CHAPTER 15

Water and Environment

Introduction

Maharashtra is one of the most industrialised and populated states in India. This makes concerns for environmental degradation in Maharashtra far more serious than those in the other states in the country. In fact, Maharashtra is among the foremost states that encountered the problems of environmental pollution and also took action to tackle them (GoM, 2003a).

The *problems of water resources* in the state are related to both *depletion and pollution.* While the issues in rural areas are lack of water supply infrastructure and difficult access to safe water, in urban areas, the ever-increasing demand, inadequate and sub standard quality of services are endemic. High levels of *indoor and ambient air pollution* are of serious concern in the state. Industries and vehicles are major man-made sources of ambient air pollution, and low quality of fuels, create indoor air pollution. *Noise level,* particularly in urban regions are at alarming stage. *Solid waste problems,* due to concentration of population and wasteful consumption patterns, are more obvious in urban areas. Inefficient solid waste management (SWM) has led to significant land degradation. Growing demand for fuel, fodder, agricultural and industrial production is fast depleting *forest and biodiversity*, resulting in the loss of genetic diversity in the region.

Thus, almost all of the natural and environmental resources in the state are under stress due to anthropogenic activities. Major sectors identified in this chapter are – Water Resources, (including water supply and sanitation, freshwater pollution and coastal pollution), Air Pollution, Noise Pollution, Solid Waste Management, Land Degradation, Forests and Biodiversity, Climate Change Issues, Trade and Environment linkages, Environmental Education and Environmental Policy. The objective is to review the state of each sub-sector and, based upon the analysis of available data and information, suggest measures for an efficient environmental management.

Water Resources

The quantity of *inland water resources* in Maharashtra accounts for only 4.93 per cent of the total availability in India. Since the state houses more than 9 per cent of the country's population, per capita water availability in the state is lower than the national average. Rivers and lakes are the main sources of surface water, but water flow of two major river basins in the state (Krishna and Godavari) is much below the national average. While the average annual surface water potential for an Indian river is 1869 km^3 per year, it is only 110.54 km^3 per year for the Godavari basin and 78.12 km^3 per year for the Krishna basin (MoWR, 2003).

The *distribution of annual rainfall* is highly uneven with Konkan region receiving as high as 2500 mm and Marathwada as low as 800 mm of rainfall per annum. The precipitation is concentrated between the months of June and September, particularly in the Konkan and Sahyadri regions. 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. Most of the districts (19 out of 35) show fall in the ground water level during the post-monsoon period over 20 cm per year and it has continued for about last 20 years (1981-2000). In 2001, drought-affected about 20,000 villages in 23 districts, 28.4 million people and 4.5 million hectares of crops. Several districts including Ahmednagar, Dhule, Sangli, Satara, Solapur, Beed, Osmanabad, Latur, Nashik have been affected by severe water scarcity (GoM, 2003b).

However, lack of water management, rather than natural scarcity of water, is the main reason for drought. Since 1960, government has spent over Rs.16, 000 crores on rural water supply and yet there are around 20,000 drought affected villages and 45 million people without safe and secure water. The reasons for problems being perpetual appear to be as follows. Firstly, political interests connected to the sugar baron lobby have resulted in accelerated growth of sugarcane, a highly water intensive crop, cultivated in areas, which get lesser rainfall than

even the desert state of Rajasthan. Sugarcane crop is grown only on 3 per cent of the irrigated area, but it consumes almost 70 per cent of the water consumed by all crops. Secondly, mismanagement of the resources by state authorities is responsible for the water scarcity. Though Maharashtra has the largest number of dams in the country, only 17 per cent of its agricultural land is irrigated. Despite ample resources and water related schemes, government regulations are such that problems do not have solutions. For example, if any farmer wants to replace a defective pump for his borewell, the regulation requires that replacement of the pump and borewell should be done together (Martyris, 2003).

Water Supply Scenario

Safe and regular water supply is a necessary aspect of development, but wide disparities exist in water supply in urban and rural areas of the state. As far as urban population is concerned, all 247 urban centres have piped water supply schemes for drinking, though the supply of water is not adequate as per the standard laid down by the Government of India. Similarly, the coverage of rural population with adequate public drinking water supply is about 70 per cent (GoM, 2003b).

Maharashtra was the first state to prepare a White Paper on Water and Sanitation in June 1995, following which the GoM established a separate department for water supply and sanitation for better coordination of the sector. As per the policy approved by the State Government, the water supply and sanitation department (WSSD) implements the programmes for provision of drinking water supply services through the MJP, the Groundwater Survey and Development Agency (GSDA), and the Zilla Parishads (ZP). The MJP is responsible for the design and construction of water and wastewater schemes in urban and rural areas and mobilisation of resources on behalf of the local bodies.

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. Subsequently, the WSSD has, with the inputs from the Committee, undertaken several positive steps, which include extensive consultation workshops for rural water supply and for introduction of sector reforms, improved groundwater management introduction of efficiency improvement 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 program to provide incentives for efficiency improvement.

In order to achieve substantial and far reaching reforms in the water sector, the Committee strongly recommended the establishment of an independent Maharashtra Water and Wastewater Regulatory Commission (MWRC). The MWRC would be responsible for regulating both water supply and wastewater disposal services. However, sanitation aspects such as solid waste management and low cost sanitation are proposed to be excluded from the purview of the MWRC (GoM, 2003b).

Urban Situation

The share of urban population in Maharashtra is about 42.4 per cent as against a national average of 27.8 per cent (GoM, 2003a). Mumbai, Pune and Nagpur are among the fifteen most populous agglomerations in India. Therefore, satisfying the basic needs of water and sanitation poses a challenge for the authorities. Data from Maharashtra Jeevan Pradhikaran (MJP) show that the water supply levels in urban areas are inadequate as only 15.3 per cent local bodies satisfied the norms of per capita water consumption. The disparity in the amount of water supply in various urban centres as well as within different areas of a city is very striking. For example, though Mumbai has a maximum 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, 2003c). Water quality is also not very satisfactory and, on an average, in 2000-01 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). The main reasons for high level of contamination are inappropriate sanitation, absence or inadequate dose of the disinfectant and recontamination in the distribution network (PHD, 1999; NEERI, 2002).

Over use and misuse of water can be observed in various human activities. Due to intermittent water supply system, it is the normal practice of every household to store more water than needed. When fresh water is to be stored, the old stock of the previous day is just thrown away to empty the containers. Unnecessary keeping the water tap running, while bathing, shaving and so on, is a common feature. Excessive use of water for gardening not only spoils the plants but also results in wastage. Leakage from water mains, feeder lines and public and private taps is a common and neglected phenomenon. It is estimated that, on an average, for domestic use about 20-50 per cent water is wasted in urban areas such as Mumbai (IDFC, 2003).

Rural Situation

About 64 per cent of villages and 72 per cent of wadis (hamlets) have a per capita water supply of more than 40 lpcd with duration of supply varying from one to three hours per day (data as of April 2002). A majority of the rural piped water supply schemes does not supply water at designed pressure. At various retail delivery points, pressure is almost negligible and consumers have to wait for an inordinately long time to fill their vessels. Even in the cases where water is available, the quality of drinking water is not satisfactory. Limited surveys conducted in rural areas show that average bacteriological contamination is 32 per cent and in some rural areas of Pune district it is as high as 66 per cent.

In rural areas, effective and sustainable management of water resources and proper maintenance of water supply infrastructure are the key issues. And therefore, many rural water supply and sanitation schemes have been initiated in the state. The Government of Maharashtra implements the rural water schemes through two main programmes, namely, the Accelerated Rural Water Supply Programme (ARWSP) funded by the Government of India and the Minimum Needs Programme (MNP). 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. Specific projects are also funded with the financial assistance made available by the World Bank and bi-lateral funding agencies (GoM, 2003b).

All new programmes based on the new policy of community led demand-driven principles, namely Government of India sponsored Sector Reform Programme, Swajaldhara Programme, Prime Minister's 15th August Special 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 the programmes are now entrusted to the villages.

Recently, the GoM has launched *Sant Gadgebaba Urban Cleanliness Drive and Jawaharlal Nehru Clean City Campaign*, which is one of its revolutionary programmes. *Sant Gadgebaba Clean Village Campaign*, initially implemented in rural areas, has received wide popularity in a very short span. And the favourable response has 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 availability of funds. The campaign needs an estimated amount of Rs. 10 crore that includes prize distribution costs of Rs. 731 lakhs and other expenses including publicity and propaganda costs of Rs. 269 lakhs. It was decided that the provision for Rs. 10 crore per year will be made by MHADA and the funds will be handed over to the state government. But, as of November 2002, MHADA has been able to provide only 10 per cent of the total amount (GoM, 2003b).

As of March 2001, MJP, the main implementing agency for ARWSP, revealed that there were 4390 schemes sanctioned for execution, of which only 1474 schemes were completed, and 1666 were in progress, which require huge funds for completion (CAG, 2000-01).

Status of Sanitation

Sanitation facilities in both urban and rural areas of state are highly inadequate. According to the 54th Round of the NSS (1999), about 46 per cent of the population in Maharashtra had access to sanitation facilities.

In r*ural areas,* as of 1997, only 6.25 per cent of the rural population had provision of sanitation, which due to government initiative, increased to about 20 per cent by 2002 (GoM and WSP-SA,

2002). Despite a subsidy programme of the state government providing 87.5 per cent of the cost 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. Thus, mere provision of facilities has proved insufficient to solve the problems of rural sanitation. And, the concept of total hygiene and creating awareness among the rural masses is essential.

