC nominated contractors. There initial cost of Rs.3 per bag has now increased to Rs.11.50 per bag, after above rules came into effect, thus increasing the costs for the hospitals tremendously. In 2001, about 214 municipal hospitals and 211 private healthcare institutes out of a total of 1340 institutes in Mumbai have entered into a Memorandum of Understanding with BMC to send their infectious waste to a common treatment and disposal facility. The BMC authorities feel that from the time the billing system has been introduced, hospitals have reduced the quantity of wastes. While the hospitals in Mumbai used to send 17 TPD in August 2001, it is reduced to as low as 1.5 TPD in 2002 which could be a serious concern if this decrease in BMW is due to unhygienic and unauthorised disposal of wastes. In order to avoid the pricing problems faced by BMC, it was decided to charge the hospitals per bed at Rs 5.70/bed/day for a general hospital or clinic and Rs.7.70/bed/day for those having obstetrics and gynaecology services.

Thane Municipal Corporation (TMC) had decided to collaborate with an NGO, Enviro-Vigil for setting up a common BMW facility (TMC: 2004). It is estimated that there are about 2500 hospital beds in Thane (of which 670 are municipal beds) 575 in Kalwa, 25 in Kopri, 30 in Balkum and 10 in Mumbra. There are around 200 private hospitals and clinics in Thane. It is expected that 500 kg of medical waste would be collected every day. The municipal beds are charged a lump sum of Rs.55000 as TMC is providing all the infrastructure facilities like land, water and electricity for common treatment plant (Holla, 2002).

There are several problems which still exist in managing the BMW. Despite the BMW Rules coming into effect, the major hospitals in Nagpur and Wardha were not abiding by them (Sarkar, 2000). It is reported that hospitals and suthorities suffer from many issues such as shortage of trained manpower and field officers who can ensure that the hospitals are fully aware about the management of hospital waste. Further, in cities like Mumbai, land prices are sky-rocketing, and small hospitals cannot afford to have their own treatment plants so a common treatment plant is the only option (Dutta, 2002:c). PSP could be an option as tried in other states, for example, in Hyderabad and Secunderabad, two private companies are lifting 90 per cent of hospital wastes generated from about 20000 beds and all the rules under the Bio-Medical Waste Rules (2000) are being adhered to.

Chapter 5: Forests and Biodiversity

Introduction

Forests are invaluable natural resources and important eco-systems, which benefit mankind in number of ways. The economic benefits include agroforestry, forest related tourism and revenue earned from trade of forest products such as fuel wood, charcoal, weaving materials, agricultural products and industrial products like gums, resins, oils, and timber. Ecological and environmental benefits of forests are in the form of catchment protection, wild life conservation, soil erosion control, regulation of local and global weather through the absorption and creation of rainfall and the exchange of atmospheric gases. However, the economic benefits, in terms of climate control, pollution abatement, and wildlife maintenance, have rarely been calculated. Several factors are responsible for the loss of forest cover across the globe. The permanent removal of forest cover and conversion to a non-forested land use constitutes deforestation. Because of the worldwide loss of forests, thousands of species of birds and animals are threatened with extinction.

Although GoI enunciated several programmes, including formulation of forest policy, as early as in 1952, for sustainable management of forests, over the years, forests in the country have suffered serious depletion. This is due to relentless pressure arising from the ever-increasing demand for fuel-wood, fodder and timber; inadequacy of protection measures; diversion of forestlands to non-forest uses without ensuring compensatory afforestation and essential environmental safeguards; and the tendency to look upon forests as a revenue earning resource. It was imperative to evolve a new strategy for forest conservation and thus, a National Forest Policy (Forest Policy of 1988) was devised with an aim to maintain, on an average, 33 per cent of the country's area under forest cover as against the world average of 26.6 per cent. India's forest cover during the last decade (1990-2000) when compared with that of Asia and the world, indicates that while the average forest cover in Asia and the world is diminishing, it is showing increasing trend in India. On the other hand, India's large and ever-increasing population has resulted in a very low per capita forest cover, which is 0.08 ha and much lower than the world average of 0.64 and Asia's average of 0.1 ha.

According to 'State of Forest Report', 2003, India's forest cover has increased from 675,538 Km^2 in 2001 to 678,333 Km^2 in 2003. The total forest and tree cover is 778,229 Km^2 constituting 23.68 per cent of the country' total geographic area. Of this, dense forest constitutes 390,564 Km^2 (63 percent is in tribal districts) and open forest 287,769 Km^2. Thus, India has lost 26,245 km^2 of dense forests between 2001 and 2003. On the other hand, the open forests- forests with a crown density of only 10 to 40 per cent have increased by 29,000 sq. km (SFR, 2003).

Biodiversity is defined as 'the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part. This includes diversity within species, between species and of ecosystems. Conservation and sustainable use of biodiversity is fundamental to ecological sustainable development. It is prudent to conserve not only those species we already have information about, but also the species we have not yet identified from an economic point of view. Habitat destruction, overexploitation and pollution are the major causes of biodiversity loss in India (UNEP, 2001). India has eight per cent of the world's species and of the 12-biodiversity spots in the world two are in India namely, North-East region and Western Ghats in the State of Maharashtra.

Forests in Maharashtra

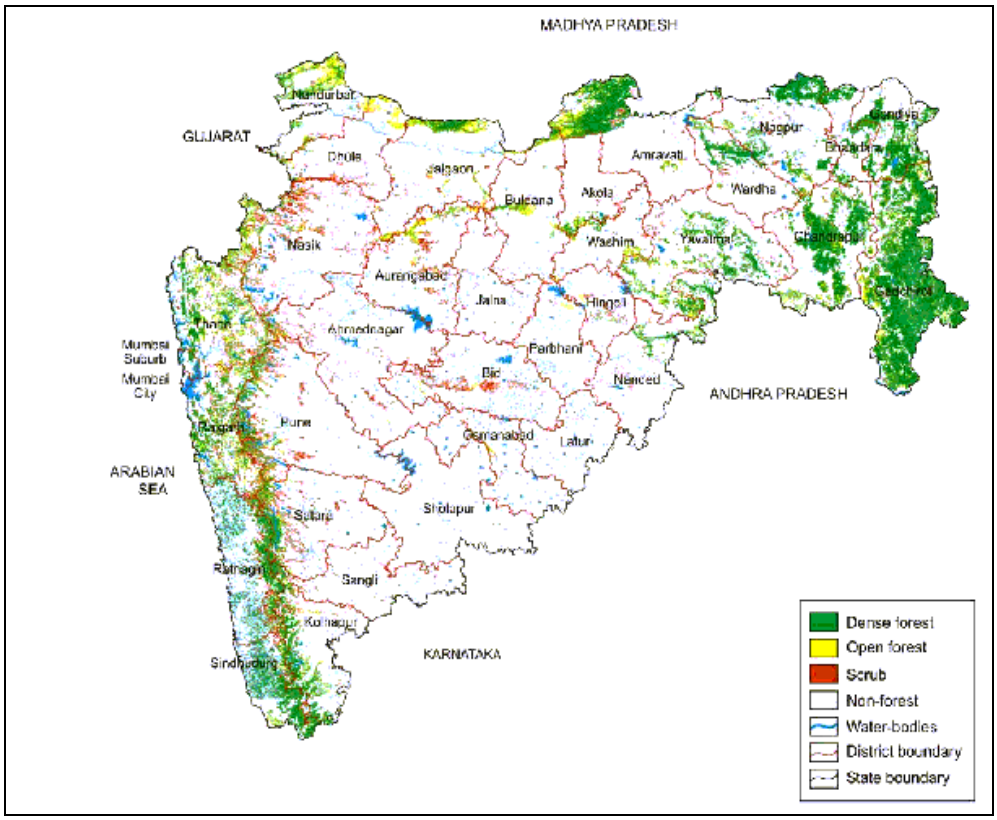
In Maharashtra, at the end of 2003-04, the total area under forests was 61,900 Km^2, which accounted for 20.13 per cent of the State's geographical area, much below the expected standard norm of 33 per cent. Out of this recorded forest area, 47500 Km^2 is forest cover of which 65.1 percent is dense and remaining is open forests. During 2003-2004 about 24,200 ha of forest land and community lands were covered under various afforestation programmes by the Forest Department and FDMC. Thus, the State has made substantial progress in terms of actual forest cover, which was only 15.17 per cent in 1999 and 15.43 per cent in 2001. However, the state's forest cover is still lesser than India's forest cover of 23.7 per cent (FSI, 2000; FSI, 2002; GoM, 2005).

Driving Forces and Pressure

Intensive land use changes and unsustainable use of forest resources have put considerable pressure on forests and biodiversity, expelling flora and fauna from their natural habitats, thereby drastically reducing their natural population. Degradation of the forests due to rapid urbanisation, industrialisation, construction of big dams, use of forestlands for rehabilitation purposes, etc. affect various components of the ecosystem such as water, air and soil. Thus, protection, preservation and development of forests, requires urgent attention. Biodiversity is also affected by a combination of driving forces like urbanisation, industrialisation, agriculture, transport and tourism etc.

The major forest cover of Maharashtra is shown in Figure 5.1.

Figure 5.1: Forest Map of Maharashtra



Source: MoEF (2002)

Types of Forests

The forests in Maharashtra may be classified into five types, each representing a unique eco-system.

Southern Tropical Semi-Evergreen Forests

These forests are found mostly on the upper hill slopes, from 450 meters to 1050 metres above the msl in the Western Ghats. The main species are Terminalia paniculata (Kinjal), Memocylon umbellatum (Anjani), Terminalia chebula (Hirda), Syzigium cumini (Jambul), Olea diocea (Parjamun) and Mangifera indica (Mango), Actinodaphne hookeri (Pisa), etc.

Southern Tropical Moist Deciduous Forests

These consist of two main sub types, namely, *Moist Teak bearing Forests* and *Moist Mixed deciduous Forests*. These are commercially important and valuable forests of the State and are mainly confined to the Project Tiger area in the Melghat region of Amravati district, Chandrapur, Gadhchiroli and Thane districts, consisting of species such as Tectona grandis (Teak); the associates are Terminalia tomentosa (Ain), Delbergia latifolia (Shisham), Adina cardifolia (Haldu), Madhuca indica (Moha), Pterocarpusmarsupium (Bija), Mitragyna parviflora (Kalam), Salmalia malabaricum (Semal) and Dendrocalamus strictus (Bamboo) etc. Teak is present occasionally and the evergreen component of species is larger than in case of teak bearing forests. The main species are Pterocarpus marsupium (Bija), Salmalia malabaricum (Semal), Terminalaia bellarica (Behada), Dalbergia latifolia (Shishum), Syzigium cumini (Jambul), Terminalia tomentosa (Ain), Lagerstremia parviflora (Bendara) etc.

Southern Tropical Dry Deciduous Forests

Forests falling in this group occupy a major part of state. The main species are Tectona grandis (Teak). These forests produce middle and small size timber and consist of the following sub-types, namely, *Dry Teak Bearing Forests* and *Dry Mixed Forests*. Principal species is Tectona grandis (Teak) and the associates are Ougeinia dalbergiaoides (Tiwas), Acacia catechu (Khair), Gmelania arborea (Shivan) and Anogeissus latifolia (Dhawada) etc.

Southern Tropical Thorn Forests

These consist of the forests in low rainfall areas of Marathwada, Vidarbha, Khandesh and Western Maharashtra. Majority of these forests are heavily degraded due to low fertility coupled with low rainfall. The main species found in these forests are Acacia arabica (Babul), Acacia leucophleca (Hiwar), Zizyphus jujuba (Bor), Butea monosperna (Palas), and Belanites rexburghii (Hinganbet), Euphorbia and Cassia scrub etc.

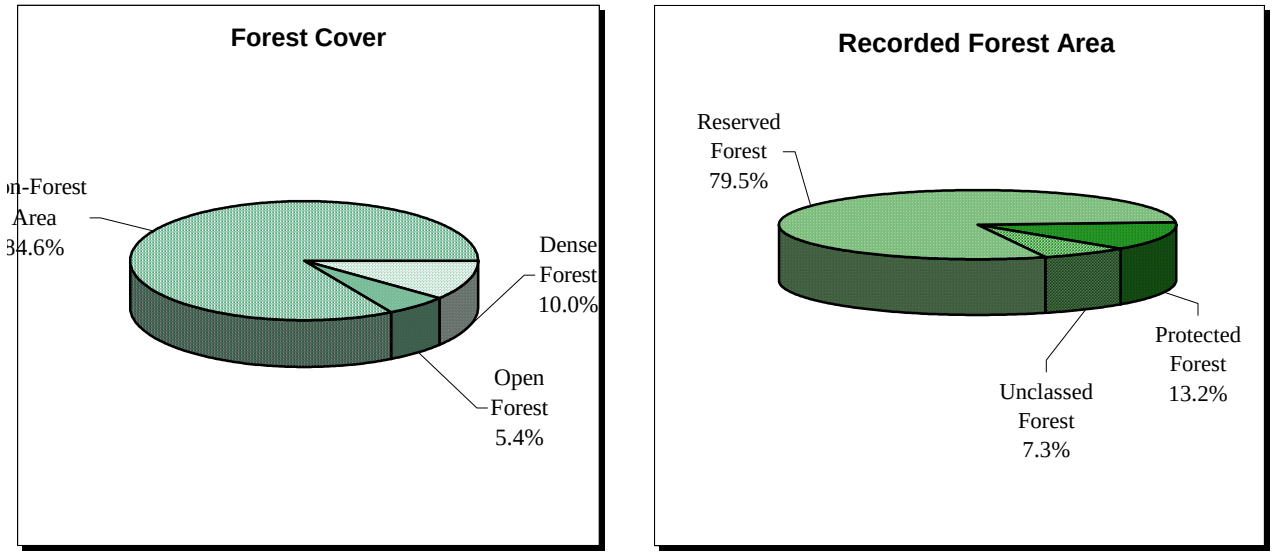
Littoral and Swamp Forests

These forests are found along the creeks and littorals in the Sindhudurg and Thane district. Although their comparative extent in the State is marginal, they are important for protection of seacoast and marine life. The typical mangrove species found in this area are Avicennia spp. and Rhizophora spp. etc.

Table 5.1 and Figure 5.3 show the trends in forest cover in Maharashtra in the last three decades and in the year 1999 and 2001, respectively. Maharashtra's actual forest cover in the 1970s was 40700 km^2, which reduced to 30740 km^2 by 1980-82 and then increased to 46143 km^2 by 1997 and 47482 km^2 by 2001. This trend is visible in the case of both dense as well as open forest area. However, the area under dense forest cover in Maharashtra has increased by 2991 km^2 from 1997 to 1999 and a further 4173 km^2-between 1999 and 2001 (FSI, 2000 and FSI, 2002). This increase is due

to the conversion of open forests, scrub and non-forest areas into dense forests. In both the assessments, Maharashtra showed the greatest increase among all the states (GoM, 2005).

Figure 5.2: Forest Cover and Recorded Forest Cover of Maharashtra



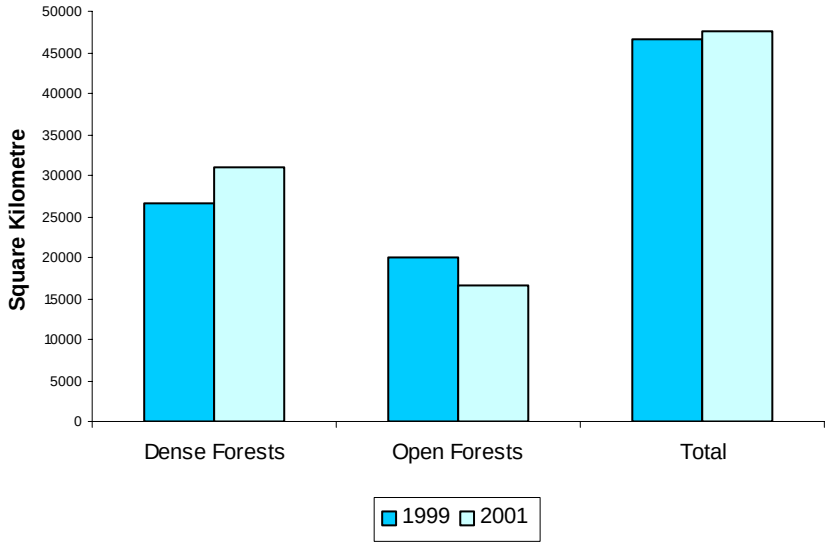
Source: GoM (2005)

Table 5.1: Forest Cover in Maharashtra

Year	Reported Forest Cover (mha)	Actual Forest Cover (mha)	% of Actual Forest to Geographical Area	Dense Forest Cover	Open Forest Cover
1972-75	-	4.07	13.22	2.90	1.15
1980-82	-	3.04	9.86	1.86	1.16
1983-85	6.41	4.74	15.41	2.72	2.00
1985-87	6.41	4.41	14.32	2.62	1.77
1987-89	6.39	4.40	14.30	2.62	1.78
1989-91	6.39	4.39	14.30	2.57	1.80
1991-93	6.38	4.38	14.20	2.57	1.80
1993-95	6.38	4.61	15	2.36	2.24
1997-99	-	4.66	15.17	2.66	1.99
2000-01	-	4.74	15.43	3.08	1.65
2002-03	-	-	20.13	-	-

Source: CSE (1999), FSI (2000), FSI (2002), GoM (2005)

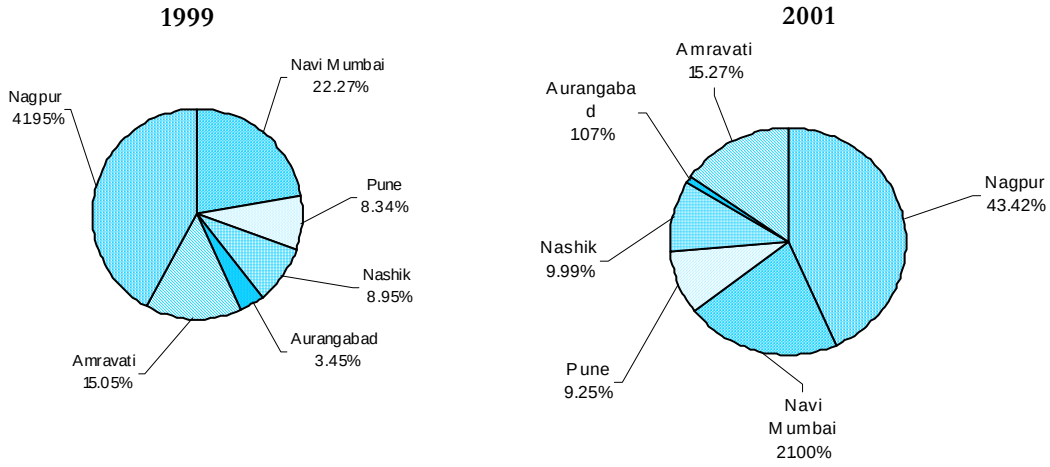
Figure 5.3: Forest Cover in Maharashtra in 1999 and 2001



Source: FSI (1999) and FSI (2001)

Figure 5.4 compares forest cover in various divisions of Maharashtra in 1999 and 2001. Accordingly, in 1999 Nagpur division had the largest share of forest cover (41.95 per cent) followed by Navi Mumbai at 22.27 per cent, while Aurangabad region has the least forest cover (3.45 per cent). In 2001, while Nagpur, Pune, Nashik and Amravati showed some increase in their forest cover, Aurangabad and Navi Mumbai showed a decline in forest cover. Gadchiroli and Sindhudurg districts have the highest forest covers in proportion to their geographical area at 69.78 per cent and 45.67 per cent, respectively. Among the districts, Solapur and Mumbai city districts have the lowest cover at 0.36 per cent and 0.64 per cent, respectively (Table 5.1).

Figure 5.4: Forest Cover in Major Regions of Maharashtra



Source: Calculated from FSI (2001)

Table 5.2: District wise Forest Cover in Maharashtra (km²)

District	Geographical Area	2001 Assessment			Per cent	Scrub
		Dense	Open	Total		
Ahmednagar[T]	17048	193	119	312	1.83	379
Akola	5,390	204	157	361	1.83	39
Amravati[T]	12,210	2,193	944	3,137	25.69	136
Aurangabad	10,107	148	341	489	4.84	371
Beed	10,693	206	55	261	2.44	389
Bhandara	3,588	686	241	927	25.84	29
Buldana	9,661	233	386	619	6.41	77
Chandrapur[T]	11,443	2,755	1,192	3,947	34.49	84
Dharashiv	7,569	60	32	92	1.22	61
Dhule[T]	7,189	96	397	493	6.86	151
Gadchiroli[T]	14,412	7,852	2204	10056	69.78	54
Gondiya	5,733	1636	538	2174	37.92	43
Hingoli	4,686	48	69	117	2.5	74
Jalgaon[T]	11,765	451	791	1,242	10.56	106
Jalna	7,718	85	17	102	1.32	60
Kolhapur[H]	7,685	1,145	669	1,814	23.6	131
Latur	7,157	66	0	66	0.92	14
Mumbai City	157	0	1	1	0.64	0
Mumbai Suburb	446	53	29	82	18.39	3
Nagpur	9,892	1,412	550	1,962	19.83	93
Nanded[T]	10,528	495	358	853	8.1	61
Nandurbar	5,961	537	901	1438	24.12	50
Nashik[H,T]	15,530	422	676	1098	7.07	1,078
Parbhani	6,355	107	27	134	2.11	10
Pune[H,T]	15,643	649	665	1,314	8.4	739
Raigad[H]	7,152	1214	1,074	2,288	31.99	375
Ratnagiri[H]	8,208	1,905	306	2,211	26.94	279
Sangli	8,572	102	48	150	1.75	63
Satara[H]	10,480	581	328	909	8.67	513
Sindhudurg[H]	5,207	1970	408	2378	45.67	109
Solapur	14,895	37	16	53	0.36	16
Thane[T]	9,558	1,253	1,418	2,671	27.95	333
Wardha	6,309	592	254	846	13.41	57
Washim	5,184	128	207	335	6.46	38
Yavatmal[T]	13,582	1,380	1,170	2,550	18.77	122
Total	**307,713**	**30,894**	**16,588**	**47,482**	**15.43**	**6,137**

Source: FSI (2002); H: Hilly and T: Tribal

The major gains in forest cover have been observed in Kolhapur, Nagpur, Wardha, Nanded, Yavatmal, Kolaba and Satara districts. The gain can be ascribed mainly due to large-scale plantation of *Tectona grandis* and mixed plantations of *Dalbergia sisso, Eucalyptus, Azadirachta indica, Prosopis juliflora* and Bamboo. The re-growth of teak has also resulted in increased forest cover.

Table 5.3 gives the per cent of forests in the hilly and tribal districts of the State. It is seen that none of the hilly districts (Raigad, Kolhapur, Nashik, Pune, Satara, Sindhudurg and Ratnagiri) have a forest cover of more than the required 66 per cent. Among these, Sindhudurg has the largest area (45.67 per cent) under forest cover followed by Raigad at 31.99 per cent (FSI, 2002).

Table 5.3: Forest Cover in Hill Districts of Maharashtra

Districts	Per cent of Area under forest cover
Kolhapur	23.60
Nashik	7.07
Pune	8.40
Ratnagiri	26.94
Satara	8.67
Sindhudurg	45.67
Raigad	31.99

Source: FSI (2002)

Mangroves are specialised coastal plants that have tremendous ecological and socio-economic significance, but these are being threatened by encroachers and developers. The area under mangroves in Maharashtra was 200 km^2 in 1972-75, which reduced to 108 km^2 in 1997 but increased to 118 km^2 in 2001. According to MMRDA, the mangrove areas in Mumbai have shown significant increase since 1991. However, this claim is under some contention, as the maximum numbers of reclamations have taken place between 1991 and 1997 (Singh, 2003). It is believed that about 70 per cent of Mumbai's mangroves have been destroyed due to various development activities. Table 5.4 shows that Thane has the largest share of mangrove area, which is followed by Raigad. There are excellent mangrove areas in Navi Mumbai along the coastline particularly near Palm Beach Marg, Nerul, Koparkhairne and these face threat of removal due to disposal of waste and also abuse of land for unauthorised uses by fishermen and builders. Mangrove area in Navi Mumai is about 50,000 sq.m including mud flats (NMMC, 2004).

Table 5.4: Mangroves in Maharashtra as of 2001(km^2)

Districts with mangroves	Area under mangroves
Mumbai City	1
Mumbai Suburbs	26
Raigad	34
Ratnagiri	9
Sindhudurg	1
Thane	47
Total Area	118

Source: FSI (2002)

Forests in Villages

About 36 per cent of the villages in Maharashtra have forests recorded as land use, which are inhabited by 19.04 million people. Among the villages, 52 per cent have a forest area less than 100 ha, 37 per cent between 100-500 ha and 11 per cent more than 500 ha. The forest cover in tribal districts of Maharashtra is 20.82 percent of the total geographic area under the tribal districts (138,272 km^2) out of which 18,656 km^2 is dense and 10,126 km^2 is open forest (MoEF, 2001).

Forest Produce

Forests, both in terms of minor and major products, have tremendous potential for generating revenues and contribute to the GDP of the country. Timber, poles, firewood is generally referred to as the major forest produce. The value of timber and firewood produced has increased considerably in the last two decades as given in Table 5.5. In 2000-2001, under forest harvesting operations, 190 Forest Labour Cooperative Societies harvested over 15282 km^2 of forest area while the remaining 7906 km^2 was covered by the forest department through engaging labourers directly. The circle wise yield of Major Forest Produce exploited through all the agencies combined during the year 2001-2002 is given in Table 5.6.

Table 5.5: Value of Timber and Firewood produced in Maharashtra (Rs. Crore)

Years	Value of Timber	Value of Firewood
1960-61	5.0	1.2
1970-71	8.6	1.5
1980-81	43.9	9.8
1990-91	39.0	2.8
1998-99	106.0	15.0

Source: MEDC (2000)

Table 5.6: Circle wise yield of Major Forest Produce

Circle	Timber		Firewood	
	Quantity in 000' Cu.M.	Value in Rs. Lakh	Quantity in 000' Cu.M.	Value in Rs. Lakh
Amravati	0.001	0.05	0	0
Aurangabad	0.833	55.23	0.180	1.86
Chandrapur (N)	3.421	199.23	7.644	33.85
Chandrapur (S)	8.429	1040.61	9.289	51.84
Dhule	0.650	41.31	1.196	3.52
Kolhapur	0.643	21.49	1.388	2.35
Nagpur	18.150	1354.19	71.238	306.97
Nashik	1.031	134.26	0.933	2.39
Pune	0.114	2.18	0.311	0.62
Thane	4.772	337.05	13.722	49.81
Yavatmal	6.980	497.33	1.448	2.49
Total	**45.024**	**3682.93**	**107.349**	**455.7**

Source: MFD (2005)

Other forest produces such as bamboo, grass, gum etc., commonly known as Minor Forest Produce or Non-Timber Forest Produce (NTFPs), are also harvested through various agencies on contractual basis. However, the collection and sale of tendu and apta leaves, also NTFP's, are regulated through Maharashtra Forest Produce (Regulation of Trade) Act 1969 and rules made there under. The output of some of the important Minor Forest Produce collected is given in table 5.7.

Table 5.7: Output of Some Important Minor Forest Products

Items	Unit	Quantity		Value Rs. in Lakh	
		2000-01	2001-02	2000-01	2001-02
Bamboo	M.T.	187619	197294	1702	1668
Tendu leaves	Std. bag	828754	810132	4662	4161
Grass	M.T	9977	16784	55	57
Hirda	Qntl.	24144	21164	643	10
Gum	Qntl.	13450	2661	1661	16
Moha flower	Qntl.	11986	64934	0.60	46
Moha fruit & Seed	Qntl.	1230	2650	0.62	2
Lac	Qntl.	3540	1030	0.47	1

Source: MFD (2005)

Biodiversity in Maharashtra

Maharashtra houses a large number of animal species including the tiger, crocodile, bison, neelgai, wild deer, sambar and rare migratory birds. The State is a home for 27, 22 and 42 per cent of mammals, reptiles and birds respectively, found in India (GoM, 2003). The State has variety of flora and fauna consisting of about 3500 flowering plants, 85 mammals and 460 bird species. There are varying physiography, geological features and forests ranging from the tropical wet semi evergreen to tropical dry deciduous forests and grasslands. There are a variety of wetlands extending over 3007 km^2, of which 216.75 km^2 are natural wetlands in the State. Seven of the 25 bio-geographic provinces in India, identified by the Wildlife Institute, exist in Maharashtra.

The hotspot of biodiversity in Maharashtra is to be found in the Western Ghat region, which is considered as one of the most important biogeographic zones of India, as it is one of the richest centres of endemism. Due to the varied topography and micro-climatic regimes, some areas within the region are considered to be active zones of speciation. About 1500 endemic species of dicotyledonous plants are reported from the Western Ghats. Biological diversity stems from a variety of habitats, which mainly include virgin or less disturbed forests, scrubs woodland, thickets and grasslands. All these are `dynamic' habitats and evolve from each other serially, depending upon the extent of anthropogenic pressure. The `static' habitats include lateritic outcrops, rocky boulders, scarps, free faces, waterfalls, streams and riverbeds, steep soil-less slopes etc. Most of these are inaccessible and/or least exploited by human beings. Of these, three groups of habitats, actually existing forests, cover not more than 18 per cent of the total region, with a highly unequal local and zonal distribution and almost all these are highly disturbed (Ghate, 1993).

Ecologically Important Areas

The Institute for Ocean Management has identified Ratnagiri and Malvan as ecologically important areas in the state. The outstanding feature of Ratnagiri district is its highly uneven nature and very narrow reverie plains that fringe the coastline. The predominant soils in the district are laterite soils. Ranpur jetty and Bhagwati Bandar are its important ports. Patchy reefs are present near Ratnagiri.

From the satellite imagery, the corals are found to be in inter tidal areas and occasionally at sub tidal depths. However, mangroves, coral reefs and sea grasses are absent within 10 km range. Saltpans are absent, no coral mining has been found, no erosion or accretion has been reported and aquaculture is not practiced within 10 km range. The ecological importance of this area is the growth of *Ipomea biloba* on the sand dunes near the shore. *Cyanodon dactylon***,** a graminae member was also found growing luxuriously along with Ipomea biloba. *Casuarina equisitifolia* plantation is also seen along the White Sea beach. Plantation and re-plantation of Casuarina equisitifolia is one of noticeable coastal protection measure taken here. The important wetland classes in Ratnagiri and Malvan are represented in Table 5.8.

Table 5.8: Wetland Classes and its Areal Extent of Ratnagiri and Malvan

Wetland classes	Area in Km²	
	Ratnagiri	Malvan
Mangroves	0.36	0.04
Mud Flats	5.6	1.54
Sandy areas	5.9	1.13
Rocky Coasts	0.27	-
Salt Marshes	0.87	0.58
Coral reefs	-	0.4
Other Vegetation	0.64	-

Source: IOM (2005)

Malvan is in Sindhudurg district, a part of Konkan coast along the West coast of India. Its coastal features rocky, dissected mainland with rias and lava promontories, occasional presence of overhanging cliffs, projecting headlands, stacks and erosion platforms, rocky shoals, several submerged reefs and boulders in a ria type coast particularly towards south. To the north of Malvan, the most striking feature is the 'littoral concrete' or 'beach rock' which occurs as a rocky beach either directly attached to the mainland or separated from the latter by a zone of sandy beach or muddy and marshy area. It has often afforded protection against the force of waves and helped the formation of sandy beach or muddy swamps between the rocky beach and the main land. Coastal erosion of narrow dunes is evident at many places along the coastal from Dahanu (Thane district) to Vengurla (Sindhudurg district). Due to erosion the coastal areas of Vengurla get flooded.

Matheran Eco-sensitive Zone

Hill stations such as Matheran, Panchgani and Mahabaleshwar are the only three sites in India, which have been declared as eco-sensitive zones by the MoEF. Matheran and its surroundings declared as the Eco-Sensitive Zone (ESZ) cover an area of about 498 sq.km including the hill range from Matheran in south to Malangad in the north and the surrounding plain land at Neral, Vangani, Badlapur, Ambernath, Panvel, Khalapur and Karjat. On February 4, 2003, the MoEF has issued the final notification covering 215 sq.km (against 498 sq.km.) of Forest Zone (F Zone) as shown on the sanctioned Regional Plan for Mumbai Metropolitan Region, 1996-2011. The ESZ now covers only the entire hill range from Matheran to Malangad, which includes the Prabhal Fort, Peb Fort and Chanderi Fort and area of the Matheran Hill Station Municipal Council. A 'Buffer Zone' of 200 mts. is delineated along the F Zone, except where the F zone is co-terminus with the Urbanisable Zone I (U-1 Zone), Urbanisable Zone 2 (U-2 Zone) and Industrial Zone (I-Zone). A Monitoring

Committee constituted by the MoEF shall oversee the development of the ESZ. Within the ESZ, the development activities shall be permitted as per the State and Local laws (MMRDA, 2005).

