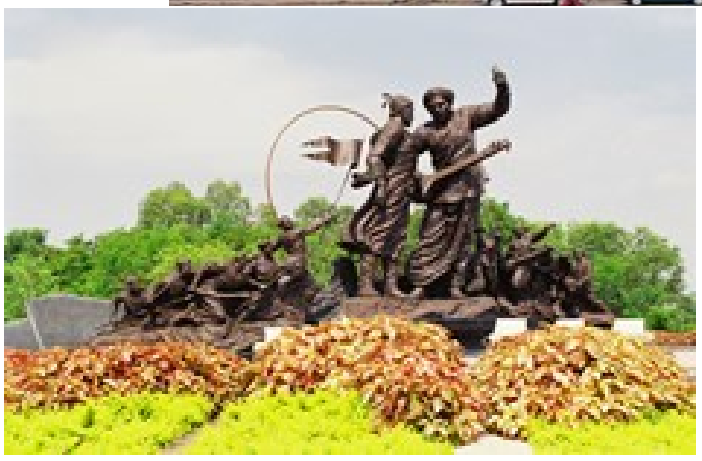
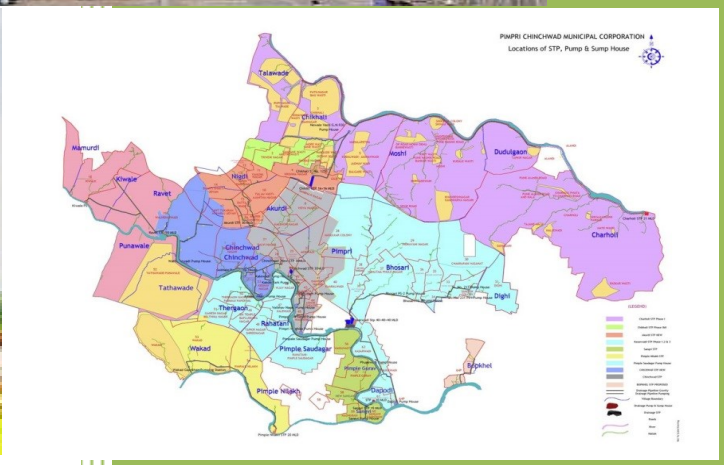
Draft Copy

Environmental Status Report 2012-13





Pimpri Chinchwad Municipal Corporation

Mayor's Note

I am overwhelmed to present the Environmental Status Report for 2012-13 to the stakeholders of Pimpri Chinchwad city. The phenomenal growth and development in basic infrastructure to enriched environment in Pimpri Chinchwad city is clearly visible. The city is experiencing gradual change in its physical and social environment.

At this juncture of rapid development in information technology, culture and education, slowly but steadily, Pimpri Chinchwad is also emerging as an environmentally aware city.

This report will guide the aware and responsible citizen of Pimpri Chinchwad city to quantatively assess the resources, its availability, trends, projections, future needs and efforts made by Pimpri Chinchwad Municipal Corporation.

I hope that eco-conscious actions of citizen of Pimpri Chinchwad city will go a long way in achieving the goal of sustainable city and thus contribute towards better future.

Mrs. Mohini Lande
Honorable Mayor

Commissioner's Note

It is an established fact that the set of physical, chemical and biological systems and their relationship with economic, social and cultural factors with direct and indirect, gradual or immediate effect, influence the quality of life in that locality.

Environmental Status Report (ESR) of a city acts as an impact assessment tool, which must be strategic in nature and should have an objective of facilitating environmental integration and the assessment of the opportunities and risks of strategic actions. Success of any municipal project is strongly linked to the formulation of policies, planning and deliberate efforts to bring about the change in the society. Policies developed in the context of planning are not intended to find out what has happened in the past rather aims to plan and steer actions that make possible routes towards a sustainable future.

Environmental Status Report will emerge as a more comprehensive document to play a vital role in aligning developmental policies in line with the environment. Maharashtra Pollution Control Board has developed a common format for the ESR alogwith the framework indicators for assessment and comparison of environmental performance of the cities across Maharashtra State. Pimpri Chinchwad Municipal Corporation has made an effort to structure the ESR using Environmental Media Framework Methodology in which information is categorized based on environmental media like social environment, air, water, solid waste etc.

Along with the primary data generated by applying certain indicators we have also used the secondary data available with the city. However, during the process of ESR preparation, issues such as information gap, data inconsistancy and availability of data in different formats were observed. Therefore, it is felt that the ESR process should be a continuous and year-long activity. It should run parallel to the planning process with an intention to provide important input into the planning process, focusing on strategic issues and the decision-making process.

I hope that the sincere effort to implement DPSIR indicators as per guidelines of MPCB in the current ESR will give a direction to the city's sustainable growth.

Mr. Shreekar Pardeshi
Municipal Commissioner
Pimpri Chinchwad Municipal Corporation

Leap towards sustainable city

As per section 67 (A) of BPMC Act-1949, it is mandatory for urban local bodies (ULB) to publish annual **Environmental Status Report (ESR)** before 31st July of each year.

ESR is one of the forms of **State of Environment (SoE)** reporting with a primary function to categorize the information and allow effective understanding of complexities and interlinkages between environmental issues and causes. SoE framework is accepted and adopted globally, so as to harmonize the ESRs with global standards.

Pimpri Chinchwad Municipal Corporation has made an effort to adopt **DPSIR** (Driving Force, Pressure, State, Impact, Response) indicator framework for this ESR. The DPSIR is an outcome of PSR framework (Pressure State Response)

Driving forces of environmental change (e.g. Rate of industrialisation)
Pressure on the environment (e.g. discharges of industrial waste water)
State of environment (e.g. water quality of rivers and lakes)
Impact on population, economy, ecosystems (e.g. water unsuitable for drinking)
Response of the society (e.g. Segregation of municipal solid waste)

The basic purpose of this framework is to structure data and information on different environmental problems and the intention of environmental indicators is to communicate such environmental information to decision makers and general public.

The analytical framework of the ESR assists in drawing meaningful inferences and guide responses towards environment protection and improvement in the city. Pimpri Chinchwad city has taken the efforts to adopt the DPSIR framework given in the guidelines, and thus initiated a step to become role model for the state.

Er. A. V. Chavan
Joint City Engineer,
Water Supply, Drainage and Environment Department,
Pimpri Chinchwad Municipal Corporation.

Disclaimer

- The information mentioned in the present Environmental Status Report is based on the following sources like Pimpri Chinchwad Municipal Corporation, Pune Municipal Parivahan Mahamandal Ltd., Regional Transport Office, newspapers, Maharashtra Pollution Control Board, Maharashtra State Electricity Distribution Company Ltd. etc.

- The present ESR 2012-13 is based on the information available on websites of different Govt., Semi governments, Non-Government Organisations, Research institutes.

- Maps, aerial photographs used in this report are not to the scale and should only be used for the understanding purposes.

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1. ABOUT THE CITY

1.1 City Profile

Pimpri Chinchwad is a modern twin city, situated South-East of Mumbai and in the North-West quadrant of Pune. Pimpri-Chinchwad also happens to be the fifth-most populated city of Maharashtra and has long been famous for being one of the most prominent industrial destinations outside Mumbai.

The twin city (Pimpri Chinchwad) is governed by the Pimpri Chinchwad Municipal Corporation (PCMC). The city is located on the Deccan Plateau and is surrounded by hills. It is situated 530 m above the mean sea level. Pavna River traverses the city, while the Indrayani River flows through the north-western outskirts and Mula River on south side, forms a boundary of Pune and Pimpri Chinchwad Cities.Various particulars of the city are given in **Table 1.1.**

The city forms a continuous urban stretch, adding to the overall Pune urban agglomeration, and contains a thriving industrial belt that primarily consists of engineering and automobile industries.

PCMC and Pune, when viewed as a unified geographical unit, make up one of India's largest industrial areas. Pimpri Chinchwad has contributed a lot to the fact that Pune is the second-largest industrial city in Maharashtra after Mumbai. This fact alone has already spelt gold in terms of the Pune property market - but there's a lot more.

Table 1.1 Basic information

Latitude	18°37′07.04″N
Longitude	73°48′13.43″E
Altitude	530 m above mean sea level
Total area	177.3 Sq. Km
Population	17,29,359 (As per 2011 census)
Estimated population	20,00,000 (based on Census 2011)
Slum population	1,47,810 (As per 2011 census)
Average rainfall	722 mm
Temperature	Max: 43.3°C (on 30 April 1987 and 7 May 1889) Min: 1.7°C (on 17 January 1935)
No. of ward offices	4
No. of wards	64

Source: *PCMC Website*

1.2 Climate

Pimpri-Chinchwad experiences three distinct seasons: summer, monsoon and winter. Typical summer months are from March to May, with temperatures ranging from 35 to 39°C (95 to 102°F), the warmest month being April. The city receives moderate annual rainfall of 722 mm, mainly between June and September as a result of the SW monsoon. Citizen experience winter from November to February, when day temperature is around 29°C (84°F), while the night temperature dips below 10°C (50°F) for most of December and January, often dropping to 5 or 6°C (40-42°F).The highest temperature recorded for Pimpri Chinchwad was 43.3°C (110 °F) on 30 April 1987 and 7 May 1889, while the lowest temperature recorded was 1.7°C (35°F) on 17 January 1935.