In u*rban areas*, about 84 per cent of the urban population, as per the 54th round of the NSS, has access to sanitation facilities as compared to Kerala (95 per cent), Punjab (85.2 per cent) and West Bengal (84.8 per cent). The amount of wastewater generation in major towns of Maharashtra (Table 15.1) shows that the domestic sector accounts for a predominant share. Very few towns have properly planned sewerage systems. While in Konkan and Western Maharashtra regions, about 45 per cent of the local bodies have underground drainage (UGD); in Marathwada and Vidarbha regions this figure is only 23.5 per cent. Even if a particular region or city has UGD, it is not necessary that the whole area under region or city must be covered. In Sangli-Miraj-Kupwad (SMK) Municipal Corporation, for example, only 51 out of the 68 wards have UGD facility with some wards being only partially covered. Consequently, about 99 per cent of the sewage generated by the Municipal Councils and over 50 per cent of sewage discharged by Municipal Corporation goes untreated. In many cases, the sewage treatment plants (STP) constructed long back for a much less capacity are overloaded now. Thus, possibility of the untreated sewage discharged into the rivers is high, which pollutes drinking water sources of many towns downstream.

Table 15.1: Wastewater Generation in Maharashtra (2001-02)

Region/City	Wastewater Generation (MLD)	
	Sewage	Effluent
Konkan		
Mumbai	2271	240
Navi Mumbai	143.52	-
Thane (2001)	160	0.03
Pune		
Pune	265 (sewage and effluent)	-
Sangli-Miraj – Kupwad	48.645	
Nashik		
Nashik	160	29.39

Source: Environmental State Reports of Various MCs (2001 03)

The data on wastewater collection is insufficient and is available for only three cities i.e. Mumbai, Nagpur and Pune. A study by CPCB in 2000 showed that though 83 per cent of wastewaters was collected in Maharashtra (Class I and Class II cities), only 13.3 per cent was actually treated (UNEP, 2001).

Fresh-water Pollution

Various water supply sources such as rivers and lakes in the state are under the threat of getting contaminated due to over-abstraction of ground water and also due to other man-made interventions like excess use of fertilisers (mostly urea), mixing of untreated effluent in drinking water resources and industrial pollution. Based upon the information from Maharashtra Pollution Control Board (MPCB), Comptroller and Auditor General (CAG) report observed that the aggregate sewage discharged by 219 councils was 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 wastewater into the rivers (ToI, 2002).

Analysis of the data from sub-regional offices of MPCB and department of environment, GoM shows that effluents from many of the industries in Thane, Raigad, Kolhapur and Sangli have a very high BOD load. Out of 9135 industries only 4657 (about 51 per cent) were providing wastewater treatment facilities. Many of the districts such as Akola, Buldhana, Nagpur and Nashik have very low performance in terms of industrial wastewater treatment as only 2 to 8 per cent of industries were providing treatment facilities. Even in the Konkan region, less than 50 per cent of industries have treatment facilities. However, the data show that almost all industries (more than 95 per cent) having treatment facilities were able to treat their effluent despite the fact that very few districts had satisfactory CETP facilities.

River Pollution

Of the total wastewater and solid waste released into *Godavari river basin*, Maharashtra's share is 40.5 per cent and 42 per cent, respectively. Most of the industrial activities are located in Aurangabad and

Nashik districts and distillery units are the largest polluters in the state followed by pharmaceuticals, leather, pulp and paper and pesticide units. Nashik is the most polluting city in terms of both wastewater and solid waste generation. Hingoli is a major contributor of wastewater and Ahmednagar accounts for about 17 per cent of solid waste generation. The stretch from Nashik to Nanded is particularly polluted with wastewater contributed from domestic and industrial sources.

The share of Maharashtra in wastewater and solid waste released into the *Krishna river basin* forms only 2 per cent and 3 per cent, respectively. Satara accounts for the largest share and releases about 32.5 per cent and 22.9 per cent of wastewater and solid waste, respectively, followed by Karad. Hence, the stretch of the river from Karad to Sangli is highly polluted due to release of effluents, mainly from sugar industries and distilleries.

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. 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. Obsolete machinery with poor up keeping has added to the pollution in the river (Deshmukh et. al, 2003).

Thus, continuous flow of untreated or partially treated wastewater into the rivers has degraded their water quality considerably. Based on the CPCB guidelines majority of the rivers in Maharashtra fall in the "D" category with respect to BOD (i.e. they can neither be used as drinking water source nor for outdoor bathing). The water is capable of propagating wildlife and can be used for irrigation, industrial cooling and controlled waste disposal. Data show that since 1994, most of the rivers have been in the "D" category while the desired category is "C" (which refers to drinking water source after conventional treatment or higher). The results obtained from the regional offices of the MPCB indicate that out of 98 monitoring stations, 40 stations show deterioration in river water quality. The state classification of rivers is designated as A-I, A-II, A-III and A-IV in decreasing order of water quality. Accordingly, the overall water quality of rivers observed in the state is more or less within the limits of A-II class, i.e, water to be used only after conventional treatment.

Lake Pollution

The Lonar salt-water lake in Buldhana, 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, three rare spider species and two scorpion species belong to this area (Gokhale, 2003). Similarly, the Powai lake in Mumbai is also under stress as a result of wastewater flowing from nearby slums, industrial and residential complexes and silting problems. This has been included, along with 21 other urban lakes, in the National Lake Conservation Programme (NLCP) of the Ministry of Environment and Forests (MoEF), Government of India (GoI) started in 1995. In Pune, three lakes namely, Katraj, Pashan and Model Colony lakes, are also being included in the NLCP.

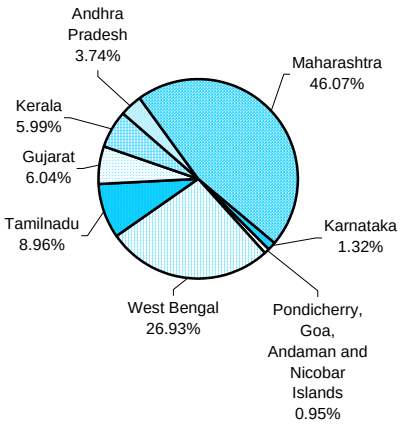
Coastal Pollution

Natural beauty and availability of livelihood resources have resulted in concentration of population in coastal areas. However, people perceive the ocean as a bottomless pit, which can accumulate and assimilate unlimited quantity of pollutants, and therefore, they go on releasing waste into it, causing harm to marine ecosystem. Maharashtra leads both in generation and collection of wastewater among all coastal states in India. It generates about 46 per cent of the total wastewater generated by all coastal states in India and collects about 52.9 per cent of its generated wastewater as shown in Figure 15.1.

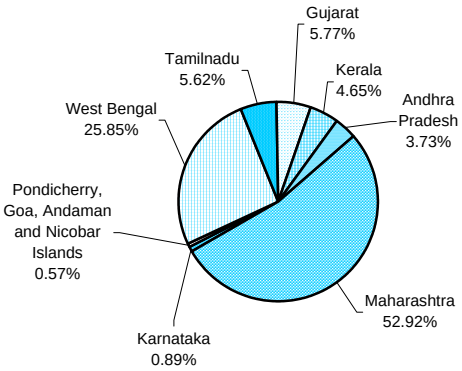
In fact, in terms of all parameters including supply of water, wastewater generation, wastewater disposal into the sea, both treated as well as untreated, Maharashtra ranks first among all the

Figure 15.1: Share of Maharashtra in Generation and Collection of Municipal Wastewater (mld) among important Coastal States in India

Generation



Collection



Source: CPCB (2002:a)

coastal states on India. About 3000 million litres of wastewater is discharged into the sea in Mumbai alone. The CAG report noted that the seawater in Mumbai is highly polluted and unfit for bathing, water sports and commercial fishing (ToI, 2002). The Coastal Regulation Zone (CRZ) needs to be properly implemented as they are of vital importance in preventing the coastal pollution.

Effects of Water Pollution

Many regions in the state receive poor water quality in terms of physical, chemical and bacteriological parameters. As many as 875 and 1183 villages, spread over 28 districts, are affected by excess iron and fluorides, respectively. Of all water resources, about 7 per cent had fluoride problem, 8.2 per cent nitrate contamination and about 3 per cent had iron problem. Most of these villages are located in Sindhudurg, Ratnagiri, Raigadh, Thane, Solapur, Nagpur, Chandrapur, Yavatmal, Nanded and Ahmednagar districts.

Chemical and bacteriological contamination of ground water has severe and serious health hazards as can be seen from the number of cases on various ailments reported from rural areas during 1999-2002 (Table 15.2). Reports from PHD show that, on an average, 1.2 million people are affected every year and about 350 people die of bacteriological contamination in drinking water. However, the trend analysis of attacks and deaths, due to water borne diseases, between 1997 and 2002 indicate progressive decline (PHD, 2002). This is due to increased availability of clean drinking water and health services provided by GoM under various programmes.

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 Gastro (Diarrhoea), Enteric Fever (Typhoid) and Hepatitis B (Jaundice). The effects of these diseases are more prevalent among 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. This indicates the possibility of mixing of sewage with water supply sources and supply mains (Sharma, 2002).

Governance in Water and Sanitation

Water tariff levels are uniformly low in almost all districts of Maharashtra. To break even, in terms of just maintenance expenses and staff salaries, the urban local bodies (ULBs) will probably need to charge 2 to 2.5 times their current tariffs. It must be highlighted that BMC, has had, a historically healthy surplus, in water and sewerage account. However, in other MCs, the cost recovery is lesser 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

Table 15.2: 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)

and as low as 17 per cent in Sangli-Miraj-Kupwad (SMK), as per the data for 1999-2000. The main reason for this is the attitude of the people to view water as a free gift of the nature.

However, it has been realised that the government does not have the capacity to invest in huge infrastructure projects that are necessary to sustain the demand of increasing population, especially in urban regions. Hence, private sector participation (PSP) is being actively encouraged in services such as water supply, sewerage and solid waste management. Maharashtra is one of the foremost states to undertake reforms in water supply and sewerage services. The state government has been giving both grants and loan guarantees to ULBs for new water projects. But these projects have been suffering from problems of poor operations and maintenance (O&M), inefficient customer service, water leakage, unauthorised connections, theft, and low energy conservation of existing systems.