Sanctuaries and Parks

About five per cent of Maharashtra's geographic area is protected area. The state government is making efforts to set up many wildlife parks and sanctuaries to protect the wildlife. Currently the state has 5 national parks (SGNP in Mumbai; Gugamal, Melghat in Amravati; Pench in Nagpur; Navegaon in Gondia and Tadoba in Chandrapur). State also has three tiger reserves namely, Melghat, Tadoba and Pench and a wetland of national importance, called Ujni, in Solapur. There are 35 wildlife sanctuaries in the State, namely, 4 in Konkan - Karnala, Phansad, Malvan and Tansa; 4 in Marathawada – Gautala Autramghat, Jayakwadi, Yedshi Ramling and Naygaon Mayur; 2 in Khandesh – Anner Dam and Yawal; 10 in Western Maharashtra – Bhimashankar, Nandur Madhyameshwar, Chandoli, Kalsubai Harishchandragad, Supe, Koyna, Sagareswar, Radhanagri, Nanaj and Rehekuri; 15 in Vidarbha – Katepurna, Painganga, Dnyanganga, Chaprala, Andhari, Tipeswar, Bor, Bhamragarh, Nagzira, Melghat, Wan, Narnala, Amba barva, Chikaldhara and Lonar (MFD, 2005).

Some of the existing wildlife sanctuaries and national parks in the State have been shown in Figure 1.11 and brief details of others are mentioned as follows.

Bhamragarh Wildlife Sanctuary and *Chaprala Wildlife Sanctuary* are located near Chandrapur and are home to a variety of wild animals like the barking deer, blue bull, peacock and flying squirrel among other animals. They also house endangered species such as the leopard, jungle fowl, wild boar and sloth bear. There are 131 species of avi-fauna recorded in this protected area of which as many as three bird species are of endangered status and two species of endangered reptiles -the Indian python and common Indian monitor. Consisting mainly of moist deciduous mix forests, this region is inhabited mainly by the Gond-Madia tribes who, even today, lead a primitive way of life and mainly depend on the forest for their day-to-day needs such as wood, timber, grass, etc.

Bhor Wildlife Sanctuary is located near Hingi in Wardha and it is a home to various wild animals species such as the tiger, panther, bison, blue bull, chital, sambar, peacock, barking deer, chinkara, monkey, wild boar, bear, and wild dog.

Chikhaldara Wildlife Sanctuary is the sole hill resort in the Vidarbha region at an altitude of 1118 m and has the added dimension of being the only coffee-growing area in Maharashtra. It abounds in wildlife, namely, panthers, sloth bears, sambar, wild boar, and even the rarely seen wild dogs. The famous Melghat Tiger Project is also nearby.

Dajipur Bison Sanctuary is situated on the border of Kolhapur and Sindhudurg districts. Surrounded by rugged mountains and dense forests, this secluded little place is completely cut-off from human habitat and is a home to the bison, wild deer, chital, gawa and many more spectacular wild animals and birds.

Nagzira Wildlife Sanctuary is located close to Gondia and has about 34 species of mammals, 166 species of birds, 36 species of reptiles, four species of amphibians and a number of fish species. The invertebrate fauna includes, besides a number of insects and ant species, several species of butterflies and wild animals such as the tiger, panther, bison, sambar, neelgai, chital, wild boar, sloth bear and wild dog.

Tipeshwar Sanctuary is about 70 kms from Yavatmal and houses animals such as the black buck, blue bull, chital, sambar, peacock, hare, snake, monkey, wild boar, bear, wild cat, wolf and jackal.

Navegaon National Park is a popular forest resort in the Vidarbha region having a picturesque lake amidst lush green hills at Navegaon. Dr Salim Ali Bird Sanctuary existing here is a home to almost 60 per cent of the bird species found in entire Maharashtra. Every winter, flocks of beautiful migratory birds visit the lake and the forest houses leopards, sloth bears, gaurs, sambars, chitals and langoors.

Pench National Park is located close to Nagpur consisting of southern topical dry deciduous forests and is a home to tigers, panthers, gaurs, sambars, chitals, barking deer, blue bulls, langoors, wild boars, bears, and wild dogs.

Tadoba National Park is a large jungle park located near Chandrapur with mixed teak forests around a tranquil lake. The Tadoba Andhari Tiger Reserve is home to a variety of wild animals such as the tiger, leopard, leopard cat, Indian wild dog, sloth bear, Hyena, wild boar, spotted deer, barking deer, blue bull, four-horned antelope, Indian pangolin, neelgai, sambar chital and porcupine.

The Convention on International Trade in Endangered Species of wild life, fauna and flora (CITES) agreement stresses on the need to prevent illegal trade of endangered species, to prevent their extinction. In Maharashtra, the black buck is regarded as one such species and efforts are required to protect it. The Rajiv Gandhi Zoo and wild animal research centre located at Katraj in Pune, is built with an aim of improving the living conditions of all animals and also to develop a wildlife research centre. Most of these animals are kept in their natural habitats. A snake park is also built at the same place. A hospital is under construction for the treatment of these animals. The development of this zoological park is an asset for the city as it can increase tourism (PMC, 2004).

Impacts of Anthropogenic Activities

Anthropogenic activities result in different kinds of damages to forests and biodiversity. Some of the State specific problems are mentioned as follows.

Problems of Encroachment

Encroachment of national parks for commercial and poaching activities is a major problem, which needs adequate attention. Timber factories are not effectively regulated and contrary to the Supreme Court's orders carry on their activities resulting in large scale felling of trees. Some of the national parks that have been affected adversely due to increased economic activities are given as follows (Sehgal, 2002).

Bhimshankar Sanctuary: This sanctuary in the Western Ghats (Pune District) is well known for the giant squirrel it houses. However, tourism projects, construction of roads through the forests and development projects designed to cater to the pilgrims' needs are bound to harm the existing habitats.

Sanjay Gandhi National Park, Mumbai: Encroachments by slumlords of this water catchment forest is threatening the water security of Mumbai. Despite the Honourable Courts' order to rehabilitate the slum inhabitants, who have strong political connections, not much action has been taken. Other encroachers are tourists, temple visitors, politically connected individuals as well as illegal liquor distilleries, which use trees as fuel wood.

Gautala Autaramghat Wildlife Sanctuary (Aurangabad): The Maharashtra Government denotified this sanctuary due to commercial interests, which is home to the sloth bear, barking deer, wild boar,

nilgai and leopard. However, a local organisation Nisraga Mitra Mandal intervened and stay-order was obtained.

Kalsubai-Harishchandragadh Sanctuary: This sanctuary was denotified in order to construct the Ghatkar Pump Storage Project and unless somebody challenges this decision in court it will continue to remain so.

Melghat Tiger Reserve: The Chikaldhara Pump Storage Project, which is being set up in this prime tiger reserve will drown large areas of the forests and disturb the tiger reserve substantially. Further, the government is planning to denotify 500 km^2 of the forest for construction and commercial activities, which will adversely affect the flow of Spine, Dolnar and Tapi rivers. While the first two rivers will become less reliable, the ability of the Tapi to supply water to downstream communities is likely to be affected.

Tadoba Tiger Reserve: A large tracts of these forests are under threat of supply of coal to the Nippon Denro Ispat's thermal power project, which threatens the Clonal Teak Seed Orchard set up in 1969 containing a variety of species of teak trees as well as the Lohara, Baranj and Bandar blocks of forests. Further, this mining area is very close to the Tadoba-Andheri Reserve, which will harm the tiger habitats, and roads will be cutting across the forest preserves.

Tiger Population

It is reported that Maharashtra's tiger population has increased from 238 to 303 in the last four years (Indian Express 4th June, 2005). However, earlier figures indicate that the State's Tiger population was down to 238 in 2002 from 257 in 1997. Only 155 of the 238 tigers are estimated to be within the Protected Areas (PA) network. Conservationists stress that more than mere figures; it is the steady downward trend in the number of tigers over the last decade that is worrying. Large continuous forest patches are found along the Satpuras in North Eastern Maharashtra, in Chandrapur and Gadchiroli districts and along the Western Ghats. These are the areas where tigers still remain, though populations are getting increasingly fragmented and unviable. The crucial reason for this is believed to be the contradiction between wild life protection and revenue earning activities of the Forest Department. Other animals such as rhinoceros, elephant, lion and brown antlered deer are not found in the State since 1993 though they were found earlier (CSE, 1999; Indiajungles, 2003).

Other Effects

The Salim Ali Lake in Aurangabad is ecologically a very important lake and is visited by about 25 to 30 species of migratory birds, like the *European-Pintale, Lodkha-Chakrawak, Siberian-Vision, Black Wing Stilt, Painted Stork, Spoonbill, Brahmin Kayta etc.* However, due to the dumping of domestic waste and sewage the ecology of the lake is under threat (AuMC, 2004). In Ichalkaranji, the area around the Panchganga and Kala odha is dominated by aquatic birds like pond heron, water hens, egrets, King fisher etc (INP, 2004). The Jain Irrigation System Ltd, which is a research and development group, has constructed a small dam in the forestland plot in Jalgaon that shows good bird life. Migratory birds like the Black Winged Stilt, Shovellers and Spotbilled Ducks were spotted (JMC, 1999). The Karnala bird sanctuary, which is about 11-km southwest of Panvel town, has a rich habitat of valued fauna, largely birds. Until recently, this bird sanctuary had the status of wildlife sanctuary, which is brought down to the status of the mere forest by the government authorities. The ecology of this entire area is on the verge of deterioration, owing to rapid urbanisation in the surroundings and

other development processes. The bird-listing programme conducted in Karnala in year 1998 by Thane wildlife division with help of local NGOs reveals that there are over 128 bird species, including a few local migratory birds (PNP, 2003).

Stakeholders' Response

Forests have an important role in the economy of Maharashtra with its large tribal population. Rising concerns about degradation of forests and biodiversity have made the GoM to consider these sectors on a priority basis and budgetary allocations for the same are being revised. With about 70000 km^2 of wastelands, which includes, community wasteland, private wasteland and degraded forests, the State has ample scope for further expanding its plantation activities. Many activities have been initiated by State government departments and authorities, which focus on conservation and protection of forests and biodiversity in the State. Plantations by the government and the Western Ghat Development Plan were initiated in the Fifth Plan.

Joint Forest Management

The Joint Forest Management (JFM) is the scheme of GoI in which degraded forest areas and block plantations raised under social forestry are to be taken up. Net proceeds from the final harvest are shared between the government and the members of the JFM committee in a ratio of 1:1. The income received from the block plantation schemes of the social forestry is distributed between the Village Panchayat and the government in the ratio of 9:1. Madhya Pradesh, West Bengal and Andhra Pradesh have brought the maximum area under the JFM programmes. The MoEF has also given certain guidelines for JFMs like providing legal status to JFMs, extension of their activities, involving women on a larger scale and formation of Forest Protection Committees (FPCs), etc.

In Maharashtra, the JFM process was initiated in 1992 and currently it covers 6,86,688 ha managed by 2153 forests protection committees. As observed from the Table 5.10 Maharashtra's position is moderate among Indian States both in terms of number of JFM committees and area under JFMs. Only about 1.5 per cent of Maharashtra's forest cover comes under the purview of any JFM activities. Given small share of JFM activities in Maharashtra, there is ample scope for expanding their activities and ensuring more efficient management of the forest resources. Through JFMs forests can be more efficiently and sustainably managed and can contribute more positively to the development of the State.

Under the JFM, on an average, Rs 9.73 lakhs was spent on each village in Maharashtra and the total expenditure on the programme during the period from 1996-97 to 2000-01 was Rs.30.52 crores. Plantations have been raised under this programme on 26,437 hectares of degraded forests. After termination of the Maharashtra Project, the JFM programme was continued with funds provided by the State government, and since 2001-02 it is supported under the centrally sponsored National Afforestation Programme for the Forest Development Agencies (FDAs). The progress of coverage of villages under JFM is given in Table 5.11 and the details of JFM villages in Maharashtra are given in Table 5.12. There are over 15,000 villages located in and adjacent to forests, which is proposed to be covered under JFM within the next two years.

Table 5.10: Progress of Joint Forest Management

State	No. of JFM Committees	Area Under JFM (ha)
Andhra Pradesh	7606	1679084
Arunachal Pradesh	13	5810
Assam	245	6970
Bihar	296	504602
Gujarat	1237	138015
Himachal Pradesh	914	111247
Haryana	471	65852
Jammu & Kashmir	1895	79546
Karnataka	2620	185000
Kerala	32	4995
Madhya Pradesh	9203	4125837
Maharashtra	**2153**	**686688**
Mizoram	129	12740
Nagaland	55	150000
Orissa	12317	783467
Punjab	188	97193
Rajasthan	3042	309336
Sikkim	158	600
Tamil Nadu	799	299389
West Bengal	3545	488095
Chattisgarh	6412	3391305
Goa	26	13000
Jharkhand	1379	430463
Manipur	58	10500
Tripura	160	23477
Uttar Pradesh	502	45025
Uttaranchal	7435	606608
Total	**62890**	**14254844**

Source: MoEF (2001)

Table 5.11: Progress of Villages Covered Under JFM in the Country

Number of villages covered	5322
Total number of JFM members (families)	9,36,284
Forest area protected by FPCs	14,33,640 ha.
Funds with the FPCs	Rs. 27 lakhs

Source: MFD (2005)

Usufruct sharing under JFM

The Government of Maharashtra passed a resolution on 25th April, 2003, which allows usufruct sharing by the JFMCs from dense forests also, and it stipulates that the FPC members will be entitled to all NTFPs (except '*tendu*' and '*apta*' leaves and cashew nuts). The other usufructs will first be distributed to the JFMC members at concessional rates to meet their genuine household demands for these forest produce. The balance forest produces will be disposed of by public auction, and up to 20 per cent of the net revenue thus obtained from dense forests and 50 per cent of the output from the degraded forests will be earmarked for the concerned FPCs. Fifty percent of the above earmarked income will be given to the FPC members in cash, while the balance will be utilized for implementing the micro-plans of the concerned villages.

Table 5.12: Data of JFM Villages in Maharashtra

Region	Total No. of fringe villages	No. of JFMCs created	Area of forests assigned (ha)	No. of families involved	Populn. of JFM villages
Aurangabad	1402	208	16754	31794	93818
Thane	2409	1035	249351	125729	634651
Nagpur	1567	534	170088	80305	399112
Pune	1462	413	27041	151032	796780
N. Chandrapur	985	293	65133	11173	48252
S. Chandrapur	985	287	108499	17348	52044
Yavatmal	1130	224	74893	14650	63087
Dhule	977	774	266865	119051	671890
Kolhapur	1881	477	105890	146176	739509
Nashik	2008	846	299833	198843	1160391
Amravati.	710	231	49293	40183	153507
Total	**15,516**	**5322**	**14,33,640**	**9,36,284**	**48,13,041**

Source: MFD (2005)

Forest Development Agencies

During the Ninth Five Year Plan, the Government of India launched the Samanvit Gram Vanikaran Samriddhi Yojna (SGVSY)- an umbrella scheme integrating all ongoing Centrally Sponsored Schemes (CSSs) related to afforestation, through a new autonomous institution called the Forest Development Agency (FDA), with JFM as the mainstay. The FDA is thus, a federation of all JFM Committees/Village Forest Committees in the Division, with the General and Executive Bodies headed by the Conservator of Forests as Chairperson and Dy. Conservator of Forests as Member Secretary/Chief Executive Officer. There is a State Level Co-ordination Committee headed by the Chief Secretary for monitoring implementation of this scheme. Based on the initial experience of implementing the SGVSY, the Government of India during the Tenth Fiver Year Plan (2002-2007) formulated the National Afforestation Programme merging all the CSSs related to afforestation. The National Afforestation and Eco-Development Board (NAEB) under the Ministry of Environment and Forests operates the scheme.

Success of JFM in the State

Some examples of success of JFMs in the State could be narrated as follows.

Avhati Village and Public Participation

Avhati is a small village having an area of 780 ha, of which 322 ha are forests in the Satana Range of the East Nashik Division, Maharashtra. It has a cattle population of 773, including 473 sheep and goats, and has an average rainfall of 500 mm. With hardly any area under irrigation, the villagers grew mainly the kharif crops of bajra and jawar The surrounding forests of this drought prone village, which once bore good teak trees, had vanished due to illicit cutting and heavy uncontrolled grazing.

In 1990s, joint efforts of the villagers and some government departments such as Forest and Agriculture Departments at Satana yielded excellent results in the form of efficient management of the forests. This was further boosted through the regulations of the GoM directing the Forest Department to involve the people in protection, conservation and management of forests. Following are some of the steps, which have put JFM on sustainable footing in the village.

'No grazing and no felling:' In a meeting, which, was attended by most of the households, the villagers adopted this resolution and declared their firm intention to implement JFM in Avhati.

Organising JFMCs: After adopting the above resolution, the villagers formed the Forest Protection Committee (FPC) with one member each from the 182 families. Of these, 11 persons were selected to form the Executive Committee to look after the management . The FPC members take turns to move in the forests and to ensure rigid protection from grazing, fires, encroachment and illicit cutting.

Tackling the problem of grazing and firewood: The villagers used to graze their cattle freely in the forests, and were also cutting away firewood by even digging out the roots. The FPC decided that initially about 100 ha, which is one-third of the total forest area will be set aside for grazing for two years and the rest of the area would be closed. This policy was enforced strictly and anyone who violated it was fined irrespective of his social status. The villagers imposed self-discipline and practised it, and even visited the neighbouring villages and urged them not to fell trees or to send their cattle into the forests of Avhati. This also evoked a positive response, and the result was that grazing and illicit felling stopped completely, and the coppices of teak, *sitaphal* (custard apple) and other species started growing vigorously. The quality and quantity of grass also improved. Presently, no grazing is permitted in the entire forests and the people are only allowed to cut and carry grass for their cattle. The poor and the landless were allowed to remove lantana branches from the forest, while the others met their firewood requirement from crop residues and by cutting branches of babul and others trees growing on their private lands.

Preparation of a Work Plan: After carrying out a detailed survey of their needs, the villagers finalised their priorities and a work plan was prepared, which was approved by the committee headed by the Conservator of Forests, Nashik Circle and Avhati was brought under the JFM programme of the World Bank aided Maharashtra Forestry Project (MFP).

Developmental Activities

The Forest Department carried out various development works at Avhati under JFM, some of them with the help of the Agriculture Department, as listed below.

Plantations: Prior to 1992-93, about 100 ha of plantations (43,200 saplings) were raised at Avhati, and during 1992-93 to 1998-99, 175 ha (88,555 saplings) was planted up. It is interesting to note that by and large, it is the community which decides about what species is to be planted, and where. In

addition to the above plantations, soil and moisture conservation works like water absorption trenches and nalla bunds were also carried out over 100 ha.

Other supporting activities: Under the JFM scheme of the World Bank aided MFP, a 17 metre deep well on panchayat land was dug during 1997-98 to provide drinking water and to irrigate panchayat land for the benefit of the land less poor. A five H.P. electric pump with a 600 ft. pipeline set was also installed.

Participation of the Agriculture Department: On a request from the Forest Department, the Agriculture Department selected Avhati for its water conservation programme and carried out the watershed development work on non-forest land as complimentary to the works done on forest land to help recharge the subsoil water. The Agriculture Department also provided valuable guidance to the FPC members about cropping patterns and use of improved variety of seeds etc. Avhati has 56 tribal households who are landless and make out a marginal livelihood by collecting firewood from the already degraded forests.

Improving Livelihood of Tribals: The forest area of Avhati is natural *'sitaphal'* bearing area along with Teak. After getting rigid protection these stunted trees grew faster and gave good yields. The villagers decided that the tribal people who do not have other means of livehood be allowed to take away '*Sitaphal*' fruits for sale in adjoining villages and market. The tribals got good amount from the sale of fruits. It is estimated that annually 'sitaphals' worth Rs. 70 to 80 thousands are sold by tribal. This reduced the tribal pressure on forests for firewood head loads, since the tribals earlier had no other option but to sell head loads for survival. Thus, the problem of providing alternate job to tribals was solved skill fully by villagers and Forest Department. Now tribals are actively engaged in forest protection works.

Thus, public participation alongwith efforts of the government brought out marvellous changes in the conservation of the forests in Avahti. In fact, there were several benefits of JFM activities in the Avahti village. Prior to 1993 when the idea of JFM germinated, Avhati was a poverty and drought stricken village. In the change scenario, with the initiatives taken by the FPC and help extended by the Forest Department, the villagers are now able to see new phase of economic development, and all indications are that these development will be sustained for along time to come. Various benefits of JFMs in Avahti are listed in Table 5.13.

Table 5.13: Benefits of JFM in Avhati

Parameters	Before JFM (Year 1993)	After JFM (Year 2000)		
Nos. of wells	46 (seasonal)	85 (Perennial)		
Area under irrigation	14.16 ha.	211 ha.		
Cropping pattern	Only Kharif crops like bajra, jawar	Both kharif and rabbi crop-i.e. Wheat, onion, groundnut, sugarcane		
Horticulture Crops	Hardly taken	Pomegranate and grape orchards over 35.8 Ha.		
N.T.F.P. yield from forests	Negligible	Sitaphal fruits: Rs. 70,000 to 80,000/yr Fodder: 100 dry MT/yr.		
Yield of timber and firewood	Nil	Yield as below		
		Year	Poles Nos.	Firewood cum.
		1997.98	355	186
		1998.99	--	195
		1999.00	--	460

Illegal grazing	Rampant	Under control
Milk yield	Negligible	300 lits per day
Employment	Seasonal	Throughout the year
Drudgery of fetching water by women	9405 'woman' days per year	900 'woman' days per year (i.e. 10% of pre-JFM figures)

Source: MFD (2005)

Efforts of MVSS Chandrapur

Maharashtra Van Sanshodhan Sanstha (MVSS) located at Chandrapur caters the research needs of the North & South Chandrapur Circles situated in agro-climatic zones VIII & IX. It has got research centres at Lohara (268 ha) near Chandrapur and Tadgaon (59 ha) near Bhamragarh. Lohara lodges the largest gene pool of teak in Asia comprising of 260 clones from all over India. Besides gene pool it has got teak seed orchards, progeny trials of teak and other species, chamber and a seed-testing laboratory situated at Chandrapur. The Institute has selected Candidate Plus Trees (CPT's) of teak and other species and seed stands and seed production areas in the field. The institute is also a pioneer in developing the technique of teak bud grafting and developing a prototype machine for teak seed treatment.

Afforestation by FDCM

The Forest Development Corporation of Maharashtra (FDCM) Ltd. is undertaking various afforestation projects on turnkey basis and helping in the process of creation of vegetative cover, which in turn will benefit the entrepreneur and society at large. This work will be in tune with National Forest Policy (NFP) of GoI, which envisages 33 per cent forest cover over the land. These projects include plantation work on agency basis on the land of corporations, autonomous bodies, Public Sector Undertakings (PSU's) etc. on their request.

Major Activities Under Turn Key Projects of FMCM are:

- **Afforestation in Mining Areas:** F.D.C.M. Ltd. is executing 66 environmental projects in the mining areas of Western Coalfields Ltd. (WCL).
- **Urban Plantation & Beautification Projects:** F.D.C.M. Ltd. is working on the Project of greening and beautification of municipal areas of Nashik, Pune, Pimpri-Chinchwad and Navi Mumbai Municipal Corporations. It has taken up the location plantation in Film City, Goregaon, Mumbai.
- **Industrial Plantations:** To maintain ecological balance and to minimise the pollution around the industries the F.D.C.M. Ltd. has taken up the plantations on the land of BSES Thermal Power Plant, Dahanu, ONGC, Panvel Dist. M/s. Power Grid Corporation, Chandrapur, etc.
- **Thinning in Teak Plantations:** F.D.C.M. provides consultancy in preparation of the management plan of private teak plantations. It also provides consultancy and technical inputs to plantation owners to prescribe a thinning schedule and to manage their teak plantations.
- **Harvesting in Government Forests:** Harvesting in government forests is undertaken by F.D.C.M. Ltd. as per the policy of the State Government.

Efforts by MCs

The garden department of Pune Municipal corporation (PMC) has taken up different projects for the improvement of present gardens, developing new gardens and also for afforestation. In the last

decade many "Green Pune" schemes were undertaken and several public gardens were developed. Efforts are being made to conserve the forests in the PMC area by forming committees to encourage public participation, planting local, indigenous and evergreen trees, strengthening the fencing etc. A noted example is the massive tree plantation on Chaturshingi Hill where about 40 hectares of private land in the 'hill top-hill slope zone', was developed by M/S Walchanagar Industries Ltd. The Garden Department of PMC not only gave technical support in planning this project, but also supplied various types of trees (ESR, PMC, 2004).

The extensive tree plantation undertaken by Nagpur Municipal Corporation (NPMC), during the last few decades, made Nagpur the second greenest city in India. Recognising the important role of trees in reducing the SPM levels, noise, etc. an extensive tree plantation programme was undertaken by NPMC and NIT. Under the IRDP nearly one lakh trees were planted during 2002-2003 with an active participation of schools, social organisations, private institutions and citizens. The "Tree plantation and beautification committee for Nagpur" planted 60, 000 trees and beautified 7 gardens of NIT during 1996-1999. NMC maintains 40 major gardens spread over 89 ha while NIT maintains 48 gardens covering 72 ha. The British referred to Nagpur city as the Gateway to the central Indian forests. Till only about 300 years back the city and its surroundings remained a tribal area in "Gondwana Land", outside the influence of major empire building in the Indian sub-continent. Remnants of the eastern edge of the rolling Mahadagarh hills, which are themselves extension of the more prominent Satpura Ranges, can be seen in the city in the form of seminary hill, Starky point hill, Ramnagar hill and the Sitabuldi hill. At the western edge of the city, on a rim of higher elevation of these hills are located the major tanks from which two rivers appear to rise and flow eastward, the true origin of the rivers lying very close to the fringe of the city NPMC (2003). In NMMC, a budget of 2.83 Crores has been proposed during 2004-2005 for tree plantation, detection squad for illegal tree felling, exhibition of flowers and fruits, etc. (NMMC, 2004).

Chapter 6: Land Resources and Degradation

Introduction

Land is one of the most precious natural resources on the Planet. All life support systems depend on it, and therefore, efficient management of land resources is of crucial importance. In many countries across the globe, land is subjected to varying degrees and forms of degradation due to the competing demand on natural resources caused by growing population, increased demand for food, fodder and fuel wood and intensive industrial activities. The key problems of land degradation are desertification, soil erosion, water logging and salination. Land degradation also includes loss in productivity over time due to various natural and man-made causes. The topsoil of the land, which forms the upper most layer of the landmass, is the bridge between the living and the nonliving entities of the nature. The present quantum of land used for various purposes and the quantity required and available for future growth are some important elements in the environmental planning of any region.

Some of the main reasons of land degradation are deforestation, improper soil conservation practices, extension of cultivation on marginal lands, improper crop rotation, imbalanced use of fertilisers , excessive surface irrigation, paucity of land, economic pressure and poverty. Heavy use of fertilisers results in excess nutrients including nitrates that are leached into groundwater causing its contamination. Improper use and maintenance of canal irrigation also significantly contributes to soil degradation . Further, the extension of canal irrigation to arid and semi arid areas has resulted in water logging and salination.

More than 50 per cent of the country's land area falls under some degree and/or category of degradation. Even the land under cultivation is substantially degraded and as estimated by the National Remote Sensing Agency (NRSA) and Forest Survey of India (FSI), about 60 percent of the total cultivated area suffers from some form of degradation. According to the land use statistics for 2002 published by the Department of Agriculture, GoI, the estimates of culturable wasteland are 13.9 million hectares (mha) in the country. While in India, about 48 per cent and 44 per cent of all canal command area is water logged and saline, in Maharashtra, these figures are as high as 88 per cent and above 95 per cent, respectively. Maharashtra's soils are not only deficient in Phosphorous (P) and Potassium (K) but also in Nitrogen (N), mainly because farmers in rain-fed areas use very little fertilisers.

Driving Forces and Pressure

Unprecedented population growth and competing uses for agriculture, forestry, pastures, human settlements and industries exert an increasing pressure on land. Insatiable demands of people on scarce land are affecting the stability and resilience of our ecosystems and the environment as a whole. Land degradation has a direct bearing on the productivity of soil, its vulnerability to rainfall variations, scarcity of drinking water, fodder and fuel wood.

Expansion of human settlements and infrastructure, intensification of agriculture, and extension of agriculture into marginal areas and fragile ecosystems often lead into conflicts over access of land and declining per capita land resources. This may affect the entire global environmental balance and

the well being of present and future generations. Therefore, special efforts are to be made towards preservation of land, water and vegetative resources of the country for sustainable development.

In Maharashtra, the land degradation takes place due to various reasons such as vast expansion of urban development, industrial activities, expansion of airports, expressways, ports, tourist resorts, rural and urban migration and extensive packages of concessions to multinational and Indian companies. The Mumbai Metropolitan Region (MMR) has been extended to cover Thane, Kalyan, Bhiwandi, Ulhasnagar and Vasai tehsils of Raigad district in order to overcome population pressure. Vast areas of agricultural land and forests are being taken over for urban and industrial development with disastrous consequences on agriculture and fisheries sectors.

Since Mumbai is treated as financial centre of the country, it has been an attractive destination to the NRI's, foreigners and even local investors. They continue to purchase more and more land in the State for meeting their requirement for industrial, commercial and residential purposes. This has resulted in manifold jump in land prices within a short pan of period. Most of the MNCs are showing interest to locate their industries in the Konkan districts as it has coastal area, which facilitates import-export business. Besides, the seacoast supplies ample water and sufficient place for discharging effluents. Thus, the effect of rise in land prices is more prominent in the Konkan region, Mumbai-Pune conurbation and other major cities of Maharashtra. Large scale land use changes are degrading land resources.

Some major reasons for land degradation in the State are as follows.

Land Acquisition

The GoM has an extensive programme of land acquisition for industry, airports, expressways, ports, tourist resorts and offers liberal package of concessions to multinational and Indian companies in some parts of Thane and Raigad districts. MIDC has so far acquired more than 35000 hectares of land over 200 locations. It has planned land acquisition for 120 industrial areas/estates covering about 30000 hectares of land including nine large industrial townships with size ranging from 2000 to 7000 hectares and deluxe industrial estates for attracting NRIs and foreign companies. Air-links to Mumbai are to be provided through private sector, which includes exemption from landing fees and sales tax on aviation fuel offered for a period of five years. Water supply is planned to be provided by Irrigation Department for the townships. Moreover, aqua parks along the coast are planned with well-equipped ponds for pisciculture, warehousing, and cold storage facilities. The acquired land will also support establishment of private hotel industry, new expressways, airports and tourist spots. For example, about 1828 hectares of land for a Navi Mumbai-Pune expressway, about 2000 hectares for a mega city projects, about 2900 hectares of land for international airport near Mandwa-Rewas in Raigad district, and about 5000 hectares for a township near this airport are some of the projects requiring large acquisition of land and will result in land use change.

Invasion of Coastal Lands

Many MNC's and large Indian companies are dependent on import-export activity and they are particularly interested in coastal locations of the State because seacoast provides port facility, water supply and space for waste disposal. Moreover, Konkan Railway and new coastal highway, which is under construction will provide strong land link to the other parts of the country. The State has over 720 kms of coastline with two-major ports-Mumbai Port Trust (MPT) and Jawaharlal Nehru Port (JNPT) in the MMR and 48 minor ports. The State Government has announced privatisation of all

the 48 ports by giving the existing port facilities on lease acquiring additional land for the private companies.

Ecologically sensitive coastal lands in the State are still owned by Khots (absentee landlords) who sell off land dispossessing peasant cultivators. In Ratnagiri district, MIDC forcibly acquired about 650 hectares of land at Anjanwel-Veldur for Dabhol Power Company (DPC), 800 hectares for the Hindustan Oman Petroleum Corporation, and 7200 hectares of land along Dabhol creek. But these lands are very rich in horticultural and in export potential of fruits, spices and marine wealth, which have been developed due to encouragement by the government earlier, are being destroyed now by handing over the lands and the ports to MNCs even when there is opposition from the locals peasants and fisher-folks. Due to the encouragement from the State Government these activities are being accelerated despite the fact that they are in contrast to the CRZ Notification of 1991 by the GoI, prohibiting such activities in coastal areas. Due to negligence, this is resulting into environmental degradations like coastal erosion, coastal flooding, salt-water intrusion, extinction/destruction of the marine fauna, etc., threatening the livelihood of thousands of local farmers and fisher folks.

Attack on Hills and Mountains

Hills, forest and green areas are the sensitive regions in the ecological balance that need to be preserved from invasions by the MNCs and builders. Opening of hill stations for development by private parties, violating the provisions of the Monopolistic and Restrictive Trade Practice (MRTP) Act and the Central Government directives can not be a right move. The GoM has given hundreds of hectares of forests in Chandrapur and Gadchiroli districts on long –lease to private companies for coal mining overlooking ecological hazards and the displacement of the tribes. Special tourism areas are being notified in hilly-forested tracts of Maharashtra e.g. Ajanta - Verul in Aurangabad, Chikhaldara in Amravati, and Lake District project in Pune district. Many tourism and related infrastructure projects have been planned in green zones/no development zones. . Exploitation of ground and surface water resources, discharges of untreated waste, alteration of hilly terrains through roads and building construction, destruction of flora and fauna zone, hydrological cycle will have devastating effect on hilly regions.