Monthly variations in temperature, humidity, pressure, rainfall, and wind velocity for 2008-09 are presented in **Table 1.2**

Table 1.2 Annual Weather Data

Month	Ambient Temperature (^{0}C)		Wind Velocity (m/s)		Relative Humidity (%)		Rainfall (mm)		Pressure (Pa)
	Max	Min	M	E	M	E	M	E	
Jan 08	30.2	9.1	2	3.7	91.7	33.5	0	0	954.0
Feb 08	31.4	10.3	2	4	76.4	32.4	0	0	954.1
Mar 08	35.8	16.2	2.5	3.9	61.1	27.3	1.0	0	942.6
Apr 08	37.7	19	2.6	4.2	52.6	25.1	0	0	952.2
May 08	36.4	21.9	4.4	7	63.2	36.6	0.4	0	951.5
Jun 08	29.7	22.6	4.6	5.0	81.0	71.4	2.5	2.3	947.3
Jul 08	27.9	21.5	4.2	6.1	84.5	75.7	1.7	0.8	946.2
Aug 08	27.3	21.0	3.9	4.8	87.3	79.3	3.9	2.1	947.2
Sep 08	28.6	20.5	3.3	3.2	NA	NA	7.0	2.4	949.1
Oct 08	32.4	16.2	2	3.3	NA	NA	0.4	0.5	953.2
Nov 08	31.8	14.3	3.2	3.5	NA	NA	0.0	0	953.8
Dec 08	30.9	12.6	3.2	3	NA	NA	1.3	0	954.4
Jan 09	31.7	11.3	2	2.9	NA	NA	0	0	955.0
Feb 09	34.4	11.5	NA	4.5	NA	NA	0	0	953.4
Mar 09	36.8	15.6	2	5.4	NA	NA	0.2	0	952.7
Apr 09	32.2	16.2	NA	4.3	NA	NA	1.2	0.5	951.1
May 09	32.2	16.2	NA	4.3	NA	NA	1.2	0.5	951.1

Source: *Department of Geography, University of Pune*

NOTE: '**M**' refers to Morning Data and '**E**' refers to Evening Data.

1.3 City Connectivity

Pimpri Chinchwad being adjacent to the Pune enjoys the excellent connectivity that Pune has. The city is well connected by road, rail and air to almost all important cities in India. Pimpri Chinchwad is situated on the confluence of NH-4 (the Mumbai-Bangalore highway) and NH-50 (the Pune-Nasik highway). The city is connected to the Mumbai through Mumbai Pune Express way.

Plate 1.1 Ravet Bridge in PCMC area

In fact, the PCMC area boasts an extensive network of national highways to major cities like Mumbai (163 km), Nashik (202 km), Nagpur (880 km), Bangalore (835 km), Chennai (1166 km) and Hyderabad (548 km).

Railway Connectivity

Railways are an important ingredient of economic growth, and Pimpri Chinchwad is located on the Mumbai-Pune mail line. It has direct broad-gauge connectivity to Mumbai, Bangalore, Chennai and Hyderabad.

Air Connectivity

Nearest airport for Pimpri Chinchwad is Pune International airport which is connected by direct flights to Delhi, Bangalore, Chennai, Ahmedabad, Mumbai, Hyderabad and Nagpur. Pune Airport, located at Lohgaon (approx. 25 km away from city) has recently acquired status of an International Airportand is connected internationally with Dubai, Frankfurt and Singapore. It is currently the only airport in the country having both domestic and military traffic.

1.4 Land Use

Pimpri Chinchwad Municipal Corporation's existing jurisdiction area is 177.3 Sq. km. It is predominantly an industrial area, which has developed during the last four decades. There has been 84% increase in the area under development in the region between 2000 and 2007. Considerable portion of the development in the last decade has occurred towards Pune city in the south and Hinjewadi IT Park in the south-western direction. Further impetus to development has been given by the westerly Mumbai-Pune by-pass and the improvements of the Aundh-Ravet road. Talwade IT Park in the north-western corner of the city is another pull factor in PCMC area. Improvements to the Dehu-Alandi road and the NH-50 will bring about development in the northern and north-western regions. The proposed international airport in Chakan in the north will further enhance growth.

Land use pattern

The combined land use distribution as per the 1986 Development Plan indicates that about 11.81 and 4.96% areas are allocated for residential use and transport respectively, while 30.54% is reserved for forest areas. The revisions proposed in 1986 are summarized in **Table 1.3-1.5** and **Fig.1.1**

'Land-use Change' is an indicator given by DPSIR. Its objective is to reduce urban sprawl. The land, and the way it is managed, affects the entire environment. It is important to monitor changes in land use, especially rapid urbanization and urban sprawl. There is a continual need to reconcile the requirements for additional land for important uses, such as housing, industry, commerce and retailing with a desire to protect the countryside and agriculture.

Table 1.3 Land use for old PCMC & PCNTDA areas (as in Old Development Plan, 1986)

Land Use	DP as in 1986			Proposed DP Post 1986		
	Area Sq.km	Developed area (%)	Total area (%)	Area Sq.km	Developed area (%)	Total area (%)
Residential	10.16	36.78	11.81	36.94	57.73	42.95
Commercial	0.40	1.43	0.46	0.29	0.45	0.34
Industrial	10.85	39.28	12.62	15.61	24.39	18.14
Public and Semi Public	0.84	3.04	0.98	3.14	4.90	3.65
Public Utilities	0.42	1.52	0.49	0.77	1.21	0.90
Transportation/Circulation	4.26	15.44	4.96	5.48	8.56	6.37
Open Spaces / Recreation	0.69	2.51	0.81	1.76	2.75	2.05
Water Bodies	1.89	--	2.19	3.63	--	4.23
Quarry	0.22	--	0.25		--	0.00
Barren / Vacant Lands	30.02	--	34.90		--	0.00
Agriculture & Reserve Forest	26.27	--	30.54	18.39	--	21.38
Sub-Total (Developed Area)	27.62	100.0	32.11	63.99	100.0	74.40
Sub- Total (Un-developed Area)	58.39	--	67.89	22.02	--	25.60
Total	**86.01**			**86.01**		