Unaccounted-for-water (UFW), which is the difference between amount of water supplied and water sold, ranges as high as 50 to 65 percent in the state. As a part of the reform process in the SMK Municipal Corporation, PSP is being undertaken in the area of water and sewerage, accounting reforms, energy and water leak detection audits, solid waste management, resource mobilisation and improved service access to the poor (FIRE (D), 2002). While data on actual leakage levels do not exist, in most cases, they are estimated to be in the range of 40 to 55 per cent.

However, due to lack of success of PSP, there are also opinions against the privatisation of water resources. For example, of the six first generation privatisation projects taken up, four have been abandoned. Pune, which was the first city to undertake PSP in its water and sewerage project, had to cancel it due to political pressure (Das, 2002). Since private participation is for a profit motive, it is bound to push up prices, which will create social inequities, as water is a necessity of life. Further, private companies are prompt in disconnecting the supply on non-payment of bills, which can be a crucial issue in a developing country like India. The main motive for bringing in PSP in the water sector is for investment purposes but, due to low possibility of returns in water sector, this may not happen similar to other infrastructure projects (Dharmadhikary, 2003).

On the other hand, there is some scope for people's participation and small-scale private initiatives (SPI) as there have been some success stories on this account. In Kolhapur district, 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. 37,000 (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. The reasons for the success were mainly the able leadership and transparency in operations. Despite the fact that the spread effect of this concept has been non-existent, the lessons to be learnt are many. Such system of management could help to overcome the fiscal problems of government organisations as well as ensure sustainable use of water resources.

Even in urban areas, involving community groups in handling water supply through private-public partnerships may be viable. City and Industrial Development Corporation (CIDCO), in Navi Mumbai, have had some success in privatisation of 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 addition, 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 ULBs and rural communities to establish a set up for water management which makes the system sustainable. USAID is working with various ULBs in Maharashtra. A study conducted by USAID in Kolhapur revealed that water could be saved up to 12,414 m^3 per day, and electrical energy consumption up to 666,029 units per year, leading to an estimated revenue savings up to Rs. 231 million with an average payback period of approximately one-year (USAID, 2001).

Air Pollution

Both ambient and indoor air pollution levels have reached an alarming stage in Maharashtra. Major sources of ambient air pollution are industries, power plants and motor vehicles emitting high levels of Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), Suspended Particulate Matter (SPM) and numerous other pollutants. Indoor air pollution is the result of low quality fuels such as wood, coal, kerosene etc., being used in rural and urban poor households.

Ambient Air Pollution

High level of SPM is a cause of serious concern in most cities in the state with Solapur and Mumbai showing much higher levels than other cities. In fact, if necessary precautionary measures to curb the air pollution are not taken, then in the near future, Mumbai may stand among one of the most polluted cities in the world. Nashik, Nagpur and Solapur have shown increasing SPM levels during 1997 and 2001. Thane is the only city, which has shown some decline in the SPM levels during the same period but the levels are still above prescribed standards of CPCB. The reasons for improvement are introduction of new vehicles with low emissions, overall improvement in road conditions and reduced congestion. Table 15.3 shows observed levels of air pollution parameters for some major locations in Maharashtra during 1997-2004.

Time series data availability on pollution parameters is scarce and as shown in Table 15.4, only three towns have the data for the past ten years. The trends show that SO_2 levels are declining due to the use of clean fuels by industries, NOx levels are increasing due to rise in vehicle population and SPM levels are fluctuating without any definitive trend and due to various reasons.

Table 15.5 compares ambient air pollution levels in Indian metro cities with some towns of Maharashtra during 2000-2004. Accordingly, SPM levels in major cities of Maharashtra are either comparable or lower than other places. But concentration of Respirable Particulate Matter (RPM) is higher than other towns. RPM levels in Mumbai, Nagpur and Solapur, both in 1999 and 2000, were found more than acceptable levels. RPM constitutes a major fraction of SPM in Nagpur but in Mumbai and Solapur, the share of RPM is reasonably less. In order to mitigate the adverse effects of RPM, the GoI has taken several steps, which apply to Maharashtra also. These include mandatory use of CNG, low sulphur diesel, phasing out of old vehicles, guidelines for various industrial units etc.

Indoor Air Pollution

High levels of pollution within houses and premises have severe repercussions on the health of women, children and aged people. However, this has been a highly neglected area in the state as access to clean fuels like LPG is limited in rural areas. Recently, some efforts have been made to provide clean fuels in rural areas. As part of the Community Biogas Plant (CBP) the state has installed 448 plants and, by 2001 end, could achieve only 20 per cent of its target for 2001-02.

The Maharashtra Energy Development Agency has installed 3 Institutional Biogas Plants (IBPs) in Sangli district and one in Mumbai for kitchen wastes during 2001-02. The National Programme on Improved Chulhas (NPIC) aims at satisfying the requirements of a good chulha. However, the state has achieved only 37.3 per cent of its targets under the NPIC programme, compared to Tamil Nadu and West Bengal (100 per cent). NCAER conducted a study in 2001-02, for evaluating the performance of NPIC programme in various states which revealed that in Maharashtra 56.2 per cent of the chulhas were working and in use, 11.8 per cent were working and not in use and 23 per cent were dismantled.

Table 15.3: Major Air Quality Parameters for Selected Locations in Maharashtra during 1997-2004 (µg/m ^{3})

Parameter	Year	Location									
		Thane	Nashik	Nagpur	Chanderpur	Solapur	Mumbai	Dombivali	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	-	-	-	36.5-44.36
	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_2	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 (2002), MASHAL (1998), http://mpcb.nic.in.

Maharashtra received the first place under the National Project on Biogas Development (NPBD) programme for 2001-02. As a part of the NPIC programme the Appropriate Rural Technology Institute (ARTI), Pune 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. ARTI has trained traditional potters to build these improved chulhas, which have had a strong impact in Sangli, Satara and Kolhapur as it enabled easier access to chulhas in rural areas. A survey conducted by an NGO, in a village of Raigadh district, revealed that PM_5 and CO were reduced by as much as 54 per cent in the kitchen due to the use of improved chulhas.

Effects of Air Pollution

Limited studies carried out in the state have shown that high levels of SPM, NOx and HC were causing high incidence of respiratory diseases like tuberculosis, cardiovascular diseases and asthma. The SPM levels reported in Mumbai range between 160 µg/m^3 and 280 µg/m^3 of which about 60 to 70 per cent are RPM. Higher levels of RPM are responsible for various health problems in the state. A study in Chembur area of Mumbai indicates that for every 10 µg/m^3 increase in SO_2 concentration,

Table 15.4: Trends in Air Quality for Three Major Cities in Maharashtra during 1990- 2004

Year	Parameter Concentration Expressed in Annual Average (µg/m^3)								
	SO_2			NO_x			SPM		
	Mumbai	Pune	Nagpur	Mumbai	Pune	Nagpur	Mumbai	Pune	Nagpur
1990	18	13.85	9.05	40	36.6	9.05	243	223	205
1991	28	17.05	8.25	45	22.05	16.7	279	197.5	248.5
1992	26	-	9.4	48	17.1	20.7	309	-	186.5
1993	26	27.8	7.95	49	39	14.5	224	179.5	130.5
1994	27	-	6.1	43	-	12.6	275	-	184.5
1995	24	22.55	8.25	43	23.45	13.6	291	140	179
1996	23	41.5	7.75	39	41.5	16.9	325	210.5	181.5
1997	24	53.1	9.05	36	61.1	18.55	272	276.5	140
1998	23	49.15	7.2	40	58.1	15.45	254	310.5	143.5
1999	26	-	-	39	-	-	255	-	-
2000	20	43.46	7.23	42	58.43	20.16	251	199	163.83
2001	17	-	-	45	-	-	240	-	-
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:b), Phatak (2002) and MPCB (2003- 04)

Table 15.5: Comparison of Air Quality Parameters in Metro Cities and Some Towns of Maharashtra (2000-04)

City	Combined Site Average of Mean of Annual Averages (µg/m³)															
	SO_2				NO_x				SPM				RPM			
	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	34.5	41.5	374	23.4*	519#	-	-
Calcutta	25.3	21.9	13.3	18.1	44.2	86.7	96.4	83.3	285	319	320		49.5	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	63.3	229.5	-	-
Hyderabad	12	11.7	6.7	5.4	29.3	32.5	27	29.5	199	59.3	187	81.3	27.1	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	77.5	192	-	-

Source: CPCB (2000), (2001:a) and http://cpcb.nic.in; *24 hourly average at traffic junctions; #24 hourly average in industrial areas

the social costs could exceed Rs. 100 million, which include only dyspnea and mortality effects. The loss of rent not including property values, could amount to Rs. 1 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 (IDR, 1999). In addition to health effects, air pollution also has several other effects such as reduction in visibility, spoiling of buildings, damage to material and machines, and effects on vegetation and animals. These are yet to be estimated for the state and detailed studies in various regions of Maharashtra are required on the economic damage of air pollution.

Monitoring and Abatement

Monitoring results at National Ambient Air Quality Monitoring (NAAQM) stations in Maharashtra for the period 1997-98 to 2000-01 revealed that out of 26 stations, monitoring is not being carried out at seven stations. The results of air quality parameters were found within limits at eight stations. Monitoring air quality within Mumbai city is mainly the responsibility of the BMC. But National Environmental Engineering Research Institute (NEERI) also conducts monitoring at some locations. MMRDA, in some project based studies, also collects data on carbon monoxide (CO), particulate matter less than and equal to 10 µm i.e. PM_{10}, lead and ozone. However, monitoring results of NEERI were not available with the MPCB. Many times, it is reported that the mobile monitoring vans were not functioning satisfactorily and the mandatory 104 measurements every year, required as per the CPCB guidelines, are rarely complied with, except in Mumbai. As per records of MCGM (Shrivastava and Kunte, 2003), its mobile monitoring van is in excellent condition and it is analysing more than 150 samples per year (156 samples during 2002-03). However, overall status of air monitoring in the state is not satisfactory (CAG, 2000-01).