Changes in Land-Use

Conversion of agriculture, coastal and hilly lands into industrial, residential and tourism projects are extensive damages. Changes in the land-use are thus being affected in a haphazard and ecologically disastrous manner, under the current unregulated market operations. Apart from the diversion of lands from cultivation to industry, housing, tourism and other non-agricultural uses and the extensive damage to cultivation due to industrial waste, pollution, water extraction by the industries, townships etc., there is a diversion of lands to chemical-intensive cultivation due to agro-processing industries and export oriented cultivation by rich land owners who establish monopoly on ground water and surface water resources and make inroads in the tribal areas. Consequently, the tribal communities are being deprived of their means of livelihood and the land under cereals and pulses is declining, threatening food security (ICAR, 2005).

Status in Maharashtra

Variety of factors influence the pattern of land utilisation, namely, population density, extent of urbanisation, industrial expansion, agriculture, grazing, irrigation requirements and natural disasters. The soil status of Maharashtra is residual, derived from the underlying basalts. In the semi-dry plateau, the regur (black-cotton soil) is clayey, rich in iron and moisture-retentive, though poor in nitrogen and organic matter. When re-deposited along the river valleys, the kali soils are deeper and heavier, better suited for Rabi crops. Farther away, with a better mixture of lime, the morand soils form the ideal Kharif zone. The higher plateau areas have pather soils, which contain more gravel. In the rainy Konkan, and the Sahyadri Range, the same basalts give rise to the brick-red laterites, which are productive under a forest-cover, but readily stripped into a sterile varkas when devoid of vegetative cover. By and large, the soils of Maharashtra are shallow and of somewhat poor quality.

Land Use and Degradation

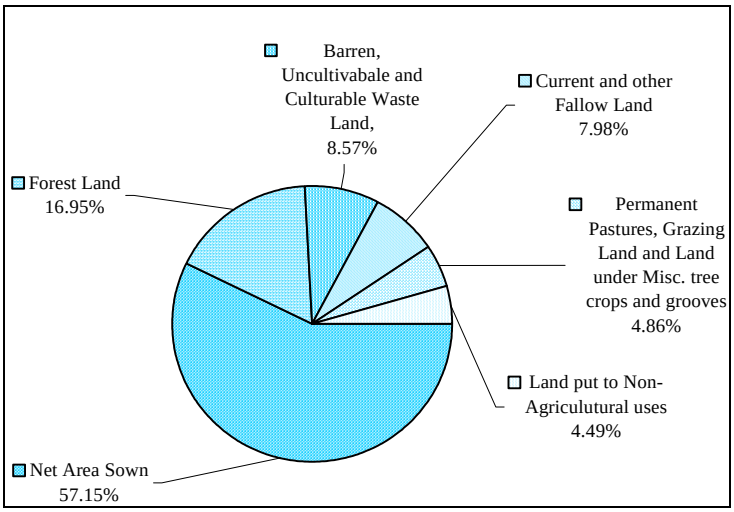
Table 6.1 and Figure 6.1 show the land utilisation statistics of Maharashtra from 1992-93 to 2002-03. Land use statistics of Maharashtra shows that of total land, around 57 percent is under the net sown area, around 17 percent is forest land, and the remaining is almost equally distributed between barren, non- agricultural and fallow land (GoM, 2004).

Table 6.4: Land Utilisation Statistics of Maharashtra (Area measured in hundred hectares)

Year	Area under forest	Land not available for cultivation		Other uncultivated land			Fallow lands		Cropped area		Gross cropped area
		Barren and uncult-ivable land	Land put to non-agricul-ture uses	Cultu-rable waste Land	Perma-nent pastures and grazing land	Land under miscellaneous tree crops and groves	Curr-ent fallow	Other fallow	Net area sown	Area sown more than once	
1992-93	51447	15906	11866	9479	11803	2874	13064	10941	180203	31683	211886
1993-94	51460	15624	12811	9430	11726	2728	9785	12138	181881	32209	214090
1994-95	51471	15423	13170	9475	11733	2795	9118	13868	180530	33046	213576
1995-96	51480	15435	13486	9596	11663	2921	10724	12478	179800	35240	215040
1996-97	51486	15435	13501	9577	11737	3080	10278	14006	178483	39876	218359
1997-98	51481	15438	13504	9632	11798	3304	10805	14406	177215	36623	213838
1998-99	53655	17015	12387	8882	13405	2219	11319	11385	177316	44231	221547
1999-00	53651	16979	12448	8894	13405	2241	11540	11513	176912	46600	223512
2000-01	52958	16957	13010	9029	13410	2256	11886	11713	176364	46194	222558
2001-02	52155	17205	13739	9143	12491	2456	12163	11918	176313	47734	224047
2002-03	52140	17195	13799	9150	12486	2468	12547	12004	175794	48,081	223875

Source: GoM (2004)

Figure 6.1: Land Utilisation in Maharashtra (2002-03)



Source: GoM (2004)

Soil Erosion

Soil erosion by water is a major factor for land degradation in Maharashtra. It is greater in the regions receiving short periods of heavy rainfall and is also accelerated by the absence of vegetation and undulating topography. Of total degraded land area accounts for about 198 lakh ha of which about 176 lakh ha is water eroded soils, and 16 lakh ha degrared forests remaining is salt affected, water logged soils, etc. Being a coastal state, it is further susceptible to land degradation due to the action of sea waves and increased soil salinity as a result of the ingression of salts from coastal waters. The extent of saline and alkaline soils in Maharashtra has been estimated by the Agricultural Department and about 5.34 lakh ha of soils in the state are salt-affected. The satellite data reveals the existence of salt affected lands to the tune of 45,532 ha in Raigad, Kolhapur, Sangli and Thane districts (MSDR, 2005).

Maharashtra's soils are highly deficient in nutrients when compared with the soils of other Indian states. They are lacking in phosphorous (P), potassium (K) and nitrogen (N), mainly because farmers in rain-fed areas use very little fertilisers. Further, excessive use of water for irrigation also leads to increasing salinity of soils. For example, in the Kolhapur region, due to the location of sugar mills, farmers started cultivating sugarcane which is a highly water intensive crop. However, the region's fine-grained black soils do not allow penetration of water, leading to a continuous build up of salt levels. It is estimated that after a single harvest of sugarcane, the soil salinity increases by 20 to 25 tonnes/ha. Excess salinity in the soil reduces the productivity of land.

The soil erosion is also a major issue, and as per the soil survey conducted by the National Bureau of Soil Survey and Land Use Planning (NBSSLP), about 94 percent of Maharashtra's geographic area is prone to water induced soil erosion. The survey has revealed that over 86 percent land area in the Western ghats and 75 percent in the Konkan Coast suffers from strong to severe soil erosion, resulting in annual soil loss of 20-40 tonnes / ha. Water induced soil erosion may, thus, be causing topsoil erosion amounting to approximately 775 million tonnes / year in the state, thereby severely affecting the rural economy. When roughly translated into financial losses, the state may be losing about Rs.2500 crores in agricultural productivity, Rs.540 crores in forest productivity and about Rs.1500 crores in livestock productivity. The NBSSLP has published a map of the soils

of Maharashtra, dividing the state into 356 soil-mapping units, which are broadly categorized as follows:

- Soils of Konkan coast-33
- Soils of Western Ghats-54
- Soils of Upper Maharashtra-92
- Soils of Lower Maharashtra- 37

Table 6.2 shows that about 96.4 per cent of the states geographic area is subjected to various degrees of erosion. The soil profile reveals that the incidence of severe erosion is the highest in the Western Ghats (53.1 percent), followed by lower Maharashtra (11.5 percent).

Table 6.2: Soil Erosion Profile of Maharashtra (Area in Hectares)

Physiographic unit	Geographic area covered	Severe erosion	Strong erosion	Moderate erosion	Slight erosion
Konkan coast	2,240,460	6,11,720 (27.3)	10,80,460 (48.2)	3,48,060 (15.5)	2,00,200 (9.0)
Western Ghats	1,913,130	1,015,910 (53.1)	6,39,800 (33.4)	2,57,420 (13.5)	Nil
Upper Maharashtra (Deccan Plateau)	5,686,040	1,064,000 (18.7)	9,55,790 (16.8)	35,38,820 (62.2)	1,27,430 (2.3)
Lower Maharashtra (Deccan Plateau)	16,443,520	1,886,750 (11.5)	34,41,550 (20.9)	10,610,570 (64.5)	5,04,650 (3.1)
Lower Maharashtra (Deccan Plateau – Metamorphic)	3,368,500	2,15,690 (6.4)	11,29,230 (33.5)	18,47,340 (54.8)	1,76,240 (5.2)
Maharashtra	29,651,650	47,94,070 (16.2)	72,40,830 (24.4)	16,602,210 (56.0)	10,08,540 (3.4)

Source: Sharma (2000)

Soil subjected to strong erosion, however, follows a different pattern with the Konkan Coast showing the highest incidence (48.2 percent), followed by Western Ghats (33.4 percent), lower Maharashtra (20.9 percent) and upper Maharashtra (16.8 percent). The highest incidence of severe erosion in the Western Ghats and the high lands of Konkan indicate an alarming rate of deforestation. Based on the estimations, the quantum of soil erosion/ year in Maharashtra works out to 773.5 million tonnes, which can be classified as given Table 6.3.

Table 6.3: Quantum of soil erosion per year in Maharashtra

Type of Soil Erosion	Quantum of Soil Eroded (million tonnes)
Slight Erosion	7.56
Moderate Erosion	257.30
Strong Erosion	221.00
Severe Erosion	287.64

Source: Sharma (2000)

The Forest Survey of India (FSI) puts the extent of degraded forests in the state at 3.864 million ha. Over 53 per cent of the wastelands in the state are classified as uplands with or without scrub.

While Pune and Konkan divisions account for 63.6 per cent of privately owned wastelands in the state, the bulk of forest wastelands exist in the Nashik and Nagpur divisions.

Wasteland

The Ministry of Rural Development, GoI, defines wastelands as "degraded lands, which are currently under-utilised and can be brought under vegetative cover with reasonable efforts and land which is deteriorating for want of appropriate water and soil management or on account of natural causes." The vast, uncultivated, uninhabited expanse; the areas devastated by mining and quarrying; deforested mountain slopes reduced to bare rock; areas subjected to nuclear explosions or even chemical warfare, the stretches of partially degraded, economically unproductive and ecologically unstable land, spread all over the country are termed as wastelands**.** It is this degraded land mass which is progressively deteriorating for want of appropriate natural resource management and which, given the appropriate inputs of technology and people centric integrated management strategies, is potentially capable of restoration. Wastelands may be classified as follows.

- Gullied and / or Ravinous land
- Upland, with or without scrub
- Water logged and Marshy land
- Land affected by salinity/ alkalinity- coastal/ inland
- Shifting cultivation area
- Sands – desert / coastal
- Mining / Industrial wastelands
- Under utilised / Degraded notified forest land
- Degraded pastures/ grazing land
- Degraded land under plantation crop
- Barren rocky / Stony waste / Sheet rock area
- Steep sloping area
- Snow covered and / or Glacial area

Table 6.4 shows the district wise wasteland area under each type in the state. As seen from the table, Pune has the major share of area under wasteland. Also, in Thane about 66 percent of the land is affected by salinity alkalinity. As NWIP survey (2002), the extent of wastelands in the State is estimated at 70.53 lakh ha, of which, community lands account for 28.73 lakh ha, private lands 24 lakh ha, and degraded forests 17.8 lakh ha. A satellite based survey by the Maharashtra Remote Sensing Applications Centre, estimated non-forest wastelands at 51.15 lakh ha. As estimated by the FSI (1999), only 23.6 lakh ha of the State's forest area of 64 lakh ha contains adequate forest cover, thereby, indicating that over 40 lakh ha forest area in the State, including inadequate tree cover, is degraded. The satellite based assessment of wasteland categories reveals that a majority, i.e. 53.13 percent of wastelands in the state are classified as uplands, with or without scrub.

Table 6.4: Waste Land Break-up in Maharashtra (Area in Sq.Km)

Name of the district	Geographical area	G&R	UL	WL&ML	S/AL	UU/DF	DPC	DPG	M&IWL	S&DL	SSA	BR/SA	Total waste land
Yavatmal	13584	227.9	2087.7	0.00	0.0	945.0	0.0	0.0	5.	0.0	0.0	82.0	3347.77
Satara	10484	1.78	1068.4	0.00	0.0	519.4	0.0	106.7	0.0	0.0	14.1	72.1	1782.64
Nashik	15530	81.57	1489.9	0.00	0.0	1721.7	0.0	19.6	0.0	0.0	78.0	104.4	3495.35
Osmanabad	14210	0.00	395.8	0.00	0.0	12.37	0.0	0.0	0. 0	0.0	0.00	97.2	505.43
Jalgaon	11765	170.6	338.3	0.00	0.0	617.9	1.0	20.9	0.0	0.0	62.1	42.3	1253.42
Nanded	9931	4.6	1013.1	0.00	0.0	364.3	0.0	0.0	0.0	0.0	0.0	39.9	1422.00
Buldhana	9661	295.3	1275.9	0.00	0.0	530.4	0.0	0.0	0.0	0.0	0.0	30.8	2132.50
Beed	11805	0.00	1343.5	0.00	0.0	141.5	0.0	0.7	0.0	0.0	0.2	70.4	1556.53
Ratnagiri	13054	0.00	2366.9	34.5	0.0	50.7	627.4	0.0	0.8	18.2	66.0	289.1	3453.94
Ahmadnagar	17020	186.8	1867.0	0.00	0.0	861.0	58.9	0.0	0.4	0.00	567.8	317.4	3859.58
Kolhapur	8047	0.00	0.00	0.00	0.0	360.3	0.0	0.0	0.0	0.00	0.0	37.8	398.12
Sangli	8572	0.02	740.7	0.76	0.0	246.5	0.0	29.4	0.0	0.00	3.3	37.7	1058.49
Aurangabad	16305	0.00	1043.6	0.00	0.0	530.4	0.0	2.2	0.0	0.00	30.8	74.9	1682.10
Akola	10575	319.2	1307.3	0.00	0.0	430.4	0.0	0.0	0.0	0.00	0.0	12.7	2069.65
Dhule	13150	260.2	620.4	0.00	12.3	1739.0	0.0	33.2	0.0	0.00	257.7	131.1	3054.17
Thane	9558	0.00	782.3	260.8	66.2	509.3	0.0	437.2	0.0	32.3	73.6	257.7	2419.52
Pune	15642	0.00	782.3	0.00	0.0	588.2	0.0	699.2	0.0	0.0	235.5	690.7	4832.00
Total	**208893**	**1548**	**20359.5**	**296.1**	**78.5**	**10168.7**	**687.4**	**1349.4**	**6.3**	**50.6**	**1389.5**	**2388.8**	**38323.2**

G&R: Guillied & or Ravinous Land; UL: Upland with or without Scrub; WL&ML: Water Logged & Marshy Land; S/AL: Land affected by Salinity/Alkanity-Coastal/Inland; UU/DF: Under Utilized Degraded Notified Forest Land; DPC: Degraded Land Under Plantation Crops; DPG: Degraded Pastures/ Grazing Land; M&IWL: Mining Industrial Wastelands S&DL: Sands- Desertic Coastal SSA: Steep Slopping Area; BR/SA: Barren Rocky/Stony Waste/Sheet Rocky Area
Source: NWIP (2002)

The districts of Pune, Ratnagiri and Thane possess wastelands in excess of 25 percent. Districts with 20-25 five percent wastelands include Yavatmal, Dhule, Ahmednagar, Nashik and Buldhana. The satellite surveys also indicate that 63.6 percent private wastelands exist in the Pune and Konkan revenue divisions. Community wastelands are more evenly spread with the exception of Amravati Division. Degraded forests are mostly encountered in Nashik and Nagpur Divisions, followed by Pune Division.

The latest State of Forest Report (2003) has once again shown positive gains made by Maharashtra in terms of tree cover, albeit on a reduced scale of Wastelands Development.

Wetlands

Wetlands are considered to be highly productive and valuable eco-systems performing many useful functions, such as flood control, shoreline stabilization, providing habitat to flora and fauna etc. There are 49 natural wetlands in Maharashtra covering an area of 21675 hectares and 1004 man made wetlands covering an area of 279025 ha, as of 2002, as given in Table 6.5.

The natural landscape of Maharashtra is divided into two regions, six river basins, 16 catchments, 74 sub-catchments, 396 watersheds, 1504 sub-watersheds and over sixty thousand micro watersheds. The Krishna and Tapi river basins, which account for 38.4 percent of the state's land area, have been severely affected by water scarcity. About 104 talukas in the state are facing similar conditions due to land degradation. During the summer of 2001, about 20,519 villages were affected by drought and many times erratic monsoons aggravate this situation causing water scarcity in several thousands of villages. The satellite imageries estimate that an area of 47,959 ha is subjected to water logging, marshy land and swamps in the districts of Sangli, Thane, Greater Mumbai, Raigad, and Kolhapur.

Table 6.5: State-wise Distribution of Natural and Man-made Wetlands

State/UTs	Natural		Man-made	
	No.	Area (ha)	No.	Area (ha)
Andhra Pradesh	219	100457	19020	425892
Arunachal Pradesh	2		N.A.	N.A.
Assam	1394	86355	N.A.	N.A.
Bihar	62	224788	33	48607
Goa	3	12360	N.A.	N.A.
Gujarat	22	394627	57	129660
Haryana	14	2691	4	1071
Himachal Pradesh	5	702	3	19165
Jammu & Kashmir	18	7227	N.A.	21880
Karnataka	10	3320	22758	539195
Kerala	32	24329	2121	210579
Madhya Pradesh	8	324	53	187818
Maharashtra	**49**	**21675**	**1004**	**279025**
Manipur	5	26600	N.A.	N.A.
Meghalaya	2	N.A.	N.A.	N.A.
Nagaland	2	210	N.A.	N.A.
Orissa	20	137022	36	148454
Punjab	33	17085	6	5391
Rajasthan	9	14027	85	100217
Sikkim	42	1101	2	3.5
Tamil Nadu	31	58868	20030	201132
Tripura	3	575	1	4833
Uttar Pradesh	125	12832	28	212470
West Bengal	54	291963	9	52564
Chandigarh	N.A.	N.A.	1	170
Pondicherry	3	1533	2	1131
India	**2167**	**1450871**	**65254**	**2588266**

Source: MSDR (2005)

While the western coastline of MMR, exposed to the Arabian Sea, consists of sandy beaches, exposed rocks, cliffs and sea walls and structures in south Bombay, the interior coastline, along creeks and rivers, consists of mud flats, marshes, mangroves, salt-pans, exposed rocks, pebbled beaches, etc. The coastline has undergone extensive changes over the last several decades on account of land reclamation. This has interfered with natural erosion process and is believed to have caused intense erosion that is witnessed in some parts of the region, such as Versova. The wetlands in this region are being reclaimed on a large scale for accommodating growing urban population and economic activities. The wetlands are also converted into agricultural lands through khar-land development programme. Wetlands are used for production of salt, fisheries and for dumping of solid waste in this region.

Mangroves

These are trees growing in brackish waters and form a good breeding ground for all aquatic life forms. Mangroves are soil binding and prevent soil erosion, thus, are ecologically very important. Many creeks, bays and tidal inlets, indent Maharashtra's coastline and determine the extent of proliferation and types of mangroves present. The mangrove cover also depends on the pressures faced by the area, type of climatic conditions etc. From Table 6.6, shows magrove cover in 2001, and it can be seen that Thane has the maximum mangrove cover followed by Raigad and Mumbai Suburb. A study of mangrove areas in Thane identified a total of 7 genera and 12 species of true mangroves along the Ulhas River and Thane creek, most of them belonging to the genera –

Rhizhopora, Avicennia, Sonneretia, *Bruguiera, Excoecaria and Aegiceras*. Mangroves are associated with the other plant species, called as mangrove associates (Sharma, 2002).

Table 6.6: District-wise Mangrove Cover in Maharashtra(Area in Km²)

States/Districts	Dense	Open	Total
Mumbai City	0	1	1
Mumbai Suburb	15	11	26
Raigad	31	3	34
Ratnagiri	7	2	9
Sindhudurg	1	0	1
Thane	36	11	47
Total	**90**	**28**	**118**

Source: MoEF (2001)

Salt-affected land

Saltpans occupy large areas of wetlands in greater Mumbai and in the rest of the MMR. Urban expansions of the past few decades have brought many of them into proximity of urban centres, consequently increasing their potential value. Salt producers are facing difficulty on account of pollution of creeks and coastal waters, which makes them unfit for salt production (MMRDA 1995). The Panvel creek lies on the western side of Panvel municipal area. Though it flows at a considerable distance from Panvel, tidal action aggravates itself to affect the southwest and western boundaries of Panvel. This has resulted in salinity prone area to almost saline lands, which exist in the western part of Panvel municipal area.

Mining and Quarrying

Maharashtra produces Coal, Iron ore, Tin and some other minerals and the State is one of the major oil and gas producing states in India. The important minerals found and the mineral reserves of Maharashtra, as on 2001, are listed in table 6.7 and table 6.8, respectively.

Table 6.7: Important Minerals found in Maharashtra

District	Minerals
Nagpur	Manganese, Coal, Dolomite, White clay/yellow ochre/Red ochre, Sand (stowing), Quartz Quartzite.
Chandrapur	Coal, Iron ore, Limestone, Dolomite, White clay/Yellow ochre, Sand (stowing), Shale, Fluorite.
Gadchiroli	Iron ore.
Bhandara	Manganese, Iron ore, Chromites, Kainite/Sillimanite/Pyrophyllite/Corundum, Quartz Quartzite, Sand.
Gondia	Quartz and vanadiferous iron ore.
Yavatmal	Coal, Limestone, Dolomite, Sand (stowing).
Amravati	Fire clay.
Sindhudurg	Iron ore, Bauxite, Silica sand, Dolomite, China clay, fire clay, Feldspar, Graphite.
Ratnagiri	Bauxite, Silica sands.

Kolhapur	Iron ore, Bauxite
Raigad, Satara, Thane and Sangli	Bauxite

Source: Bhandara (2004)

Table 6.8: Mineral Reserves in Maharashtra

Mineral	District	Total Reserves (in Million Tonnes)
Coal	Chandrapur	2904.674
Limestone	Chandrapur	750.325
Manganese Ore	Bhandara	11.464
Iron Ore	Bhandara	4.65
Kyanite Sillimanite	Bhandara	2.618
Pyrophyllite	Bhandara	0.995
Bauxite	Satara	30.145
Silica and Sea Sand	Sindhudurg	50.757
Copper Ore	Chandrapur	6.40
Chromite	Bhandara	0.480
Dolomite	Nagpur	28.740
	Yavatmal	29.810
Vanadium ore	Gondia	4.65
Tungstone ore	Nagpur	19.98
Zinc Ore	Nagpur	8.27
Quartz	Bhandara	2.123
Granite	Chandrapur	24.00
	Bhandara	178.00

Source: Bhandara (2004)

In general mining industry had earned ill reputation as eco-damaging industry. Consequently, the locals, the lobby groups, the Green NGOs and the Government had lost faith in the environmental behaviour of mining industry. In the backdrop of these sentiments, the ever-increasing environmental demands and the need for growth of Bauxite Mining (since Belgaum Alumina Plant was poised for major expansion), industry decided to demonstrate its environmentally responsible behaviour through actions. Many technological improvements were included in the design and operation of mining itself. However, these actions failed to bring out a positive and favourable impact on the minds of stakeholders, despite significant improvement in the environmental performance.

One of Indis's bauxite mine is located at Durgamandwadi at Kolhapur district of Maharashtra. The capacity of this mine is about 660,000 MT per annum. The bauxite deposits in Durgamandwadi occur at an elevation of 1100m above MSL in an area of 285 Ha. The reserve contains about nine million tonnes of bauxite and has a life span of about 12 years. The bauxite deposits of the Indian West Coast are unique in their origin, and accordingly, in their characteristics. The plateaus are bald, barren, and rocky, due to prevalence of extreme environmental conditions. The topsoil is scanty, due to heavy wind and water erosion, resulting in total absence of green cover. The vegetation is limited to slopes; that too strewed and stunted due to lack of plant nutrients in the soil. The local population

predominantly consists of nomadic tribes, living below poverty line, which does not have any skills in commerce or industry. A bison sanctuary is also situated adjacent to the mine, at an aerial distance of less than 20 km. Also, there are two major fresh water reserves surrounding the mine that supply water to district head quarters at Kolhapur.

Mineral Development

There are three continuing schemes in this sub-sector in the State, viz. Mineral Development and Mineral exploration, share capital to Maharashtra State Mining Corporation (MSMC) and share capital to Manganese Ore (India) Limited (MOIL). An outlay of Rs.1470 lakh was allocated in the Ninth Plan but no outlay is proposed for Tenth Five Year Plan 2002-2007.

The residents who were affected by the coalmines submitted a representation requesting to impose ban on polluting coalmines of Western Coalfields Ltd. in Chandrapur. There are several coalmines of Western Coalfields Ltd. in Chandrapur District of Maharashtra including Chandrapur, Ballarpur and Vani areas. Due to these coalmines, the residents of Chandrapur district have reported that they are facing very serious air pollution as well as water pollution problems. Due to pollution, the residents of this district are becoming victims of various respiratory ailments and skin diseases. As a result of blasting the mines, the houses and articles of residents living in this area are being damaged and felt an earthquake like situation. The Local representatives requested the Union Coal Ministry and Environment Ministry of State Government to take action to stop the pollution. The representation was forwarded by the MPCB to the MoEF for furnishing their factual comments on the points raised in the representation. It reported that there are 29 coalmines in the area (15 – opencast and 14 – underground). There are four coalmines (all underground) within the municipal limits of Chandrapur. These are: (i) Hindustan Lalpeth, (ii) Mahakali, (iii) Chandrapur-Rayawati and (iv) Durgapur-Rayawati.

Quary Operations

Gravel and stone quarry operations in the State result in extensive manipulation of the landscape and of the ecosystems indigenous to their sites. Quarrying results in conditions favourable for accelerated erosion because the topsoil environment required for stabilising vegetation is eliminated. Once quarry resources are exhausted or operations cease, the landscape has often been degraded to an extent that decolonisation by pre-disturbance communities is difficult, if not impossible. Such degraded lands lead to safety, ecology, and aesthetics-related concerns. Many areas in the Stare are affected by quarry operations of which some are being carried out in ecologically sensitive regions. There are over 200 quarries in Navi Mumbai Municipal Corporation (NMMC) area (Nerul 106, Turbhe 92, Koparkhairane 8, and Dighe 3). In view of land degradation due to stone quarrying, restoration of degraded areas is a challenge for NMMC.

Impact of Land Degradation

Land degradation results in number of adverse ecological impacts such as loss of vegetation, accelerated soil erosion, floods, landslides and avalanches, effect on the biodiversity etc.. Land degradation also results in many socio-economic problems as due to loss in soil productivity, people from rural areas, migrate to urban areas in search of better livelihoods. As the soils are eroded, sedimentation reduces the life span of reservoirs and hydroelectric dams. As a consequence of various development activities of urbanisation, industrialisation and other infrastructure development ecological imbalances is growing in terms of declining ground water table, land and

water pollution, water logging, soil salination etc. This is affecting the agricultural productivity considerably in the State. Natural grasslands are disappearing because of overgrazing.

In addition, Maharashtra soils show greater nutrient deficiency than other states in the country, thereby, causing the negligence of agriculture sector. Large diversion of lands from agricultural sector and forests area to non-agricultural uses affect overall growth and productivity of the agricultural sector. Due to the vast industrial development and making of roads in the tribal areas, the tribal communities are compelled to leave their lands, which they have been maintaining for their livelihood, resulting in less production of cereals and pulses.

For example, the district of Chandrapur is endowed with very good fertile natural resources, but anthropogenic activities have led to soil erosion, excessive land degradation, diminishing soil fertility, low agricultural production and degradation of forests in this area. Excessive use of water for irrigation also leads to increasing salinity of soils. In the Kolhapur region, due to the location of sugar mills, farmers started cultivating sugarcane which is a highly water intensive crop. However, region's fine-grained black soils do not allow penetration of water, leading to continuous build up of salt levels in the top soils. It is estimated that salt content of soils increase by 20 to 25 tonnes per hectare after a single crop of sugarcane is grown. Increase in salinity also reduces the yield of sugarcane on the same land in successive years (Jayan, 2003). Increasing gravel and stone quarry has led to accelerated soil erosion because of the loss of the topsoil nutrient, which are required to maintain vegetation cover. Due to constant quarry blasting causes disturbance in the entire region affected not only people in the neighbourhood but also the wildlife. For example, it is reported that the constant blasting of hills in Borivali, Mumbai poses threat to wildlife in the Sanjay Gandhi national park.

Response of Stakeholders

Central Government

The Central and State Governments have initiated several programmes and schemes to check the land degradation. These include centrally sponsored the Integrated Wastelands Development Programme (IWDP), the Draught Prone Area Programme (DPAP), Employment Assurance Scheme (EAS) and National Watershed Development Project For Rainfed Areas (NWDPRA). In addition, rehabilitation of degraded lands is also covered under the state sector Integrated Wasteland Development Programme (IWDP) and EAS. The Ministry of Rural Development implements DPAP, DDP and the IWDP. Indo German Watershed Development Project (IGWDP), piloted by National Bank for Agriculture and Rural Development (NABARD) in 103 villages in the State has emerged as a front-runner in terms of participative approach to watershed development in the country. The Watershed Development Fund (WDF) set up in NABARD by the GoI in 1999, provides for restoring degraded lands, especially in the tribal areas.

The National and Eco-Development Board (NAEB) was constituted in the Ministry of Environment and Forests in 1992 with the responsibility of promoting ecological restoration and eco-development activities in the country with special attention to the degraded forest areas, lands adjoining the forest areas, national parks, sanctuaries and other protected areas as well as the ecologically fragile areas like the Western Himalayas, Aravallis, Western Ghats, etc. The Central Government is also implementing a number of sponsored schemes like Scheme for Raising of Minor Forest Product including Medicinal Plants, Scheme of Aerial Seeding, Seed Development

Scheme, People's Nursery Scheme, etc. These are aimed at harnessing the inputs of science and technology for reducing land degradation, enhancing biomass production, achieving cost effectiveness and sustainability. Various demonstration projects covering saline/alkaline lands, gullied and ravine lands, marshy and water logged areas, etc. have been launched. Besides, the regular monitoring by the State Governments, monitoring of progress of tree planting/ activities were under taken at the Central Government level through various independent agencies. The MoEF is implementing an Integrated Afforestation and Eco-development Scheme to promote the development of degraded forests.

The Planning Commission had also set up a committee to prepare a 25-year perspective plan for the development of rainfed areas. The report of this committee has recommended that people be empowered to select technologies in view of their experiences. In addition to detailed guidelines on agriculture diversification in different zones, the plan also highly emphasised the need for a coordinated approach to the development of degraded lands in the country. In the 10th Five Year Plan, high priority has been given to afforestation and the marginal land has been brought under tree crops production with technical inputs. Importance has been given to watershed programmes during the Plan to prevent further land degradation and for the restoration of the carrying capacity of lands. The Working Group on Watershed Development, Rainfed Farming and Natural Resource Management for the Tenth Plan had projected that 107 million hectare of land in the country are subject to degradation. It is estimated that 88.5 mha would be treated under watershed programmes in the Tenth and subsequent Plan periods.

In the Tenth Plan, emphasis has been given to improve the ecological conditions of the Western Ghats Area of Maharashtra, which allocates considerable funds for Forestry and Agriculture sectors. The Western Ghats area in Maharashtra, comprises 62 talukas in 11 districts, has been covered (Thane, Raigad, Ratnagiri, Sindhudurg, Nashik, Dhule, Ahmednagar, Pune, Satara, Sangli and Kolhapur) in this project. The 20-year Perspective Plan envisaged by the Working Group for treatment of degraded lands during the Tenth and Thirteenth Plan is presented in table 6.9.

Table 6.9: Watershed Development Programme during the Five-Year Plans

Five Year Plans	Area covered (million ha)	Estimated cost of development (Rs./ha)	Total cost	Cost sharing Ratio *	By Centre	Cost Sharing by States	By People
Tenth Plan (2002-07)	15.0	5,000- 7,000	9,000	50:25:25	4,500	2,250	2,250
Eleventh Plan (2007-12)	20.0	6,000-8,000	14,000	40:30:30	5,600	4,200	4,200
Twelfth Plan (2012-17)	25.0	7,500-9,500	21,250	30:30:40	6,375	6,375	8,500
Thirteenth Plan (2017-22)	28.5	9,000-11,000	28,500	25:25:50	7,125	7,125	14,250
Total	**88.5**	**-**	**72,750**	**-**	**23,600**	**19,950**	**29,200**

* Cost-sharing ratio between Centre, State and People/Community
Source: Tenth Five-Year Plan Report

Environmental Management in Western Coalfields

Western Coalfields Limited (WCL) is one of the eight Subsidiary Companies of Coal India Limited (CIL), which is under administrative control of Ministry of Coal. It has mining operations spread over the states of Maharashtra (in Nagpur, Chandrapur & Yeotmal Districts) and Madhya Pradesh

(in Betul and Chindawara Districts). Coal India Ltd. has well defined Environment policy, that includes compliance with statutes and guidelines issued by Central and State government authorities. It also includes compliance with conditions stipulated in Environmental clearance and taking all necessary measures for mitigation of adverse impacts of mining activities. The degradation of land due to open cast mining is taken care of by following activities.

Technical reclamation: Some of the measures adopted are levelling and terracing, gully plugging, top Surface drainage, filling of cracks and fissures and coil matting wherever necessary.