Source: *Town Planning Department, PCMC*

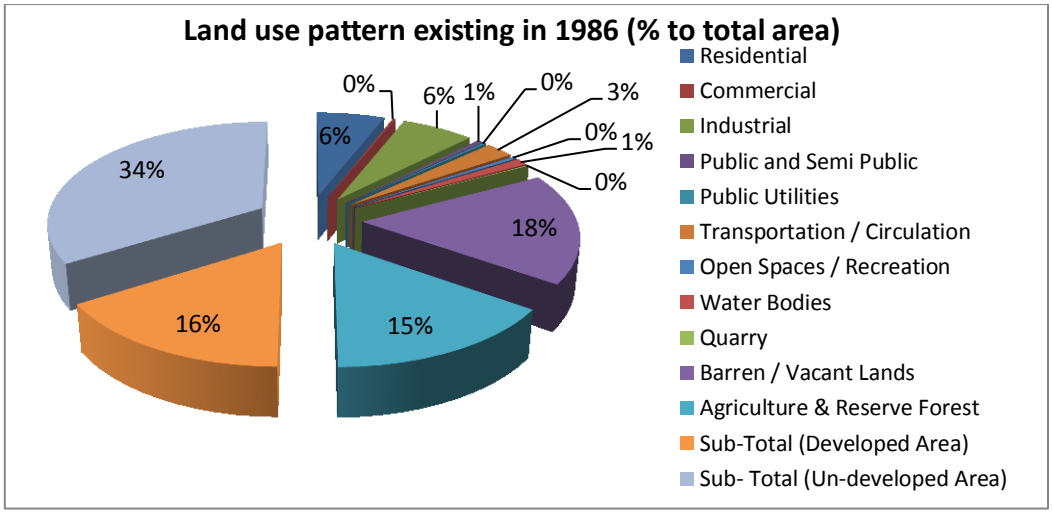


Figure 1.1 Land use pattern existing in 1986

Source: *Town Planning Department, PCMC*

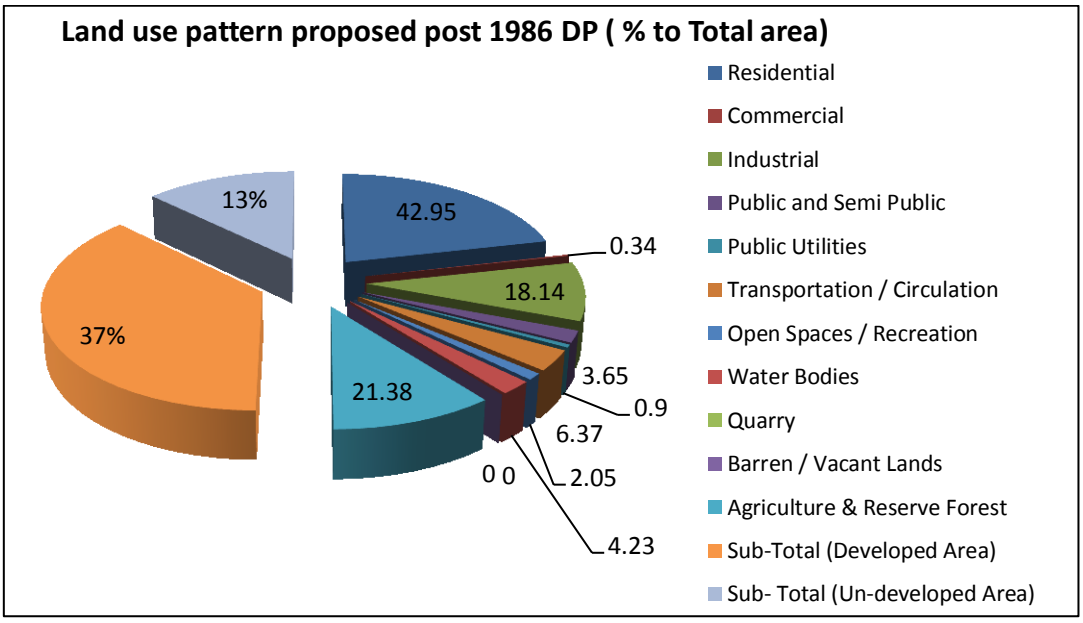


Figure 1.2 Land use pattern proposed post 1986 DP

Source: Town Planning Department, PCMC

Table 1.4 Summary of Existing and Proposed Land-Use Analysis in the Newly emerged areas of PCMC

Land Use	Existing Land Use Analysis			Proposed Land Use Analysis		
	Area Sq.km	**Developed area (%)**	**Total area (%)**	**Area Sq.km**	**Developed area (%)**	**Total area (%)**
Residential	10.16	17.62	11.82	47.28	67.92	55.94
Commercial	0.40	0.69	0.46	2.68	3.85	3.17
Industrial	10.85	18.82	12.61	2.52	3.60	2.98
Public and Semi Public	0.84	1.46	0.90	2.66	3.82	3.15
Public Utilities	0.42	0.73	0.49	0.97	1.39	1.14
Transportat and Communications	4.26	7.40	4.96	10.94	15.74	12.95
Garden, Play fields, Fair Ground etc.	0.69	1.20	0.80	2.56	3.68	3.03
Vacant	30.02	52.08	34.90	--	--	--
Developed Area	57.64	100.00	67.02	69.59	100	82.36
No Development Zone	--	--	--	12.88	--	15.25
Agricultural	26.27	--	30.54	--	--	--
Water Bodies	1.89	--	2.19	1.33	--	1.57
Quarry	0.22	--	0.25	--	--	--
Total	**86.00**		**100**	**83.82**	**--**	**99.18**
MIDC, Software Technology Park	--	--	--	0.70	--	0.82
Grand Total	**86.00**	**--**	**100.00**	**84.51**	**--**	**100.00**

Source: *Town Planning Department, PCMC*

Table 1.5 Existing and Proposed Land Use Analysis of Villlage Tathawade

Land Use	Existing Land Use of Tathawade village			Proposed Land Use of Village Tathawade		
	Area Sq.km	**Developed area (%)**	**Total area (%)**	**Area Sq.km**	**Developed area (%)**	**Total area (%)**
Residential	0.37	18.11	5.72	3.12	51.10	48.86
Commercial	0.05	2.35	0.75	0.30	4.98	4.76
Industrial	0.41	20.48	6.47	0.60	9.87	9.44
Public and Semi Public	1.16	57.55	18.21	1.05	17.26	16.50
Mixed Use	0.03	1.50	0.47	--	--	--
Public Unitility	--	--	--	0.058	0.94	0.91
Transport and Communication Roads & Parking	--	--	--	0.88	14.50	13.88
Park Garden, Play Ground, River Front development,	--	--	--	0.08	1.33	1.28
Total Developed Area	2.01	--	31.60	6.10	100	-
NDZ, Green Belt	--	--	--	0.17	--	2.68
Agriculture	1.99	--	31.21	--	--	--
Pad	1.92	--	30.06	--	--	--
Water Body Area	0.10	--	1.60	1.11	--	1.69
Road Area	0.35	--	5.45	--	--	--
Cremation Ground	0.0036	--	30.54	--	--	--
Total	**6.38**	**-**	**100.00**	**6.38**	**--**	**100.00**

Source: Town Planning Department, PCMC

Objective of DPSIR indicator 'Sustainable land use' is to increase the amount of green and restored areas and to eliminate losses of protected sites and reduce contamination of land.

As per DPSIR indicators, the ideal floor area per person cannot be defined. Hence, individual cases should be considered. Floor area per person is a response indicator as well.	*Indicator, 'Protected areas as per cent of total areas' relates to conservation of biodiversity. Protected areas are a form of defense against changes in land use and in other human activities; if unsustainable, they can pose a threat to ecosystems and landscapes, and lead to biodiversity changes including natural habitat loss.*

1.5 Demography

1.5.1 Past and Present Population Growth

Population is a key parameter in any type of city planning. The environment management plan is also based on the same for any city. During the last two decades, the decadal growth rate of population has been 72% (between 2001 and 2011) and 93% (between 1991 and 2001) while 1960s and 70s witnessed population growth of around 150%. As per the 2001 Census, population of Pimpri Chinchwad was 10,06,417, while as per Census 2011, it has increased to 17,29,359 (**Table 1.6**) and presently it is estimated to be 20,00,000.

Table 1.6 Population Growth in Study Area since 1951

Census Year	Total Population	Decadal Change	Growth Rate (%)	Area sq km	Density/sq km
1951	26,367	-	-	-	-
1961	39,654	13,287	50.39	-	-
1971	98,572	58,918	148.58	-	-
1981	2,51,769	1,53,197	155.42	86.01	2,927
1991	5,20,639	2,68,870	106.79	86.01	6,053
2001	10,06,417	4,85,778	93.30	170.51	5,902
2011	17,29,359	7,24,942	71.98	177	9,770

Source: *PCMC CDP- Vol. – 1*

As per DPSIR, 'Population growth' is an important indicator, with an objective to harmonise the annual growth of a city's population with its environment and the overall system of settlements. The urban population, similar to population density, is an indicator that measures the pressures on the environment including: exploitation of natural resources, such as water and land; contamination of a city and its surroundings; air pollution by traffic and manufacturing industries, increased or decreased pressures on an urban environment illustrates population growth over time.

Pimpri Chinchwad has a population density of 9754 persons per sq km as per 2011 census, which is comparatively less than that of its neighbouring city, Pune. However, this is mainly due to the large extent of vacant spaces available in the peripheral, undeveloped areas of the city. Demographic features of PCMC area are tabulated in **Table 1.7**, while status of PCMC with respect to Tehsil and District is presented in **Table 1.8**.

The city is tucked between the Mula, Pawana and Indrayani rivers that form the natural boundaries of the city on the northern and southern sides whereas Pawana traverse the city. The densely populated old city is located in the centre, with the Pawana River on one side and the Mumbai-Pune railway line on the other. The interiors of oldPCMC and PCNTDA areas comprising Morwadi, Kharalwadi, Pimpri Waghere and Pimple Saudagar still retain their rural character and have narrow road widths. The geographical location of the city between the rivers on one side and vast defence areas on the eastern side of the city form

natural barriers to the growth. Comprehensibly, the western side of the city facing Mumbai has the maximum potential for growth and development.