As per records of MPCB and GoM, most of the industrial estates in Konkan and Pune (90 to 100 per cent) have provided air pollution abatement facilities, whereas in Nagpur and Nashik region, the provision of facilities for controlling air pollution is highly unsatisfactory. In Amravati region, the number of industries providing abatement facilities ranges from 75 per cent to 100 per cent. One reason for less number in Nagpur and Nashik could be that only few industries have air polluting potential.

Noise Pollution

Noise pollution is an unwanted sound that is produced by various natural or man-made sources such as oceans and construction and industrial activities. Noise can have many adverse effects like hearing impairment, sleep disturbance, reduced performance, annoyance and harming physiological functions. There are several legislations relating to noise pollution including Noise Pollution (Regulation and Control) Rules, 2000. As a safeguard against harmful noise levels, the CPCB has specified noise standard for various categories of areas such as silence or sensitive (40-50 dB), residential (45-55 dB), commercial (55-65 dB) and industrial (70-75 dB) where lower range in brackets is for night and upper range is for daytime noise levels.

In Maharashtra, noise levels in many towns exceed standards in all categories of areas, for both day and night, by wide margins, mainly due to industrial and vehicular noise. The noise levels are much higher during festival times like Ganeshutsav and Navratri. In sensitive areas, even the higher end of the noise level exceeds acceptable standards

(CSO, 2001). In Mumbai, aircraft noise is a major source of noise pollution generated during landing, take-off and ground operations of aircrafts. Night-time noise levels are particularly higher in Mumbai than in other cities, mainly because several activities in the city take place on a round-the-clock basis.

Some data for residential areas indicate that Thane had an average figure of 62 dB(A) while Navi Mumbai and Nashik were higher at 69.9 dB(A), and 81 dB(A), respectively in 2000-01 (TMC, 2001; NMMC, 2000-01; NMC, 2001-02). Aurangabad had a noise level of 67.9 dB(A) in 1998 (MASHAL, 1998). Obviously, these figures are much above the limits prescribed for residential areas. Records of MPCB for industrial regions show that except for one industrial estate in Thane, where the sound levels are very high at 245 dB, they are within specified limits in other industrial areas.

Solid Waste Management

Solid Waste Management (SWM) in Maharashtra, particularly in major towns, is highly inefficient at all stages, i.e., collection, transportation, treatment and disposal. There are several crucial environmental, economic and social issues involved in SWM and that are to be addressed in the case of Municipal Solid Waste (MSW), Hazardous Waste (HW) and Bio-Medical Waste (BMW).

Municipal Solid Waste

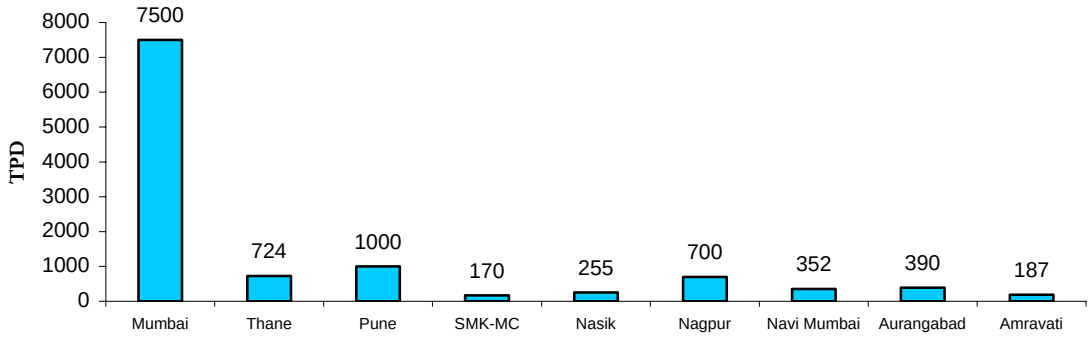
Maharashtra generates over 16,000 tonnes per day (TPD) of MSW of which around 50 per cent is generated in three cities (Mumbai, Pune and Thane) only (Figure 15.2). Per capita solid waste generation in urban Maharashtra is between 0.4 and 0.5 kg per day. Compared to other metro cities in India as well as in Maharashtra, MSW generation is highest in Mumbai and city alone generates about 7500 TPD followed by Pune at 1000 TPD and Thane at 724 TPD (TMC, 2001; Shrivastava and Kunte, 2003).

Composition of MSW differs in various regions of Maharashtra as shown in Figure 15.3 for 6 major cities. Although authentic data on solid waste composition are not available, some MCs maintain proper records. Data for Mumbai show that city's MSW has about 63 per cent non-biodegradable waste and 37 per cent biodegradable wastes. These figures for Nagpur are 65 per cent and 35 per cent, respectively. The share of biodegradable waste is more than 50 per cent for all the cities other than Mumbai. In Pune, about 95 per cent of solid waste is either biodegradable or recyclable and for Navi Mumbai it was almost 100 per cent. For Nashik about 73 per cent is biodegradable and for Thane, mixed garbage accounted for 63 per cent, which could not be classified into any category. Mumbai's clearing efficiency of solid waste is about 86.2 per cent, which is the highest among all the major cities in Maharashtra, followed by Thane's at about 57 per cent (CSO, 2001). The high content of biodegradable and recyclable wastes provide ample opportunities for more efficient and resourceful waste management. However, despite some limited efforts of composting and power generation, alternative solutions of SWM have not been very successful, mainly due to their high cost.

Hazardous Waste

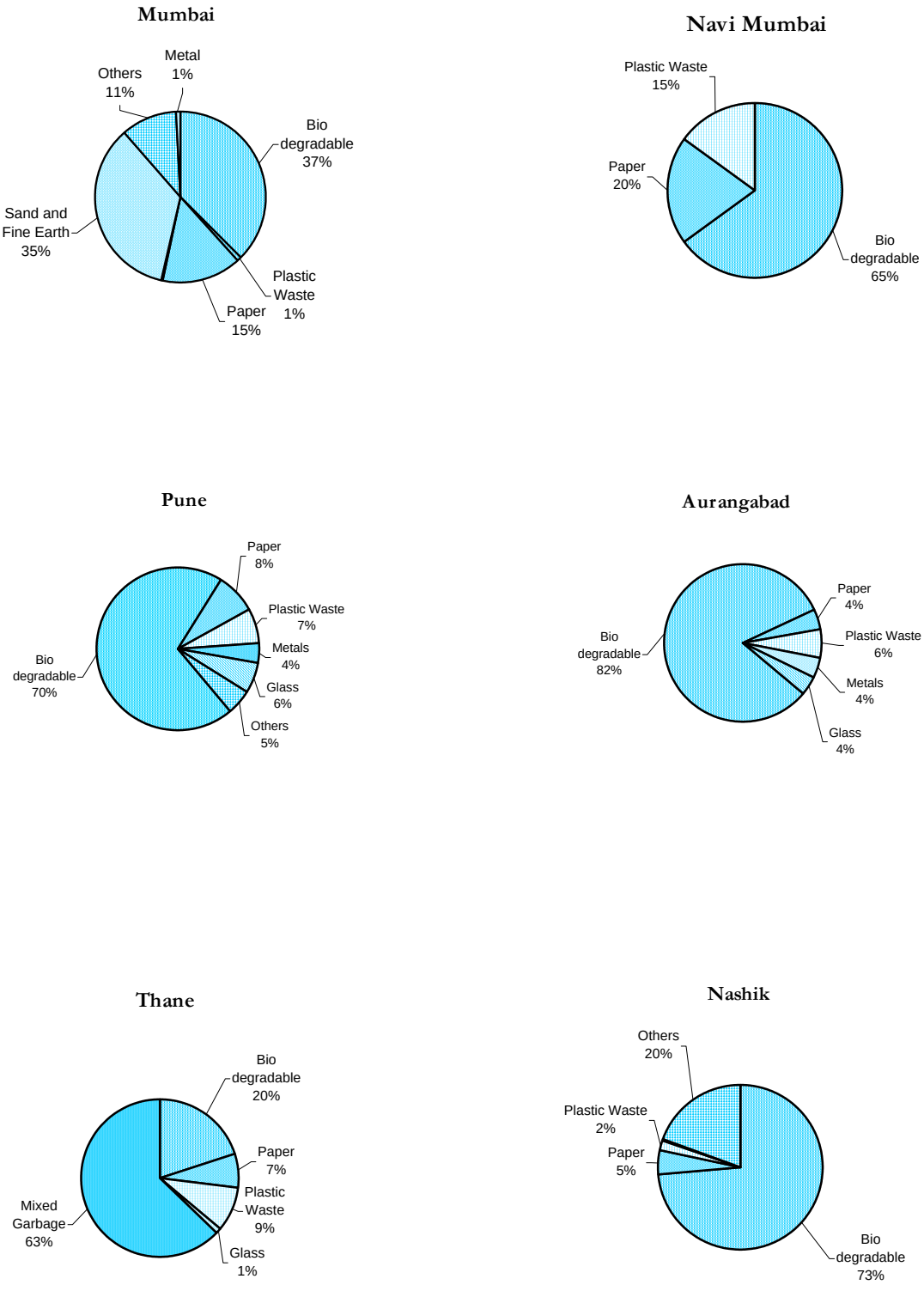
Hazardous wastes (HW) generated by industries are highly toxic and have serious repercussions on health. The state accounts for about 21 lakh tonnes per year of HW, which is about 50 per cent of total HW generated in India. Despite Maharashtra being the largest generator of hazardous waste in the country, very few industrial estates have provided for HW treatment facilities. Thane, Ratnagiri and

Figure 15.2: Solid Waste Generation in Major regions of Maharashtra (2001-02)



Source: Compiled from Environment Reports of various MCs (1999-2002)

Figure 15.3: Composition of Solid Waste in Major Cities of Maharashtra



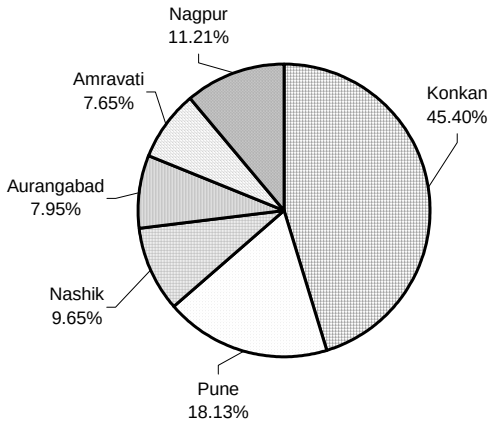
Source: Compiled from Environment Reports of various MCs (1999-2002)

Raigad are generating the maximum amount of hazardous waste. This waste is dumped either without or with improper treatment causing health hazards and environmental pollution. Despite the commissioning of a sanitary landfill and incineration facility at Taloja, the industries are unwilling to pay for the treatment cost.