Biological reclamation: This includes broadcasting of grass seeds, bio-technical measures like using micro culture and plantation to avoid further leaching of contamination. Plantation work has already been done in WCL as plantation is one of the best-known mitigation measures to arrest Air pollution, land degradation and Noise pollution. The WCL has received awards from Government of Maharashtra, International green land society, National wasteland development board attached to MoEF and International Association of educators and world peace affiliated to United Nations, for their meticulous service towards environmental management (WCL, 2004).

State Government Agencies

Action by MPCB

The MPCB prepared an action plan to combat the environmental degradation in the region of coalmines. According to the MPCB, an estimated 1,02,880 people are residing in and around Chandrapur, nearby the coalmines. The average number of blasting carried out in the mines of Chandrapur area is about 95 per month in the Opencast Mines. On an average, there is one blasting per day in each mine but on some days, no blasting is required or done. Controlled blasting techniques prescribed by the Director General of Mines Safety (DGMS) are used to control vibrations caused by blasting operations. In addition, regular monitoring of blasting is undertaken and records maintained thereof, wherever blasting is done within 300 metres of the stipulated danger zone. Blasting in opencast mines is carried out with requisite delay detonators. A study on blasting vibration was conducted by the Chandrapur Engineering College, which indicates that vibrations were within the limits (CoP, 2003).

Efforts of MSEB

The Maharashtra State Electricity Board (MSEB) had set up a special purpose vehicle (SPV) for the exploitation of about 40 virgin coal mine blocks with reserves of more than 100 million tonnes from Nagpur, Chandrapur and Bhandara districts in Vidarbha region. The SPV had entered into a joint venture with private sector for this purpose. In a related development, MSEB has signed a memorandum of understanding with the WCL (Western Coal Fields Ltd) for supply of coal from mines situated at Adasa and Kamptee (underground mines) in Nagpur district, Kolgaon in Yavatmal district, Bhatadi in Chandrapur district and Ghatrohan in Nagpur district (all open caste mines). WCL has been supplying coal to MSEB on cost plus/negotiated basis. At present, of its total requirement of 26 million tonnes of coal per year, MSEB gets 15 million tonnes from WCL and the balance 11 million tonnes from Orissa, Madhya Pradesh and Andhra Pradesh. According to the MoU, WCL signed a commercial agreement with MSEB for the commencement of production of Adasa and Kolgaon. With this understanding, WCL said that base operating levels for underground mines would be 75 percent while it will be 85 percent for opencast mines. The commencement of these mines would produce 2.5 million tonnes per year and it will ultimately help MSEB save Rs.75 crores.

Steps of ULBs

As per the requirements of MoEF, GoI, MCGM has carried out compensatory mangrove plantation on a 40-hectare area, which is identified as suitable coastal area for such plantations by BNHS. Beach cleaning operations have also been undertaken using mechanical beach cleaners at Girgaum, Shivaji Park, Mahim, Juhu and Versova beaches (BMC, 2004).

The NMMC has planned to assess the feasibility of using abandoned quarries for rainwater harvesting; planting trees for restoration of land under abandoned quarries and implement better handling operational facilities with pollution control measures in quarries in operations. In Kolhapur Municipal Corporation (KMC) some of the abandoned quarries are used for dumping of solid waste. A big quarry located at Takala is also under consideration for creation of amusement park (KMC, 2003). The MMRDA commissioned a study on quarrying activities in MMR as early as in 1990. The study was prompted by the environmental damage caused by indiscriminate quarrying for construction material practiced in the region. The objectives of the study were-

- To identify quarry sites for the future requirement of the construction materials in MMR,
- To suggest methodology for scientific quarrying,
- To suggest measures for minimising environmental damage caused by quarrying activity and
- To suggest measures for the restoration and rehabilitation of ravaged quarry sites.

Special Projects in Maharashtra

Adivasi Development Programme in Tribal Areas

The successful implementation of Wadi model in Gujarat, it is being replicated in Maharashtra (Nasik and Thane districts) with grants from Kreditanstalt fur Wiederaufbau (KfW), Germany through Maharashtra Institute of Technology Transfer for Rural Areas (MITTRA), Nasik, an NGO promoted by BAIF, Pune. The programme with a project period of ten years (2000-2010), aims to support 15,000 tribal families by developing wadis on their marginally productive lands. The project, which was launched in September 2000 has covered an area of 2076 ha under wadis belonging to 5676 families from the 160 villages and has been instrumental in bringing about an overall improvement in the quality of life of the families in the project area.

Transfer of Technologies for Sustainable Development

The project is under implementation since 1996-97 through BAIF, Pune and assisted by CEC. It aims at achieving sustainable development of selected small and marginal farmers and landless families by promoting income generating activities and by adopting simple but appropriate technologies. The major activities are orchard development, livestock development, sericulture, watershed, Jana Utthan (basket of activities), health & sanitation and other suitable off-farm activities. The programme covers 217 villages of 11 districts spread over 5 States of Gujarat, Karnataka, Maharashtra, Rajasthan and Uttar Pradesh.

Indo-German Watershed Development Programme

On successful implementation of Phase I of the programme, KfW, Germany has signed a Separate Agreement in April 2000 to provide a further grant assistance under Phase II of *Indo-German Watershed Development Programme*. The programme aims at development of micro watersheds in an integrated and comprehensive manner for achieving sustainable production system through people's participation. During a decade of its implementation, about one lakh hectares of land has already

been treated with the involvement of 65 NGOs and the total disbursements under the programme is more than Rs. 75.45 crore (Phase I + Phase II) as on 30 June, 2004 for 122 watershed projects in 24 districts of Maharashtra. The impact evaluation study of the project areas has shown increase in water table, higher productivity and rise in income levels of the community.

Chapter 7: Disaster Management

Introduction

Natural disasters like floods, earthquakes, droughts, landslides, etc. are caused due to natural disturbances but *manmade disasters* occur mainly due to human negligence or interference. Most of the natural calamities occur quite suddenly without any forewarning. Although some disasters such as floods and cyclones can be predicted in advance, these warnings are often inadequate to take precautionary measures. However, natural calamities like droughts are long lasting and have prolonged adverse impacts. The threats posed by different disasters require protection measures, which differ considerably in terms of preparedness and amelioration of affected areas and people. Calamities could be either major as earthquakes, floods etc., causing great damage to human life and property or minor, as hailstorms, landslides and fire accidents etc., causing relatively less damage.

Over the years, many regions in India have faced the natural calamities of varied degree and scale. Of the 35 states and union territories in the country, 22 are disaster-prone. Floods are a regular feature of Eastern India where the Himalayan Rivers inundate large parts of its catchment areas, uprooting houses, disrupting livelihoods and damaging infrastructure. The flood hazards are compounded by the problems of sediment deposition, drainage congestion and synchronisation of river floods with storm surges in the coastal plains. Major rivers causing floods in different regions of India are Brahmputra and Ganges in the Indo-Gangetic plains, Narmada and Tapi in the Northwest region, and Mahanadi, Krishna and Kaveri in Central India and Deccan region.

Droughts are the natural disasters caused by lack of water in the region. This can be result of less rainfall, which happens mainly due to large- scale deforestation, excessive use of water resources, like wells, etc lead to water shortage. In India, 28 percent of total cultivable area is drought-prone. In 2001, more than eight states suffered the impacts of severe droughts. Analysis of rainfall behaviour for the past 100 years reveals that the frequency of occurrence of below-normal rainfall in arid, semi-arid, and sub-humid areas is 54 to 57 per cent, while severe and rare droughts occur once every eight to nine years in arid and semi-arid zones.

Of all natural hazards, earthquakes seem the most terrifying as they inflict tremendous damage within seconds. Tremors and surface faulting are often just the forerunners of secondary damage, such as fires, floods (caused by dam bursts), landslides quick soil and Tsunamis. About 57 per cent of geographical area of India is earthquake-prone. The fragile Himalayan mountain ranges are extremely vulnerable to earthquakes (and landslides and avalanches). The seismic zoning map divides India into five seismic zones, namely, Zone I, Zone II, Zone III, Zone IV and Zone V, in increasing order of severity of earthquakes where Zone V and Zone I are the seismically most and least active regions, respectively.

With regard to cyclones, about five to six tropical cyclones form in the Bay of Bengal and the Arabian Sea every year, of which two or three are severe and lash the densely populated coastal areas causing severe damage. The states most exposed to cyclone-related hazards, including strong winds, floods and storm surges, are West Bengal, Orissa, Andhra Pradesh and Tamil Nadu along the Bay of Bengal. Along the Arabian Sea on the west coast, the Gujarat and Maharashtra coasts are most vulnerable.

Around 80 per cent of India's geographical area is vulnerable to various disasters as well as other localised hazards. About 76 lakh hectares of land, 37 lakh hectares of crops and over thousands of lives are lost every year due to floods in the country. The super cyclone in Orissa killed over 10,000 people in 1999, and around 16000 people perished in Kutch (Gujarat) due to an earthquake in 2001. Recently (December, 2004), the Indian coastline was badly hit by the Tsunami triggered by an earthquake of magnitude 9.0 on the Richter scale. The total loss in India due to disasters in the year 2003 was estimated more than Rs 700 crores. Natural disasters that have occurred in the country during 1990-2005, population affected and the loss of property incurred are given in Table 7.1.

Table 7.1: Natural Disasters in India during 1990-2005

Type of Disaster (Year)	Location/Area	Affected Population (in million)	Loss of Human Lives (No.)	Loss of Crops and Public Property (Rs. Billion)
Cyclone (May, 1990)	Andhra Pradesh	7.78	928	22.47
Earthquake (Oct, 1991)	Uttarkashi, Uttar Pradesh	0.40	768	0.89
Cyclone (Nov, 1992)	Tamil Nadu, Kerala and Karnataka	0.80	497	8.02
Flood (June-Sept, 1993)	12 States of Assam, Arunachal Pradesh, West Bengal, Bihar, Punjab, Uttar Pradesh, Jammu & Kashmir, Himachal Pradesh, Haryana, Tripura, Mizoram and Maharashtra were affected by floods	28.80	1643	21.06
Earthquake(30 Sep, 1993)	Marathwada in Maharashtra, Karnataka and Andhra Pradesh	0.20	7611	3.10
Cyclone (Dec, 1993)	Tamil Nadu and Pondicherry	-	-	8.85
Cyclone (1999)	Orissa	-	10000	-
Earthquake (Jan 2001)	Gujrat, Kutch	-	16000	-
Tsunami (Dec 2004)	Tamil Nadu, Kerela, Andhra Pradesh, Pondichery, West Bengal, Andaman & Nicobar Islands, Orissa	2.7	10000	
Flood (July 2005)	Maharashtra (Konkan Region)		900	

Source: CSO (1997) and NIUA (2000), Indiastat 2005

Disasters in Maharashtra

Maharashtra is prone to various disasters such as drought, floods, cyclones, earthquake and accidents. While low rainfall areas of the state are under the constant risk of droughts, high rainfall zones of eastern and western Maharashtra are prone to flash floods and landslides. The Koyna reservoir and surroundings fall under the high risk of earthquake hazards. Similarly, Industrial belt of Pune, Mumbai and Nashik are prone to the risk of accident and industrial hazards. Other disasters like fire and road accidents occur in congested areas lacking proper infrastructure. The state has suffered huge losses, both direct and indirect, caused by various disasters. For example, the infamous Latur earthquake of 1993, resulted in the loss of several thousands of human and animal lives. In addition, it caused damage to entire infrastructure such as buildings, roads, railways, pipelines, and electricity network, etc. In order to avoid such losses due to disasters, the GoM has established a

mechanism for disaster preparedness and mitigation by integrating science and technology with communication network facilitates.

Many areas of the State have faced droughts for consecutive years, which damaged agriculture and caused water shortage in more than 20,000 villages. Floods, though, are not a regular phenomenon, took 180 lives in 1996 and, more recently, in July 2005, about 900 people died in the Konkan Region due heavy rainfall of about 37 inches. Box 7.1 and Table 7.2 give an account of disaster vulnerability and district-wise vulnerability of the state, respectively.

Floods and Droughts

In Maharashtra, floods mainly result from damage to the dam embankments, release of excessive water from dams, improper storm-water drainage systems and unplanned urbanisation. Increased migration and rising population due to urbanisation exert tremendous pressure on the existing storm-water drains in the cities. Floods in the urban areas occur due to following reasons.

- The drainage systems in many cities are inadequate and have become obsolete. For example, Mumbai's drainage system was built more than 75 years ago. Considering the growth of city during this period, and the damage that has occurred, the system falls short of needs.
- The problems in drainage system are aggravated because of the large number of new buildings and construction activities in the cities.
- The growth of slums and unauthorised settlements along the drainage system has reduced the width of the natural water streams. Many unauthorised cattle-sheds and waste dealer shops are built near the nullahs, which increased accumulation of solid waste and other garbage into them, thus, making it difficult for the authorities to clean them periodically.
- The gutters in coastal towns are mostly below the sea level, which aggravates the problems of drainage during high tides. Rains during this period flood these cities with rainwater, which takes time to recede, adding to the havoc and disrupting the entire traffic system.

Box 7.1: Disaster Vulnerability of Maharashtra

Floods	The rivers, which cause flood in the state, are the Tapi, Wardha and occasionally the Pen- Ganga. The eastern parts of the state are prone to floods. The 1996 flood in the state destroyed 2,899 lakh hectares of land, killing 198 people and 38 cattle.
Droughts	The Deccan plateau constitutes 50 percent of the drought-prone areas of the state. 12 percent of the population lives in drought-prone areas. Once in 5 years, deficient rainfall is reported. Severe drought conditions occur once every 8-9 years. The 1996 drought affected 7 districts and 266.75 lakh people. The 1997 drought affected 17 districts.
Earthquakes	This state lies in seismic Zone I. Latur in Maharashtra experienced a number of shocks between August and October 1992. An earthquake measuring 6.4 on the Richter scale shook Latur on September 30, 1993. Extensive damage was caused to life and property in the districts of Latur and Dharashiv. The earthquake killed 7,938 people, injured 16,000, and left 15,847 livestock dead. 52 villages were razed to the ground and around 27,000 houses were totally damaged. The Koyna dam is situated in one of the most active seismic zones of Maharashtra and in 35 years this region has witnessed more than one lakh tremors. A severe quake occurred in Koyna on December 11, 1967. The quake was the strongest earthquake on Maharashtra Konkan coast in the 20th century. The magnitude ranged between 6.5 and 7.5 on the Richter scale and was felt all over western Maharashtra, Goa and Karnataka; the epicentre was near the Koyna Dam. Over 200 people died and hundreds more were injured. An earthquake measuring 3.7 on the Richter scale hit Maharashtra Koyna region as recently as March 2001.

Source: Infochange (2005)

Table 7.2: District-wise disaster vulnerability of Maharashtra

District	Flood	Earthquake	Cyclone	Droughts0.
Ahmednagar	Three per cent of the population lives in flood-prone areas	83 % of human settlements are in areas with non-specific building codes	Yes	Drought-prone
Akola	Patur taluka has the largest flood-prone area (57%), followed by Barsi Takli (48%), Akot (45%), Balapur (40%) etc	Yes	No	Yes
Amravati	Flood-prone along the Wardha river; eight floods in the last 15 years	Yes	No	Yes
Aurangabad	Small floods (Ranks 3 in the district disaster management plan)	Yes	No	Yes
Beed	Flood-prone: almost 26 % of the population lives in flood-prone areas	Yes	No	Yes
Bhandara	Flood-prone along the Vainganga river	Yes	No	Yes
Buldhana	No	No	Yes	Yes
Chandrapur	Flood-prone; 12 major floods in last 30 years causing 47 deaths and loss of Rs 3400 lakhs	Minor seismic activity	No	Yes
Dharashiv	Medium probability	Ranks first in disasters in the state. Large-scale property and loss of life in the 1993 earthquake.	No	Yes
Dhule	170 villages identified as flood-prone every year	Yes	No	Yes
Gadchiroli	Three major floods in the last 10 years; 9.89 % of the population lives in flood-prone areas	Probability increased after the Jabalpur earthquake	No	Yes
Jalgaon	No	No	No	No
Jalna	7 floods in the last 30 years; 196 villages flood-prone	Weak zone possibility after the Marathwada earthquake of 1993	No	Yes
Kolhapur	Severe floods in 1989 and 1994; 188 riverside villages are prone to flood	Earthquakes with epicentres in the adjoining districts affected villages in 1967-68 and 1993-94	No	Yes
Latur	No	Indicated in zone IV: very high probability; massive earthquake in 1993	Yes	Drought-prone
Mumbai	Yes	Yes	Yes	No
Nagpur	Flood-prone during monsoons. Seven major floods in the last 30 years. 13 % of the population lives in flood-prone areas.	Vainganga and Wardha river basins are earthquake-prone. Total population at risk: 3,66,631. Recorded tremors of 4.2 on the Richter scale during the Jabalpur earthquake.	No	Yes
Nanded	History of frequent floods due to heavy rainfall and release of water from irrigation projects	Yes	Likelihood of cyclones because of proximity to Andhra Pradesh	Yes
Nashik	Three major flood-prone areas: Chandori, Saikheda, Niphad; 38.33 % of the population lives in flood-prone areas	Two earthquakes on the same day in 1993 (5.2 and 4.5 on the Richter scale); frequent tremors around Kalwan taluka from 1995 onwards	No	Yes
Parbhani	Medium probability, based on rainfall	Yes	No	Yes
Pune	Yes	Tremors felt during all major earthquakes that affected western and Marathwada regions of the state and also during the Gujarat earthquake.	No	Yes
Raigad	Yes	Yes	Yes	No
Ratnagiri	Possibility of river floods in the monsoon	The Koynagar earthquake of 1967 affected Chiplun and Sangameshwar talukas killing three people. Chances of future earthquakes are rare.	167 km coastline could attract cyclones. No major cyclones in the past.	No
Sangli	Flood-prone. 15 floods in the last 30 years	Vulnerable to earthquake. Severe earthquake in 1967 (6 on the Richter scale); in 1993 (5.5 on the Richter scale)	No	Yes
Satara	Possible monsoon floods	Strong possibility of earthquake. Also reservoir-induced seismicity.	No	Yes
Sindhudurg	Prone to floods due to high rainfall and rush of seawater during high tide	Yes	No	Yes
Solapur	Possibility of floods. Major flood on the Bhima river in 1996.	Tremors felt during the 1967 Koyna earthquake. 11 dead during the 1993 Latur earthquake. Included as seismic zone II	No	Commo
Thane	Yes	Yes	No	Yes
Wardha	Great threat of floods. Major flood in 1994	Yes	No	Yes
Yavatmal	Heavy floods in 1994	Yes	No	Yes

Source: Compiled from Infochange (2005)

The eastern parts of the state are more prone to floods. The Tapi, Wardha and occasionally the Pen Ganga are the rivers causing floods in the State. The 1996 floods in the state destroyed 2,899 lakh hectares of land, killing 198 people and 38 cattle. In some cities like Mumbai land reclamation over the years has disturbed the natural drainage system. Therefore, city's low-lying areas are under the threats of floods even if there are minor rains. In Mumbai, there are 111 places in the city, 26 in Mumbai city district, and 73 in the eastern suburbs and 12 in the western suburbs that were identified in 1993 as flood prone areas. On July 26, Mumbai's suburbs were hit by 949 millimeters (37 inches) of rainfall, the heaviest downpour in a century. This resulted in heavy floods killing at least 900 people and huge damage to property.

Drought-affected districts in the State get annual rainfall in the range between 600 to 750 mm through Southwest monsoon, almost all of which is received between June to October. About 50 percent of the drought prone areas of Maharashtra are in the Deccan Plateau. About 90 per cent of the land in the state has basaltic rock, which is non- porous and prevents rainwater percolation into the ground and thus makes the area drought prone.

Earthquakes and Landslides

Earthquakes in Maharashtra are showing major alignment along the west coast and Western Ghats region. Seismic activity can be seen near Ratnagiri, along the western coast, Koyna Nagar, Batas and Surry areas of Thane district. The north-south trend further continues deep inside Gujarat. The striking characteristic of this narrow region is its alignment with the hot spring belt. The off-coast activities are associated with submerged faults along the west coast of Maharashtra. In north Maharashtra, the seismic activities near Dhule, Akola, Jalgaon and Amravati could be due to movements on the faults present in the area associated with the complex system of Narmada, Tapi and Purna. In north-east corner of Maharashtra, the earthquake activities in Nagpur and Bhandara districts may be associated with Deolapar thrust or sheared and faulted zones of Ramtek and Sakoli Basins.

Earthquakes in Koyna region occur mainly due to the weight of the reservoir water in demand due to the Koyna river faults. It can be seen that the river flows straight southward upstream of the dam and then turns abruptly to the east at right angles further downstream. These two straight segments of the river are the "faults" and anyone of them may be responsible for the tremors at any particular time (ToI, March, 2005). Isolated activities are experienced near Beed, Nanded, Ujjani and Solapur in eastern Maharashtra and Uran, Kolhapur and Sindhudurga in southwest Maharashtra. These activities may be due to movements on local faults in the basement. Seismicity is also seen near Bhatsanagar and Suryanagar. Recently, isolated activities also occurred in Latur, Dharashiv districts in southeast Maharashtra. Table 7.3 represents the district wise seismic zones in Maharashtra and possible earthquake intensity on MSK (Medvedev-Sponheuer-Karnik) scale.

A landslide is sudden collapse of a large mass of hillside where earth, rock, mud, and debris flow down the side of a slope. Landslides occur, mainly due to vertical cutting of hills, for construction of houses, roads, railway lines, etc. In absence of proper embankment material, heavy rains lead to falling of earth matter and debris. Most cases of landslides occur during heavy rains associated with high velocity winds. Many regions in the state face the risk of landslides due to increased pressure on land. For example, in Greater Mumbai region, many vacant sites on hill slopes or bottoms of hills have turned into inhabited area and thereby become vulnerable to landslides. Landslides sometimes result in loss of human lives and damage to structures such as houses and roadways.

Table 7.3: District wise Seismic Zones in Maharashtra

District	Geo-Graphical Area	Seismic Zones of Towns	Earthquake Intensity MSK
Ahmednagar	17048	III	VII
Akola	5429	II	VI
Amravati	12210	II	VI
Aurangabad	10107	II	VI
Bhandara	3895	II	VI
Beed	10693	III	VII
Buldhana	9661	II	VI
Chandrapur	11443	III	VII
Dharashiv	7569	III	VII
Dhule	8063	III	VII
Gadchiroli	14412	II	VI
Gondia	5425	II	VI
Hingoli	4524	II	VI
Jalgaon	11765	II	VI
Jalna	7718	II	VI
Kolhapur	7685	III	VII
Latur	7157	III	VII
Mumbai	157	III	VII
Mumbai (Suburban)	446	III	VII
Nagpur	9802	II	VI
Nanded	10528	II	VI
Nandurbar	5034	III	VII
Nashik	15530	III	VII
Parbhani	6517	II	VI
Pune	15643	III	VII
Raigad	7152	IV	VIII
Ratnagiri	8208	IV	VIII
Sangli	8572	III	VII
Satara	10480	IV	VIII
Sindhudurg	5207	III	VII
Solapur	14895	III	VII
Thane	9558	III	VII
Wardha	6309	II	VI
Washim	5153	II	VI
Yavatmal	13582	II	VI

Source: Infochange (2005)

Cyclones

Cyclones are less frequent in Maharashtra and mainly occur due to change in temperature and pressure of atmosphere. The coastal region of Maharashtra is climatologically an area where frequency of cyclonic disturbances is very low. However, the coastal districts, especially the 167 km long coastlines along Ratnagiri can be hit by cyclones. In the Arabian Sea, during the period 1890-1995, around 207 depressions, mild cyclonic storms or severe cyclonic storms have been recorded. However, most of them have moved away from Maharashtra as out of 207 disturbances, only 19 have affected Maharashtra-Goa coast. Out of these 19, six were major ones causing 70 deaths, with 150 boats and 160 crew missing and extensive damage to trees and ships. Thus, in spite of having a long coastal region, Maharashtra has experienced only 6 cyclones in last 50 years, though there have been numerous threats. Thus, climatologically, the state is having low risk of cyclone.

Manmade Disasters

Unnatural and manmade disasters such as road accidents, industrial accidents, fires, accidents in quarries and mines, drowning, explosion etc. may occur due to some technical blunders or man made changes in the environment. Some of the examples of such disasters are described as follows.

Road Accidents

Road accidents occur mainly due to poor maintenance of roads, mixed and heavy traffic, unsafe vehicles, lack of safety belts and helmets, lack of safe driving habits, poor emergency services and lack of enforcement of regulations.

In India around 80,000 people are killed in more than two lakh road accidents every year, of which 50 percent of the deaths occur in the metros. Roads in India are dangerous, as per developed country standards, with an annual fatal accident rate of about 2.65 deaths per 1000 registered vehicles. This is very high when compared to a range of 0.15 (Japan) to 0.38 (France) in developed countries and even for Maharashtra state (1.87) (World Bank 1995). A comparison of the trend in the number of accidents shows that from 1970 to 1980 the total number of accidents in India increased by 19%, while the counterpart figure for Maharashtra State was of the order of 10%. In the next ten years between 1980-1990, the respective figures for India and Maharashtra were 49% and 31%, respectively. The rate of increase fell, stabilising between 1990 to 1993 for India as a whole while in the case of Maharashtra state, between 1991 and 1993, the figure decreased sharply by 34%.

Table 7.4 shows the accident-prone spots on the national and state highway. National highways have about 107 accident prone spots (107) with maximum spots at NH 4 i.e. Mumbai-Pune highway (51) and State highways have 50 of such spots. This highway has the maximum traffic density and the main cause of accidents on this highway apparently was due to carelessness of drivers especially during overtaking. Table 7.5 gives the district-wise statistics of road accidents occurred in the State. The data indicates that more than nine cities (Amravati, Aurangabad, Mumbai, Nagpur, Nashik, Navi Mumbai, Pune, Solapur and Thane) account for more than 60 per cent of road accidents with highest share of more than 30% from Mumbai only.

Table 7.4: The distribution of accident-prone spots on the National and State Highways

National Highways	No. of accident prone spots	State Highways	No. of accident prone spots
NH 3	18	Sion-Panvel Expressway	8
NH 4	51	SH 10	12
NH 6	9	SH 30	2
NH 7	1	SH 60	21
NH 8	6	SH 204	7
NH 9	9		
NH 17	13		
Total	**107**	**Total**	**50**

Source: RRD (2004)

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Table 7.5: District-wise Number of Road Accidents in Maharashtra for various years

Districts	Number of Accidents (Calendar Year)						
	1995	1996	1997	1998	1999	2000	2001
Raigad	2108	2243	2222	2157	1911	1875	1957
Ratnagiri	939	1084	1004	1001	1038	1058	1027
Sindhudurg	467	574	670	654	636	548	546
Thane (Rural)	3605	3776	3578	3551	3555	3124	3050
Total Thane Range	**7119**	**7677**	**7474**	**7363**	**7140**	**6605**	**6580**
Kolhapur	1474	1565	1485	1529	1518	1580	1156
Pune (Rural)	3569	3879	3632	3437	3526	3411	1759
Sangli	1078	1120	1113	1083	1116	1169	900
Satara	1483	1624	1736	1632	1572	1662	866
Solapur (Rural)	1178	1356	1368	1334	1182	1246	731
Total Kolhapur Range	**8782**	**9544**	**9334**	**9015**	**8914**	**9068**	**5412**
Ahmadnagar	2157	2186	1988	1935	2225	2221	2000
Dhule	1536	1686	1700	1452	1295	1397	1134
Nandurbar				215	474	461	397
Jalgaon	1099	1153	1108	1115	1188	1058	938
Nashik (Rural)	2365	2476	2501	2520	2621	2465	2377
Total Nashik Range	**7157**	**7501**	**7297**	**7237**	**7803**	**7599**	**6846**
Aurangabad (Rural)	494	465	609	616	618	632	548
Jalna	287	317	352	360	411	400	421
Beed	441	544	553	604	628	607	597
Dharashiv	639	659	619	565	631	650	592
Total Aurangabad Range	**1861**	**1985**	**2133**	**2145**	**2288**	**2289**	**2158**
Nanded	702	701	713	703	725	736	837
Latur	405	541	573	598	553	553	577
Parbhani	524	648	615	569	424	314	360
Hingoli					88	245	276
Total Nanded Range	**1631**	**1890**	**1901**	**1870**	**1790**	**1860**	**2050**
Akola	905	954	1115	1019	793	695	790
Washim				136	274	263	285
Amravati	1128	1203	1093	943	667	722	1221
Buldhana	590	604	636	616	630	636	625
Yavatmal	848	949	884	937	955	903	831
Total Amravati Range	**3471**	**3710**	**3728**	**3651**	**3319**	**3219**	**3752**
Bhandara	580	700	694	759	604	437	449
Gondiya					222	347	506
Chandrapur	605	710	730	840	744	585	257
Gadchiroli	189	150	178	198	201	240	498
Nagpur (Rural)	1406	1329	1496	1406	1230	1074	442
Wardha	464	574	564	719	621	563	996
Total Nagpur Range	**3244**	**3463**	**3662**	**3922**	**3622**	**3246**	**3148**
Mumbai City	27564	29808	27496	26941	25945	26436	26329
Thane City	3115	3034	2913	3017	2262	2038	2159
Nashik City	1180	1308	1316	1300	1199	1245	1119
Aurangabad City	548	579	608	568	569	591	533
Solapur City	359	391	385	368	335	353	375
Pune City	3177	2801	2844	2644	2588	2384	2199
Navi Mumbai	2410	2306	2428	2576	2488	2614	2114
Amravati City				168	378	475	517
Nagpur City	1467	1575	1748	1644	1591	1528	1703
Total Cities	**39820**	**41802**	**39738**	**39226**	**37355**	**37664**	**37048**
Grand Total for State	**73085**	**77572**	**75267**	**74429**	**72231**	**71550**	**66994**

Source: Motor Transport Statistics of Maharashtra (2002)

Industrial Accidents

Industrial hazards occur mostly due to accidents during chemical processing, manufacturing, storage, transport and disposal of toxic waste. Thousands of industries are involved in the manufacturing, processing or storage of hazardous goods. Many of the storage godowns are in the close proximity of the residential and industrial estates, which increased the risk of fires and chemical explosions in these areas.

As seen from the Table 7.6, the maximum number of accidents in the State, in all the selected categories of industries, are recorded in Thane and Mumbai. The industry category showing maximum number of accidents and fatalities is the manufacturing of rubber, coal and petroleum. Districts with a large number of Major Accident Hazard Units in Maharashtra are Thane, Mumbai, Nashik, Pune, Raigad and Ratnagiri. Maximum number of accidents in industries manufacturing chemical and chemical products were in Nashik, Mumbai and Thane divisions. The number of accidents recorded in the manufacture of non-metallic mineral petroleum is almost half of those recorded in the other two categories. Raigad division shows the maximum number of accidents due to gassing. Thane and Aurangabad had the maximum number of explosions, while fire related accidents were the highest in Nashik. The major concentration of the hazardous industries is seen in the Chembur-Trombay belt, spread over an area of about 10 sq.km, having major chemical complexes, refineries, fertiliser plants, atomic energy establishment and thermal power station. Clustering of various operating units make them highly vulnerable. This area is also in close proximity to the port activities of Mumbai Port Trust (MPT), which handles hazardous cargo. MPT has identified 32 hazardous chemicals, require frequent handling and storage during loading and unloading operations.

Table 7.6: Number of Fatal and Non-Fatal Accidents* recorded for specific categories of industries.

Name of Office	Category of Industries**						
	30		31		32		
	F	NF	F	NF	F	NF	Total
Mumbai	4	235	9	369	1	131	749
Thane	8	221	6	514	9	273	1031
Pune	3	190	-	154	-	43	390
Nashik	-	315	3	92	-	1	411
Kolhapur	2	58	-	22	1	12	95
Aurangabad	-	18	14	39	-	24	95
Nagpur	2	21	-	25	2	28	78
Raigad	7	54	1	11	2	46	121
Total	**26**	**1112**	**33**	**1226**	**15**	**558**	**2970**

Source: RRD (2004); Note: F - Fatal; NF - Non-Fatal * The fatal and non-fatal accidents shown in this table are only those recorded due to explosions, fires and gassing. ** Categories of Industries are: Industry No.30- Manufacture of chemical and chemical products; Industry No.31 Manufacture of rubber, coal and petroleum; Industry No.32 Manufacture of non-metallic mineral petroleum

Fire Accidents

The fire risk can arise either from industrial processes, accidents in storage godowns or closely built timber framed buildings. Many areas in the State have faced fire accidents in godowns, during manufacturing in factories and festival seasons. Major cities in the State, due to congestion, are more prone to fire accidents. For example, in Mumbai, various fire accidents occur due to inadequate fire-fighting facilities in high-rise buildings, illegal electrical connections, increased load on transformers, commercial activities, and industries such as oil refineries, petrochemical industries and large slum settlements. Fire accidents resulted from LPG blast in the hotels and homes, short circuit in the electrical fittings of the houses and factories, explosion in godowns storing hazardous chemicals, firecrackers, etc. have caused heavy damage to life and property in the State.