Table 1.7 Demographic status of PCMC (2001 Census)

Particulars		Details
Households		2,31,562
Total Population	Total	10,12,472
	Male	5,47,050
	Female	4,65,422
Children below 06 years	Total	1,43,034
	Male	75,688
	Female	67,346
Scheduled Caste	Total	1,40,567
	Male	73,416
	Female	67,151
Scheduled Tribes	Total	19,401
	Male	10,243
	Female	9,158

Source: *Demography Department*

Table 1.8 Demographic details of PCMC with respect to Tehsil and District (Census 2001)

Sr.No.	Particulars	District	Tehsil	PCMC Jurisdiction
1	Population (Total)	72,32,555	13,53,050	10,12,472
2	Male/ Female Population Ratio	52/48	54/46	54/46
3	Population under 06 year (%)	13.40	14.15	14.13
4	Scheduled Caste (%)	10.53	13.21	13.88
5	Scheduled Tribes (%)	3.62	1.95	1.92
6	Literacy (%)	69.67	71.79	73.61
7	Male / Female Literacy Ratio	57/43	58/42	58/42

Source: *Census Handbook 2001*

1.5.2 Population Projection

During the two decades (1981-2001) prior to the last one, the decadal growth rate in population has been around 100%. Subsequently, the addition of new areas showed a downward trend; however, this would still be on the higher side for the next three decades due to all-round economic development of the Pune region. Accordingly, the population reached to 17.29 lakh in 2011 and estimated to reach 21.50 lakhs in 2021 and over 29 lakhs in 2031 (**Table 1.9**). A large chunk of the current younger generation is expected to start families within the next decade and the population is likely to escalate to the projected level. It may be mentioned that the population of Pimpri Chinchwad in the last two decades grew at an annual average rate of over 7% against the national average of 2.1% and state average of about 3.3%.

Table 1.9 Population forecast in PCMC area till 2031

Census Year	Total Population	Decadal Change	Growth Rate (%)
2021	21,50,317	6,43,074	42.67
2031	29,07,757	7,57,440	35.22

Source: *CMP for PCMC*

Highlights of Demography structure

- Average sex ratio in the city is 916 females per 1000 males, as per 2001 Census.
- Literacy rate of PCMC: 73.61 % (Source: PCMC Web portal) whereas, Male/ Female Literacy ratio is 58/42.
- Population as per Census 2011: 17, 29, 359 (Source: PCMC Web portal)
- Population Density: 9754 per Sq km (Source: PCMC Web portal)

As per DPSIR, 'PopulationDensity' is an importantindicator and its objective isto harmonize the annual growth of a city's population. Density of population affects human health in general by spreading diseases more quickly. Increased or decreased pressure on an urban environment illustrates population density growth overtime.

Considering all the available records from different sources, the present population of PCMC area in 2013 is projected as **20,00,000** for the purpose ESR 2013.

1.5.3 Other Demographic Indicators

As per the 2001 Census, Pimpri Chinchwad has a literacy rate of 73.61%, which is marginally lower than that of Pune city (77%). In Pimpri-Chinchwad, more than 60% of the population growth has taken place as a result of migration, largely due to employment opportunities, prevailing in the region. Pimpri Chinchwad has a sex ratio of 916 females for every 1000 males as per Census 2001, which is much better than that of Pune wherein it is 840 females for every 1000 males.

1.5.4 Literacy Rate

Pimpri-Chinchwad city has a literacy rate of 73.61% (**Table 1.10**). Males have a higher literacy rate of 78.93% as compared to 67.36 % for females.

Table 1.10 Literacy rate in PCMC area

	Total	Percent	Literate	Percent
Population	10,12,472	100.0	7,45,317	73.61
Male	5,47,050	54.3	4,31,785	78.93
Female	4,65,422	45.7	3,13,532	67.36

Source: *Census 2001*

'Literacy Rate' is one of the important DPSIR indicators, and its objective is to achieve universal literacy. Literacy is important:

- *as a human right,*
- *for inner discovery and self-liberation,*
- *for creating and sharing knowledge and wisdom universally,*
- *for individual and community empowerment for all (female and male),*
- *as a tool for integrated sustainable development,*
- *for an active contribution to the information revolution,*
- *for overcoming exclusion,*
- *for learning throughout life*
- *As a tool for participation, democratization and political*

1.6 Economy

Pimpri Chinchwad is a major industrial hub and hosts one of the biggest industrial zones in Asia. Industrialization dates back to 1954 with starting of Hindustan Antibiotics Limited, when MIDC took initiative and bought land in this area. This town is home to the Indian operations of major automobile companies like Premier Limited, Mahindra Navistar, Bajaj Auto, TATA Motors (formerly TELCO), Kinetic Engineering, Force Motors (formerly Bajaj Tempo), Daimler Chrysler and Autoline Industries. In addition to this, several heavy industries, such as Forbes-Marshall,Thermax, Thyssen Krupp and Alfa Laval & Sandvik Asia have their manufacturing units in the town. Also, the German company KSB Pumps, Swedish bearing company SKF and Rajiv Gandhi Infotech Park hosting several Software and Information Technology majors like Accenture, IBM India, KPIT Cummins, Tata Technologies, Infosys, Wipro, Geometric Limited, Finolex cables limited, SQS India, Infosystems Pvt. Ltd., BNY Mellon (India) etc. are the key attractions of PCMC area.

Chakan is now home to a Special Economic Zone (SEZ) promoted by the Maharashtra Industrial Development Corporation (MIDC). It has evolved into a major automobile hub. It hosts automobile production plants for the Volkswagen Group, Mercedes-Benz, Mahindra & Mahindra and Bajaj Auto. Over 750 units of large, medium and small industries, including a number of automobile component manufacturers are based in this area.

1.7 Slums

1.7.1 Area and Population

The urban poor population (slum population) of Pimpri Chinchwad is estimated to be about 14.56% (**Table 1.11**) of the total population of the city. Rapid growth of slums has been largely the function of the economic growth of city, non-availability of EWS/LIG housing and adequate service levels in some pockets of slums leading to deteriorating environmental conditions. In total 71 slum settlements are distributed in 3 different types of lands (**Table 1.12**).

Table 1.11 Details of slums in PCMC area

Particulars	Numbers
Number of Slum settlements	71
Total population in Slums	1,47,810
Declared Slum Nos.	37
Non-declared Slum Nos.	34
Declared slum Population	80,862
Non declared slum Population	66,948
Population living in Slum (%)	14.56

Source:*PCMC website*

Table 1.12 Location of Slums as per land tenure

Land ownership	No. of slum
Government Land, PCMC	22
Government & Private land, PCNTDA, MIDC	24
Private	25
Total	71

Source: *PCMC website*

1.7.2 Access to Basic Services and Amenities in Slums

PCMC had engaged an independent agency to identify the existing level of services in the slums. **The agency concluded a poor level of services in each of the slums independently and as a comprehensive unit**. According to City Development Plan (2006-2012), there are 12 seats of public accessibility for every 1000 slum dwellers and there are six water tap connections for every 1000 slum dwellers indicating the inadequacy of basic amenities like water supply and sanitation to the slum dwellers in the city. In addition to infrastructure services, social meeting points like welfare centres are also missing in all slums in the PCMC area.

1.7.3 Slum Rehabilitation Projects

Under JnNURM-BSUP following Slum Rehabilitation Projects have been taken for the purpose of providing better services to slum dwellers **(Plate 1.2**). The beneficiaries of these projects are summarised in **Table 1.13.**

Slum area prior to SRA scheme

After implementing SRA scheme

Plate 1.2 Implementation of SRA scheme in PCMC area

Table 1.13 Beneficiaries of Slum Rehabilitation Projects

Name of the Project	Beneficiaries as on Jan '13
Sector 22, Nigdi	2800
Ajanthanagar	336
Vitthalnagar	672
Vetalnagar	336
Udyognagar	--

Source: *SRA Department, PCMC*

Carpet area of one tenement is 25 sq. m (269 sq. ft). Each tenement contains one multipurpose hall, one kitchen with attached W.C. and bathroom. The buildings are being constructed with the help of monolithic construction technology.

1.7.4 Key Issues With Regard to Slums

- A large number of slum dwellers in the city have taken shelter to easily available locations like the river bed and banks, edges of railway lines and hill slopes apart from vacant industrial lands. These **slum dwellers do not have access to basic services and thus their living conditions are unhygienic**. Also, these concentrations of slums along environmentally sensitive areas are dense. This is also leading to environmental degradation of these locations.
- There is a general lack of awareness of the various slum development schemes and programmes announced from time to time by the central and state governments. Even the innovative SRA scheme is also facing a similar situation. This is primarily leading to long delays in implementation of the programmes and hence the benefits are not reaching to concerned people.
- While the Government of Maharashtra has notified that slum dwellers settled prior to 1995 will be eligible under various slum development and rehabilitation programs, there is not enough clarity on those who settled in the city post-1995. Recent surveys indicated large numbers of such slum dwellers in this area. This situation can turn into

a potential cause for confrontation leading to delays in the implementation of related programmes.

1.8 E-Governance

Digital Governance is about giving better services to citizens. Major change is required in the way we work. Additionally, municipal outlook towards citizen also needs to be changed. E-governance is a mechanism to build prosperity and provide better environment to the citizens in the PCMC area.

E-governance or electronic governance may be defined as delivery of government services and information to the public using electronic means. Use of IT in government facilitates an efficient, speedy and transparent process for disseminating information to the public and other agencies, and performing administration activities.