Bio-Medical Waste

Maharashtra contributes to the largest share of bio-medical wastes (BMW) among all states at about 31 tonnes per day, which is about 60 per cent of total BMW generated in India. As can be seen from the Figure 15.4, the Konkan region accounts for 45.23 per cent of the BMW generation, with Mumbai's share being the largest, while Pune and Nagpur account for 18.13 per cent and 11.21 per cent, respectively. Despite the Bio-medical waste Rules coming into effect, the major hospitals in Nagpur and Wardha were not following them (Sarkar, 2000).

Figure 15.4: Region wise Generation of BMW



Source: Data from MEDC (2001)

Various MCs and MPCB have taken steps to specially handle medical waste. For instance, BMC allocated one acre of land near Deonar dumping site for handling of BMW. The site is made inaccessible to rag pickers and guarded from foraging animals. Many of the hospitals have been asked to set up their own incinerators and were also advised to have shared treatment facilities. In 2002, MPCB served notices to 62 hospitals, which were responsible for generating 75 per cent of the total medical waste, under the 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:a).

Thane Municipal Corporation (TMC) is seeking help of private parties for setting up a common bio-medical waste facility on a Build, Own, Operate and Transfer (BOOT) basis. Hospitals in TMC region will be charged either on per bed basis or lump sum amount per year as all infrastructure facilities like land, water and electricity for common treatment plant will be provided by TMC (Holla, 2002).

The major hurdle in handling the BMW is the high cost of disposal and treatment, which may result in unethical practices being adopted by hospitals. For example, in 2001, 214 municipal hospitals and 211 private healthcare institutes out of about a total of 1340 institutes in Mumbai have entered into a MoU with BMC to send their infectious waste to a common facility. However, the BMC authorities feel that after the billing system has been introduced, hospitals are sending less quantity of wastes to treatment facility. While the hospitals in Mumbai used to send 17 TPD of BMW in 2001, it is reduced to as low as 1.5 TPD in 2002 which is a serious concern. Other problems are lack of trained manpower and low level of awareness among hospitals regarding hospital waste management, as largely felt by field officers of MPCB.

Health and Other Effects

There are several environmental and socio-economic implications associated with solid waste in Maharashtra. Uncontrolled and open dumping of waste on land attracts rodents, insects, etc., and creates highly unhygienic conditions. Excessive dumping and land filling with waste deteriorates the quality of land and also the groundwater gets polluted due to leaching of hazardous substances. Solid wastes released directly into water bodies are highly polluting. Thane-Belapur industrial belt in Navi Mumbai creates more than 100 TPD of solid waste, most of which is highly toxic. The water bodies such as the Ulhas River have registered high levels of mercury and arsenic. This could be due to unauthorised dumping of solid waste in the river.

Indiscriminate burning of waste releases toxic fumes, which have serious health effects. 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. This

resulted in a public interest litigation forcing BMC for some improvement (ToI, 2003). Further, the opportunity cost of the land used for dumping of waste is not considered, which could be very high in cities like Mumbai.

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. Rag picking has both positive and negative aspects. On the one hand, it is a source of income and employment for the migratory labour. They 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 lesser than the market rate for their recyclable wastes. They are also not aware about the unhygienic conditions that they are working in and the harmful effects of the toxic waste that they are dealing with (Sharma et. al, 1997).

Steps by Authorities

Maharashtra has taken the lead in the country for adopting eco-friendly disposal of waste as six MCs in the state have decided to put up MSW power plants. The first MSW power plant in the country using 500 TPD of waste and with 5 MW generating capacity came up in Nagpur in 2000. Power plants of varying capacity have been planned at Mumbai, Pune, Kalyan, Solapur and Pimpri-Chinchwad. Most of 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. The central and state governments, on their part, have provided a number of incentives to such plants like interest subsidy, assured power purchase, 100 per cent income tax depreciation and protection from foreign exchange fluctuations (Vaidya, 2000).

Community groups have been involved in management of solid waste in many cities. Treatment and disposal of solid waste by vermi-culture composting has become an important method. In Mumbai, as a result of BMC's efforts to ensure segregation of dry and wet waste, as many as 12,500 odd residential societies are now segregating their waste at source and 45 vermiculture sites are converting the wet garbage into compost (ToI, 2003:a). However, one recent survey revealed that 60 per cent of the housing societies did not segregate waste. On one hand, people showed a lack of willingness and awareness and, on the other hand, BMC officials did not provide the necessary infrastructure to do so (Moitra and Ramachandran, 2003). In order to handle the solid waste in urban areas, some of the projects have been put up for PSP, thus, changing role of authorities from governance to facilitation. However, some incidences of mismanagement by private contractors have been reported such as while contracts were given for 4000 TPD collection, in reality only 2500 TPD waste was collected, causing huge losses to the BMC (Sen, 2003).

Forests and Biodiversity

State of Forests

There are six forest types in the state, namely, Tropical Semi Evergreen, Tropical Moist Deciduous, Tropical Thorn, Subtropical Broadleaved Hill and Littoral and Swamp Forests. Deciduous forests can be found in Nashik and Thane districts and the `Mawal' strip. Raigad, Ratnagiri and Sindhudurg districts though capable of producing semi-evergreen trees have predominantly deciduous trees due to human interference. Evergreen forests can also be found in Ahmednagar, Pune, Satara, Sangli and Kolhapur districts (Ghate, 2003).

Maharashtra has a total geographical area of 30.77 million hectares. As per the assessment by the Forest Survey of India, state's forest cover accounted for 15.17 per cent of the total geographical area in 1997, which has increased to 20.13 per cent in 1999 (FSR, 1999 and 2001). Thus, as per FSR (2001), the forest cover in the state is marginally higher than the average forest cover in India (19.39 per cent). However, the state is still lagging far behind the target of 33 per cent forest

cover envisaged by the GoI in the country. Maharashtra's actual forest cover in the 1970s was 40700 km², which was reduced to 30740 km² in 1980-82 but increased to 47482 km² 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 km² between 1997 and 1999 and 4173 km² between 1999 and 2001. In both the assessments (1999 and 2001), Maharashtra showed the greatest increase among all the states in India (FSI, 2000 and 2002; GoM, 2003c).

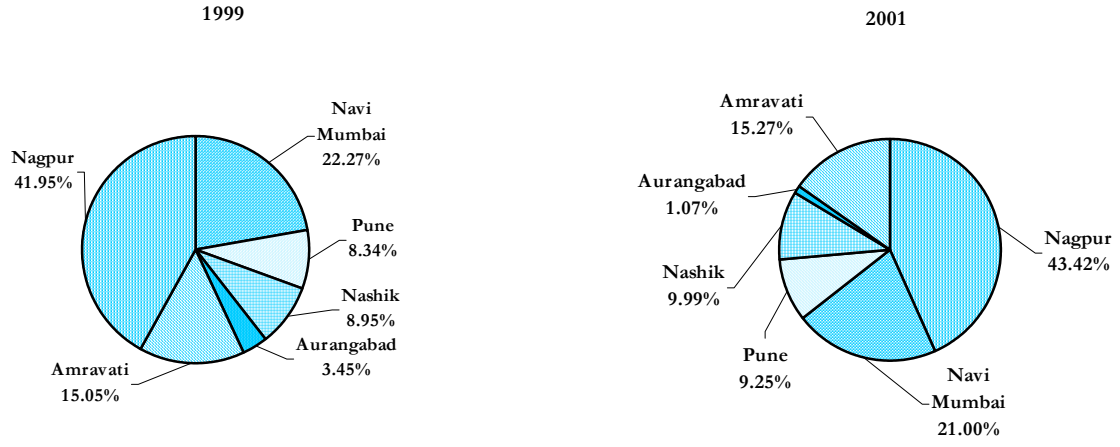
The increase in dense forests is due to the conversion of open forests, scrub and non-forest areas to dense forests. The net decrease of 16 km² of mangroves is on account of degradation on one hand and conversion from non-forest area to mangrove on the other. None of the seven hilly districts in the state (Raigadh, Kolhapur, Nashik, Pune, Satara, Sindhudurg and Ratnagiri) have a forest cover of more than the required one of 66 per cent. Sindhudurg has the largest area under forest cover at 45.67 per cent followed by Raigarh at 31.99 per cent (FSI, 2002).

The major reasons for depletion and degradation of the forests are rapid urbanisation, industrialisation, construction of big dams, use of forestlands for rehabilitation purpose etc. In addition, the state is facing an acute problem of water shortage. Average rainfall in the state is much less as compared to other parts of the country, therefore, much attention is required for water harvesting as well as protection, preservation and development of catchment areas. Lack of attention on forestry sector is creating havoc in various components of entire eco-system including water, air and soil. The Forestry sector is among the least priority sectors as the state's plan and non-plan budget reflect. The total plan of the state is Rs. 13000 crores where as funds allotted for forests is only Rs. 30 crores and on Non-plan side provision for the State is Rs. 55000 crores where as for the forests it is only Rs. 300 crores. This is approximately 0.1 per cent of total budgetary provision of the State (GoM, 2003c).