Impact of Disasters

Floods

More than two lakh hectares of land in Maharashtra is prone to floods and Patur taluka in Akola district has the largest flood prone area in the State. Nanded and Nashik are frequently affected by floods in the monsoons. A severe flood hit Wardha, Yavatmal, Kolhapur and few other districts in 1994. Chandori, Saikheda and Niphad are the three major flood-prone areas in Nashik district. A series of landslides triggered by heavy monsoon rains have killed at least 418 people in Maharashtra in the month of July, 2005, and more than half of these deaths are reported from Mumbai (Indian Express, 28 July 2005). A number of landslides had occurred in Mumbai and Raigad districts due to heavy rains in July and August 2005 killing several people and causing loss to property.

Droughts

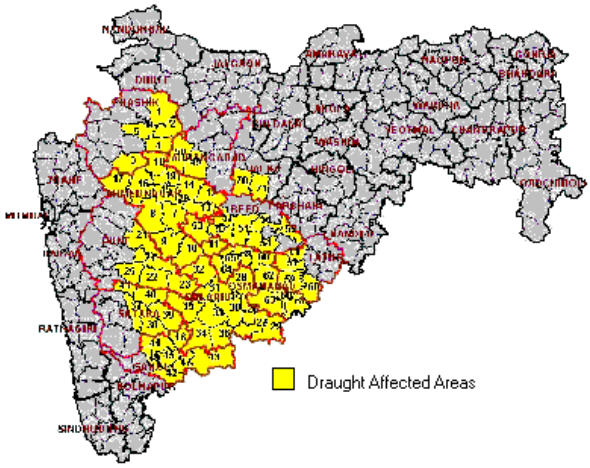
In 2001, droughts affected about 20,000 villages in 23 districts; 28.4 million people and 4.5 million hectares of crops in the State. According to a report from the GoM, number of districts affected by droughts in the year 2002-03 and 2003-04 were 33 and 11, respectively. Deficient rainfall in Western Maharashtra and Marathwada regions for successive years has severely affected agriculture in the region, which is the main source of livelihood and employment. The situation of droughts in Maharashtra continued to deteriorate in 2004. Following the failure of monsoon in 2003, the GoM declared droughts in 11 districts namely, Pune, Satara, Sangli, and Solapur (Pune Division), Nashik and Ahmednagar (Nashik Division) and Beed, Latur, Dharashiv and Aurangabad (Aurangabad Division). Altogether 71 talukas in these 11 districts are seriously affected by the droughts (Figure 7.1). The list of drought affected districts and talukas of the state for 2003-04 is given in Table 7.9. and some major impacts of droughts are mentioned as follows.

Effect on Water Storage

Poor rainfall has affected all the irrigation projects in the drought-affected regions of the State. The situation has become extremely difficult for the people who are dependent upon agriculture for their livelihood. The live storage in all the dams has been going down since 2000 in three divisions viz. Nashik, Pune and Aurangabad. In Nashik division, where only Ahmednagar and parts of Nashik district are affected, the water storage has slightly improved this year. However, in Pune and Aurangabad divisions, the total water available in reservoirs has depleted substantially. The water storage in Jayakwadi, the biggest dam in Maharashtra, was at an all-time low, just above the dead storage. In other major dams in the drought-affected areas such as Bhima, Ujani, Majalgaon and

Lower Terna dams, there is no live storage. Not only has the low level of water storage reduced the water for irrigation and impacted the cultivation; it has a major impact on the availability of drinking water in these districts.

Fig 7.1: Drought Affected Areas



Source: RRD (2004)

Table 7.9: Drought-affected Districts and Talukas

District	No. of affected Talukas	Name of Taluka
Ahmednagar	14 (All)	Sangamner, Kopargaon, Shrirampur, Akola, Pathardi, Parner, Shrigonda, Ahmednagar, Rahata, Jamkhed, Shevgaon, Rahuri, Nevasa, Karjat.
Aurangabad	2	Vaijapur, Gangapur
Beed	7	Parli, kaij, Ashti, Patoda, Beed, Shirur, Wadvani.
Dharashiv	8 (All)	Dharashiv, Tuljapur, Umarga, Lohara, Kalamb, Vashi, Bhum, Paranda
Jalna	2	Ambad, Ghansavangi.
Latur	4	Latur, Renapur, Ausa, Nilanga.
Nashik	6	Yevala, Sinner, Nandgaon, Chandvad, Devla, Malegaon,
Pune	5	Baramati, Daund, Indapur, Purandar, Shirur.
Sangli	7	Jat, Kavatemahankal, Tasgaon, Miraj, Khanapur, Atpadi, Kadegaon.
Satara	5	Maan, Khatav, Khandala, Phaltan, Koregaon
Solapur	11 (All)	Barshi, Karmala, Madha, Malshiras, Mangalvedha, Mohol, Pandharpur, Uttar Solapur, Sangola, Dakshin Solapur, Akkalkot.

Source: RRD (2004)

Effect on Agriculture

The droughts have affected agriculture many districts and areas in Pune division are more affected than others. About 14 percent of the land under kharif crops has remained unsown in the year 2003-2004. As a result, the kharif production has suffered heavily in affected 11 districts. There are serious production and monetary losses for all the crop groups in these districts. Except for kharif oilseeds, the production losses have been more than 25 per cent. The production loss in the drought-affected districts is 1.77 times more than the State figures and the monetary loss in the affected districts is 0.62 times more than the State figures under kharif. Similarly, the production loss for all the crop groups under rabi has been more than 40 per cent. The production loss for rabi crops in the affected districts is 1.13 times more than the state figures and the monetary losses in the affected districts is 0.6 times of the state figures. In many districts, particularly Solapur, Sangli, Pune and Ahmednagar, horticultural plantations are very seriously affected by droughts. Most of the plantations completely dried up, and many of them had to be uprooted. There is a large area in these districts where re-plantation of horticultural crops would have to be undertaken. Of the fruite crops, pomegranate and grapes are most damaged.

In a report submitted to the National Human Rights Commission (NHRC), the Maharashtra government has admitted that 140 farmers in the state committed suicide between 2001 and 2004, as they could not cope with the twin burdens of crop failure due to droughts, and heavy indebtedness.

Earthquakes

On several instances, earthquakes have caused severe damage in the State. A massive earthquake struck Maharashtra on September 30, 1993 at Killari in Latur district. Extensive damage was caused to life and property in the districts of Latur and Dharashiv with 7,928 people killed, 16,000 injured and 15,847 livestock killed. In Latur and Dharashiv, 52 villages were razed to ground wherein 27,000 houses, amenities and related infrastructure facilities were totally damaged. Nearly 2,20,000 houses in the adjoining villages of Latur and Dharashiv and 11 other districts of Solapur, Satara, Sangli, Beed, Parbhani, Ahmednagar, Nanded, Kolhapur, Aurangabad, Pune and Nashik suffered varying degrees of damage. A moderately strong earthquake of magnitude 5.1 Richter occurred on 14 March 2005, with its epicentre around Koyna. This area has been witnessing a large number of tremors of low magnitude consistently over a quarter of a century since the first earthquake appeared in 1968.

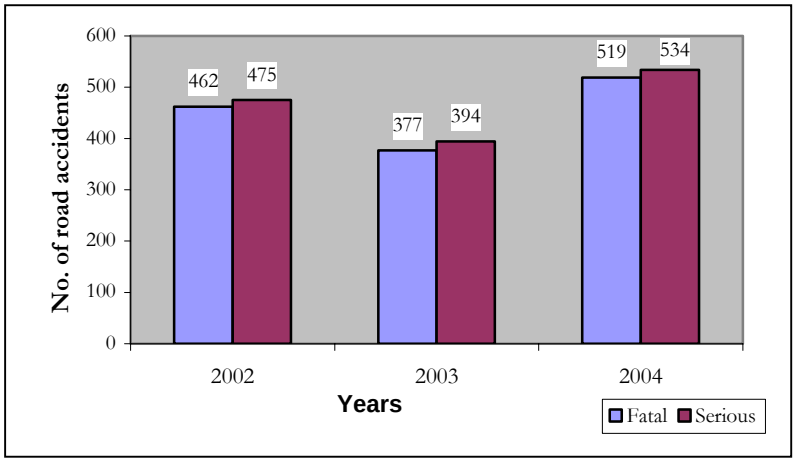
Road and Industrial Accidents

Table 7.5 shows the loss of life due to road accidents in various districts of the State. One major cause for the increase in road accidents is due to the mobile phone culture. Use of mobile phones even whilst crossing the road, results in divided concentration leading to several accidents. Impact of road accidents are more frequent in major cities due to large number of vehicles. For example, Mumbai currently has a vehicular population of 11.23 lakh and more than 200 new vehicles roll on the roads every day. The latest statistics of road accidents in the city shows that about 385 males and 52 females have been killed in fatal accidents in 2004. Maximum number of deaths due to accidents is recorded among the people between the age group 26–40 years (Figure 7.2).

Among industrial hazards, oil and gas industry is one of the major culprits. Some of the industries are receiving crude oil through underground pipelines. These include, NOCIL, HPCL, BPCL and Patalganga. There have been incidents of underground leakages and fires. Monitoring of these pipelines particularly when these are passing through areas adjoining residential and slum

settlements in the city is currently done through monitoring points. These pipelines, therefore, pose a constant risk. In addition, piped natural gas supply to households has started in some suburban areas and is intended to cover most of the suburbs. In view of this, the risk of fires due to leakage of gas is an added dimension.

Figure 7.2: Road Accident Statistics of Mumbai



Source: ToI, April 2005

Response of Authorities

As most of the disasters are natural and can not be prevented or controlled in advance, the GoM, along with National Disaster Management Division of GoI, has prepared action plans for handling various situations, which lead to disaster. This includes Contingency Planning, Disaster Management Plan, District Disaster Management Plan (DDMP) and is also working on GoI-UNDP Disaster Risk Management Programme. All these plans help in combating disaster in well organised manner.

GoI and UNDP

Ministry of Home Affairs (MHA), GoI and United Nations Development Programme (UNDP) are implementing the project entitled "Disaster Risk Management Programme (DRMP) " in Maharashtra in consultation with Relief and Rehabilitation Department identified as the State Nodal Agency of the GoM. The programme is being implemented in a phased manner in 17 states in India, and in Maharashtra it is being implemented in 14 identified districts and seven major cities. The implementation period of the programme is 2003-2007 as given in Table 7.10.

Table 7.10: Identified Programme Districts under DRMP in Maharashtra (2003-2007)

Division	Districts
Pune Division	Kolhapur, Pune, Satara
Aurangabad Division	Latur, Dharashiv
Konkan Division	Mumbai, Mumbai Suburban, Raigad, Ratnagiri, Sindhudurg, Thane
Nashik Division	Nashik, Ahmednagar, Dhule

Source: NDM (2003)

Objectives of the DRM Programme

The objectives of the programme include sustainable reduction in vulnerability to disasters in the most multi-hazard prone districts in the state. The programme components include:

- Setting up the system and framework for disaster risk management.
- Development of national/state database on vulnerability to disasters, risk management and sustainable recovery.
- Strengthening the state government initiatives through support for hardware and software for DRM and capacity building of institutions.
- Support to include disaster management in school curriculum and schedule to organise drills in disaster prevention and response for schools.
- Promoting partnerships with academic institutions and private sector in development of disaster risk management plans.
- Development of training manuals in disaster management for District, Block, Gram Panchayat, Villages/Wards for the state in vernacular languages.
- Capacity building activities for all stakeholders including people, civil society organisations in the rescue, relief and restoration in disaster situations, and the use of equipments involved and awareness campaigns on disaster mitigation and preparedness.
- Updating of district multi-hazard preparedness and mitigation plans integrating Block/ULB, Gram Panchayat, Village/Ward plans which would involve revision of, if required, vulnerability mapping, risk assessment and analysis, hazard zoning, resource inventory, etc.
- Strengthening disaster management information centres in the state and districts for accurate dissemination of early warning and flow of information for preparedness and quick recovery operations.
- Dissemination of cost effective technologies for hazard resistant housing – including retrofitting/roof-top rainwater harvesting features as long-term mitigation measures.
- Updating vulnerability and risk indices, and annual vulnerability and risk reduction reports for creating benchmarks to measure DRM.

Many times it is possible to alert public or authorities concerned with disaster regarding onset of warnings for disaster. These warnings help people to prepare for disaster, and to certain extent reduce the impact of disaster by actions. For example, evacuation of people from coastal areas in case of cyclones, can be taken and damage can be minimised. It is assumed that the district administration would be one of the key organisations for issuing warnings and alerts. Additionally, the following agencies authorised by DAMP for issuing warning or alert are as given in Table 7.11.

Table 7.11: Agencies Issuing Warning

Type of Disaster	Agencies
Earthquakes	IMD, MERI, BARC
Floods	Meteorological Department, Irrigation Department
Cyclones	IMD
Epidemics	Public Health Department
Road Accidents	Police
Industrial and Chemical Accidents	Industry, MARG, Police, DISH, BARC, AERB
Fires	Fire Brigade, Police

Source: RRD (2004)

GoI and GoM

The Government of India has released Rs. 77.46 crores from the National Contingency Calamity Fund (NCCF), out of which an amount of Rs. 33. 21 crores was for relief employment. Table 7.12 shows the funds released under the calamity relief funding during 2000-2005. It also has released 35.82 crore as an advance instalment of the CRF allocation for 2004-05. The total funding that the Government of Maharashtra has availed through the Calamity Relief Fund (CRF) and the NCCF for the last three years is given in Table 7.13.

Table 7.12: Calamity Relief Fund during 2000-2005

Year	Rs. in lakhs
2000-2001	15720
2001-2002	16506
2002-2003	17332
2003-2004	18198
2004-2005	19108
Total	**86864**

Source: NIDM (2005)

Table 7.13: Allocation under the CRF and NCCF *(Rs. in crores)*

Year	Total Allocation under CRF	GoI's Share	State's Share	NCCF	
				(Rs. in Crores)	Foodgrains (Lakh MTs)
2001-02	165.88	123.81	41.27	-	1.5
2002-03	173.32	129.99	43.33	20	2.32
2003-04	181.98	136.49	45.49	77.46	7
2004-05	191.07	143.31	47.77	-	-

Source: Indiastat (2005)

Disaster Management Plan of the GoM

As a part of overall preparedness of the State, the GoM has a State Disaster Management Plan to support and strengthen the efforts of district administration. The Centre for Disaster Management (CDM) of the GoM was set up in August 1996 with support from the Natural Disaster Management Division, Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India. Its infrastructure consists of Documentation Centre and a stand-by Control Room (with 30 seconds connectivity for Video Conferencing, VSAT, Email and Fax Communication (www.yashada.org).

The functions and activities of the CDM are-

- To co-ordinate the activities related to disaster management in Maharashtra, especially, at the State and District levels;
- To develop a set of training modules and case studies on disaster management; and
- To develop disaster preparedness and capacity building through preparation of district disaster management plans.

Under 1996 Disaster Management Council's mandate, the Government of Maharashtra prepared a plan, which involves:

- Scrutinising disasters like earthquakes, floods, cyclones, epidemics, road accidents, industrial and chemical accidents, and fires,
- Estimating their footprint and reach,
- Listing down the monitoring facilities and regulatory regimes,
- Tracing the counter measures available to handle the disasters.

The existence of a scarcity manual and a national contingency action plan, which establishes the Union Ministry of Agriculture as the nodal agency for drought management, has kept drought out of the DMP. Social scientists in disasters and development, while appreciating the step taken, argue that the exclusion of drought from the ambit of the Central plan is unscientific and politically motivated.

The DMP outlines institutional contingencies, including public and private resource inventories and has a satellite-backed VHF (very high frequency) network connecting 323 blocks to control rooms in 31 districts, uplinked to six divisions with access to the Emergency Operations Centre at the administrative headquarters in Mumbai. An urban version will link Mumbai's 23 civic wards to municipal headquarters. A Geographical Information System (GIS) will incorporate a digitised database on land resources, vegetation, drainage and river networks, terrain conditions, and socio-economic structure of every city, town, taluka, and village in the state on a scale of 1:50,000. The proposed scale in Mumbai is 1:2,5000. While the GIS will handle hazard forecasting, loss estimation, emergency responses, and development planning, its optimisation depends on data input quality.

District Disaster Management Plan

To support and strengthen the efforts of district administration, every district has evolved its own District Disaster Management Plan (DDMP) that addresses the districts' response to the disasters.

The objectives of DDMP are-

- To improve preparedness at the district level, through risk and vulnerability analysis of disasters and to minimise their impact in terms of human, physical and material loss.
- To ascertain the status of existing resources and facilities available with the various agencies involved in the district and make it an exercise in capacity building of district administration.
- To utilise different aspects of the disaster for development planning as a tool for location and area specific planning for development of district.

As a part of this plan the control rooms are established at the Collectorate and at each Tehsil office in the district, which are kept functioning 24 hours a day, during the rainy season only. The phone numbers are informed to all departments. The Superintendent of Police office and public hospitals are directed for preparations in case of emergency situations and contact is maintained with the police control room. The District Control room has facilities of wireless communication, hot line, fax, e-mail and video conferencing.

Measures for Droughts

In response to the serious drought situation that persists the State, the GoM has undertaken to implement relief measures, which include Provision of relief employment, Supply of drinking water, and Distribution of fodder in cattle camps. These measures have been continuing since the beginning of the financial year, 2003 and as the droughts conditions got intensified, the scale on and the expenditure on these measures has also been increased. The GoM is incurring a huge

expenditure on drought relief and mitigation. The average expenditure per day works out to be between Rs. 4 to 5 crores on all the measures. The total expenditure on drought mitigation has been Rs.1,194 crores till the end of March 2004. It is reported that the GoM has agreed to pay a compensation of Rs 1 lakh to the families of the 140 dead farmers (TIE, 2005:b). The break-up of these expenditures for all the drought prone 11 districts is given in Table 7.14.

Table 7.14: Expenditure on Droughts

Activity/ Measure	Expenditure
Water Supply	Rs. 242.00 crores
Cattle Camps	Rs. 190.00 crores
Lift Irrigation Scheme	Rs. 20.11 crores
Employment Guarantee Scheme	Rs. 742.66 crores
Total	**Rs. 1,194.77 crores**

Source: RRD(2005)

Employment Guarantee Scheme (EGS)

The total number of works and labour under the Employment Guarantee Scheme (EGS) in drought prone districts is 10,290 and 8.62 lakhs, respectively. The scale on which relief employment has increased, shows the lack of agricultural employment in rural areas and an ever-increasing demand for employment. Every week there is an increase in the number of workers by thousands and it is expected to go further. In all the districts, the number of labour under the EGS has gone up significantly. The two districts with the highest attendance under the EGS are Solapur and Ahmednagar, where the demand for employment has exceeded 1.20 lakhs. These districts are considered the worst affected by droughts. The GoM received a total allocation of 5.25 lakh tonnes of foodgrains through the special component of the Sampoorna Grameen Rojagar Yojana (SGRY) in 2003-04 to use under the EGS.

In view of the persistent drought for the last four years, there is a gradual increase in the number of tankers as well as the villages covered. In 2003-04, the situation has become the most acute The Government has set up a large number of cattle camps in many districts for providing fodder to cattle population. These cattle camps are being run by cooperatives, NGOs, and local organisations. The number of cattle camps has also gone up significantly. As against 400 cattle camps in mid-November 2003, which admitted 3.8 lakh cattle, there are at present 700 camps, admitting more than 7 lakh cattle. In addition to these cattle camps, a number of districts have set up fodder depots. The GoM has arranged to transport fodder from the surplus areas to the drought-affected districts.

Cyclone Warnings

The India Meterological Department (IMD) is responsible for cyclone tracking and warning and Area Cyclone Warning Centre (ACWC) at Colaba in Mumbai is responsible for issue of cyclone warning bulletins for Arabian sea and inform warnings for coastal districts of Goa and Maharashtra. Cyclone tracking is done through INSAT satellite and 10 cyclone detection radars. Warning is issued to cover ports, fisheries and aviation departments. The warning system provides for a cyclone alert of 48 hours and a cyclone warning of 24 hours. There is a special Disaster Warning System (DWS) for dissemination of cyclone warning through INSAT satellite to designate addresses at isolated

places in local languages. The cyclone warning process is coordinated by the weather centre in the office of DDGM (weather forecasting) at Pune and the Northern Hemispheric Analysis Centre at New Delhi. New scheme of dissemination of cyclone warnings has been introduced by issuing VSAT where the cyclone messages prepared by ACWC, Mumbai, are transmitted to the satellite uplink station at Yeour (Mumbai).

The division of ACWC provides Doordarshan and AIR stations at New Delhi with cyclone warning bulletins for inclusion in the national broadcast/telecast. Information on cyclone warnings are furnished on a real time basis to the control room set up in the ministry of agriculture, government of India, besides other ministries and departments of the government. Cyclone warnings are disseminated through a variety of communication media, such as radio, television, print media, telephones, fax, telex, telegrams and police wireless network. A specially designed cyclone warning dissemination system, which works via the INSAT satellite, provides area-specific service even when there is a failure of conventional communication channels. Warnings are issued for general public, fishermen, farmers and different categories of users such as central and state government officials responsible for disaster mitigation and relief, industrial and other establishments located in the coastal areas, railways, aviation, communications and power authorities.

Measures for Earthquake and Landslides

To overcome this disaster Govt. of Maharashtra implemented largest ever rehabilitation programme called as Maharashtra Emergency Earthquake Rehabilitation Programme (MEERP). The programme was initiated to rehabilitation Latur earthquake victims in 52 affected villages and restoration of damaged housing stock and infrastructural facilities in the other 13 affected districts. The rehabilitation policy formulated by the GoM involved funding by agencies like the World Bank (WB), Asian Development Bank (ADB), Department for International Development (DFID), United Nations Development Programme (UNDP), GoI, GoM and Donors. Although the primary objective of the GoM was comprehensive and satisfactory resettlement and rehabilitation of affected people and villages, it also focussed on mitigating the effects of disasters and ensuring preparedness for any future disaster and improving seismic monitoring capability.

Maharashtra Government has enacted the Maharashtra Slum (Improvement, Abolition and Rehabilitation) Act, 1971 under which slums in specified areas are notified as regularised slums and given protection. Since 1991, under the slum improvement programme, these slums are being improved by Slum Improvement Board, a unit of Maharashtra Housing Area Development Authority (MHADA). These slums are being provided with basic amenities. To avoid the damages due to landslides, the Slum Improvement Board is carrying out a programme of constructing retaining wall.

Road Accidents

The main agency responsible for taking spot action in the event of a road accident in the state is the Traffic Police. The various emergency services likely to be involved in accident management are fire brigades, ambulance services, medical aid facilities and vehicle salvage services. The officials to be contacted immediately on occurrence of an accident are the district collector of the district, tehsildar of the taluka or deputy / assistant regional transport officer under whose jurisdiction the area lies. For accident relief, there were 25 Police Aid Posts on the national highway, equipped with wireless facilities, first aid etc. in the past. In addition there were eleven state highway posts. Recently, the state govt. has approved the proposal by the state police department to merge these posts to form 36

Police Aid Post. These posts will be fully equipped with adequate first aid and medical facilities and wireless sets for immediate communication in the event of an accident.

Transport of hazardous substance via road poses a major accident risk. These accidents constitute 40-60% of the total road accidents that occurred in the state during these two years. The four most important highways that have a high traffic density, both with respect to transport of passengers and goods, and which have a high incidence of accidents are: NH-8 (Mumbai-Ahmedabad), NH-4 (Mumbai-Pune-Bangalore), NH-17 (Mumbai-Goa) and NH-3 (Mumbai-Agra). Accidents involving motor vehicles carrying dangerous or hazardous substances often result in the leakage of gases or spillage of liquids. Feasibility study on vulnerability and risk assessment of transportation of dangerous chemicals were completed for four states, namely, Gujarat, Maharashtra, Andhra Pradesh and TamilNadu, which have large number of Maximum Accident Hazard (MAH) units. The pilot study entitled 'GIS based emergency planning and response system with respect to chemical accidents in MAH Installations' in major industrial clusters in the four States, namely, Gujarat, Maharashtra, Tamil Nadu and Andhra Pradesh, has been completed and now been extended to cover other States (MoEF 2005).

Industrial Accidents

The Directorate of Industrial Safety and Health maintains records of industrial accidents in Maharashtra. Emergency response centres (ERC) have also been established in some of the industrial areas in the state. The Thane-Belapur Industries Association operates and manages a fully government owned emergency response centre at Thane-Belapur. MIDC provided the investment for setting up of this facility to as a part of the disaster management plan for the industrial belt.

An emergency response centre has started functioning since August 1996 at the Hindustan Organics Limited premises. The Patalganga Industrial Complex, where the ERC is located, is one of the four industrial areas that had been identified by the Ministry of Environment and Forests (MoEF), Govt. of India. This is a joint venture of MoEF and DISH (state government) to be operated by the industries located in this region. This ERC will respond to emergencies due to hazardous chemicals within a radius of 20 km and for factories located in the Patalganga - Rasayani industrial belt. Presently the ERC is being housed at the fire station in HOCL. Operating procedures for telephone operator, duty manager, fire and safety officers have been developed. A format for recording of the emergencies has also been developed. An inventory of the emergency facilities, such as fire services, ambulances, essential medical services, breathing apparatus etc., available with the member industries has also been prepared.

Some of the major public sector establishments such as MPT, BARC, HPCL, BOCL, RCF, etc. have their plans such as independent fire service and a disaster management plan. The atomic energy establishment, with its residential colonies, has taken adequate measures to reduce the risk. It also has a comprehensive on-site hazard management plan with necessary know-how and equipments. Industries in the Chembur-Trombay region, though handling flammable and toxic liquids and gases, are equipped to take care of minor to moderate emergencies.

Chapter 8: Relevant Global and Other Issues

Introduction

The preceding chapters focussed on various local environmental issues. The sources and effects of local pollution are, generally, short term and reversible and confined to national boundaries. On the other hand, regional and global environmental issues, which include transboudray pollutants such as acid rains, green house gases (GHGs), ozone depletion, trade and environment linkages, etc., may have long term and irreversible impacts not only on present but also the future generations. Global regional and local issues are not unique but rather interlinked and share a cause-effect relationship. Thus, the use of nitrogenous fertilisers to increase agricultural productivity may give higher yields and benefit the people locally. However, increased use of these fertilisers can affect the global climate through the release of GHGs.

Since global issues are of serious concern and involve countries the world over, several institutional arrangements and multilateral agreements have emerged to deal with the situation. In India, the MoEF handles various environment related multilateral conventions and protocols. These include the Global Environment Facility (GEF), United Nations Framework Convention on Climate Change (UNFCCC), Clean Development Mechanism (CDM), Convention on International Trade in Endangered Species (CITES), Convention on Wetlands of International Importance (CWII), especially as waterfowl habitat, Convention on the Conservation of Migratory Species of Wild Animal (CCMSWA), Vienna Convention for the protection of the Ozone Layer, Montreal Protocol on ODS, Conventions on Biological Diversity, Kyoto Protocol, the Basel Convention on Trans-boundary Movement of Hazardous Substances, Convention to Combat Desertification, Stockholm Convention on Persistent Organic Pollutants, etc.

This chapter discusses some important environmental issues, which are of relevance to both, India and Maharashtra. These issues pertain to the challenges arising out of global environmental concerns, the environmental infrastructure and environmental education. Initiatives of both central and state governments on these aspects are included.

Global Environmental Issues

Major international environmental issues of importance for both India and the State are climate change, ozone depletion and trade and environment linkages, which may have a significant impact on the development of the State as described below.

Climate Change

In general, the term climate change refers to changes over all timescales and in all components of the Earth's climate such as precipitation as well as temperature. These changes could be the result of both anthropogenic activities and natural factors. UNFCCC uses terms “climate change” to refer to former and “climate variability” to refer to the latter. India is a party to this multilateral treaty, which has its main objective as stabilisation of the GHG concentrations in the atmosphere at levels that would prevent dangerous anthropogenic interference with the climate system. The Convention enjoins upon the parties to implement commitments contained in its various provisions. As per the existing commitments, India is not required to adopt any reduction or limitation of GHGs’ emissions. The Intergovernmental Panel on Climate Change (IPCC) is an inter governmental

scientific body set up by the UNEP and the World Meteorological Organization (WMO) to prepare periodic scientific and technical assessments on various aspects of climate change such as its science, impacts, mitigation and adaptation.

In India, the MoEF is the nodal agency for climate change issues. The Mnistry is taking several steps for assessing the sources and sinks of GHGs at national level. Since assessments of sinks of GHGs are still methodologically primitive, the estimate is largely confined to gross emissions, but an estimate of net emissions is made for the forestry sector. With regard to mitigation options, an assessment of costs was undertaken for various carbon dioxide limiting options that were implemented in India upto the year 2000. The technologies investigated were as follows.

- Improved efficiency of energy used in the electricity, industrial, transport, and domestic sectors;
- Deployment of several renewable energy technologies; and
- Afforestation, which in the forestry and changed land use sector, is dealt with in terms of three scenarios: " potential", "feasible" and "business as usual". Estimates of the national carbon emissions, the forestry offsets potential, and the costs of implementing the feasible scenario are also included.

Impacts of Climate Change

The GHGs increase the earth's temperature which may result in many adverse impacts such as sea level rise and inundation of coastal land, changes in weather patterns, accelerated rate of fresh water evaporation, effect on the agricultural productivity, increase in disease carrying vectors, etc. It is estimated that GHGs emissions from the Asia-Pacific region will be about half of the global emissions by the end of year 2100. The global average surface temperature increased by 0.6ºC over the course of the 20th century. Global warming has caused a decline in snowfall by about 10 per cent since the 1960s, raised the global average sea level by 10 to 20 cm during the 20th century and also changed the rainfall patterns in the Northern Hemisphere, with generally more rain at high latitudes and near the equator and less in the sub-tropics.

According to the IPCC Third Assessment Report (2001) anthropogenic activities are the key factors causing climate change. They are responsible for the increased atmospheric concentrations of GHGs and aerosols since the pre-industrial era. Some of the findings of this report are as follows:

- The atmospheric concentrations of key anthropogenic GHGs (i.e., carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and tropospheric ozone (O_3) reached their highest recorded levels in the 1990s, primarily due to the combustion of fossil fuels, agriculture, and land-use changes. In fact, the 1990s have been recorded as the hottest decade of the century.
- The atmospheric concentration of CO_2 is now 31% higher while atmospheric methane has increased even more dramatically, by 151% than it was two and a half centuries ago (in 1750). Almost three-quarters of the increase in CO_2 levels is attributed to fossil fuel burning, while the rest is mostly due to deforestation.
- Nitrous oxide and synthetic greenhouse gases (halocarbons) emissions have also increased.
- The frequency of heavy rainfall events in South and Southeast Asia are also increasing.

In developing countries like India, climate change could put an additional stress on the ecological and socio-economic systems that are already facing tremendous problems due to rapid urbanisation, industrialisation and economic development. The major impacts of climate change in India could be on agriculture, forestry, water resources and health. Agriculture and allied activities are essentially

dependent on the weather as duration of crop cycles and yields are inversely propotional to the climate. Thus, warm temperatures shorten the duration of crop cycles, which in turn result in lower crop yield per unit area. Similarly climatic change affects the geographical distribution, composition and productivity of the forest ecosystems, which affect the survival of flora and fauna. Climatic change and variability could also upset the spatial and temporal distribution of the rainfall patterns. Lower rainfall and increased evaporation may lower the quantity of run-offs into the watersheds thereby affecting the availability of freshwater. Some studies have revealed that the melting of snow in the high Himalayas could cause major floods in the catchment areas. Lastly, with regard to health, climate change and variability also breeding grounds for vector-borne diseases such as malaria. Areas with warmer and wetter climate encourage faster reproduction and greater survival of disease-causing viruses, bacteria, fungi and parasites. Increased flooding may cause non-vector borne diseases like cholera, salmonellosis and leptospirosis. Additional indirect effects include respiratory and allergic disorders due incease in air pollutants, pollens and mould spores due climate change.

District wise estimates show a substantial negative impact in the State affecting its agricultural productivity, water resources, coastal communities, and health of people. Semi-arid regions of western India are expected to receive higher than normal rainfall as temperatures soar, while central India will experience a decrease of 10 to 20 per cent in winter rainfall by the 2050s. A rise in sea level due to climate change could have a significant impact on the long and densely populated coastline and economy of India that is largely dependent on the natural resource base. In the absence of protection, a one-meter sea level rise on the Indian coastline is likely to affect a total area of 5763 km^2, and put 7.1 million people at risk. The dominant cost as indicated is land loss, which accounts for 83 percent of all damages at India level. The State has a long coast line that will be affected by sea level rise putting a pressure on land and coastal communities. The extent of vulnerability, however, depends not only on physical exposure, but also on the level of economic activity in the region. (Sharma, 1996 and 1998; TERI, 2002).

Maharashtra's coastal regions are agriculturally fertile and sea level rise will make them highly vulnerable to inundation and salinisation. Coastal infrastructure, tourist activities, and onshore oil exploration are also at risk. The impacts of any increase in the frequency and intensity of extreme events, such as storm surges, could be disproportionately large, not just in heavily developed coastal areas, but also in terms of the paralysing devastation in low-income rural areas. In the state of Maharashtra, over 1.3 million people are estimated to be at risk. Mumbai's northern suburbs like Versova Beaches and other populated areas along the tidal mud flats and creeks are vulnerable to land loss and increased flooding due to sea level rise. Beyond actual inundation, rising sea levels will also put large number of people at greater risk of flooding displacement and result in rapid landward urbanisation, straining resources and putting more pressure on civic amenities. Increased seawater percolation may further reduce freshwater supplies. The recent deluge in July 2005 which flooded many parts of Maharashtra such as Mumbai, Kalyan, Raigad, Chiplun Ratnagiri etc. and similar occurrences of extreme weather in other parts of India are indicators of the dangers of climate change due to GHGs emissions from various anthropogenic activities.