The advent of Information Technology as a highly leveraged enabling tool for delivery of services in the public has now been universally recognized. This has refined the fundamentals and has the potential to change the institutions and its mechanism. The objective of E-governance goes far beyond mere computerization. This gives new set of responsibilities to employees of corporation. In last few years government has taken tremendous initiatives toward ushering in Information Technology. The emphasis was providing better services to citizens and improving internal productivity.

1.8.1 Vision

The vision for fully e-Governed Corporation of Pimpri Chinchwad is that the citizen of PCMC area should be the focal point of each operation and every employee of PCMC should be able to give support and information to the citizens immediately. Citizen should be able to get the information live on the website as and when required on any issue. There should not be any duplication of work and the data should be managed very efficiently, which should also be helpful in decision making. Every employee of PCMC should be computer-literate and should have proficiency in doing the job with the help of computer. Attempt has been made on such activities by PCMC in recent years, which has been recognized through different awards (**Plates 1.3 to 1.8**).

1.8.2 Benefits to Citizens

The first and the foremost benefit of e-governance to citizen is the access to information at help desk. The benefits to citizens are listed below

- Direct contact with the head of the officials through mail. This will help them to have a dialogue with them to satisfy the queries.
- One visit solution: The citizens should get all the information from the web and they will have to come only once to get any certificate from the PCMC Office.
- Citizens will be able to register their complaints online on the PCMC website.

- Payment services: This will enable them to pay all the bills of PCMC as well as other agencies at one place and on all days. The environment will have electronic queuing system and best infrastructure will be provided to these services.
- Reduction in response time to the processes of PCMC.
- Overall increase in efficiency will help to lift the satisfaction amongst citizens.
- Information through web to all citizens.
- As citizen-customers become more familiar to web they will expect more services on net.

Accordingly the mission statement of each year can be defined as:

- **First Year:**All computerization efforts are oriented towards providing better services to citizens by computerization of select departments.

- **Second Year:**In the second year efforts should be concentrated on enhancement of facilities to citizens and Industries on the web and computerization of all the departments should be completed.

- **Third Year:**Enhancement of Web related services and introducing revolutionary approaches to the system for optimization of resources. During this year, the focus will be on stabilizing all the processes for further improvement by introducing innovative approaches.

- **Fourth Year:**The year will focus on introduction of High tech solutions to citizens, like providing smart card to every citizen and making payments through such cards.

Recognition Received by PCMC

Plate 1.3

Plate 1.4

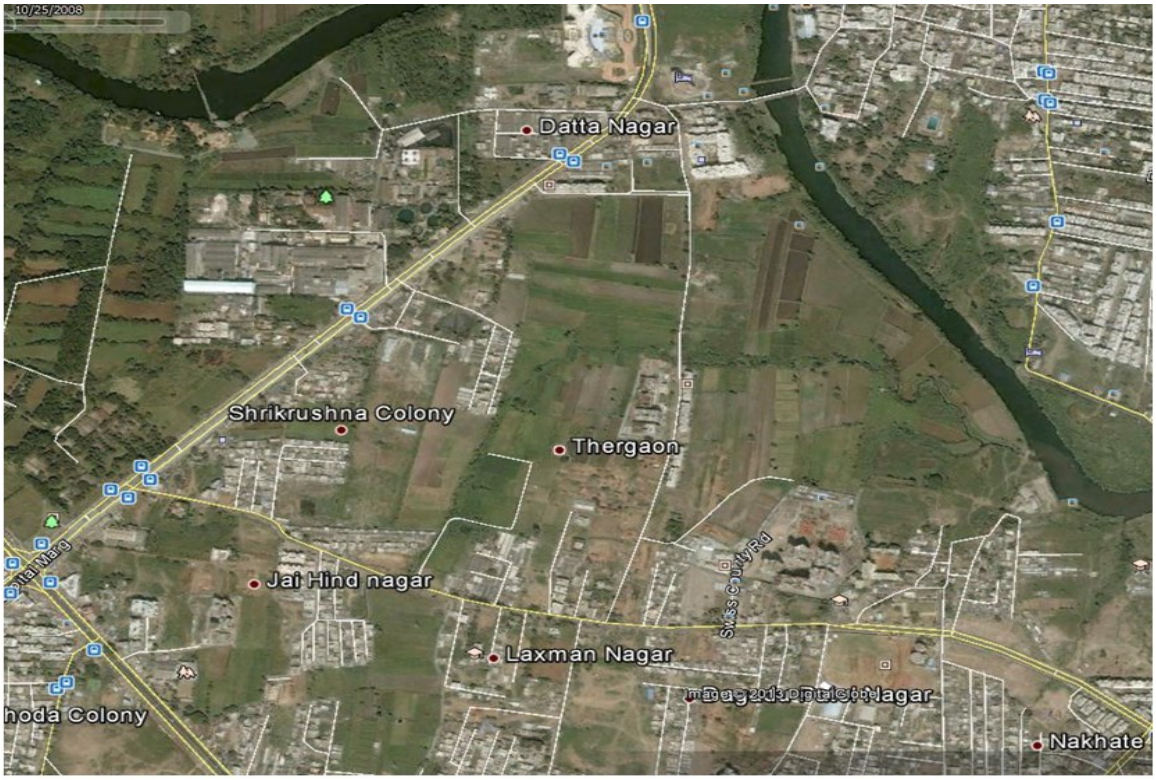
Plate 1.5

Plate 1.6

Plate 1.7

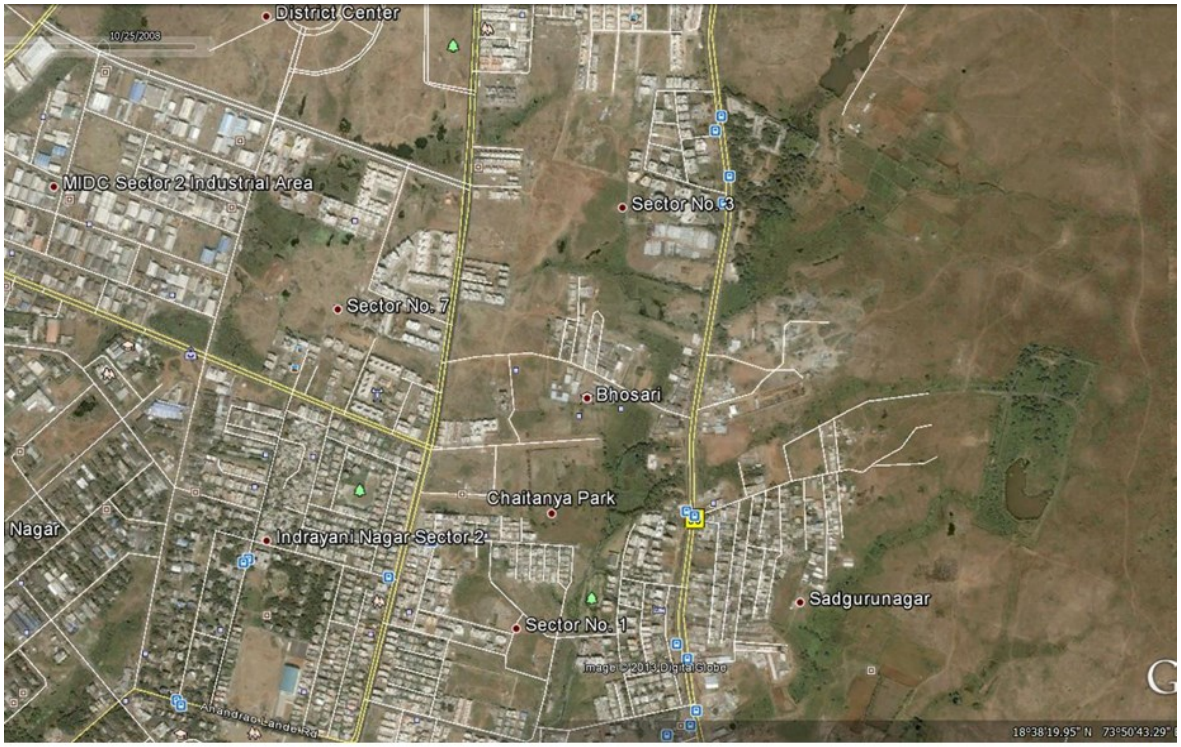
Plate 1.8

Plate 1.3 Plate A: JnNURM Awards 2011 for improvement in Water Supply and Waste Water Sector"
Plate 1.4 JnNURM Best City Award 2011
Plate 1.5 JnNURM Awards – 2011Best City in Effective Enforcement of Pro-Poor Reforms
Plate 1.6 Urban Transport Award – 2010, New Delhi
Plate 1.7 National e-Governance Awards 2012-For Exemplary Implementation of e-Governance initiatives. SKOCH Awards–Citizens Service
Plate 1.8 EDGE Award, Mumbai