Mangroves are specialised coastal plants that have tremendous ecological and socio-economic significance, but are being threatened by encroachers and developers. The area under mangroves in Maharashtra was 200 km² in 1972-75, which was reduced to 108 km² in 1997 but increased to 118 km² 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).

As shown in Figure 15.5, in 1999, the Nagpur division had the largest share of forest cover in Maharashtra (41.95 per cent) followed by Navi Mumbai at 22.27 per cent. Aurangabad region has the least forest cover at 3.45 per cent. In 2001, while Nagpur, Pune, Nashik and Amravati showed some increase, Aurangabad and Navi Mumbai showed a decline in their forest cover.

Figure 15.5: Forest Cover in Major Regions of Maharashtra



Source: Calculated from FSI (2002)

About 5 per cent of Maharashtra's geographical area is declared as protected area. The state has 5 national parks, 36 wildlife sanctuaries, 40 forests parks and two tiger reserves named Melghat and Tadoba and a wetland of national importance, called Ujni, in Solapur. About 36 per cent of the villages in Maharashtra have forests as a recorded land use, which is inhabited by 19.04 million people.

The number of villages having forest area of less than 100 ha, between 100-500 ha and more than 500 ha are 52 per cent, 37 per cent and 11 per cent, respectively, which indicate the problem of encroachment. On the forestland, there are two types of encroachment. First is done by the local inhabitant, specially tribal for cultivation and to meet their livelihood, second is done by forest mafia mainly in and adjacent to the city area for construction of building, farm houses, etc. The state government has appointed the committee at district and state levels to monitor and supervise the removal of encroachments on the forestland.

Joint Forest Management

Having a large tribal population, forests have an extremely important role to play in the economy of Maharashtra. In pursuance of National Forest Policy 1988, Government of Maharashtra declared its intentions of going ahead with Joint Forest Management (JFM) in degraded and dense forests. JFM in the state envisages people's participation for protection, development and preservation of forest. Through JFM, not only the task of protection and preservation of forest ecosystem is taken, but it also generates employment in tribal areas and enhances the livelihood means of the weaker section of the society who live in and around forest areas. In the State about 15,000 villages are in and around forest area covering more than 34,000 km^2 forest area. About 4,100 JFM committees have been established and up to March 2004, JFM Committees will cover the all forest fringe villages (GoM, 2003c). There are many NGOs in the state involved in activities such as increasing forest cover and development of the tribal areas at the grass root level. Government authorities could support their efforts.

Biological Diversity

The Western Ghats region in Maharashtra falls among the most important bio-geographic zones of India, as it is one of the richest centres of endemism. Due to varied topography and micro-climatic conditions, 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. However, due to increased anthropogenic activities, Matheran, Panchgani and Mahabaleshwar are the three hilly sites in the state, which have been declared as eco-sensitive zones by the MoEF.

Damage due to *encroachment* into national parks for commercial and poaching activities has not been given due attention. Some of the important biodiversity spots adversely affected by human activities in the state are as follows (Sehgal, 2002). *Bhimashankar 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 may harm the existing habitats. *Sanjay Gandhi National Park (Mumbai)* is heavily encroached by slumlords and, being a water catchments forest area, encroachment is indirectly threatening the water security of Mumbai. Despite the court's order to rehabilitate the slum inhabitants, the authorities have not taken any substantial action, due to political patronage to the slum inhabitants. Other encroachers in the park are tourists, temple visitors, politically connected individuals and illegal liquor distilleries, which use trees as fuel wood. Timber factories are not regulated sufficiently and, contrary to Supreme Court's orders, they carry on their activities resulting in large scale cutting of trees.

Gautala Autaramghat Wildlife Sanctuary (Auranagabad), which is the home to the sloth bear, barking deer, wild boar, nilgai and leopard is denotified due to commercial interests. However, a local organisation, Nisraga Mitra Mandal, intervened and a stay-order from the court was obtained. Similarly, *Kalsubai-Harishchandragadh Sanctuary* was denotified in order to construct the Ghatkar Pump Storage Project, which may be detrimental to the sanctuary.

Reduction in tiger population over the last decade is a matter of serious concern. The crucial reason for this is believed to be the contradiction between wild life protection and revenue earning activities of the Forest Department (India jungles, 2003). *Melghat Tiger Reserve* is being disturbed by

Chikaldhara Pump Storage Project, which may drown large areas of the forests, lead to the construction of roads and disturb the tiger reserve substantially. Further, the government is planning to denotify 500 km² of the forests for construction and commercial activities, which would adversely affect the flow of Sipna, Dolnar and Tapi rivers. This may adversely affect the supply of water to the downstream communities. In *Tadoba Tiger Reserve,* a large tract of forests supplies coal to the Nippon Denro Ispat's thermal power project. This proposal threatens a large variety of species of trees such as teak, 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 the forest reserves. Other animals such as rhinoceros, elephant, lion and brown antlered deer are not seen in the state since 1993 though they were found earlier (CSE, 1999).

Wildlife conservation strategy 2002 has highlighted the importance of encroachments and suggested that illegal activities from within forestlands and Protected Areas should be removed. Fully tapping the potential in wildlife tourism and at the same time taking care that it does not have adverse impact in wildlife and protected areas. The revenue earned from increased tourism should be used entirely to augment available resources for conservation. People should be encouraged to take up afforestation and conservation in new areas.

Land Degradation

It refers to loss in land productivity due to human activities such as demographic pressure, socio-economic activities, land use change etc., resulting in depletion of essential crop nutrients, water-logging and salinity. 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 100 per cent, respectively. Maharashtra 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.

In fact, Maharashtra soils show the greatest deficiency compared to other states in the country, thereby, causing the negligence of agriculture sector. 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, region's fine-grained black soils do not allow penetration of water, leading to continuous build up of salt levels. It is estimated that salt content of soils increases 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).

Environmental Education

Promotion of *Environmental Education* (EE) among people is of utmost importance for making them understand their relationship with the nature. 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 MoEF and GoM.

EE in the state is also boosted through the efforts of international organisations, like, India Canada Environmental Facility (ICEF) and World Wild-Life Fund for Nature (WWF). About 231 Nature Clubs (NCs) have been established under ICEF-WWF programmes in the state. Of this 102 are located in the Konkan region, 77 in the Pune region and 52 in the Nagpur region. The Environment Department, 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; Warade, 2003).

Some Relevant International Issues

Two of the international issues of importance for Maharashtra could be *global warming and climate change* and *trade and environment linkages* as they may have significant impact on the future development of the state.

Possible Impact of Climate Change

For a coastal state like Maharashtra, climate change has severe implications. Preliminary estimates show a substantial negative impact on the state affecting its agriculture productivity, water resources, coastal activities, and health of people. The coastal regions are agriculturally fertile and a rise in sea level will make them highly vulnerable to inundation and salinisation. Coastal infrastructure, tourist activities, and onshore oil exploration are also at risk. For example, Mumbai's northern suburbs like Versova Beaches and other populated areas along tidal mud flats and creeks are vulnerable to land-loss and increased flooding. Beyond actual inundation, rising sea levels will also put over 1.3 million people of the state at a risk of flooding. This will displace a large number of people and result in rapid landward urbanisation, straining resources and putting more pressure on civic amenities. Further, it will also increase seawater intrusion into freshwater resources, thus, reducing the available freshwater supplies. The dominant cost, as indicated is land loss, which accounts for 83 per cent of all damages. In present value terms, the damage could be as high as thousands of billions of rupees (Sharma, 1998c; TERI, 2002).

Trade and Environment

It refers to how trade affects the environment and vice-versa. In Maharashtra, many export-oriented industries, producing goods for foreign consumers, are responsible for the deteriorating local environment. At the same time, there are several non-tariff trade barriers, such as product and process standards and packaging requirements adopted by importing countries, which may hinder the state's export to these countries. Some of the industries affected by these regulations could be textiles, leather, and agriculture and food products.

Some studies have shown that trading of waste paper has more positive effects on the environment as its use for the production of new paper reduces the pressure on primary resources. The Western Ghats region in the state is rich in biodiversity and has several unique species of flora and fauna. The Convention on International Trade in Endangered Species of Wild Life and Fauna (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 (Sharma, 1995; Sharma et. al, 1997).

Efficacy of Environmental Regulations

The environmental laws and policies regulate all aspects of the environment; starting right from identification of the problem to its solution. Maharashtra is one of the leading states in the country, enforcing such legislations. Since the state does not have its own 'water or forest policy', the National Forest Policy and National Water Policy apply by default. However, steps are being taken to formulate a state-specific water policy, involving a shift from supply driven to demand-driven wherein the government would play the role of a facilitator rather than that of a provider. There is also a proposal to create Maharashtra Water and Waste Water Regulatory Commission (MWRC) and Maharashtra Water Resource Planning and Regulatory Authority (MWRPRA) for the independent fixation of service standards and tariffs and other allied issues (Khatua, 2002).

Role of Authorities

The Environment Department, GoM, MPCB and various MCs are involved in administration of environmental regulations. MPCB monitors air and water quality, solid waste management, noise pollution, and conducts environmental awareness and training programmes. There are 33 water quality stations monitored under MINARS and 5 stations under GEMS, the results of which are sent to the Central Laboratory in Belapur for analysis. MPCB has also established 13 monitoring stations along the sea coast of Mumbai to monitor the effect of pollutants on seawater on monthly basis. In November 1995, the state was declared as *Air Pollution Control Area.* MPCB observes the extent of air pollution throughout the state by using 51 air monitoring stations covering 19 different areas. Within cities MCs have set up their own monitoring stations. In addition, regular monitoring and

assessment of air pollution caused by stacks emissions from industries is conducted. Stack samples are analysed for parameters such as Sulphur Dioxide, Nitrogen Oxides, and Total Particulate Matter etc., as per the requirements of the Air Act of 1981.