Ozone Depletion

The Ozone layer in the stratosphere contains a certain concentration of ozone, which is a chemically active triatomic allotrope of oxygen (O_3), that acts as a shield, preventing the earth from the harmful effects of ultra violet (UV) and other high energy radiation from the sun. Ozone depletion refers to a

reduction in the amount of ozone in the stratosphere either due to natural or anthropogenic processes. Natural causes include the conversion of atmospheric nitrogen into oxides of nitrogen due to solar action, volcanic eruptions that release ozone-depleting sulphates etc. On the other hand, anthropogenic processes produce nitrogen oxides, sulphates, chlorofluorocarbons (CFCs) chlorine, bromine, etc., which are responsible for devouring the ozone molecules in the upper atmosphere. Thinning of ozone layer due to reaction of these chemicals is termed as *'ozone hole.'* It refers to that area of the ozone layer, which is seasonally depleted of ozone e.g. the Antartic ozone hole in the South Pole region, which appears in September and after eight weeks passes over New Zealand and Australia. Every year, the world over, sixteenth September is observed as International Day for Preservation of the Ozone Layer.

As a result of ozone depletion higher levels of UV radiation penetrate the earth affect human health, plants, animals, marine ecosystems, bio-geochemical cycles. It is known to cause sunburn, skin cancer, cataract, weaken the immune system, retard plant growth and damage the genetic structure of plants and animals.

Montreal Protocol

In seventies, efforts started globally to protect the stratospheric ozone layer and the discovery of the *"ozone hole"* over the Antartica led to the adoption of the Vienna Convention in 1985 followed by the Montreal Protocol (1987) on Substances that deplete the Ozone Layer. Subsequently, several multilateral agreements and projects have been initiated under Montreal Fund to phase out the Ozone Depleting Substance (ODS).

India has made significant efforts to comply with the provisions of the Montreal Protocol (MP). The consumption of CFCs has been reduced by 2165 MT's from the baseline consumption of 6681 MT's in 1995-1997 through implementation of projects approved by the Montreal Fund. Similarly, production and consumption of halons have also been phased out. The National Phase-out Plan of Carbon Tetrachloride (CCl_4) has been approved by the Executive Committee of the Montreal Protocol at a cost of 52 million dollars. The geographical distribution of industries consuming ODS particularly Small and Medium Enterprises (SMEs), the Project Management Unit (PMU), established for CFCs production phase out) of the Ozone Cell of MoEF organised series of workshops in various States and Union Territories (UTs) since 2001 to create public awareness on the Montreal Protocol and phase out of ODS. Workshops have been conducted in more than 33 States and 5 Union Territories (UTs) attended by representatives from the States and (UT's), including Departments of Environment, Industry, Small Industries Services Institute, Pollution Control Boards, Association of Refrigeration, Equipment Services Agencies, Association of Refrigerant Gas Sellers, Industries using ODS and regional offices of the MoEF. During these workshops, the representatives of the Ozone Cell apprised the participants, the need for the industry to avail funding and technology transfer support from the multilateral fund of the Montreal Protocol to switch over to non-ODS technologies.

Trade and Environment

Trade and environment in the context of development refers to how the trade affects the environment and vice-versa. It indicates how mandatory pollution-control norms, health or labour standards affect the competitiveness of industries. Many developed countries have introduced stringent, international environmental regulations in the form of *Environment Product Declarations*

(EPDs) or ecolables restricting the import of goods that do not comply with these standards. This may result in loss of revenue for the exporting (mostly developing) countries. These regulations are of three types, namely, *Product Standards* consisting of replacing conventional chemicals with eco-friendly chemical contents of the products; *Process Standards* pertaining to eco-friendly production processes and *Packaging Requirements,* which put the entire packaging responsibility on the exporter and tend to push up costs considerably as they require specific quantity and quality of packaging to be undertaken (Sharma, 1995 and 2004).

The second issue relates to direct trade in endangered species and in waste (both hazardous andnon-hazardous). The third issue relates to the nature of trade between developing and developed countries. Many developing countries produce several goods for exports to the latter, and in the process pollute their own local environment. For example, in the case of leather or mining, it is the initial processes of tanning or extraction, which are more polluting and less value adding. Thus, while the importing country enjoys the benefits of such products, it does not share the burden of their production on its environment.

In Maharashtra, many such export-oriented industries, producing goods for foreign consumers, are responsible for the deteriorating local environment. While these units mostly cater to the demand of the foreign markets, their impacts are felt within the State. Further, the non-tariff trade barriers, such as EPDs, ecolables, produc standards etc. may hinder the State's export of textiles, leather, agriculture and food products and increase competitiveness in the international market. A study based in Mumbai has shown that trading waste paper for the production of new paper has more positive effects on the environment compared to no trade. This is because the use of waste paper reduces the pressure on primary resource (forests) and also reduces the volume of MSW and thereby the pressure on the landfills. At times, it has been opbserevd that under the disguise of recylable waste (such as waste paper), hazardous waste (particuary E-waste) is beign exported to devlopign countries (Sharma et al., 1997).

Multilateral Agreements and Initiatives

Various countries, all over the world, have adopted measures to minimise the damage and prevent further deterioration of the environment. Some important institutional efforts for preserving the global environment are as follows.

Global Environment Facility

The Global Environment Facility (GEF), established in 1990, is a co-operative venture among national governments, the Word Bank and UNEP to facilitate international cooperation and finance ameliorative measures to address four critical threats to the global environment, namely, biodiversity loss, climate change, degradation of international waters and ozone depletion. Related work in the areas of land degradation and Persistent Organic Pollutants (POPs) are also eligible for GEF funding. Countries eligible for GEF support have two focal points designated for liaison with it; one is the political focal point, which is responsible for liaison with the GEF council and Assembly, and the other is the operational focal point, which is responsible for liaison with individual GEF projects. In India, the Department of Economic Affairs in the Ministry of Finance is the political focal point and the Ministry of Environment and Forests (MoEF) is the operational focal point.

India has been a leading developing country participant in the GEF since its inception and has played a major role in shaping the restructuring of the GEF. India has formed a permanent

constituency in the Executive Council of the GEF together with the Bangladesh, Sri Lanka, Bhutan, Nepal and Maldives. Being both, a donor and a recipient of GEF funds, India had contributed US $6.0 million to a core fund of US $1.3 billion of GEF Pilot Phase. The first replenishment of the GEF had over US $2.0 billion to its core fund. India had pledged an amount of US $9.0 million towards the resources of first GEF replenishment. The second replenishment had over US $2.75 billion to its core fund and India pledged and paid an amount of US $9.0 million towards its resources. For the third replenishment, an amount of US $3 billion has been pledged out of which India's contribution will be US$9.0 million. So far the GEF funds of approximately US $193.4 million have been committed/obtained for different projects of the country since ts inception (MoEF, 2005).

ODS Phaseout Projects

In India, the provisions of Montreal Protocol came into effect from 1992 and to ensure compliance, the government grants exemption of duty on goods required for ODS phase out projects and new investments with non-ODS technologies. The Reserve Bank of India has directed all financial institutions and banks not to finance new establishments with ODS technology. Licensing system has been adopted to regulate trade of ODS with a ban imposed on it with non-parties.

Maharashtra has initiated some multilaterally-funded ODS phase-out projects, in various industrial sectors namely, Aerosol phase-out Projects, Halon phase-out Projects, RAC phase-out Projects and Solvent phase-out Projects, as shown in Tables 8.1a, 8.1b, 8.1c and 8.1d.

CDM Projects

The Clean Development Mechanism (CDM) project activities are aimed at assisting developing countries to achieve sustainable development and to comply with their emission limitations. These activities, under the Kyoto Protocol, are expected to be a cost-effective, flexibility measure to mitigate climate change and to promote the transfer of climate friendly technologies, thereby, contributing to the ultimate objective of the UNFCCC. Market forces drive the CDM projects to reduce GHG emissions against a validated baseline. The project investor takes a risk based on the returns provided by certified emission reduction units, which correspond to the reduction of GHG emissions achieved. The CDM also provides a trade opportunity for the developing countries to collaborate with investors in industrialised countries to develop new industries and technologies. This form of trade in credits under the CDM requires that the project in developing countries must contribute to the sustainable development of the host country. Under the protocol, the country must create a designated national authority to approve or reject such project proposals. The trade may also be registered only if the CDM project results in real and measurable reduction and must be validated, monitored and verified. Thus, CDM offers an opportunity to promote sustainable development and to direct the flow of capital, expertise and technology from developed countries to developing economies.

Table 8.1a: Multilaterally-funded Aerosol phase-out Projects in the State

Project	Aerosol Phase Out (Tonnes)	Funds Approved In US $	Details of Disbursement
Aero Pharma Aerosol Conversion	36.0	62,250	59,405
UltraTech Specialty Chemicals Pvt Ltd. Aerosol Conversion,	30.8	79,100	70,000
Aero pack Products Aerosol Conversion	20.4	107,875	69,450
A.A. Attarwala and Co. Pvt. Ltd. Aerosol Conversion	30.6	151,703	114,243
Chem Versa Consultants Ltd	18.0	76,076	65,452
SaraChem Pvt. Ltd. Aerosol Conversion	23.3	100,755	59,441
Spray Products Ltd. Aerosol Conversion	16.8	73,999	62,511
Midas Care Pharmaceuticals Ltd.	25.2	125,294	108,151
Syncaps Aerosols, Maharashtra Foam	53.5	182,515	94,520
Sunpra Ltd., Pune	20.0	467,820	370,228
Eagle Flasks Industries Ltd.	20.0	412,450	361,253
Alfa Foams	19.0	248,487	186,167
Blue Star Ltd.	13.0	253,120	162,674
Milton Plastics Ltd.	30.0	515,845	363,122
Milton Polyplast	15.0	266,680	177,820
Shroff Textiles Ltd	25.0	222,836	197,200
Asha Handicraft	19.4	138,425	115,844
Wimco Pen Co.	18.5	134,798	115,065
Kaygee Foams P. Ltd.	33.0	245,493	216,053
Mahavir Enterprises	19.4	106,785	94,280
Omkar PUF Insulation	10.6	66,670	59,000
Amar Enterprises	16.2	135,600	119,943
Bharat Cottage Industries	7.8	68,930	58,954
Blowkings KFTZ	17.6	149,160	117,607
Delta Foams Engineering Co	12.0	96,050	69,775
Bluplast Corporation	10.1	85,880	76,000
Joti Foam Products Pvt. Ltd	37.6	196,948	174,003
Nandadeep Fibrotech Pvt. Ltd	11.3	100,034	72,611
Lear Insulation Engineering P.Ltd	10.6	93,301	72,463
UNC Plast Industries, Navi Mumbai	11.4	101,256	67,767
Expanded Incorporation, Mumbai	72.0	502,130	479,599
Polymermann (Asia) P. Ltd., Mumbai	290.0	435,050	378,108
Vora Cork Industries	39.6	298,885	215,822

Source: MoEF (2005)

Table 8.1b: Multilaterally-funded Halon phase-out State Projects

Project	Halon Phase Out (Tonnes)	Funds Approved In US $	Details of Disbursement
Nitin Fire Protection Industries Ltd.	212.0	187,374	165,818
New Age Industries	133.0	149,440	131,956
Bharat Engineering Works	49.5	82,784	65,509
Zenith Fire Services	36.0	60,206	49,9711
New Fire Engineers Pvt. Ltd.	120.0	146,900	130,0001
Kooverji Devshi & Co Pvt. Ltd.	25.5	42,646	37,340

Source: MoEF (2005)

Table 8.1c: Multilaterally-funded RAC phase-out State Projects

Project	RAC Phase Out (Tonnes)	Funds Approved In US $	Details of Disbursement
Blue Star Ltd,	36.0	567,000	-
Meghdoot Refrigeration Industries	18.0	185,987	158,930
V.Krishna & Co.	14.8	166,133	135,446
Friz-tech. Pvt.Ltd.	11.5	150,200	132,920
V.Krishna Pvt Ltd.	17.0	229,153	88,404
Seepra Refrigeration Pvt. Ltd.	15.0	194,258	167,411
Godrej-GE appliances Ltd.	568.0	3,041,474	2,659,305
Standard Refrigeration Appliances	18.8	192,303	170,015
Polar Enterprises	10.8	156,155	138,000
Videocon Appliances	351.7	2,706,290	2,359,168
Saikrupa Industries	14.8	141,948	136,142
Sarkar Refrigeration Industries	12.0	135,409	115,145
Sandeep Refrigeration	9.9	121,683	106,911
Kirloskar Copeland Ltd., Karad	125.5	547,900	515,368
Godrej G.E. (compressor)	71.7	2,285,500	-
IOC for Sarkar Refrigeration	-	4,955	-
IOC for Saikrupa Refrigeration	-	11,892	-

Source: MoEF (2005)

Table 8.1d: Multilaterally-funded Solvent phase-out State Projects

Project	Solvent Phase Out (Tonnes)	Funds Approved In US $	Details of Disbursement
Vidyut metallics Ltd	19.7	254,761	177,124
Blue star Ltd.	6.6	85,911	30,200
Sapna coils Ltd	22.8	276,877	87,840
Engineering Industries	20.2	269,817	86,184
Sapna Engineering	14.5	271,692	88,088
Pradeep Shetye Ltd.	133.9	315,271	-
Benzo Chemical Industries	23.0	154,568	-
FDc Ltd	34.1	269,359	-
Chiplun Fine Chemicals Ltd	16.7	176,088	32,086
Amoli Organics Ltd	38.5	435,465	263
Navdeep Engineering Palghar	53.9	744,645	-

Source: MoEF (2005)

Renewable Energy

The GoI had already constituted a Climate Change Advisory Group on Renewable Energy in order to take the advantages of the vast opportunities available to the renewable energy sector under this project. The GoM has also adopted the policy to encourage generation of power from Non-Conventional Energy Sources.

Maharashtra is having a total installed capacity of 15580 MW (including Central sector share) of centralised power plants and 623 MW of decentralised non-conventional power plants. However, there is still a large potential in the non-conventional energy sources sector, which can be tapped. As on 31st March 2003, Maharashtra ranks second in the country in the production of power from renewables. It has 663.056 MW installed capacity (including small hydros), which is 4.6 per cent of the total capacity is the state, which in terms of units generated comes to 2.88 per cent. Policies of

the GoM have encouraged private participation in three major non-conventional energy initiatevs, namely, biomass energy, wind energy and waste-to-energy. Table 8.2 gives the potential and achievement of the State for various kinds of non-conventional power sources.

Table 8.2: Potential and Achievements in Non-Conventional Energy in MW

Source	Potential	Achievements (As of March 2003)	Target 10th Plan (2002-07)
Wind	3650.00	399.355	500
Small Hydro	600.00	226.575	25
Biomass/Bagasse Cogeneration	1781.00	30.00	500
Municipal Solid Waste	100.00	0.000	35
Industrial Waste	210.00	6.126	--
Solar	--	--	2
Total	**6341.00**	**663.056**	**1062**

Source: MEDA (2005)

Biomass Energy

Maharashtra has agricultural and agro-industrial surplus biomass with a potential of about 781 MW distributed through the state. This distributed potential can be harnessed to meet increasing power demand and to improve the techno-economic scenario. The social, economic and environmental benefits of biomass power for long-term sustainability have been accepted. The technology has attained maturity and is reaching the stage of commercialisation. The national potential of grid quality power from surplus biomass material is assessed to be 16,000 MW while the same in Maharashtra is 781 MW. Biomass power plants of total 132 MW (29 numbers) are already in operation in the country. Attractive policy for private participation in Maharashtra is showing encouraging trend from private investors. As a result, first private Agro-waste power project is about to be commissioned (7.5 MW) in village Tumkheda in Gondia district. Some more projects of 116.5 MW are in pipeline. National potential of power through Bagasse co-generation is about 3500 MW, while in Maharashtra it is 1000 MW. Bagasse-based co-generation power projects are one of the important schemes of MEDA. There are nearly 160 sugar factories in Maharashtra of which, nearly 50 have shown their interest for co-generation.

Wind Energy

The GoM has adopted investor-friendly policy, which has resulted in effective commercialisation of wind power sector in the state. Assessed wind power potential in the country is about 45,000 MW, while in Maharashtra it is 3650 MW. Out of total potential 211 sites for wind power in the country, 28 are in Maharashtra. The MNES has supported demonstration projects having 8.53 MW installed capacity. MEDA with its own funds has also set up 3.75 MW additional demonstration Wind Power Project as a source of revenue generation. Thus, the total demonstration Wind Power Project capacity in Maharashtra is 12.28 MW (Table 8.3). Projects have attracted private investment of more than Rs 2000 crores in the wind power sector so far. Nearly 400 MW of private wind power projects have been installed in the State. The total units generated from all wind power projects upto September 2004 are 1507 million units (MEDA, 2005). Asia's largest Wind Park has been developed at Vankusavade, Chalkewadi, and Thoseghar plateau of Satara district, 1,150 m above M.S.L. Identified as a high wind-potential site (21.7 km/hr) by the GoI, it has over 975 windmills spanning 27 kms and 2500 hectares of mountainous terrain. This wind park generates 320 MW of wind energy in total (MEDA, 2005).

Table 8.3: Details of Demonstration Wind Power Projects in Maharashtra

Place of the Project	Name of the owner	Year	Installed Capacity in MW
Devgad, Dist. Sindhudurg	MSEB	1986-87	0.55
Dahanu, Dist. Thane	MSEB	1987-88	0.09
Devgad, Dist. Sindhudurg	MSEB	1988-89	0.55
Vijaydurg, Dist. Sindhudurg	MEDA	1993-94	1.50
Chalkewadi, Dist. Satara	MEDA	1996-97	2.00
Gudepanchagani, Dist. Sangli	MEDA	1998-99	1.84
Motha, Dist. Amravati	MEDA	2003-04	2.00
Chalkewadi, Dist. Satara	MEDA	2004-05	3.75
Total In stalled Capacity			**12.28**

Source: MEDA, 2005

Waste-to-Energy

In Maharashtra, the potential for waste-to-energy projects is estimated to be more than 100 MW. Already 52.88 MW proposals in four places in Maharashtra (under BMC, KDMC, PCMC and Nanded MC as shown in Table 8.4) are under active consideration through private sector participation using municipal solid waste as raw material. Industrial Waste (Biogas) based power projects of aggregate capacity 6.12 MW are working successfully in Maharashtra.

Table 8.4: Status of Municipal Solid Waste Power Projects In Maharashtra.

MunicipalCorpn	Name of Promotor	Capacity	Status
Greater Mumbai	M/S MSW Pvt. Ltd. Mumbai, M/S Waste Management Ind. Ltd. Mumbai, M/S EDL India Ltd. New Delhi.	14.98 MW (12 MW) 10.0 MW 21.0 MW	LOI issued, Land allotted, Waste supply agreement completed, MERC has not declared the rate of power purchase Section 44 & PPA pending with MSEB.
Kalyan Dombivali.	Not Finalised.	5.52 MW	LOI not issued.
Pimpri-Chinchwad	M/s Sound craft Indus. Mumbai.	3.9 MW	LOI issued, Waste supply agreement completed, Land Lease Agreement completed.
Nanded Waghale City	M/s Hydro air Tectonics (PCD) Pvt. Ltd.	1 MW	LOI issued.
	Total	**52.88**	

Source: MEDA (2005)

Environmental Infrastructure

It encompasses the provision and upgradation of infrasturture as per the needs of the public, industry, and government and includes facilities for water supply, sanitation, industrial waste treatment, development of renewable energy, etc. Lack of adequate environmental infrastructure leads to adverse health and other impacts. Status of various types of environmental infrastructure is described as follows.

Water Supply and Sanitation

Table 8.5 indicates the number of villages that have different types of water supply for various districts and regions in Maharashtra in 1998-1999. It is evident from this table that the number of villages that have tap water within their premises and other public water supply schemes are invariably more than the number of villages that acquire water through tankers during the summer.

`Table 8.5: District-Wise Water Supply in villages in the State

Districts	Tap Water Suppy	Public Water Supply	Tanker-water supply during summer
Mumbai Division	**1889**	**1905**	**547**
Thane	395	1213	80
Raigad	85	16	141
Ratnagiri	1182	0	326
Sindhudurg	227	676	0
Nashik Division	**3546**	**4107**	**445**
Nashik	756	1826	172
Dhule	562	776	0
Jalgaon	1427	70	0
Ahmadnagar	801	1435	273
Pune Division	**3253**	**617**	**425**
Pune	1019	23	158
Satara	1557	19	188
Sangli	224	30	5
Solapur	361	528	70
Kolhapur	92	17	4
Aurangabad Division	**4034**	**1457**	**589**
Aurangabad	1212	132	127
Jalna	613	343	43
Parbhani	25	297	8
Bid	599	575	210
Nanded	1452	4	35
Dharashiv	77	7	3
Latur	56	99	163
Amravati Division	**1312**	**1976**	**60**
Buldhana	541	758	53
Akola	68	0	6
Amravati	81	0	0
Yavatmal	622	1218	1
Nagpur Division	**755**	**3110**	**21**
Wardha	226	99	0
Nagpur	120	49	15
Bhandara	215	1456	0
Chandrapur	155	177	6
Gadchiroli	39	1329	0
Maharashtra	**14789**	**13172**	**2087**

Source: MEDC (2001:a)

Table 8.6 gives the details of some Major Water Supply and Sanitation Schemes in Maharashtra. Accordingly, several programmes in last 35 years have been initiated in the state to cover both rural and urban areas. The sewerage facilities in various urban regions of Maharashtra are given in table 8.7, and it shows that there are some MCs and cities where UGD is still not available.

Table 8.6: Some Major Water Supply and Sanitation Schemes in Maharashtra

Name of the Scheme /Plan	Area Covered	Investment	Year of Implementation	Implementing Agency	Objectives
ARSWP	Rural Maharashtra	Central Budgetary Allocation	1972-73 Ongoing	GOI	
MNP	Rural Maharashtra	State Budgetary allocation	Ongoing	GOM	
Rural Water Supply and Environmental Sanitation Project	560 villages over ten districts	Rs 504 Crores	1991-1998	GOM and World bank	Delivering rural water supply, environmental sanitation and health education in an integrated manner.
Rural Water Supply and Sanitation project	187 villages in Jalgaon, Nashik and Dhule districts	Rs 58 crores	1991-1997	GOM and DFID	Overall management of drinking water as well as O&M of the schemes through Water Management Units
Rural Water Supply and Sanitation Project	Districts of Ahmednagar, Aurangabad and Pune	Rs 153 crores	2001-2007	GOM and KFW	Provision of sustainable rural drinking water supply, environmental sanitation, health and hygiene promotion, and watershed interventions and human resource development.
Sector Reform Pilot Projects	Districts of Dhule, Amravati, Nanded and Raigad	Rest 140 crores (estimated)	2000 to 2003	GOI and GOM	

Source: GoM (2003)

Table 8.7: Sewerage Facilities in Urban Maharashtra

Region/No. of Local Bodies	Corporations	Class A	Class B	Total
Mumbai and Konkan				
Total Local Bodies	4	3	6	13
Having UGD	3	2	1	6
Having > 110 lpcd water	3	3	1	7
Having > 110 lpcd water and UGD exists	3	2	1	6
Having > 110 lpcd water and UGD does not exists	0	1	0	1
Western Maharashtra				
Total Local Bodies	6	8	17	31
Having UGD	3	5	6	14
Having > 110 lpcd water	6	4	8	18
Having > 110 lpcd water and UGD exists	3	3	4	10
Having > 110 lpcd water and UGD does not exists	3	1	4	8
Marathwada and Vidharbha				
Total Local Bodies	3	9	22	34
Having UGD	3	2	3	8
Having > 110 lpcd water	2	1	4	7
Having > 110 lpcd water and UGD exists	2	0	1	3
Having > 110 lpcd water and UGD does not exists	0	1	3	4

Source: MMRDA (1998)

Provision of effluent treatment in the industries is one of the important issues which is relevant to environmental infrastructure. Table 8.8 shows its status for the industries of Maharashtra and it is observed that many of the industries, provide proper treatment to effluent generated by them as of 2002-03.

Table 8.8: Provision of Industrial Effluent Treatment in Maharashtra

District	No: of industries			Industries providing treatment		Total Pollution Load/BOD Load	Amount of Wastewater Treated		CETP Provided
	Large	Medium	Small	Number	%	Kg/day	(M^3)/day	%	
Nashik	40	26	2162	46	2.06	72	1200		NA
Yavatmal and Washim	2		7	6	66.67	289	1512.9	99.8	None
Nagpur	3	4	270	23	8.30	2.2-160	1640	95	NA
Ratnagiri	12	26	84	122	100.0	1230	1400		For 4MLD
Ratnagiri & Sindhudurg	1	5	328	334	100.0	293.5	778		None
Akola	1	4	413	16	3.83	39467	68.18	100	NA
Buldhana	1	7	173	13	7.18	48.8	488	98	NA
Sangli		9	890	899	100.0	2018	2278	98	For 2 MLD
Raigad	34	54	65	72	47.06	118589	45387	100	To be commissioned
Kolhapur	7	23	1702	1733	100.0	2263.41	4357.5	100	Not Provided
Satara	6	9	514	529	100.0	0.05315	All	100	None
Thane	14	7	293	314	100.0	2817.98	13146.54	100	8 MLD, 250CMD
Thane	4	5	22	31	100.0	69.77	2075.7	100	NA
Thane	14	54	808	310	35.39	-	18000	100	2MLD
Thane	2	11	965	150	15.34	-	1995036	100	NA
Amravati	1		53	54	100.0	227.264	64.46 km2	100	None

Source: GoM (2003)

Renewable Energy

The renewable energy projects producing electricity on a large scale need suitable grid interface for the evacuation of power and its penetration into the grid of utility. For a reliable and stable source of power, an Extra High Voltage (EHV) system is needed. Approach roads need to be constructed, as the project sites are located in remote and hilly areas. In order to provide the infrastructure consisting of approach roads and power evacuation arrangements for wind power projects in Maharashtra, MEDA has made investments worth Rs 122 crores through contributions from private sector investors. Under this programme, 220 KV EHV S/s and 220 KV transmission lines from Vankusawade project site to Malharpeth and Satara MIDC and Lonand S/s are constructed jointly by MEDA and MSEB. The evacuation arrangement is also constituted of 33 KV S/s, bays and transmission lines worth Rs 40 crores. It also consists of 64 km-long roads constructed at various project sites. The cost of these roads is Rs 20 crores. All the above infrastructure developments have taken place mostly in the districts of Satara, Sangli, Ahmednagar and Dhule where suitable sites were available for exploiting the wind power. MEDA now has a plan of expanding the wind power programme to other districts of Maharashtra where potential windy sites are available.

Efforts of the GoM

Many studies, such as the Sukthankar Committee Report, have documented the need for improved water and sewerage services in Maharashtra. The state government provides grants and loan guarantees to urban local bodies (ULBs) for new water supply projects. Consequently, many

augmentation projects have been initiated to meet the water demands of a growing population. However, inadequate attention is given to operations and maintenance (O&M), customer service, water leakage, unauthorised connections, theft, and energy conservation of existing systems. Unaccounted for water (UFW), the difference between the amount of water produced and supplied to the distribution system and the amount sold, is a large portion of the total quantity of water supply and estimated to range from 50 to 65 per cent in the state.

Financial analyses have shown that local bodies' expenditure on O&M for water is more than revenue earned from water tariffs, and UFW is the major reason for this. Also, about 50 to 60 per cent of the water system's operational costs are for energy for electricity and fuel to pump water from intake to treatment plants to customers. Reducing water and energy losses, cutting costs and increasing revenues by operating more efficiently enables the municipalities to obtain resources to invest in rehabilitation of the existing projects and to build additional ones. Provisiosn for use of following tools, that help local officials assess the situation and plan improvements, have been made.

- *Leak detection surveys* identify leaks in transmission pipelines and throughout the distribution system. They help officials to design leak reduction programmes to stop leaks that waste or contaminate treated water. They also help to develop a plan for maintenance and repairs, to improve connections to consumers, and the water quality.
- *Water audits* measure production and use of water, and include enumeration of all consumers (registered and unregistered), a map of the distribution network, measurement of water flow, and a check of the functioning of water meters. Officials can use them to help create awareness among the citizens about the need to conserve water, improve water billing and collection, locate water theft, regularise unauthorised connections, control unrecorded water and keep accurate records of water use.
- *Energy audits* include an inspection of energy consumption and of pumping stations and how efficiently they use energy. The audits identify energy saving measures and their costs. Suitable energy conservation measures can reduce energy costs between 25 and 40 percent. In September 2000, the GoM directed that all municipal corporations and MCs in class A cities (cities with more than 100,000 residents) undertake these assessments and develop action plans to reduce UFW and bring about energy conservation, either with their own staff or with technical service providers approved by the state. In the same resolution, the state announced a restructured capital grants programme and directed these cities to encourage private sector participation and introduce a double-entry accrual-based accounting system.

Steps by MCs and other ULBs

Example of NMMC in promoting public-private-partnership (PPP) in the provision of water supply infrastrustrucre is worth mentioning. The water supply system in Navi Mumbai is operated and maintained by 42 contracts covering billing; operation and maintenance (O&M) of the main reservoir, chlorination plants, pumping stations, and elevated reservoirs; and repairs and maintenance of the feeder mains and distribution systems. These contracts are managed and supervised by the city engineer and his staff of four deputy engineers and 14 junior engineers in the municipal Water Supply Department.

The city's water supply revenue comes principally from water charges received from customers. Water tariffs were 87 percent of total water revenue of Rs. 300 million in 2000-01. However, total

water revenues were only 60 percent of the total expenditure on water supply (about Rs. 503 million). About 75 percent of the total expenditure was for bulk water purchase from Maharashtra Industrial Development Corporation (MIDC) and Maharashtra Jeevan Pradhikaran (MJP). The annual cost of the service contracts was Rs.30 million. Pipeline and pump repairs cost Rs.88 million, or 18 percent of total water supply expenditure, and included contract services. Another seven percent expense was for electricity charges. Table 8.9 shows the various sources of revenue income and expenditure in water supply in NMMC.

Table 8.9: Water Supply Revenue Income and Revenue Expenditures, 2000-01

Particulars	(Rs. In million.)
Revenue Income	
Water Charges	259.68
Connections and Others	19.24
Water Benefit Tax	21.24
Income from Municipal Property	0.30
Total Revenue Income	300.46
Revenue Expenditure	
Staff, Establishment & Admin.	1.94
Engineering Works	0.16
Water Purchase	376.62
Pipeline & Pump Repairs	88.12
Electrical Charges	36.00
Total Revenue Expenditure	502.84
Surplus/Deficit	(202.38)

Source: NMMC (2002).

The cities of Sangli, Miraj, and Kupwad merged into one municipal corporation in 1998. Located on the banks of the Krishna River in southern Maharashtra, Sangli is a major business centre. The existing water and sewerage systems are over 40 years old and no new schemes have been undertaken. Poor water quality, a main concern of residents, is due to inadequate sewage collection, treatment, and disposal, as well as the dilapidated water supply network and facilities. The project of United States Agency for International Development (USAID) on Financial Institutions Reform and Expansion (FIRE) is supporting the SMK-MC as a model for medium-sized cities for improvement of service delivery. The FIRE project is undertaking a comprehensive programme for providing technical support to the SMK-MC, with regard to PSP in water and sewerage, accounting reforms, energy/water/leak detection audits, solid waste management, resource mobilisation, and improved service access to the poor.

The SMK-MC is implementing an accrual accounting system and computerising its records and has introduced area-based property tax assessments for new properties and issued service contracts for solid waste collection. The Sukthankar Committee visited Sangli city to discuss the need for reforms in the water sector. At a workshop in Pune in February 2000, the PMC officials decided to work with FIRE and Infrastructure Leasing & Financial Services Ltd (IL&FS) to develop a demonstration water supply and sewerage project with PSP. The first phase of the project proposes reduction of leaks and energy savings, improved O&M practices, customer service, staff training, and preparation for second-phase investments. The first phase will be implemented through a three-year management contract. The second phase consists of attracting investments to augment the service, and will be implemented through a long-term contract such as a concession that will use a special purpose vehicle jointly operated by the SMK-MC and IL&FS.

The PMC applied to the state government for a grant under the restructured capital grants programme and gained its support for the first phase in December 2001. The state provides an Incentive Grant of Rs. 60 million (US$ 1.25 million) to cover 75 percent of the management contract cost. It is expected that the state will award another grant to cover 23.3 percent of the system rehabilitation costs. The PMC entered into an agreement with IL&FS to support the city in the development of the project in February 2, 2002. PMC's proposal played an important role in the state's formulation of government resolutions to implement the new Incentive Grants program.