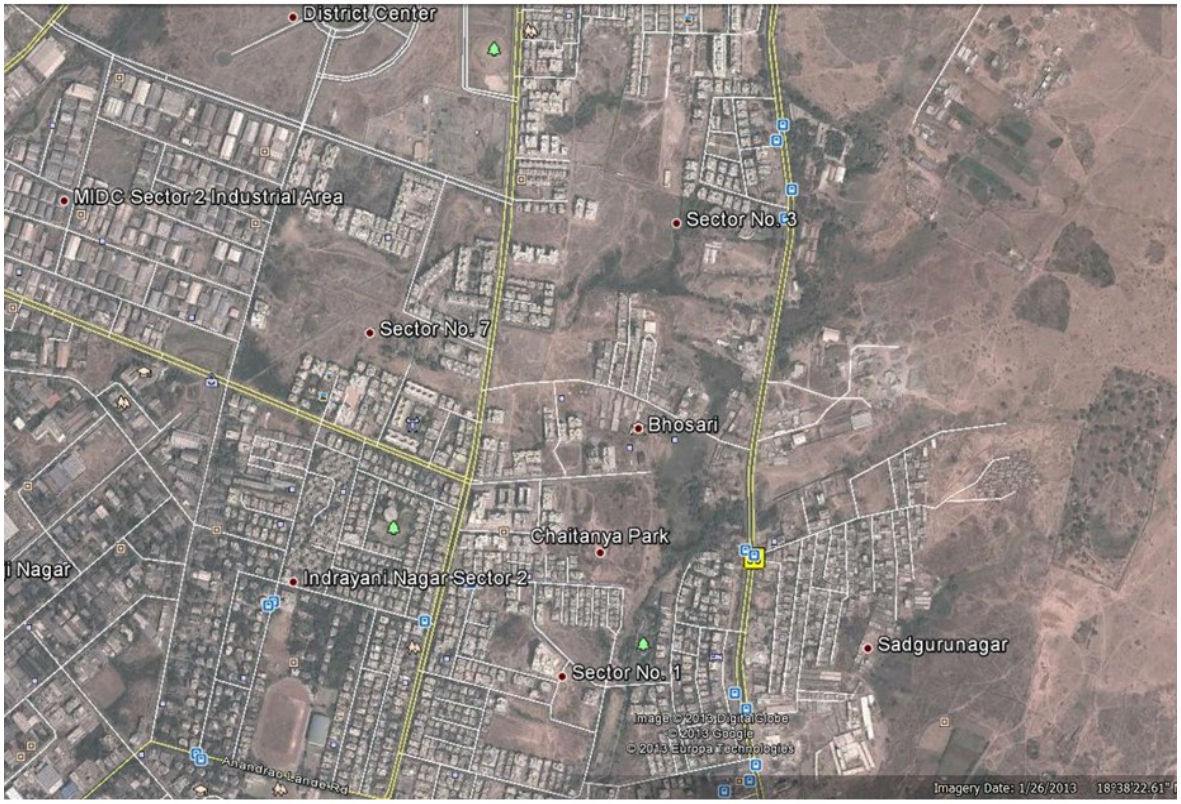


Thergaon in 2008

Thergaon in 2013



Bhosari in 2008



Bhosari in 2013

2. Social Environment

2.1 Introduction

Social environment deals with places where people live, work and interact with each other. Social environment also influences the health and well-being of the surrounding people. It includes factors, such as living conditions, health & hygiene, education, and infrastructural facilities. Socially disadvantaged people who live in slums or Below Poverty Line (BPL) tend to have less access to the basic living amenities. Hence, it is mandatory for every urban local body to provide all the necessary facilities equally in their jurisdiction. This chapter deals with facilities, amenities and services provided by the Pimpri Chinchwad Municipal Corporation; such as, health & educational facilities, power & water supply, transport, sewage system, solid waste management and entertainment. Water supply, sewerage system and solid waste management are covered in detail in respective chapters.

2.2 Health

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. Environmental health addresses all the physical, chemical and biological factors external to a person and all the related factors that can potentially affect health. Changing food habits is proven to be one of the major causative factors of most of the diseases prevalent today.

Social health care is an important Driver, Pressure, State, Impact and Response (DPSIR) indicator and its objective is to improve health conditions. Health care costs are linked to social, economic and environmental conditions in a city. Better environmental conditions and improved public health play an important role in sustainable economic growth which is a necessary for reducing poverty.

2.2.1 Heath Care Facilities in PCMC Area

Pimpri Chinchwad Municipal Corporation has recognised that the good health is essential to human welfare and to sustain economic and social development. Health being the fundamental human right and a worldwide social goal, PCMC has adopted the World Health Assembly's vision of 'Health for All' and is directing its actions towards attaining this goal.

Since 1981 PCMC has been developing its primary health care system so that it reaches out to the most of its underserved population. From a very small beginning of

merely 2 dispensaries in 1981, today PCMC has a network of 21 dispensaries to cater to the primary health needs of its citizens.

In addition to its 21 dispensaries there are two secondary care hospitals, five maternity homes and one superspeciality hospital (Yashwantrao Chavan Memorial Hospital) which has fully trained specialist and super specialists and all modern equipment, a cathlab, dialysis unit, MRI and CT scan services.

Apart from services provided by the municipal corporation there is a government run Aundh District Hospital within the area of PCMC which is also well equipped with 300 beds. There are 89 private hospitals and in total 275 Maternity Homes, Pediatric Nursing Homes, and Eye Hospitals registered in PCMC jurisdiction.**Table 2.1** enlists number of health care facilities and other attributes available in PCMC area**.**

Table 2.1 Health care facilities available in PCMC (2011-12)

Sr.No.	Category	Number
1	PCMC hospitals	8
2	Dispensaries	21
3	MCH	31
4	ICDS. (Integrated Child Development Scheme)	2
5	Veterinary clinics	2
6	Blood Bank	1
7	Post mortem center	1
8	ART center	1
9	Urban leprosy Center	1
10	TB Unit	1

Source: *Health Department, PCMC.*

There are total 1030 hospital beds in Government hospitals run by PCMC and additional 300 beds are available in Aundh District Hospital run by the State Government.Whereas, 7208 additional beds are available in 364 private hospitals spread across the city. Taking into consideration private and Government hospitals there are 8358 beds available for the estimated PCMC populationof 20 lakh. Statistically there are mighty 4.18 beds available per 1000 persons. The world average is 3.96, and overall average in India is 0.7 for the same (Report on Health System of India, *Academy for International Health Studies 2008)*. Number of hospital beds per 1000 persons available in PCMC facilities appears to be too high for the Indian standards and slightly more than the world average.

There are some sectors, where strong and obvious links between health and environment is observed. To name a few, linkages between population and social health, water supply and sanitation, environmental pollution and natural resources/food security are of great importance. In most developing countries, health is directly affected by negative changes in the environment, such as soil erosion, drought, floods

and pollution. The health sector administration in many cases is still oriented towards the curative rather than the preventive measures.

2.2.2 Communicable Diseases

Communicable diseases are the illness caused by microorganisms and transmitted from an infected person or animal. These diseases are transmitted by direct or indirect contact with infected persons or with their excreta. Most diseases are spread through contact or close proximity because the causative bacteria or viruses are airborne; i.e. they can be expelled from the nose and mouth of the infected person and inhaled by anyone in the vicinity. Such diseases include diphtheria, tuberculosis, polio measles, mumps, whooping cough, influenza and chicken pox. Diseases like swine flu, dengue and AIDS are of great public concern in recent years.

The infectious agents are called pathogens and they are spread through air, water, food, body fluids, and through non human carriers called vectors like insects (mosquitoes, flies, ticks etc.) and animals (rodents, monkeys etc.). Depending on the mode of transmission, communicable diseases are categorized into water, air or vector borne diseases.

According to the indicators given by DPSIR, health care is an important indicator and its objective is to improve health conditions. Health care indicator costs are linked to social, economic and environmental conditions in a city. Improving the health of people as well as of the environment is necessary for sustainable economic growth, and is a precondition for reducing poverty.

Waterborne diseases are the diseases acquired by drinking contaminated water at its source or in the distribution system, or by direct contact with recreational waters. Waterborne diseases result from infection with pathogenic microorganisms or chemical poisoning. Number of patients suffering from waterborne diseases in 2011-12 has been reduced as compared to previous year, while sexual transmitted disease cases have increased since 2011-12. Details regarding number of patients suffering from different diseases are listed in **Table 2.2**.

Table 2.2 Patients suffering from diseases in PCMC area

Source	Diseases	2010 – 2011	2011 – 2012
Mosquito	Malaria	413	274
	Dengue	390	86
Water	Gastroenteritis	538	520
	Jaundice	149	161
	Typhoid	635	289
Human Sex	AIDS	473	552
	STD	6844	9067

Source: *Health Department, PCMC.*

2.2.3 Non-communicable Disease

A non-communicable disease(NCD) is a medical condition or disease which by definition is non-infectious and non-transmissible to other people. NCDs may be chronic diseases of long duration and slow progression, or they may result in more rapid death such as some types of sudden stroke. They include autoimmune diseases, heart disease, stroke, cancer, asthma, diabetes, chronic kidney disease, osteoporosis, Alzheimer's disease, cataracts and more. The World Health Organization (WHO) reports NCDs to be by far the leading cause of mortality in the world, representing over 60% of all deaths.