The MPCB has divided the industries into red, orange and green categories based on their pollution potential, in decreasing order. The industries, which are in the red category, are subjected to more frequent monitoring activities. Any industry, operation, process, or an extension and addition thereto, which is likely to generate any kind of pollution, will have to obtain the consent of the MPCB under the provisions of various Acts. There are three types of consents issued, namely, *Consent to Establish,* required before the actual commencement of the works for establishing the industry/activity; *Consent to Operate,* needs to be taken before the actual commencement of production including trial production, and it is valid for certain duration and *Renewal of Consent to Operate* for renewing the consent after expiry of the period mentioned in the consent to operate. The consent application is very comprehensive and requires detailed information regarding location, functioning and environmental management of the industry.

The MPCB prescribes certain mandatory conditions and standards so that pollution parameters are not exceeded by the industries. These are based on the industry type, raw materials used, processes involved, qualities of waste generated and overall environmental conditions in which the industry exists. When a particular industry has failed to comply with these conditions, action is taken against it. MPCB is also involved in research activities to improve its performance and taking policy decisions so as to improve overall environment quality in the state.

As far as watersheds are concerned, an important element of long term sustainability is to forge linkages with permanent institutions in the area. Efforts will be made to strengthen linkages between watershed community organisation and Panchayat Raj Institutions (PRI). Since PRIs are in varying degrees of administrative effectiveness in the states, the latter are likely to follow different mechanisms for linkages between the watershed institutions and the PRIs. Wherever possible Panchayats should be encouraged to undertake direct implementation of the Watershed Project. Elsewhere linkages should be forged between the Panchayats and the watershed communities. Some of the mechanisms being adopted at present include: (i) provision of nominating two representative of the Village Panchayat into the Watershed Committee of which one is a woman; (ii) declaring Watershed Committee as a sub-committee of the Land Management Committee under the Panchayat Raj Act.

For some schemes such as Drought-prone Areas Programme (DAP) and Desert Development Programme (DDP), Panchayati Raj Institutions have been assigned very active role at the district, block and village. The State Governments have been authorised to empower the Zilla Parishads to discharge all functions of the District Rural Development Agencies (DRDAs) for planning and development of the watershed projects. In that capacity, the Zilla Parishad will select the Watershed Projects and the Project Implementation Agencies, approve Watershed Committees and monitor and review the implementation of the programme.

The Panchayat Samitis have been given the right to monitor the implementation of the programme at the block level and give guidance for integration of other area development programmes. At the village level, the Gram Panchayat is to be fully involved in mobilising the community, training, dovetailing of other programmes and maintenance of common property resources such as pasture lands, fisheries tanks, plantation etc. The gram Panchayat has been entrusted with the task of monitoring the implementation of the programme. In addition to the above-mentioned functions, the Panchayati Raj Institutions are also entitled to take on the responsibility of planning and development of a cluster of watershed projects. In the capacity of a Project Implementation Agency, the Zilla Parishad/ Panchayat Samiti/Gram Panchayat concerned shall be subjected to the complete discipline and control of DRDA as any other PIA. They will have to constitute Watershed Development Team on the same lines as any other PIA and shall accordingly be entitled to demand and receive the prescribed administrative cost for each project.

For example, Ralegaon Siddhi Project, covering four watersheds in geographical area of about 892 hectares in Maharashtra, is one of the success stories. In a total project outlay of Rs. 112.75 lakh, the State Government contributed Rs. 52.75 lakh, Rs. 47 lakh was borrowed from banks, Rs. 11 lakh was put together by villagers through shramdan and the remaining Rs. 2 lakh was raised from other sources. Result of the initiative: a series of checkdams, cemented bandharas, and nullah bunds have been built at strategic locations. All these increased the infiltration of harvested water and recharged ground water. Today Ralegaon Siddhi has two percolation tanks, thirty nullah bunds, eighty-five wells, and eight borewells all of which are viable right through the year. Farmers now grow two or three crops every year including fruits and vegetables. All the soil and water conservation structures were built through community action. The villagers have stopped grazing their animals on common lands; instead, they have switched to other ways. To take care of equitable distribution of water, they have formed associations called pani puravatha mandals. The success story owes much to leadership of Shri Anna Hazare who turned a once poverty stricken Ralegaon Siddhi into a self-sufficient village. It is the people's participation that gave it all element of sustainability.

Reasons for Underperformance

Although responsible authorities in Maharashtra follow the rules and regulations prescribed under the various Acts of the MoEF, the performance of the state on environmental fronts is far from satisfactory. There are several reasons for not achieving desired results and some of them are summarised as follows:

Problems from Authorities

- Multiplicity of authorities responsible for environmental sector is a serious problem in the state. The Department of Environment, MPCB and MCs are jointly responsible for environmental management. Recently, the Traffic Police Department is also involved in PUC checking. However, neither the common man nor many industries know the exact role of each of the authorities. Often, there are conflicts in carrying out the duties and sharing of data and information.
- Mismanagement of resources, rather than lack of resources, seems to be one of the main reasons for the under performance of the environment sector. For example, in many MCs, a large number of their fleet of vehicles for waste collection is under repair, the timings of waste collection are inconvenient; and there is a lack of efforts from local authorities to educate people to manage their waste.
- Some of the MCs are taking steps to adopt efficient SWM but have not planned it properly. For example, they have planned to increase waste collection points and also ordered for several new waste collection bins but they are the same as old ones and not meant for segregated waste.
- Absence of a central database or environmental information system makes it difficult to track the defaulters. The officials are reluctant to reveal data and information to researchers or to the public, thus making it difficult to analyse the changes in the quality of the environment. Further, the findings of different agencies are too inconsistent, and therefore, analysis results could not be certain.

Problems from the Public

- There is a general lack of civic sense and willingness to play a constructive role in improving the environment. People feel that solving environmental problems is the state's responsibility and they do not have any role for themselves in it.
- In many cases, lack of awareness and education among masses about the environmental issues is the main reason for deteriorating conditions.
- Misuse or overuse of resources is a predominant reason for waste of natural resources. For e.g., a recent finding in Mumbai indicates that about half of the water provided to citizens is used inefficiently for non-potable purposes such as showering, brushing teeth, toilet flushing, shaving and car washing etc. (IDFC, 2003).
- Even among the elite and educated class, "*not in my backyard and throw away*" attitude is damaging as although it can clean their own premises/establishments, it is harmful for their surroundings.

- Some of the environmental regulations are stringent and the technology to meet them is quite expensive. Hence, the defaulters try to circumvent the regulations, thus increasing the possibility of the use of unethical practices.
- Emerging environmental extremism in the state is a serious issue as, at times, it halts important development projects under the disguise of environmental damages due to the project.

Gaps in Existing Policies

- The existing environmental policies are lacking in some technical and other aspects. For example, surface water pollution due to washout of air pollutants and groundwater pollution through leaching of toxins from solid waste dumpsites, find no mention under regulations.
- The provisions for controlling the waste of a mine, quarry or a major construction site, which may be washed by rain into a water stream, are not sufficient.
- It is difficult for people to proceed against the polluter without prior sanction of the pollution board. This increases chances of collusion of defaulter with pollution authorities. Prosecution is difficult under the Environment Act, as polluters cannot be prosecuted for want of knowledge on their part.

Conclusions and Recommendations

Maharashtra, being a highly industrialised and populated state of India, has enormous environmental problems, which need urgent attention. All sub-sectors of environment i.e. water and waste waster, air pollution, solid waste, forest and biodiversity etc., require an efficient management.

Based upon the analysis of available data, information and personal interaction with the authorities, following suggestions could be helpful for improving environmental conditions and achieving sustainable development in the state.

Water and Wastewater

Educating all stakeholders, including commons, authorities responsible for distribution and policy makers, through mass awareness, media, training programmes etc. could reduce the problems of wastage of water. Steps should be taken to create awareness about the importance of this natural resource so as to reduce the wastage of water at every stage.

- Improvement in rural water supply will require major institutional reforms as follows. Adopting demand responsive approach (DRA) for service provision and the use of participatory process; Empowering local institutions (Zilla Parishads and Gram Panchayats) and user groups (village water committees) to assume the lead role in decision-making and operations; and Ensuring financial viability of rural water supply through the DRA and an appropriate regulatory framework.
- Most of the MCs are making loss due to low charges for water. The structure of water tariff should be such that it ensures recovery of production cost. Demand side management, conservation and increasing the water tariffs for various uses will also discourage the users to misuse or over-use water.
- The scope exists to save as much as about 20-50 per cent of water if simple conservation measures are used in daily routine activities such as using water in a glass instead of use of running tap for shaving, using a bucket rather than hose for car washing etc. (IDFC, 2003).
- Regulating exploitation of ground water resources and at the same time strengthening the sources through community initiative programmes like *Shivkalin Pani Sathwan Yojana* in rural areas and innovative programmes such as *Aquifer Management Pilot Programme*, which has been included in the World Bank aided *Jalswarajya Project* should be encouraged and their proper implementation must be ensured.
- Rainwater harvesting, a traditional art in water scarce areas of India, could be revived as a potential way to meet the water demand both in rural and urban areas. Many parts of Maharashtra receive heavy rainfall during the monsoon season and this water could be trapped in underground constructed reservoirs, tanks etc. and used for various purposes other than drinking. Some of the MCs have made rainwater-harvesting compulsory for all new building proposals. This could be extended to all parts of Maharashtra and for existing buildings. It will also be useful for

ground water recharge, through borewells and inundation tanks, particularly in areas of scanty rainfall.