Initiatives of MPCB

MPCB has classified various industries based upon the extent of pollution they cause as given in the first chapter under section on industrial pollution. Based upon its investigation, the MPCB has also taken legal action against the industries that do not provide sufficient treatment to the effluents generated by them as shown in table 8.10. This has compelled industries to provide necessary infrastructure for taking care of their wastes and, thus, has created a sense of corporate responsibility for environmental protection in the State.

Table 8.10: Region-wise Status of Industrial Units in Maharashtra

Sr. No	Region	Total No. of Units	Total No. of units Closed	Total No. of units complying with the standards	Total No. of units not complying with the standards	Action taken against defaulters
1	Mumbai	19	6	13	-	-
2	NaviMumbai	48	13	35	-	-
3	Thane	54	14	38	2	1
4	Raigad	69	3	40	26	-
5	Kalyan	19	4	15	-	-
6	Pune	79	10	43	26	15
7	Nashik	135	38	96	1	1
8	Nagpur	49	2	10	37	7
9	Amravati	27	6	19	2	1
10	Aurangabad	83	16	58	9	4
11	Kolhapur	284	75	203	6	1
	Total	**866**	**187**	**570**	**109**	**30**

Source: MPCB (2005)

Environmental Education

Promotion of Environmental Education (EE) and awareness among people is of utmost importance for making them understand their relationship with the nature. This is also required for the success of environment protections measures of the government and other authrorities. The MoEF has initiated several programmes in the country such as National Environment Awareness Campaign (NEAC), Eco-Clubs (National Green Corps), Global Learning and Observation to Benefit the Environment (GLOBE) and mass awareness through the electronic media. In Maharashtra, environmental concepts have been included in school syllabi. In fact, there are many formal education centres, which teach environment as a part of the course curriculum both at school and higher levels.

In the case of informal education, several NGOs are involved in promoting the schemes of the MoEF and the GoM. The Regional Resource Agency for Maharashtra for monitoring the NEAC is

Bharatiya Agro Industries Foundation (BAIF) based in Pune. There are several other NGOs involved in education and awareness activities. The GoM has also initiated Eco–Clubs or National Green Corps for Maharashtra state, which is implemented in 100 schools in each district of Maharashtra. Table 8.11 shows the details of financial assistance sanctioned for various activities related to public awareness, education and environmental knowledge up gradation in Maharashtra.

Table 8.11: Financial Assistance for Environmental Awareness, Education and Knowledege Upgradation

Programme/Proposal	Amount Sanctioned Rs. Lakhs
Establishment of 200 Nature Clubs at various colleges in Maharashtra, Assistance given to NSS, Higher & Tech.Education, GoM, Mumbai	12.00
Establishment of Sulabh Shauchalaya Complexes with `Night Soil' waste biogas plant in Sindhudurg & Ratnagiri districts. Assistance given to Maharashtra Energy Development Agency, Pune.	23.62
Preparation of Documentary promotional film for environmental awareness	4.41
Purchase of PUC equipments for monitoring HC, CO & Smoke density for petrol and diesel driven Vehicles. Assistance given to NSS Cell Units, University of Mumbai	3.00
Environmental enrichment & Nature care camps of 10 days duration with the help of NSS volunteers at 5 MIDC areas. Assistance given to NSS Cell Units, University of Mumbai.	3.00
Purchase of vehicular emission monitoring equipments for Transport Commissioner's Office i.e. 8 Smoke density meters & 8 Gas analysers for 8 RTO Offices in the State of Maharashtra. Assistance given to Transport Commissioner, Gum.	25.60
Publicity to information on activities and achievements of the Board during last 4 years through newspaper as a part of awareness programme	7.31
Printing of Nature Calendars for the year 1999 for the Board in collaboration with Wilson College Nature Club, Mumbai.	1.30
Installation of Incinerators assistance given to Municipal Corporation, Pune.	10.00
Consultancy charges for carrying out the pre-feasibility report for establishment of proposed Maharashtra Environment Protection Consultancy Origination (MEPCO)	4.00
To get the control equipments (Carbon Clean System) of M/s. Approach Marketing Pvt.Ltd. tested from Vehicles Research & Development Establishment Ahmadnagar, to establish authenticity for Vehicular emission control.	7.44
Total	**101.68**

Source: Info Change News & Features (2003).

Hundreds of schools in the State now have a syllabus that aims at improving children's understanding and knowledge of the environment. This change stems from a World Bank-aided study, undertaken by the Indian government since 1999, with the objectives of strengthening environment education in the formal school system. Apart from Maharashtra, seven other states -- Andhra Pradesh, Assam, Goa, Jammu and Kashmir, Orissa, Punjab and Uttaranchal -- were selected for the pilot implementation of this project. The project reviewed the text books on environment taught in schools and also involved orientation for all the major stakeholders of environmental education. This was done through workshops for the educational administrators, concerned officials

of the State Council of Educational Research and Training (SCERT), Textbook Bureaus and state education departments, besides school principals and parents of students. At the same time, workshops were also conducted for textbook writers and illustrators, where experts from the field of environment education provided inputs and helped the writers revise the existing textbooks. Model textbooks have thus been created by each state for standards 6, 7 and 8 (Info Change News & Features, August 2003).

Several testing facilities for testing of environmental pollution have been established in the State. The Environmental Laboratories, (Govt./Semi-Govt./Public Sector Undertaking/Educational Institutes) in the State with valid recognition (updated upto 1st February 2002) under Environment (Protection) Act 1986 are as given in table 8.12.

Table 8.12: Environmental Laboratories based in Maharashtra.

Name of Laboratory	Gazette notification no. And date	Validity upto
Central Laboratory Maharashtra Pollution Control Board CIDCO Bhavan, 5th Floor South Wing, Belapur, C.B.D. Navi Mumbai-400614	S.O.336 (E) Dated 1st January, 1999	30stDcember, 2003 (5 years)
Air and Water Pollution Control Laboratory Marathwada Institute Of Technology P.O.No.327 Aurangabad-431005 Maharashtra	S.O.336 (E) Dated 1st January, 1999	31st December, 2003 (5 Years)
Environmental Quality Offsite &Utilities Laboratory Indian Petrochemicals Corporation Limited Maharashtra Gas Cracker Complex Division Nagothane-402125 Tal: Roha Dist. Raigad, Maharashtra	S.O.336 (E) Dated 1st January, 1999	31st December, 2003 (5 Years)
Process and Products Control Laboratory LPG/CSU Plant. Oil and Natural Gas Corporation Limited Mumbai Regional Business Centre Uran-400702 Maharashtra	S.O.44 (E) Dated 1st August, 2000	31st July, 2005 (5 Years)
Chemical Laboratory Ore Dressing Division Indian Bureau of mines Plot No.l-8 MIDC, Hingna Road Nagpur –440016 Maharashtra	S.O.44 (E) Dated 1st August, 2000	31st July, 2005 (5 Years)
Hindustan Organic Chemicals Ltd. Laboratory Hindustan Organic Chemicals Limited Rasayani, Distt.Raigad-410207 Maharashtra	S.O.44 (E) Dated 1st August, 2000	31st July, 2005 (5 Years)

Source: CPCB (2002)

Public Participation

Environmental Education in the State is also boosted through the efforts the GoI, the GoM, MPCB and international organisations. For example, India Canada Environmental Facility (ICEF) and World Wild-Life Fund for Nature (WWF) established about 231 Nature Clubs (NCs) under ICEF-WWF programmes in the state. Of this 102 NCs are located in the Konkan region, 77 in the Pune

region and 52 in the Nagpur region. The Environment Department (DoE), GoM has also established about 200 Nature Clubs (NCs) in the state. Activities of NC's include seminars, exhibitions, essay writing and poster competition, SWM, anti-plastic campaigns etc. The students go to rural areas and demonstrate the advantage of cleanliness and upkeep of environment to the villagers. It was found that generally the participation rate in schools was low because a fee was charged from student members to join NC under ICEF-WWF programme, which they could not afford (Sharma et. al, 2002; DoE, GoM, 2005).

The MoEF, GoI in association with the DoE, GoM and the MPCB observed International Day for the preservation of the Ozone Layer on 16 September 2003 at Rangasharada Auditorium, Bandra, Mumbai. In was a joint effort of the State Environment Department, the MPCB, the Maharashtra Nature Park and the Maharashtra State Science Education Institute. It organised awareness programmes throughout the state with assorted activities such as essay and poster competitions.

MPCB has made several efforts for increasing public awarenss on environmental issues in the State. It has organised workshop and seminars such as that on environmental management of sugar industries and distilleries in Maharashtra in 2003. Several activities have been suggested by the MPCB on the occasion of World Environment Day. A Marathi TV serial 'Kayapalat', sponsored by MPCB, was useful in creating awareness among masses. MPCB has initiated several awareness programmes to educate citizens about the condition of the environment and factors impacting it. These programmes also inform people of the role and activities of the MPCB. Intensive efforts in this direction were made which include publication of reports such as the Impact of Mass Bathing on the water quality of Godavari River during Kumbh Mela at Nashik; the Environmental Status of Nagpur Region; Water Pollution of Mithi River (June 2004) and The River Water Quality of Maharashtra (January 2005).

Some other efforts of MPCB include-

- Quarterly publication of "Paryawaran Sevak" in Marathi,
- Re-launching of the MPCB website and creation of the Environmental Information Centre for public awareness and assistance,
- Organising a high-level conference in March, 2005, for developing strategies for control of air pollution in Mumbai,
- Providing technical and financial assistance for the production of a feature film named "Chakachak", the theme of which was the importance of proper management of domestic solid waste;
- Production and telecast of other short films on environment protection during Diwali (noise and air pollution due to fire crackers) and Holi (avoid use of chemical colours, plastics which are harmful to public health),
- Mass awareness activities in collaboration with NGOs such as commemoration of Ozone Day, Earth Day, World Environment Day, etc.
- Environment First: Maharashtra, 2004: Mega event organised in 2004 for on the occasion of Foundation Day of the MPCB.

The Honourable Supreme Court of India has appreciated the efforts of MPCB for effective management of municipal solid wastes while the Supreme Court Monitoring Committee has

appreciated its management of hazardous wastes. Further, the Mumbai High Court (Nagpur Bench) has appreciated the noise pollution monitoring work conducted by MPCB (MPCB, 2005).

Relevant Environmental Legislations

The government of India has formulated comprehensive legislations to enable the institutions like the State Pollution Control Boards to effectively protect the environment. All of these regulations are applicable at national level and also relevant for the State of Maharashtra

Some major legislations/ regulations are listed as follows.

- The Water (Prevention and Control of Pollution) Act, 1974, as amended up to 1988.
- The Water (Prevention and Control of Pollution) Rules, 1975.
- The Water (Prevention and Control of Pollution) (Procedure for Transaction of Business) Rules, 1975.
- The Water (Prevention and Control of Pollution) Cess Act, 1977, as amended by Amendment Act, 1991 .
- The Water (Prevention and Control of Pollution) Cess Rules, 1978.
- Coastal Regulation Zone – Notification, 1991.
- Coastal Regulation Zone - Notification dated May 21, 2002.
- Aquaculture Authority – Notifications.
- Coastal Zone Management Authority Notifications.
- The Air (Prevention and Control of Pollution) Act, 1981, as amended by Amendment Act, 1987.
- The Air (Prevention and Control of Pollution) Rules, 1982.
- The Air (Prevention and Control of Pollution) (Union Territories) Rules, 1983.
- 2-T Oil (Regulation of Supply and Distribution) Order, 1998.
- Noise Pollution (Regulation and Control) Rules, 2000.
- Municipal Solid Wastes (Management & Handling) Rules, 2000.
- Bio-Medical Waste (Management and Handling) Rules, 1998.
- Hazardous Wastes (Management and Handling) Rules, 1989.
- Hazardous Wastes (Management and Handling) Amendment Rules, 2000 - Draft Notification.
- Manufacture, Storage and Import of Hazardous Chemical Rules, 1989.
- Manufacture, Use, Import, Export and Storage of Hazardous Micro-Organisms, Genetically Engineered Organisms or Cells rules, 1989.
- Manufacture, Storage and Import of Hazardous Chemical (Amendment) Rules, 2000 - Draft Notification.
- Re-cycled Plastics Manufacture and Usage Rules, 1999.
- Re-cycled Plastics Manufacture and Usage Amendment Rules, 2002.
- Dumping and Disposal of Fly ash Notification.
- Batteries (Management & Handling) Rules, 2001.
- National Forest Policy, 1988.
- Forest (Conservation) Act, 1980.
- Forest (Conservation) Rules, 1981.

- The Eco Sensitive Zone - Pachmarhi, Notification, 1998.
- The Wildlife (Transaction and Taxidermy) Rules, 1973.
- The Wildlife (Stock Declaration) Central Rules, 1973.
- The Wildlife (Protection) Licensing (Additional Matters for Consideration) Rules, 1983.
- Recognition of Zoo Rules 1992 Wildlife (Protection) Rules, 1995.
- Wildlife (Specified Plants - Conditions for Possession by Licensee) Rules, 1995.
- Wildlife (Specified Plant Stock Declaration) Central Rules, 1995.
- The Environment (Protection) Act, 1986.
- The Environment (Protection) Rules, 1986.
- The Environment (Protection) (Second Amendment Rules), 1999 - Emission Standards for New Generator Sets.
- Environmental impact Assessment of Development Projects.
- Environment (Siting for Industrial Projects) Rules, 1999 – Notification.
- Taj Trapezium Zone Pollution (Prevent and Control) Authority – Order.
- Dumping and Disposal of Flyash – Notification.
- Ozone Depleting Substances (Regulation) Rules, 2000 - Draft Notification.
- Scheme of Labelling of Environment Friendly Products (ECO-MARKS), 1991.
- The National Environment Tribunal Act, 1995.
- The National Environmental Appellat Authority Act, 1997.
- The Public Liability Insurance Act, 1991.
- The Public Liability Insurance Rules, 1991.
- National Environment Policy-2004 (Draft).

Details of these legislations are avaialable on the MoEF website (www.envfor.nic.in). Department of Environment, GoM and MPCB are the implementing and enforcing agencies for these regulations in the State.

Chapter 9: Conclusions and Recommendations

A comprehensive account of all major environmental sectors in Maharashtra, based upon the driving force, pressure, status, impact and response, is given in the preceding chapters. Maharashtra, being the leading State in the country, in terms of higher industrial and economical growth, may generate high levels of pollution and, thus, needs increased attention for resource conservation and environmental protection. In addition, major towns of Maharashtra are experiencing a higher growth rate of population than the rest of the country bringing State's natural and environmental resources under tremendous pressure. At the same time, the State houses India's best bio-diversity hotspots, sanctuaries and national parks, which need to be protected. Therefore, balanced strategies, which focus on sustainable economic growth and cause minimal damage to natural resources and environment are required.

Based upon the analysis of available data and information, sector-wise conclusions drawn and recommendations made are given as follows.

Chapter 1: Socio-Economic Profile of Maharashtra

Conclusions

- **Economic Profile:** Maharashtra contributes about 20 per cent to the industrial output and 13 per cent to the GDP of the country as of 2003-04. Per capita State income at Rs 29,204 is higher than the National Income at Rs 20,989 (current prices). This higher per capita State Income was attributed to the predominance of the manufacturing and tertiary sector in the State. Past three years have shown an upward trend with an impressive economic growth rate of about seven per cent. The target set for GSDP annual growth rate in Tenth Plan (2002-07) is eight per cent. Over the last four decades, the share of the primary sector has declined from 34.4 per cent to 13.4 per cent while that of the secondary sector has remained more or less constant at about 26 per cent; however, the share of tertiary sector has increased from 39.9 per cent to 60.8 per cent.
- **Population Growth:** For about half a century, the towns of Maharashtra are experiencing an unprecedented population growth. The rate of growth has been much higher than that for the country for past few decades i.e. during 1961-2001. This is exerting a tremendous pressure on natural and environmental resources, urban infrastructure and civic amenities in the State.
- **SDIs, Health and Nutrition**: The infant mortality rates have decreased from 60 in 1991 to 45 in 2001 but continue to remain high when compared to the internationally accepted norms of 5 per 1000 live births. Life expectancy has increased from 64.8 years in 1991 to 65.4 years in 2001. The sex ratio has declined from 934 in 1991 to 922 in the latest census of 2001.
- **Education:** Efforts of GoM on education sector have yielded good results. Maharashtra's literacy rate exceeds the national average as the state provides free compulsory education for children between the ages of six and fourteen. The State ranked as the second most literate state, after Kerala, in the country and its literacy rate has increased from 64.87 per cent in 1991 to 77.27 per cent in 2001.
- **Housing and Slums:** Nearly 63 percent of households in urban areas and 46 percent in rural areas considered their houses to be in good condition. Only three per cent of the households stated that they considered their houses to be in a dilapidated state. About 47 per cent of the households in urban Maharashtra are housed in one-room tenements. Nearly 90 per cent of lack

of housing facilities pertains to the weaker sections. Mumbai and other major cities in the State are densely populated as they have attracted a lot of migrants. However, cities are unable to cope with this increasing population and a large number of migrants have been forced to squat on open lands thereby contributing to the proliferation of slums. While share of urban slum population has been decreasing for India for the past 20 years, it has remained constant for Maharashtra over the same period and is spreading to all major cities of the State. Efforts of some organisations for improving housing in the State are commendable such as those of CIDCO in Aurangabad and Navi Mumbai and the SRS initiated in Brihanmumbai.

- **Urbanisation:** Although the state is highly urbanised, the levels of urbanisation are uneven across regions and districts within the state. About 42.4 per cent (4.10 crores) of the state population resides in the urban areas as against 27.8 per cent (28.53 crores) for all India. In terms of the urban population, Maharashtra ranked second in the country with a share of 42.4 per cent, next to Tamil Nadu with a share of 43.9 per cent.
- **Infrastructure:** Maharashtra finalised its own road development plan within the overall national road development plan framework. The basic objective of this plan was to connect all the villages having a population in excess of 500 in rural areas with at least one all-weather road. On an average, Maharashtra has well-established road and rail network but the transport infrastructure has not been able to cope with the pressure of the ever-increasing population. The road infrastructure is highly inadequate and in poor condition due to increasing vehicular population. One of the major initiatives taken by the GoM towards development of road and road transport is the creation of Maharashtra State Road Development Corporation (MSRDC), which has completed several prestigious projects in record time. Due to the increasing load on the existing rail and road transportation system in Mumbai, the GoM has also initiated development of inland water transport with the help of PSP.
- **Agriculture and allied sectors:** Agriculture emerges as a key sector in the State as far as workforce figures are concerned. About 55 percent of the workforce in the State is employed in agriculture in comparison to 59 per cent for India. State's cropping pattern is shifting towards commercial crops. The state utilises the largest area and has the highest production in the country devoted to fruits and fifth largest area under vegetables. Commodity wise share to SDP was 25.5 from food grains with 60 per cent GCA, 19.3 from Sugarcane to with 3 per cent GCA, 24 percent from fruits and vegetables, with 5.6 per cent of the GCA. This sector is heavily dependent on monsoons and only 15 per cent of the GCA is irrigated compared to national average of 38.7 per cent. The state ranks first in cotton production in the country.
- **Energy Sector:** Maharashtra is ranked first in terms of production and consumption of electricity in the country. The state accounts for about 12 per cent of India's total installed capacity in power sector and about 80 per cent of the population in the state has access to electricity. The State ranks second in the country in production of power from renewable by having around 638.7 MW installed capacity (including Small Hydro), which is 4.43 per cent of total installed capacity in the state. MEDA implements the programmes covered under the non-conventional energy source with excellent PSP. The consumption of electricity is highest for residential sector (21%) followed by industrial sector (19%) and agriculture sector (18%).
- **Industries:** The state is grouped into seven industrial regions, namely, Greater Mumbai, Konkan, Pune, Nashik, Aurangabad, Amravati and Nagpur. The principal industrial zone is the Mumbai-Thane-Pune belt, accounting for almost 60 per cent of the State's industrial output. The State has

66 industrial clusters with spread of industrialisation has happened in and around Mumbai and districts of Pune, Thane and Raigad are the developed districts. There are 226 functioning industrial areas in MIDC, of which 8 are five star units, 74 major and 61 minor industrial areas and 39 growth centres. In terms of pollution, industries are divided into green, orange and red categories with green being the least polluted. MPCB investigated 866 industries and found that about 64% were complying with the standards, 21% defaulting units were closed, 12% were not complying with the standard and some action initiated against 3%. For regulation of Consents, the MPCB has introduced a *"fast track system"* for disposal of consent applications in an expeditious manner, which may be helpful in attracting investment in the State.

- **Tourism and Heritage:** The State has recognised tourism as a major thrust area for economic growth in the state, and therefore, budgetary allocations for promoting tourism in the state is increased by ten times from 10 crores in 2002-03 to 101 crores in 2003-04. The scenic 720 km long coastline of the Konkan has been included for development as the National Tourism Circuit. The hill stations, beaches in the state and the capital city Mumbai, attract tourists from all over the world. The primary government agency responsible for the growth and development of tourism is MTDC, which is working to boost the tourism industry in the state and marketing Maharashtra as a premier global tourism destination, thereby generating employment and enhancing productivity. The award-winning promotion campaign - 'Maharashtra...Unlimited', has been created by MTDC to highlight the tourism potential of the state.

Recommendations

- To remain as the leading State in India, Maharashtra has to pay an increased attention on it socio-economic and environmental sectors. The State should gear up to harness its entrepreneurial, financial, managerial and administrative resources to achieve higher levels of human development and to grow at a sustainable rate of 8 to 10 % per annum. This would require enlarging the scope of the private sector, which may improve both availability of infrastructure and efficiency through competition. Political willingness to implement the reforms can enable the State to access more funds from the central schemes as has been the case with some other state governments.
- Integration of some of the infrastructure schemes such as construction of roads with the employment and income generation programmes may help in the alleviation of poverty. Medical facilities and provisions in rural areas should also be upgraded. The infrastructure facilities especially power, ports and road network should be improved. Privatisation of distribution of power and water may help in reducing T&D losses, leakages and unauthorised connections.
- There is a need to provide more and efficient irrigation facilities such as properly managed watershed development programmes, drip and sprinkler irrigation systems, etc. Improvement in agricultural productivity and diversification of the traditional patterns of horticulture, animal husbandry etc., is also required. Offshore fishery resources should be promoted through the introduction of newly designed, fuel saving, multi-day mechanised fishing vessels, deep sea fishing vessels, and production of both marine inland to increase the overall fish production. There is a need to educate fishermen and disseminate information to them about mechanised fishing techniques and efficient marketing of fish-catch. The export promotion drive would have to be synchronised with the State's changing crop pattern in agriculture and allied sectors.

- Department of Industries should introduce such schemes, which focus on total quality management resulting in quality improvement, cost reduction, higher productivity. For industrial development in the backward regions of the state, better institutional support should be provided. Systematic planning, which involves sustainability, local participation and ecological conservation is required to boost the tourism industry in the State. A marketing strategy is required to address the needs of domestic and international tourists and publicise the tourism potential of Maharashtra through appropriate media.
- The State has done well in reducing IMR and overall death rate but health and nutrition still has to be a thrust area. For reducing the regional imbalances, an improvement in social infrastructure, equity and human development in backward regions of the State is recommended. Mere provision of services is not enough and authorities should conduct health awareness programmes, particularly in rural areas and the urban slum areas, to educate people about health and hygiene and take advantage of government schemes.
- Increasing growth in slum population has to be checked and provision of housing for needy and other poor sections of the society should be a priority. The GoM may take help of private sector and NGOs, in order to improve housing and reduce slums. However, housing project must be discouraged in open spaces, on hills, or on wastelands. Instead, builders may be asked to focus on slum redevelopment schemes. If required, additional benefits such as extra FSI, financial help in the form of loans, etc. may be provided to encourage the builders in such schemes.

Chapter 2: Water Resources and Sanitation

Conclusions

- **Status:** The state of water demand and supply indicates that per capita water availability in the state is lower than that at national level. This is because of the fact that while the State shares more than 9 per cent of the country's population, it houses only 4.93 per cent of the total inland water resources in the country. Also, the water flow of two major river basins (Krishna and Godavari) in the State is below the national average river flow.
- Water utilisation indicates that groundwater usage is about 50 per cent of total use. The recharge ground water depends on rainfall, which is non-uniformly distributed. Wide disparities exist in the provision of water supply in the urban (96%) and rural areas (70%). More than 53 percent of the households have water supply within their premises and about 64 per cent of the households get their water supply through taps. Water supply is skewed within urban areas and cities. For example, while Mumbai receives more than 272 lpcd, it is around 158 lpcd in Nagpur. Similarly, while slum areas of Mumbai are not getting even 90 lpcd, the well off areas of the city receive as high as 300-350 lpcd (GoM, 2003:a).
- Over-exploitation and misuse of resources is causing water shortage in the State, which may aggravate due to the demand of increasing population and accelerated economic activities. Unaccounted for water (UFW), which includes leakages, theft and wastage and misuse, is as high as 50% in some areas of the State. Water Tariff levels are uniformly low in almost all MCs and municipal councils, which causes them financial losses and also encourages misuse of water.
- River water quality indicates that there is a wide variation in the quality of water in 21 notified rivers in the States. The results obtained from respective regional offices of the MPCB in respect of river water, indicate that out of 98 stations, 40 stations show deterioration in river water

quality. No station in A-I class (State classification of rivers) was adhering to the prescribed standards i.e. "drinking water source without conventional treatment but after disinfection."

- Records from MPCB and MCs indicate that while the most of the sewage (90%) is still untreated or partially treated, industrial effluents of about 77% industries are being adequately treated. Some of the small rivers, for example, Mithi River in Mumbai, have very high BOD and COD loads and low DO levels. Bacterial contamination of groundwater was found in 39% of resources in 1999, which has come down to about 32% in the year 2002. MPCB records indicate that MPN in surface waters is within the limits of 50 per 100 ml.
- Some lakes in the State are polluted due to the excessive flow of sewage and other waste into them. For example, Mumbai's Powai Lake has been adversely affected as a result of sewage flowing from nearby slums and residential complexes and silting problems. Lonar salt-water lake in Buldhana, which is located in the world's oldest meteoric crater, is coming under threat as a result of unchecked sewage flow.
- Coastal areas are subjected to erosion, siltation, pollution and destruction of mangroves. The State ranks high among all coastal states both in terms of generation of wastewater and its disposal into the sea. In some areas, the status of the coasts and the creeks is alarming with respect to dissolved oxygen (DO), Bio-chemical Oxygen Demand (BOD) and organic pollution levels (BMC, 2004).
- Sanitation facilities, in both urban and rural areas are inadequate. Provision of Under Ground Drains (UGD) is highly uneven amongst MCs. While in Konkan and Western Maharashtra about 45 per cent of the ULBs have UGD, in Marathwada and Vidarbha this figure is only 23.52 per cent. About 83 per cent of wastewater is collected in Maharashtra, from Class I and Class II cities, but only about 13.3 per cent of it was properly treated (UNEP, 2002).
- **Impact**: Overuse and misuse of resources result into water shortage. Over-exploitation of ground water and flooded irrigation practices put pressure of resources. Due to the UFW, the total availability of water to the consumers gets reduced and there is also loss of revenue to the ULBs. In 1183 villages spread over 28 districts, about seven per cent of water resources are contaminated due to fluorides, eight per cent due to nitrates and three per cent due to iron. A majority of these villages are located in Sindhudurg, Ratnagiri, Raigad, Thane, Solapur, Nagpur, Nanded, Yavatmal and Chandrapur districts.
- Sampling of drinking water sources by the Public Health Department (PHD) across the State shows that contaminated water sources are resulting into various health hazards. On an average, 1.2 million people are affected every year and about 350 people die of bacteriological contamination of drinking water. The records during 1995-2002 in a hospital in Mumbai show that, on an average, about 50 per cent of the cases are related to water borne diseases like Diarrhoea (Gastro), Enteric Fever (Typhoid) and Hepatitis B (Jaundice). The effects of these diseases are more prevalent in the children below 12 years of age. However, the trend analysis of attacks and deaths due to water borne diseases between 1997 and 2002 indicates a progressive decline in water borne ailments.
- **Response**: Maharashtra is one of the foremost states to undertake reforms in water resources sector including water supply and sewerage services. To meet the growing demand, the GoM has taken several steps, for example, allotting four water sources to be developed by MCGM to meet the projected water demand of 4600 MLD in the year 2011 and 5100 MLD in the year 2021 (BMC, 2004).

- The State prepared a white paper on Water and Sanitation as early as in June 1995, following which a separate Department for Water Supply and Sanitation (WSSD) was created. The WSSD implements the programmes for provisions of drinking water supply through the Maharashtra Jeevan Pradhikaran (MJP), the Groundwater Survey and Development Agency (GSDA), and the Zilla Parishads (ZPs). Various schemes such as Swajaldhara Programme, PMGY Programme, World Bank aided Jalswarajya Project ARWSP and MNP have been promoted by the GoI and GoM alongwith ULBs and MPCB.
- The State has introduced the National River Action Plan (NRAP) of MoEF to check and reduce river water pollution and has covered major rivers under this scheme. Several lakes have been included in the National Lake Conservation Programme (NLCP) of MoEF. Impact of water borne diseases are on reducing due to increased availability of clean drinking water and health services provided by the GoM under various programmes. In order to improve the efficiency of water and sewerage services the GoM has asked the MCs to conduct leak detection surveys, water audits and energy audits.
- GoM is also supporting privatisation of water resources and Private Sector Participation (PSP) is being actively encouraged. Some successful examples of PSP are steps of CIDCO in Navi Mumbai wherein maintenance of sewerage pump, water pumps, meter reading and billing, maintenance of parks and gardens, collection of CIDCO's service charges have been privatised. MPCB has taken several steps in enforcing the regulations, discouraging the mis-use of water resources and reduce pollution. Provisions of Water Cess Act are applied in the State effectively. A concerted effort has been made by MPCB to ensure provision of, and compliance with standards by the, CETPs.

Recommendations

- Water shortage is a major problem in the state, and therefore, it is necessary to introduce a supply and demand management strategy. The government should find ways to transfer water from water surplus basins to water scarce regions. Water conservation measures such as rainwater harvesting and reuse and recycle of wastewater for irrigation and gardening would reduce the load on civic services.
- Tariff levels are uniformly low in almost all MCs and municipal councils in Maharashtra. To break-even in terms of just the maintenance expenses and staff salaries, the urban local bodies will probably need to charge 2 to 3 times their current tariffs. ULBs may also think of applying minimum charge for each household and over and above this use can be billed through meters.
- Installation of dual volume flushing system in toilets at household level, big societies and commercial establishment may be made compulsory. This will save lot of water used for flushing as water volume flushed out will not be a fixed quantity for each use but as per requirements.
- Toilets prepared have not been used for the purpose. Hence, mere provision of facilities has proved insufficient to solve the problems of rural sanitation. Thus, alongwith promoting integrated water and sanitation projects, it is necessary to inculcate the concept of environmental sanitation and personal hygiene amongst the rural masses.

Chapter 3: Air and Noise Pollution

Conclusions

- **Status:** Air quality monitoring is conducted by MPCB and MCs and at some places by NEERI. MPCB's monitors air quality at 89 NAAQM stations as per norms collecting 104 samples each

year. In addition, it has seven "mobile air quality monitoring vans." The data and information are published regularly and also placed on website of the MPCB, which could be useful for public information. In terms of SPM and RPM levels, which are responsible for health damages, Maharashtra towns are better than northern cities like Delhi, Calcutta and Ahmedabad, but worse than southern cities like Chennai, Bangalore and Hyderabad. However, time series data indicate that the pollutant levels are showing deceasing trend over the last 4-5 years.

- As per MPCB records, most of the industrial estates in Konkan, Pune and Amravati regions (between 75 to 100 per cent) have provided air pollution abatement facilities. In Nagpur and Nashik regions, the provision of these facilities is not satisfactory possibly because only a few local industries have air pollution potential. Vehicle population in the State has increased by almost 150% in last decade (1991-2001) and in some regions (Thane) it was as high as 311%. Within during last three years only (2001-2004) the increase is more than 30%. This has increased emissions from vehicular sources. As per the estimates of CRRI, vehicles in Mumbai contributed about 190 MT of CO, 46.4 MT of NOx, 90 MT of HC and 10.6 MT of SPM but such estimates are not available for other cities.
- Noise levels in major cities of the State exceed the prescribed standards in all categories for both day and night, by wide margins, mainly due to industrial and vehicular noise. The situation worsens during festivals and functions. Data for many MCs are not available and, wherever they are available, in most of the places, the noise levels are above prescribed limits.
- **Impact:** The SPM levels have high percentage of RSPM, which may be responsible for various health problems in urban areas. Major cities like Mumbai, Thane, Pune etc. have higher incidences of chronic respiratory problems. A study by the KEM hospital, Mumbai indicated that cases of interstitial lung disease (inflammation of capillaries) have increased from 1,479 in 2000 to 1,871 in 2004. The health status of 78 traffic policemen in Mumbai, exposed to vehicular pollution at busy traffic junctions, showed that they were exposed to high levels of CO and other pollutants and often suffered from eye irritation, cough and dyspnoea. Some micro-level studies in a small area of Mumbai indicate that for every 10 $\mu g/m^3$ increase in SO_2 concentration, the social costs could exceed Rs.100 million, which include only dyspnoea and mortality effects. Non-health effects such as the loss of rent not including property values, could amount to Rs. one million per year and the cumulative loss in property value due to each 100-unit increase in SPM concentration could be around Rs.2000 million. Other potential damage are due to visibility reduction and global effects of air pollutants. However, more detailed studies are required to estimate total economic damage of air pollution in the State.
- **Response:** Various measures for abatement of air and noise pollution have been taken by the GoM and its Agencies such as ULBs, MPCB, MSRDC, MEDA, etc. The strategy for construction of flyovers by MSRDC, to some extent, has eased the movement of traffic, and reduced the accumulation of various air pollutants at traffic junctions. A large number of vehicles have been converted to CNG and LPG Driven thereby reducing vehicular pollution.
- MEDA has promoted NCE sources such as Institutional and Community Biogas Plants and achieved 74 per cent of its estimated potential, which was the second highest in the country following Mizoram (95 per cent). As part of the NPIC programme the Appropriate Rural Technology Institute, Pune (ARTI) is the Technical Back up Unit (TBU) for Maharashtra and designs improved stove technologies. A study conducted by an NGO in a village in Raigad

district in Maharashtra revealed that PM5 and CO levels reduced by 54 per cent in the kitchen as a result of improved chullahs.