Sufficient data on NCD in PCMC area are not available. A recent publication by Bayan *et. al* (*Int.J.Critical Illness & Injury Sc*., vol. 3,1, p8-11, 2003) on a series of cases of non-fatal road traffic accidents in two tertiary care hospitals in Pimpri, Pune, revealed that a total of 212 non-fatal road traffic accident patients were admitted over a period of one year in these two hospitals. The ratio of male: female was almost 5: 1. The maximum accidents occurred on Sundays and Mondays and the least around mid week (Wednesday). Pedestrians were the most vulnerable group, followed by drivers and pillion riders on two wheelers. These categories of road users contributed to almost 80% of the cases of Road Traffic Injuries. Accidents were more likely in the time zone of 8 pm to midnight, followed by 4 pm to 8 pm. A majority of the victims reported impaired visibility and fatigue as the cause of accident. Almost half (46.22%) of the injured people confessed that they were under the influence of alcohol during the accident.

The life expectancy at birth is probably the best indicator of a community's current health status and is often cited as an overall measure of a population's welfare or quality of life. Therefore, life expectancy in developing countries is lower than in developed countries. As per DPSIR indicators, 'life expectancy at birth' is an indicator having an objective to improve health status and quality of life.

2.3 Education

Schools in Pimpri Chinchwad city are either run by PCMC, which are called as municipal schools, or privately run by trusts and individuals. According to studies conducted by the education department of PCMC, there are total 136 primary schools with 49,369 students and 1313 teachers(**Table 2.3**). These schools are categorized under four groups based on media (Marathi, Urdu, Hindi and English) of teaching. There are in total 208 secondary schools in the city educating 94,733 students (**Table 2.4**).

Table 2.3 Primary educational facility in the city schools, managed by PCMC

Language	No. of Schools	No. of students	No. of Teachers
Marathi	119	43305	1163
Hindi	03	996	23
English	02	922	21
Urdu	12	4146	106
Total	**136**	**49,369**	**1313**

Source: *Education Department, PCMC.*

Table 2.4 Secondary schools in PCMC area

	Aided schools	Un aided schools	All time un-aided schools	Total
Total no. of schools	72	21	115	**208**
No. of Municipal Schools	15	00	03	**18**
No. of students	38,122	8976	47,635	**94,733**
No. of staff	774	162	841	**1777**

Source: *Education Department, PCMC.*

Student Teacher Ratio for primary schools is 38:1 and for secondary schools it is 53:1. Lower student-teacher ratio indicates the accessibility of the teachers and it can possibly affect the quality of education. The fact that basic education is necessary and it is a fundamental human right has long been recognized by the international community.

*'Access to Education' and 'Years of Formal Education' are the **DPSIR** indicators with an objective of free and compulsory education for all, at least at the elementary and fundamental levels - commonly known as a 'basic education'; (Article 26 of the Universal Declaration of Human Rights).*

*'School Attendance' is one of the indicators of **DPSIR,** with an objective to improve access to and completion of primary and secondary education. For this, data required is pupils from ages 12-15 who attend public schools versus the total number of pupils from ages 12-15 that are required to attend.*

2.4 Power Consumption

Supply of adequate, uninterrupted and quality power plays a crucial role in development of any city. Most of the civic amenities and utilities of Pimpri Chinchwad are dependent on power supply. Presently, Maharashtra State Electricity Distribution Company Limited (MSEDCL) is a licensee to distribute electric power in Pimpri-Chinchwad city.

The data provided by MSEDCL, as shown in **Table 2.5,** indicate that maximum unit consumption is in residential sector while least in water supply. Loss in electricity distribution has been reduced in 2011-12 (**Table 2.6)** as compared to previous year.

Table 2.5 Sector –wise Electricity Consumption in 2011-12

Sector	**Units (Million KWh)**
Residential	287.67
Commercial	69.8
Industrial	42.25
PCMC Building & Facilities	
Street Light	13.27
Water Supply by PCMC	0.75
Others	1.17

Source: *MSEDCL, PCMC.*

Table 2.6 Total Sale and Loss in Electricity Distribution

City	**Total Sale (Millions Units Yearly)**			**Total Loss in %**		
	2010-2011	2011-2012	% increase	2010-2011	2011-2012	% increase
Pimpri Chinchwad City	1109.37	1221.26	10.09	17.67	16.36	- 1.31

Source: *MSEDCL, PCMC.*

As per DPSIR 'Total Energy Consumption' indicator aims to reduce overall energy consumption. By reducing the amount of electricity that we consume, we can reduce emissions of greenhouse gases and help stop global warming. Electricity consumption impacts air quality and greenhouse gas emissions.

2.5 Transport

Transportation system of a city has one of the biggest impacts on the health of the city and citizens. Cities which relay on private motorized vehicles (cars and two-wheelers) suffer from congestion, pollution and increased number of road accidents. Additionally, natural and built heritage of the city is under severe threat of destruction due to increasing demand of space required for developing transportation infrastructure. Internationally and now even at the national level (see box on National

Urban Transport Policy); transportation policy gives importance to public transport with an added emphasis on pedestrians and cyclists.
It is projected that Pimpri-Chinchwad population would increase up to 29 lakhs in 2031.The mobility needs of the current population, as well as those yet to join the urban population are to be met through planning of traffic and transport systems.

Vision of the National Urban Transport Policy

- *To recognize that people occupy center stage in our cities and all plans would be for their common benefit and well being*
- *To make our cities the most livable in the world and enable them to become the "engines of economic growth" that power India's development in the 21st century*

To allow our cities to evolve into an urban form that is best suited for the unique geography of their locations and is best placed to support the main social and economic activities that take place in the city.
The objective of the National Urban Transport Policy is to ensure safe, affordable, quick,comfortable, reliable and sustainable access for the growing number of city residents to jobs,education, recreation and such other needs with our cities. http://moud.nic.in

2.5.1 Pune Mahanagar Parivahan Mahamandal Ltd. (PMPML)

Public transport is any form of transport that can carry many people at a time along pre-specified routes following pre-published schedule. Since Public Transport carries many people in one vehicle, the pollution, resource consumption and accident rates are much lesser than individual private vehicles.

The Pimpri-Chinchwad Transportation operates a fleet of about 345 buses on 75 routes (**Table 2.7**). Considering insufficient public transport provision, a number of major manufacturing companies have provisions to provide commuter bus service for the sole use of their employees, thereby guaranteeing their employees reaching destination on time.

Table 2.7 Statistical details of PMPML for PCMC area

Sr.No.	Particulars	Number (2011-12)
1	Own buses (average per day)	256
2	Rental Buses (average per day)	89
3	Shuttle marg	18
4	Depots	3
5	Routes	75
6	Passengers traveling in a month (Ticket Sale + Passes)	70,39,170
7	Distance traveled by buses per day (Km)	67,162
8	Diesel consumed (liters per day)	6,667
9	Revenue per day: Ticket Sale + Passes (Rs.)	25,02,325
10	Distance traveled per bus per day(km)	231.7
11	Employees	1574
12	Total population of the city	17.29 lakhs

13	Citizens per bus	5011

Source: *PMPML, PCMC.*

Different transport modes place pressures on the environment. Public transport saves valuable space and energy compared to private transport, and has positive health benefits. The objective of ***DPSIR*** *is to improve access to public transportation for all. The number of buses per lakh population is an important indicator for the adequacy of services in the city. The CIRT norms specify 40 buses per lakh population.*

Traffic volumes are defined as number of vehicles (vehicles-km) and number of vehicles on main routes. This indicator measures the pressures on both physical and human environments in a city. The DPSIR indicator for Transport Mode is applied in good details wherein the modal split is shown in ***Table 2.8.***

2.5.2 Private Transportation

In 2012, a total of 88,659 vehicles were registered in the city of which 63,339 are two wheelers accounting for about 74.8 % of newly registered vehicle fleet (**Table 2.8**).

Table 2.8 Registered vehicles in PCMC area (2011-12)

Sr. No.	Category	As on 31.12.12
1	**Total 2 Wheelers**	63,339
2	Motor Cars	17,448
3	Station Wagons	13
	Total 4 Wheelers	17,461
4	Taxi Cabs, Rickshaws, Bus. Ambulances, Trucks, tractors etc.	7,859
	Total	**88,659**

Source: *Pune Police Commissioner and Pune District Rural Police (Dehu Road & Vishrantwadi Poice Station)*

2.5.3 Road Accidents

The information from Pune Police Commissioner towards accidents in 2012 for the broad area covering PCMC, Cantonment boards and suburban areas is presented in **Table 2.9**.