- Focusing on quality of water is essential as polluted water is causing several diseases in the state. Improving the conditions of water supply lines will reduce leakages and recontamination of water, and hence, would save water and reduce water related health hazards. Checking of water contamination at service connections, preventing mixing of sewage and drainage with water supply, cleaning storage and overhead tanks, repairing deteriorating internal lining of water mains and stopping seepage of surface water into mains through joints etc. are necessary. Some simple measures such as water boiling, using clean vessels etc. could help in reduction of water borne diseases.
- Public cooperation is needed in not polluting the water resources by actions such as idol immersion, dumping of material used for worshipping like leaves and flowers during various festivals such as Ganapati, Navratri and Durga celebrations. This again, requires generating awareness among masses and their willingness to improve the conditions.
- Treatment of wastewater for re-use in irrigation and campaign for sansitisation of the community in urban areas programmes such as Sant Gadge Baba Sanitation Campaign should be encouraged.
- Surface water resources such as rivers and lakes need special attention in terms of both their usefulness and aesthetic appeal. Stress should be on cleaning and restoration of these resources, identifying sources of pollution and diverting them to other areas, and de-silting of resources for increasing the capacity etc.
- Some of the resources such as Lonar Salt Lake should be given special status and priority for carrying out the conservation and pollution prevention activities.
- The steps taken by GoM such as policy for restricting the location of industries along the riverbank according to the pollution potential of the industry could bring fruitful results in preventing river water pollution. Distillery units are of major concern in terms of environmental pollution. Therefore, it is essential to restrict their further development in these regions and existing ones should be asked for providing additional treatment facilities.
- There is an urgent need for regulations to address the issue of sustainable use of groundwater resources as their over exploitation has resulted in depletion in many areas of the state.
- Maharashtra, being a coastal state, needs special care to keep its beaches and other public places clean. This may result in boosting the flow of tourists to the state and improve its economy. Coastal biodiversity has special ecological significance and mangroves, saltpans and marine resources should be protected for sustainable development of coastal areas.
- Conventional treatments for municipal wastewater could be accompanied by low cost methods such as disposal of wastewater into constructed wetlands, particularly in areas where land prices are low. In rural areas, it can be treated using the duckweed-based system. Aerated lagoons, successfully tried in some areas could also be extended to other regions. In urban areas, adopting in-house wastewater recycling by housing societies, industrial premises and other establishments could reduce the load on conventional municipal systems.
- While major industries can take care of their effluents, small and medium level firms, due to high cost, find it difficult to treat their wastewaters to meet the prescribed standards. Accelerated and improved concept of CETPs, both in terms of technology and management, could be beneficial for such firms.
- Municipal wastewater, after proper treatment, could be used for irrigation purposes. This would be beneficial for areas with water scarcity and will also provide necessary nutrients for crops, thereby reducing the use of chemical fertilisers.

Air Pollution

Air pollution could be curbed substantially by controlling pollution from vehicles and industries.

- Programmes directed towards educating the public about measures for curbing vehicular pollution like avoiding idling, maintenance of vehicles etc. through mass media should be launched. Industries should be asked to

internalise the cost of environmental pollution into their economic accounts. In rural areas, cheap availability and easy access to clean fuels such as LPG will reduce the risks of indoor air pollution, especially among women and children.

- In order to achieve an effective abatement of air pollution, source identification and apportionment of pollutants is necessary. Approaches such as source models, receptor models etc. can reveal both qualitative and quantitative contributions from all major sources in the study area. These techniques could be very effective in policy formulation and enforcement as they make it easy to identify the major culprits (sources) causing the pollution and focus on abatement measures for them. Some of such studies on source apportionment of aerosols in Mumbai were conducted in early nineties and have also been started recently by MMRDA (Sharma, 1994; Sharma, 1998b; Shrivastava and Kunte, 2003).
- Improvement in road infrastructure and traffic management is the key to reduce vehicular pollution. Construction of structures facilitating smooth traffic flow such as flyovers and subways are required in urban areas. Convenient and cheap mass transport schemes should be encouraged to reduce private traffic and congestion on the roads. Clean fuels such as low sulphur diesel, CNG, LPG or ethanol-blended fuels require large-scale introduction for use in automobiles.

Solid waste

- An efficient SWM would include the safe and hygienic collection, transport, treatment and disposal of all categories of waste i.e. MSW, industrial waste and BMW. Policy for SWM should be framed using the principle of the 4 R's i.e. reduce, recover, reuse and recycle. In fact, only 10-12 per cent of waste in general is of high risk, which could be separated at source in order to prevent it from getting mixed into the MSW.
- Some of the MCs in the state have already asked housing societies for source separation of waste, which will help in managing bio-degradable and recyclable waste. Similarly, individual premises could be asked to increase vegetation cover such as plantation, gardening etc. Vermiculture and composting at housing society level should also be promoted. However, despite the month long awareness programme by BMC, a survey revealed that 60 per cent of the housing societies did not segregate waste. On one hand, people showed a lack of willingness and awareness and on the other hand BMC officials did not provide the necessary infrastructure to do so (Moitra and Ramachandran, 2003).
- Use of innovative technologies, such as waste-to-energy, waste-to-building-material, waste-to-manure etc. could be of double benefit as these not only manage the waste in a scientific way but the end products may fetch revenue for the resource crunched state.
- Creating awareness among workers and adopting low waste manufacturing processes could minimise quality of industrial waste occupational hazards among workers. Encouraging common hazardous waste management facilities for industries, and adopting better manufacturing processes can also manage waste.
- Social issues associated with SWM are to be tackled in an appropriate manner. Problems related to the health and exploitation of informal waste pickers and health of MC's staff. These could be solved to a great extent by educating them about the adverse impacts of MSW on health and providing them with preventive measures such as gloves, masks, etc. Rag pickers could also be provided with photo identity cards, which they can show to various housing societies/households and collect source separated waste from them.

Miscellaneous Issues

- Norms for noise pollution could be met by restricting the use of loud speakers during festivals (like Ganeshutsav Navaratri etc.), marriages and other events. Banning blowing of horns at traffic junctions is also needed, particularly in urban areas with high traffic density. Green belts surrounding industrial estates would also be helpful. Keeping in mind the vast area (almost 9,000 sq.km.) covered by Bamboo in the State and its various uses, a policy should be devised to cater rural needs of the State. . Use of this species as a means of employment generation

by training artisans for creating quality handicraft and utility items for market may be explored. A well-planned discussion between the State Forest Department and various communities (bound to be affected from JFM) should determine Joint Forest Management (JFM). This will empower communities in deciding the structure of the forests in their neighbourhood. A specific scheme incorporating above viewpoint may be considered in the State Plan for implementation of JFM.

- Energy saving measures and the promotion of renewable energy will have long lasting impact on the environment. Steps such as installation of solar water heaters, photovoltaic systems for garden and street lighting, use of compact fluorescent lamps, energy conserving building design, energy audits for industries and energy conservation campaigns are required to be taken. Use of wind energy in the state has been started but requires proper cost-benefit analysis for further promotion.
- The role of NGOs and Community participation in expanding activities of JFMs is very important, as it would lead to increase in forest cover and development of the tribal areas. Hence, such initiatives at the grass root level should be promoted and supported by both state and central governments and local people.
- To achieve the goal of 33 per cent tree cover in the state, a massive afforestation programme, with the help of other departments such as Public Works, Irrigation, School Education, Environment and Urban Development etc. should be initiated.
- Integrated environmental management of slum areas especially in larger cities like Mumbai, Thane, Pune etc., are of utmost importance. Many of these settlements are unauthorised and are plagued with the problems of congestion, un-hygienic conditions and pollution related diseases. Improving conditions of slums requires collaboration among all stakeholders, i.e., public, government, NGOs etc. Programmes such as Slum Redevelopment Scheme could only be useful when people are more aware of hygienic conditions and, in addition to incentives of free housing, they are also persuaded to shift to these tenements and not to sell them.
- For an overall better management of the environment, a system of incentive and punishment should be introduced. Achievers of pollution norms should be rewarded and defaulters should be penalised to discourage them from further lapses.
- Although research for innovations in ecology and environmental issues is the need of the hour, for a financially troubled state, repetition of the same kind of research is a sheer wastage of funds and could be avoided. Instead, action oriented projects that practically bring change in the society should be promoted.
- Recently, use of Public Interest Litigations (PILs) by NGOs, CBOs and individuals have drastically increased. While some of these are justified, others might just come up without having adequate information about the concerned project and retard the development activities. Hence, it becomes important to enhance public consultation and impart information, in general, as this would help in avoiding confrontation during project implementation stage and would make project feasible with the public support. Restricting unnecessary use of PILs is required so that they do not halt the development project of public interest. People should be given a reasonable time to put their views before commencement of activities and, after that no one should be permitted to obstruct the work.
- Conflicts between regulations of Central and State governments, which affect development plans of the state government, should be avoided. One such example could be of the CRZ regulations of the Central government and the Slum Redevelopment Scheme of the State government. Another recent example is the proposal of State government to increase the capacity of the Vaitarna Lake so as to have more water for Mumbai, which was turned down by MoEF on the grounds that it was harmful for the flora and fauna of the region that would be submerged due to an increase in the height of the Vaitarna Dam. Such conflicts can be reduced by making state level committees of experts who have done substantial work in the area of conflict. They would be able to convince the authorities regarding the positive and negative aspects of the concerned issues.

Handling the issues related to encroachment, biodiversity conservation and forest offences needs capacity building and higher investment. Forest management planning and protection need to be reinforced through appropriate HRD activities and adequate infrastructure. Recent trends for dealing with anthropogenic impact on biodiversity include village eco-development for which models are now available in the India Eco-development Project of MoEF and project was funded by UNDP in 1994. The main objective of the Project is to conserve bio- diversity through eco-development and aims at Improved Protected Area Management (IPAM), Village Eco-development and Eco-development support. The Project also envisages preparation of Future Biodiversity Projects covering a larger number of Protected Areas. The India Eco-development project is being implemented in seven areas, namely Buxa, Palamau, Nagarhole, Periyar, Pench, Ranthambore, Tiger reserves and Gir national park to conserve biodiversity through eco-development.

- Many of the public actions like spitting, urinating and defecating openly not only indicate uncivilised behaviour, but also create unhealthy conditions. Such actions can be stopped only by the cooperation of the public and stringent action by authorities.
- Capacity building is required in all areas of environment such as education, science and technology, economics and policy, social dimension etc. EE efforts, particularly in schools of rural and poor urban areas, are required to be accelerated. Care should be taken to encourage the students to join the EE programmes such as NCs, campaigns, trainings, nature trails etc., with as far as possible, no financial contribution from children's side.