- MPCB has taken several steps to regulate the industrial pollution within norms and, as per its records, most of the industries are in compliance with the standards. It has issued directions to more than 3800 brick manufactures for utilisation of the fly ash. Co-operation of District Collectors is also sought for implementation of the notification of MoEF. MPCB, as per the Supreme Court order, has prepared a report on various actions plans to be implemented to control air pollution in Pune and Solapur cities which includes Use of Cleaner Fuels (LPG/CNG), Prevention and control of adulteration of auto fuels, Supply of Petrol with 1% Benzene and Diesel with 500-ppm sulphur for the vehicles in the city and to further achieve EURO-III compliance, Implementation of new PUC norms; Construction of a by-pass to divert outbound traffic from the city, etc.

Recommendations

- To reduce air pollution, particularly in urban areas, improvement in transport infrastructure, specially roads, improved vehicle design, alternate clean fuels and better traffic management, is required. Vehicles should be periodically checked for emissions and PUC system should be made more effective. Mumbai and other major cities should be provided with more CNG filling stations, so that a major portion of the public transport vehicles can be converted to CNG. Promotion of mass transport by improving the condition of existing mass transport system, encouraging private car pool, etc. will reduce air pollution to a great extent.
- Measures to reduce indoor air pollution include facilitating access to clean fuels and electricity in rural areas, reducing the cost of energy supplied to low-income households, promotion of renewable energy such as biogas, installation of solar water heaters and other systems.
- Need for reviewing the air quality monitoring practised is emphasised to ensure uniformity, as per standards, throughout the State. An emission inventory for only few districts/cities is available. Specific studies need to be carried out to determine the contribution of sector-specific emission loads at district / city level to enable delineation of effective pollution control strategies.
- Source identification and source apportionment are important exercises to find out the qualitative and quantitative contribution of various sources. Such exercises have been conducted by researchers as early as in 1988-89 in Mumbai who recommended them for each city (Sharma, 1994). It is suggested that such exercises may be carried out at district/ major city level to find out the quantitative contribution of each source in district/ city so that abatement strategies could be designed to focus on major contributors of pollution.
- For reducing air and noise pollution during festivals like Diwali, authorities should promote the concepts of mass celebrations of fireworks such as “Hanabi” of Japan. In such system, people congregate at a common place such as the beach, bank of a river or a large water body on one side. On the other side of the bank or water body the fire works are displayed for on a pre-designated date and time. Such fireworks are much more safe, enjoyable, economic and reduce air and noise pollution.

Chapter 4: Solid Waste Management

Conclusions

- **Status:** Solid waste included in this chapter encompasses Municipal Solid Waste (MSW), Industrial Waste (IW), Hazardous Waste (HW) and Bio-Medical Waste (BMW). Per capita MSW generation in various towns of the state ranges between 100 and 600 gm per day. In total, over 16000 tonnes per day (TPD) of MSW is generated of which around 50 per cent is generated in three cities only, namely Mumbai, Thane and Pune. Mumbai generates the highest proportion of MSW amounting to about 7500 TPD followed by Pune at 1000 TPD and Thane at 724 TPD.
- On composition of MSW, authentic data and information are not available except for few cities. The overall MSW, as of 2001, includes 2.63 per cent paper, 0.96 per cent textiles, 0.33 per cent leather, 1.31 per cent plastics, 1.95 per cent glass, 62.28 per cent ashes and fines and 32 per cent compostable matter. MSW composition figures for cities like Mumbai, Navi Mumabi, Pune, Nagpur etc. show that a large percentage of MSW contains biodegradable and recylable matter. However, in class II towns, due to consumption patterns and comparatively low standard of living , amount of MSW is lower and its composition also differs than that in Class I towns.
- The existing SWM system in urban areas has several shortcomings such as low removal frequency, uncontrolled dumping and obsolete methods. There is a lack of new sites for disposal due to lengthy land acquisition procedure, public opposition, scarcity and high cost of land. Waste collection bins are short of proper design, capacity and placement. The workers are not well trained and thus the waste is handled in an unhygenic way. Further, there is under-utilization of potential of MSW as secondary resource in vermi-composting, recycling or electricity geenration.
- Maharashtra generates more than eight lakhs TPA of HW from more than 4000 industrial units. The industries, inspite of being provided with common facilities and secured landfill sites are not prepared to bear the treatment cost involved in managing the hazardous waste generated by them. Region wise statistics of HW generation shows that the largest share (21%) of HW comes from Mumbai region followed by Kalyan (19%) and Raigad regions (14%) with least share being from Amravati region (1%).
- The state accounts for the highest generation of BMW in the country, which is at about 31.5 TPD. Division-wise generation of BMW for 2001 shows that Konkan division accounts for 45.40%, Pune and Nagpur account for 18.13 % and 11.21 %, respectively. Nashik accounts for 9.65 %, Amravati for 7.65 % and Aurangabad for 7.95 %.
- The MPCB appointed a committee to assess the BMW treatment facility in the state, which concluded that BMW was not segregated properly at the source, because of lack of training and control. It was observed that some BMW mangement facilities like at Pune and Nagpur had only incineration facility and no proper arrangement for ash disposal, none of the BMW treatment facilities was properly maintained and the compliance level was unsatisfactory. Hospitals report that the cost to be incurred for proper disposal and treatment of BMW is too high.
- **Impact:** There are several environmental and socio-economic implications associated with solid waste in the State. Low removal frequency, causes accumulation of waste in the form of unsightly heaps which often blocks the the drains and sewer lines. Uncontrolled dumping not only causes anaesthetic conditions but also adds to ground water pollution due leaching of toxic chemicals, which may be aggravated during rainy season. Many open dump sites are accessible to

humans (informal waste-pickers) and animals causing health hazards. Example of Gorai and Devnar dumping grounds in Mumbai explain the adverse impact of MSW.

- Social dimension, in the form of the involvement of informal sector in SWM, is very important as this system works very efficiently through a chain of waste (rag) pickers, waste buyers and wholesalers. Rag picking on the one hand, is a source of income and employment for the migratory labour and also controbutes to SWM by segregating recyclables, which is not done by municipality workers. On the other hand, these rag pickers are exploited by the middlemen and get paid much less than the market rate for their recyclable wastes. They are also not aware of the harmful effects of the toxic waste and unhygienic conditions in which they are working.
- Among the non-health effects, the opportunity cost of the land used for dumping of waste is also important. The cost of land in cities like Mumbai, Thane and Pune is very high and a large chuck of land is used as dump sites. Furhter, the cost as well as the rental value of residential and commercial properties lcoated near dumpsites is reduced due to unsightly condistions, odour, and nuisance due to flies, rodents and mosquitoes.
- **Response:** The task of adopting a proper SWM system is enormous, however, various Central and State level authorities (MPCB, ULBs etc.) have taken steps for an efficient SWM. MPCB is implementing the Court orders in terms of cleaning up operations, compliance of environmental standards by the industries, public awareness, stringent action against defaulters by way of levy of fines, prosecutions etc. Until April 2003, most of the ULBs even did not obtain mandatory authorisation from the MPCB as per rules. Several of them were not in compliance of the rules and regulations. MPCB persuaded successfully all the ULBs to obtain mandatory authorisation, prepare action plan for management of MSW and identify/notify suitable land for setting up of facilities for treatment and disposal of waste generated in the city.
- Some ULBs (e.g. MCGM) are encouraging the community participation and PSP in SWM. Co-operative housing societies in Mumbai are using Advance Locality Management (ALM) so that separation of solid waste is done at the various sources as a result of which 584 ALM systems and 25 vermiculture locations have been developed at various locations in Mumbai. In many areas of the city, vermi-composting is used to dispose off market waste. (BMC, 2004). House to house collection system has recently been started in some towns such as Nashik and Nagpur and some parts of Mumbai. In some cities like Pune, efforts have been made to collect source-segregated waste, separately. In few cities, private participation has been encouraged in waste collection.
- In management of HW, the MPCB has made commendable efforts including the implementation of the Honorable Supreme Court orders. Two common facilities for management of hazardous wastes have been set up at Taloja and Trans Thane Creek in Thane district having the state-of-the-art technology of international standards. The MoEF through MPCB and MIDC have provided capital subsidy to these facilities so as to reduce the tariff and motivate the user industries for management of their HW in an environmentally sound manner. Efforts are also being made to develop such facilities in other districts. As per MPCB records, of the total HW generated in the State, about 50% is disposed off in secured landfills, 19% though incineration and 32 percent is recycled.
- BMW is being efficiently manged with the efforts of MPCB and MCs, which have taken steps for special handling of medical waste. MPCB has asked hospitals and clinics to take care of their BMW either themselves or through the Common Biomedical Waste Treatment and Disposal

Facility (CBMWTDF). About 22 common facilities for management of BMW in different cities are available which are strictly maintained in compliance with environmental standards.

Recommendations

- Improved design of "waste collection bins (WCBs)" is very much needed not only in Maharashtra but also all over the country. WCBs which are being used have either one or two compartments. Instead, the WCBs must be designed to have at least four or preferably six compartments. Each compartment may be assigned and marked (both in writing and with pictures) for a particular type of waste, such as wet, recyclable, paper, glass, plastic etc. The opening of WCBs must be tilted and comparatively of small size or better of swinging type. This may discourage people from throwing the waste from a distance and they may come near to WCB to drop the waste. Compartmentalised WCB will also encourage them to put different type of waste in the designated compartment.
- Policies for SWM should be framed using the principle of the 4 R's i.e. Reduce, Recover, Reuse and Recycle. Model of "Gomi (waste) Days" in Japan may be practiced in India. Under such schemes, all housing societies, and commercial establishments are required to have enclosure as waste collection point. The authorities responsible for collection of waste must ensure that the atleast two types of wastes are collected on each day one of which must be biodegradable waste and another could be any other type of non-biodegradable waste such as recyclables (paper, plastics, metal and glass) or e-waste items (computer and electric and electronic items, etc.) or discarded large items such as broken furniture etc. A calendar of waste collection must be notified by the authorities and people should be trained to adhere to this schedule for keeping the waste in the enclosure within their premises as per the calendar. This will ensure collection of source segregated waste at household level and facilitate its reuse and recycling. This will also reduce the cost for ULBs as they will not require any WCBs. Further, households may be instructed to keep their waste in enclosures during night hours and collection at late night hours by ULB workers will also avoid unsightly conditions existing presently.
- The responsibility of a clean neighbourhood could be entrusted upon the locals thereby, both housing and commercial establishment societies, groups of shopkeepers etc. would be held responsible for any waste, which is haphazardly dumped in their surroundings. A heavy fine could be imposed on the defaulting societies/establishments.
- Public awareness and education should be increased for waste minimisation in purchasing, use and disposal of consumer products. Such measures may promote the use of simple solutions such as purchasing goods with less packaging, maintaining and repairing household appliances, and carrying reusable shopping bags instead of disposable bags. Promotion of concepts like "formation of ND squads by PMC" and "ALM of MCGM" should be taken up at large scale and implemented in other parts of the state to check illegal dumping of solid waste and construction debris along the lakesides and other water bodies.
- There are several socio-economic issues attached to the informal sector's participation in SWM. Awarness level of waste pickers and other stakeholders in informal sector should be increased about health and hygiene. Help of NGOs and CBOs may be taken for this and also, in general for waste awareness campaign may be taken.
- Instead of improper dumping of solid waste the authorities should use technically planned and well-maintained sanitary landfill sites for MSW disposal. Abandoned quarries can be restored by

sanitary land filling with inorganic wastes including construction debris by adopting suitable slopes from stability angle and with due compaction.

- Inspite of legislations banning the import of toxic wastes, WEEE and HW items such as PCs, refrigerators and other items containing toxic residues are often imported to India under the disguise of non-hazardous recyclable wastes. Attempts must be made to stop such illegal trade by imposing heavy fines on defaulters or may be by suspendin their importing licenses.

Chapter 5: Forests and Biodiversity

Conclusions

- **Status:** Maharashtra is among the states, which have largest forest cover in India. The actual forest cover in at the end of 2003-04 was 20.13 per cent of State's geographical area. This is much higher than the figures for 2001 (15.43 per cent). Gadchiroli and Sindhudurg districts have the highest forest cover of 69.78 and 45.67 percent, respectively, whereas Solapur and Mumbai have the lowest cover at 0.36 and 0.64 percent, respectively. Division wise forest status indicates that while Nagpur, Pune, Nashik and Amravati showed some increase in their forest cover, Aurangabad and Navi Mumbai showed a decline in forest cover.
- Among the districts, Gadchiroli and Sindhudurg districts have the highest forest at 69.78 per cent and 45.67 per cent, respectively and Solapur and Mumbai city districts have the lowest cover at 0.36 per cent and 0.64 per cent, respectively forests in the hilly and tribal districts of the State. None of the hilly districts (Raigad, Kolhapur, Nashik, Pune, Satara, Sindhudurg and Ratnagiri) have a forest cover of more than the required 66 per cent and the largest cover is only 45.67 per (Sindhudurg) followed by Raigad at 31.99 per cent.
- Maharashtra houses a large number of animal species and is a home for 27, 22 and 42 per cent of mammals, reptiles and birds, respectively, found in India. About five per cent of Maharashtra's geographic area is protected area and currently the state has 5 national parks, 35 wildlife sanctuaries, and three tiger reserves. The Western Ghats region is the hotspot of biodiversity in Maharashtra. The MoEF has declared hill stations of Matheran, Panchgani and Mahabaleshwar as eco-sensitive zones.
- **Impact:** Various anthropogenic activities affect the forests and biodiversity ecosystems. The national park, sanctuaries and reserves are affected by encroachments and land use changes. Due to indiscriminate construction activities, vehicular pollution and alarming number of tree felling, hill stations such as Lonavala, Khandala, Matheran and Mahabaleshwar are losing their natural charm and beauty. Although State's Tiger population has increased from 238 to 303 in the last four years but looking at the past trend, it can be considered under threat. The Salim Ali Lake in Aurangabad is ecologically a very important lake and is visited by about 25 to 30 species of migratory birds. However, due to the dumping of domestic waste and sewage the ecology of the lake is under threat (AuMC, 2004).
- **Response:** Many activities have been initiated, which focus on conservation and protection of forests and biodiversity in the State. JFM scheme of GoI was initiated in 1992, which envisage people's participation for protection, development and preservation of forests. The GoM since April, 2003, allowed usufruct sharing by the JFMCs from dense forest, which stipulates that the FPC members will be entitled to all NTFPs. The other usufructs will first be distributed to the JFMC members at concessional rates to meet their genuine household demands for these forest produce. The balance forest produces will be disposed of by public auction, and up to 20 per

cent of the net revenue thus obtained from dense forests and 50 per cent of the output from the degraded forests will be earmarked for the concerned FPCs. Fifty percent of the above earmarked income will be given to the FPC members in cash, while the balance will be utilized for implementing the micro-plans of the concerned villages.

- The state government is making efforts to set up many wildlife parks and sanctuaries to protect the wildlife. Currently, about five per cent of Maharashtra's geographic area is protected area. The state is taking special care of its national, parks wildlife sanctuaries forest parks, tiger reserves and wetlands. Other efforts are made by FDC, ULBs and NGOs and some examples of afforestation are by FDCM, JFMs at Avahti Village, MVSS at Chandrapur and efforts of PMC, NMC, NMMC, etc are worth mentioning.

Recommendations

- Strict enforcement of rules and regulations prohibiting activities that affect the forest ecosystem adversely is required to protect them from destruction. The revenue earned from increased eco-tourism, visits to nature parks, forests and protected areas should be used entirely for resource conservation.
- JFMCs envisage people's participation for protection, development and preservation of forests. They not only deal with protection and preservation of the forest ecosystem, but also generate employment for the tribes thereby enhancing the means of livelihood for the weaker sections of the society who live in and around forest areas. However, as of now, only a small percentage of Maharashtra's forest cover comes under the purview of JFM activities. Thus, there is ample scope for expanding theses activities and ensuring more efficient management of the forest resources in the State.
- People's participation should be encouraged in afforestation and conservation schemes within cities and towns. Local bodies (MCs, Panchayats etc.) could undertake programmes and steps to beautify their cities/towns/ villages following the examples set by some MCs, NGOs and individuals.

Chapter 6: Land Resources and Degradation

Conclusions

- **Status:** Land use statistics of Maharashtra shows that of total land, around 57 percent is under the net sown area, around 17 percent is under forest land, and the remaining is almost equally distributed between barren, non-agricultural and fallow land. Soils are highly deficient in nutrients in comparison to other states mainly because farmers in rain-fed areas use very little fertilisers. Excessive use of water for irrigation leads to increased salinity in soils. Also, in some regions, the fine-grained black soils do not allow penetration of water, leading to a continuous build up of salt levels. Total wastelands in the State are estimated at 70.53 lakh ha, of which, community lands account for 28.73 lakh ha, private lands 24 lakh ha, and degraded forests 17.8 lakh ha. Districts of Pune, Ratnagiri and Thane possess wastelands in excess of 25 percent.
- Water induced erosion is the major cause for soil erosion and land degradation, which is aggravated by the reducing vegetation cover. It is greater in the regions receiving short periods of heavy rainfall and is also accelerated by the absence of vegetation and undulating topography. Being a coastal region, the State is further susceptible to land degradation due to the action of sea waves and increased soil salinity as a result of the ingression of salts from coastal waters.

- More and more land demand for residential, commercial and industrial uses has resulted in large scale acquisition and invasion of coastal and hilly areas. Vast areas of agricultural land and forests are being taken over for urban and industrial development resulting in land degradation. Tourism and related infrastructure projects are planned in green zones or no development zones cause further damage. Gravel and stone quarry operations in ecologically sensitive regions of the State impact the topsoil nutrients required to maintain the vegetation cover, thereby, accelerating the process of soil erosion and degrading the landscapes and eco-systems.
- **Impact:** Development activities on ecologically sensitive areas are causing land degradation such as coastal erosion, coastal flooding, salt-water intrusion, extinction/destruction of the marine fauna, etc., threatening the livelihood of the local farmers and fishing community. National Bureau of Soil Survey and Land Use Planning (NBSSLP), found that about 94 percent of Maharashtra's geographic area is prone to water induced soil erosion and as much as over 86 percent land area in the Western Ghats and 75 percent in the Konkan Coast suffers from strong to severe soil erosion, resulting in annual soil loss of 20-40 tonnes / ha. This was roughly translated into financial losses of about Rs.2500 crores in agricultural productivity, Rs.540 crores in forest productivity and about Rs.1500 crores in livestock productivity. Due to constant quarry blasting, disturbances are affecting not only people in the neighbourhood but also the wildlife. For example, it is reported that the constant blasting of hills in Borivali, Mumbai poses threat to wildlife in the Sanjay Gandhi national park.
- **Response:** The Central and State Governments have initiated several programmes and schemes to check the land degradation. These include centrally sponsored the Integrated Wastelands Development Programme (IWDP), the Draught Prone Area Programme (DPAP), Employment Assurance Scheme (EAS) and National Watershed Development Project For Rainfed Areas (NWDPRA) etc. In the Tenth Plan of GoI, emphasis has been given to improve the ecological conditions of the Western Ghats Area of Maharashtra by allocating considerable funds for Forestry and Agriculture sectors of Ghats covering 62 talukas in 11 districts.
- The MPCB prepared an action plan to combat the environmental degradation in the region of coalmines. Regular monitoring of blasting is undertaken and records maintained thereof, wherever blasting is done within 300 metres of the stipulated danger zone. A study on blasting vibration was conducted, which indicates that vibrations were within the limits.
- Many ULBs, are taking steps to check the land degradation and soil erosion. As per the requirements of MoEF, GoI, MCGM has carried out compensatory mangrove plantation on a 40-hectare area, which is identified as suitable coastal area for such plantations by BNHS. Beach cleaning operations have also been undertaken using mechanical beach cleaners at Girgaum, Shivaji Park, Mahim, Juhu and Versova beaches (BMC, 2004). The NMMC has planned to assess the feasibility of using abandoned quarries for rainwater harvesting; planting trees for restoration of land under abandoned quarries and implement better pollution control measures in quarry operations. KMC is already using abandoned quarries for dumping of solid waste and a big quarry located at Takala is also under consideration for creation of amusement park (KMC, 2003). The MMRDA commissioned a study on quarrying activities in MMR to assess the environmental damage caused by indiscriminate quarrying for construction material practiced in the region. Some special projects such as Adivasi Development Programme in Tribal Areas, Transfer of Technologies for Sustainable Development, and Indo-German Watershed Development Programme have also been started in the State.

Recommendations

- The major problem that requires immediate attention under soil erosion. It is recommended that the government should take measures to prevent/minimise soil erosion in the state through measures such as preventing the felling of trees, adopting afforestation programmes throughout the State, particularly, in the Western Ghats and minimise land use changes.
- Quarry operations must be carried out with state-of-the-art technology and to minimise damage to surrounding areas air and noise pollution control facilities should be provided.
- Use of vermi-compost and organic farming should be encouraged reducing the use of chemical fertilisers, pesticides and insecticides.

Chapter 7: Disaster Management

Conclusions

- **Status:** Maharashtra is prone to natural disasters such as droughts, floods and earthquakes. Due to scanty rainfall and scarcity of water most of the semi-arid and arid regions of the State suffer from severe droughts. About 50 percent of the State's droughts are concentrated in the Deccan plateau. About 90 per cent of the land in the state has basaltic rock, which is non-porous and prevents rainwater percolation into the ground and thus makes the area drought prone. On the other hand, Konkan region of the State often gets heavy rainfall causing frequent floods.
- Maharashtra lies in the seismic zone II to IV, on a scale of severity of zone I to V, in India, where Zone V and Zone I are the seismically most and least active regions, respectively. Koyna dam and its surroundings are highly prone to earthquake. In addition, several man-made disasters occur in the State. For example, the industrial belt of Pune, Mumbai and Nashik are prone to the risk of industrial accidents and hazards and disasters like fire and road accidents occur in congested areas lacking proper infrastructure.
- While natural disasters are beyond our control, some of these disasters have enhanced adverse impact due to anthropogenic activities. For example, floods gets more severe if the drainage systems are blocked by the encroachment upon them. In urban areas, there are several growths of unauthorised settlements, which also dump solid waste and other garbage into the drainage systems reducing their water carrying capacity.
- **Impact:** The State suffers several socio-economic and other losses due to adverse impacts of disasters. Droughts for consecutive years have damaged agriculture and have caused water shortage in more than 20,000 villages. For instance, more than 71 talukas in 11 districts were seriously affected by droughts in 2003-2004 forcing about 140 farmers to commit suicide during 2001-2004. Poor rainfall has affected all the irrigation projects in the drought-affected regions of the State. The situation has become extremely difficult for the people who are dependent upon agriculture for their livelihood. About 14 percent of the land under kharif crops has remained unsown in the year 2003-2004 due to droughts.
- Earthquakes have claimed several thousand lives, injured many others and caused damage to property. For example, in 1993 Latur quake, almost 8,000 people and 15000 of animals lost their lives, more than 16000 got injured, and there was extensive damage to property. In recent (July 2005) floods in Konkan Region, about 900 people died because of heavy rainfall of about 37 inches. A series of landslides triggered by these rains has killed about 418 people. Also, due to reduced economic activities, there was a huge loss to State economy.

- Road accidents occur mainly due to poor maintenance of roads, mixed and heavy traffic, unsafe vehicles, lack of safety belts and helmets, lack of safe driving habits, poor emergency services and lack of enforcement of regulations. National highways have about 107 accident prone spots with maximum spots at NH 4 i.e. Mumbai-Pune highway (51) and State Highways have another 50 of such spots. The data indicates that more than nine cities (Amravati, Aurangabad, Mumbai, Nagpur, Nashik, Navi Mumbai, Pune, Solapur and Thane) account for more than 60 per cent of road accidents in the State with highest share of more than 30% from Mumbai only.
- Industrial hazards occur mostly due to accidents during chemical processing, manufacturing, storage, transport and disposal of toxic waste. Many of the storage godowns are in the close proximity of the residential and industrial estates, which increase the risk of fires and chemical explosions in these areas. Data indicate that the maximum number of accidents in the State, in all selected categories of industries, are recorded in Thane and Mumbai.
- **Response:** As a part of overall preparedness of the State, the GoM has a State Disaster Management Plan to support and strengthen the efforts of district administration. In this context, every district has evolved its own District Disaster Management Plan (DDMP). The Centre for Disaster Management (CDM) of the GoM was set up in August 1996 with support from GoI. It is expected that these multi-hazard response plans would increase the effectiveness of administrative intervention.
- For 2004-05, the GoM has allocated about Rs. 200 crores through the Calamity Relief Fund (CRF), which included about Rs.150 crore share of GoI. The GoM is incurring a huge expenditure on drought relief and mitigation. The average expenditure per day works out to be between Rs. 4 to 5 crores on all the measures. The total expenditure on drought mitigation has been Rs.1,194 crores till the end of March 2004. Thousands of works under EGS have been initiated which employ more than 8 lakhs people.
- Recently, the GoM has approved the proposal by the State police department to upgrade about 36 Police Aid Post along the national and state highways which will be fully equipped with adequate first aid and medical facilities and wireless sets for immediate communication in the event of an accident. The Directorate of Industrial Safety and Health maintains records of industrial accidents in Maharashtra. Emergency response centres (ERCs) have also been established in some of the industrial areas in the state. The Thane-Belapur Industries Association operates and manages a government owned ERC. An ERC is designed to respond to emergencies due to hazardous chemicals within a radius of 20 km.

Recommendations

- Natural disasters cannot be prevented but they can be managed to reduce their impact on the society. Applications of advance IT is necessary for use in pre-disaster activities such as early warning, preparedness and prevention. Post-disaster activities such as provision of basic necessities to victims, their R&R and must be quick and effective in practice.
- Modern Civil Engineering and architectural concepts must be used in design of buildings and other infrastructure projects to make them earthquake, fire and accident resistant.
- It is observed that, most of the time, large damage to life and property occur, due to impatience shown by he people. The people get panicked during the disaster as very few are aware of precautionary measures. All disaster management programmes should focus on public awareness and education so that people are prepared to face the situation under disasters.

Chapter 8: Relevant Global and Other Issues

Conclusions

- **Status:** Major international environmental issues of importance for the State are related to climate change, ozone depletion and trade and environment linkages. Global issues are being tackled through several institutional arrangements and multilateral agreements such as UNFCCC, GEF, IPCC, Kyoto Protocol, Montreal Protocol, Basel Convention, CDM and ODS Phase out projects etc. Other relevant issues of importance are provision of environmental infrastructure, promotion of renewable energy and enhancement of environment education and awareness. The State ranks second in the country in the production of power from renewable having 663 MW installed capacity (including small hydros), which is 4.6 per cent of the total capacity is the State.
- Infrastructure for water supply and sanitation indicates that the number of villages that have tap water within their premises and other public water supply schemes are invariably more than the number of villages that acquire water through tankers during the summer. Several water supply schemes in last 35 years have been initiated in the state to cover both rural and urban areas. Data on sewerage facilities indicate that, in some MCs and cities, UGD is still not available. Provision of effluent treatment in the industries is satisfactory as most of the industries provide proper treatment to their effluents.
- In the case of environmental education and awareness, many institutions and NGOs are involved in promoting the schemes of the MoEF and the GoM. The Regional Resource Agency for Maharashtra for monitoring the NEAC is Bharatiya Agro Industries Foundation (BAIF) based in Pune. There are several other NGOs involved in education and awareness activities. The GoM has also initiated Eco–Clubs or National Green Corps for Maharashtra state, which is implemented in 100 schools in each district.
- **Impact:** District wise estimates of climate change show a negative impact in the State affecting its agricultural productivity, water resources, coastal communities, and health of people. The State is expected to receive higher than normal rainfall as due to temperatures rise. A rise in sea level due to global warming could have a significant impact on the long and densely populated coastline and economy of the State.
- Maharashtra's coastal regions are agriculturally fertile and sea level rise could make them highly vulnerable to inundation and salinisation. Coastal infrastructure, tourist activities, and oil exploration may also be at risk. Beyond actual inundation, rising sea levels will also put large number of people at greater risk of flooding displacement and result in rapid landward urbanisation, straining resources and putting more pressure on civic amenities. Increased seawater percolation may further reduce freshwater supplies. The recent deluge of July 2005 which flooded many parts of Maharashtra such as Mumbai, Kalyan, Raigad, Chiplun Ratnagiri etc. are possible indicators of the dangers of climate change due to increased GHGs emissions from various anthropogenic activities.
- The industries and EOUs in the State that mostly cater to the demand of the foreign markets, may be adversely affected form the issues of trade and environment. Non-tariff trade barriers, such as EPDs, ecolables, product and process standards etc. may hinder the State's export of textiles, leather, agriculture and food products and increase competitiveness in the international market. Some studies in India and State have shown that trade of leather, fisheries and waste paper have felt the heat of these issues. However, trade (import) of non-hazardous waste such as waste paper for the production of new paper has more positive effects on the environment compared

to no trade. This is because the use of waste paper reduces the pressure on primary resource (forests) and also reduces the volume of MSW and thereby the pressure on the landfills. But, it has been observed that under the disguise of recyclable waste, developed countries may export hazardous waste (such as E-waste) to developing countries.

- **Response:** The State has started multilaterally-funded projects on CDM and ODS phase-out projects, in various sectors. The CDM projects are being planned in renewable energy, industrial, solid-waste, and forestry sectors. Some of the ODS phase out projects initiated in the state are Aerosol phase-out Projects, Halon phase-out Projects, RAC phase-out Projects and Solvent phase-out Projects. Policies of the GoM have encouraged private participation in three major non-conventional energy initiatives, namely, biomass energy, wind energy and waste-to-energy.
- The GoM has attractive policies for private participation in biomass power projects and some projects based on agro-waste and baggase have been initiated. Baggase-based co-generation power projects are one of the important schemes of MEDA and out of more than 160 sugar factories in the State about 50 have shown their interest for co-generation. Investor-friendly policy of GoM has attracted private investment of Rs.2000 cores so far in the wind power sector. Asia's largest Wind Park has been developed in Satara district. Waste-to-energy projects are also being promoted by many MCs such as MCGM, KDMC and PCMC.
- In water supply infrastructure, the GoM alongwith MCs has taken several steps such as leak detection surveys, water audits and energy audits to find the UFW. MEDA and MSEB have been working jointly to provide the infrastructure consisting of approach roads and power evacuation arrangements for wind power projects focusing in the districts of Satara, Sangli, Ahmednagar and Dhule. MEDA is expanding the wind power programme to other districts of Maharashtra where potential windy sites are available.
- MPCB has classified various industries based upon the extent of pollution they cause. Based upon its investigation, MPCB has also taken legal action against the industries that do not provide sufficient treatment to the effluents generated by them. This has compelled industries to provide necessary infrastructure for taking care of their wastes and, thus, has created a sense of corporate responsibility for environmental protection in the State.
- EE in the state is boosted through the efforts of the Environment Department, GoM, which has established more than 200 Nature Clubs (NCs) in the State. Some international organisations, like, India Canada Environmental Facility (ICEF) and World Wild-Life Fund for Nature (WWF) have also established about 231 Nature Clubs (NCs) in the State, of which 102 are located in the Konkan region, 77 in the Pune region and 52 in the Nagpur region.
- MPCB has made several efforts for increasing public awareness on environmental issues in the State. It has organised workshops, seminars and several other activities, in general, and specially on the occasion of World Environment Day. MPCB has also promoted EE through media and sponsored a Marathi TV serial 'Kayapalat,' a feature film "Chakachak on solid waste management," published a quarterly publication of "Paryawaran Sevak" in Marathi, organised campaign at religious places, published reports such as the Impact of Mass Bathing on the water quality of Godavari River during Kumbh Mela at Nashik; the Environmental Status of Nagpur Region; Water Pollution of Mithi River (June 2004) and The River Water Quality of Maharashtra (January 2005).

Recommendations

- Efforts are required to make all stakeholders well aware of global environmental issues and to encourage private participation, increased involvement of NGOs and communities in these issues.
- Renewable Energy is seen as an effective option for meeting ever-increasing energy demands as well as a mean to provide energy security. Use of solar energy by the societies, commercial establishments etc. will reduce conventional demand for energy production and would also redcue GHG emissions.
- Environmental education and awareness require a significant capacity building in all sub-sectors of gobal environment and at all levels such as schools, colleges, community, government etc.

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