Table 2.9 Accident cases in PCMC and associated areas 2012-13

Criteria	Year 2012
Seriously injured	129
Minor injury	274
Total injuries	403
Death	151
Total accidents	494

Source: *R.T.O, Pimpri Chinchwad, Pune.*

2.6 Socio-Economic Status

Industrialization in Pimpri area commenced with the establishment of Hindustan Antibiotics Limited in 1954. The establishment of the Maharashtra Industrial Development Corporation (MIDC) in 1961-62 considerably facilitated industrial development in the area. The wave of establishing industries (Bajaj and Telco pioneering this wave in 1966 and 1976 respectively) was initiated in the middle of the 20th century.

The urban development of Pimpri Chinchwad took place almost entirely along the old Mumbai-Pune highway. Civic amenities like shopping complexes and hospitals are also situated along the old Mumbai-Pune highway. Establishment of the Pimpri-Chinchwad New Town Development Authority (PCNTDA) in the 80s helped the development of proper residential colonies in the 90s. Affordable housing was provided by the PCNTDA to a large number of workers and lower & middle income group citizens. The establishment of large-scale core industries has led to the growth of ancillary and small-scale industries in and around this industrial belt. The landscape in the region has seen significant changes over the years with agricultural land giving way to enclosed factory campuses. Today, Pimpri Chinchwad is a major industrial center in the Pune region and possibly of the entire country. The statistical details of different categories of people in PCMC area and its proportion to the District and Tehsil is summarized in **Table 2.10**

Indicator 'Unemployment Rate' is used to minimize unemployment rate. Unemployment levels express health of economy and the success of government economic policies. Data required includes, the average number of unemployment men and women during the year, as a fraction of the workforce.
'Household income disparity' is a DPSIR indicator used to reduce to inequalities and decrease the gap between richest and poorest people. A large income disparity causes inequalities in access to education, resources, power, poverty, and related problems. It also threatens the long term stability of economy. Income disparity among cities' richest and poorest people, as measured by the amount of household income earned over one or more decades.

Table 2.10 Working Population Scenario

#	Particulars	District (%)	Tehsil (%)	PCMC (%)
1	Total Workers to Total Population	40.85	36.72	34.6
2	Non Workers to Total Population	59.15	63.28	65.4
3	Main Workers to Total Population	36.58	33.81	32.38
4	Main Workers to Total Workers	89.54	92.09	93.59
5	Marginal Workers to Total Workers	10.46	7.91	6.41
6	Main Cultivators & Main Agricultural Labours to Main Workers	37.31	16.1	2.39
7	Marginal Cultivators & Marginal Agricultural Labours to Marginal Workers	58.57	34.12	9.26
8	Total Cultivators & Total Agricultural Labours to Total Workers	39.54	17.53	2.83

9	Others to Total Workers	60.46	82.47	97.17
10	Total Cultivators & Total Agricultural Labours to Total Population	16.15	6.44	0.98
11	Others to Total Population	83.85	93.56	99.02
12	Male/Female Total Workers	68/32	79/21	84/16

Source: *Census Handbook 2001*

Auditorium, Malls and Multiplexes in Pimpri Chinchwad Area

As per Government norms, Pimpri Chinchwad Municipal Corporation (PCMC) has introduced following concessions for encouraging the I.T. Industries in PCMC area.
1) PCMC relaxed its Octroi Rules in 2001 and introduced total exemption for the material/goods imported during the period 14/04/2005 to 03/06/2008 to the I.T. Industries as per the Government Resolution no. ITP/2003/3311/industries/7 dated. 12/07/2003
2) While assessing the taxes for I.T. Industries PCMC implemented the systems of 12% taxes instead of 28% tax for the properties of I.T. Industries. Further, PCMC adopted the policy of charging the concessional rate of Rs. 1/- per sq. for non-residential properties of I.T. Industries, while those who constructed on their own plot and started I.T. Industries for a period of 5 years (2005 - 2006 to 2009 – 2010) were not assessed the properties as non-residential properties following the rules prevailing on date. Different types of encouragements are mentioned hereunder.

- For encouraging the automobile industries, chemical industries, medicine & heavy industries in PCMC area, the corporation have reduced the octroi rates from 3% to 1.65%.
- For modernization of old industries, expansion of industries, as well as introducing new industries octroi rates have been reduced from 2.50% to 1.25% for import of machinery.
- Godown facility under the control of Maharashtra Ware Housing Corporation is available.
- Being a pioneering industrial & education township, Pimpri Chinchwad has skilled workmen.
- Various transport & communication facilities for transports industrial goods in abundance such as vehicles, railway. It is proposed to start an International Airport at Chakan.
- PCMC distributes the vacant blocks/galas as per first come first serve system on rent / lease base. Similarly new commercial blocks galas are given to the highest bidder on rental basis / leave basis / on sale too. For this purpose tenders are floated in daily newspapers. After finalization of tender, approved tender has to enter into an agreement with the municipal corporation and has to pay 6 months' rent in advance to the corporation and accordingly the gala is handed over to the lease holder.

2.7 Green Building Rating System

In order to conserve and protect the environment in the city, the Pimpri Chinchwad Municipal Corporation has implemented Green Building Rating System. GRIHA; a Green Rating System, developed by Ministry of New and Renewable Energy (MNRE) and TERI is implemented in the city through ADaRSH. Projects having more than 2500 sq. m area are considered for GRIHA rating whereas, plots smaller than 2500 sq. m are rated under SVAGRIHA green building rating system.

The primary objective of the rating system is to help designing green buildings that will be useful to evaluate the 'greenness' of buildings. The voluntary rating system devised by

TERI aims to achieve efficient resource utilization and to enhance resource efficiency and quality of life in buildings.

GRIHA has a 100-point system consisting of some core points, which are mandatory to meet while the rest are non-mandatory or optional points that can be earned by complying with the commitment of the criteria for which the points are allocated. Under the Green Building Initiative of PCMC it is expected that all future buildings within the PCMC shall be GRIHA compliant, developers who commission GRIHA compliant projects shall qualify for rebates on premium and owners of GRIHA compliant buildings will receive a rebate in property tax.

Premiums and rebates in property tax given by the PCMC to compliant of GRIHA and SVAGRIHA projects are as follows:

Table 2.11 Premium and rebate given to GRIHA and SVAGRIHA projects

% points scored	Rating	Rebates on premium	Rebate in Property Tax
GRIHA Projects			
50-60	*	10%	--
61-70	**	20%	--
71-80	***	30%	5%
81-90	****	40%	8%
91-100	*****	50%	10%
SVAGRIHA Projects			
25-30	*	10%	5%
31-35	**	20%	8%
36-40	***	30%	10%
41-45	****	40%	12%
46-50	*****	50%	15%

Source: *PCMC Green building rating system*

2.8 Heritage

The great Saint Tukaram Maharaj was born in village Dehu, situated in the vicinity of Pimpri Chinchwad Municipal Corporation. The great saint had taken heavenly abode 350 years ago. Whereas Shivaji Maharaj was the founder of the Maratha Empire and he established a competent and progressive civil rule. The meeting of two great architects of Maharashtra indicates the unique presentation of strength, spiritualism and accordingly aunique project, named "Bhakti Shakti" is developed in this area. The entire complex is situated on

Plate 2.1 Bhakti Shakti Statue in Nigdi

a hill rock just near Mumbai Pune National Highway in sector no. 23 of Nigadi, PCNTDA. On this location PCMC has taken a great opportunity to install a group statue of Shivaji Maharaj, the great emperor of Maharashtra and saint Tukaram Maharaj. The entire complex of sculpture on the hill rock is planned with proposed beautiful landscaping in a 0.8 sq km area and the same has become the most acknowledged landmark for Pimpri Chinchwad Municipal Corporation.

2.9 Tourism

Pimpri Chinchwad Science Centre: The Pimpri Chinchwad Science Centre has been set up by National Council of Science Museums, an autonomous society under the Ministry of Culture, Government of India with active support from the PCMC, one of the richest municipal corporations in India. The centre, through its interactive science exhibitions and non-formal science education programmes are expected to cater the people of the region.

Plate 2.2 Science Centre

The Science Centre having a built-up area of approx. 4000 sq. m holds three exhibition halls, a temporary exhibition hall, an inflatable dome planetarium, science demo station area, activity corner, an air-conditioned auditorium,3D science show facility, a library cum conference hall, a small work shop for maintenance and development of exhibits and other public facilities surrounded by a large science park.

Nisargakavi Bahinabai Chaudhary zoo: Bahinabai Choudhary Pranisangrahalay, previously known as Snake Park & Aviary, is a small zoo established by PCMC, and recognized by the Central Zoo Authority. This zoo has witnessed continuously increasing visitors that are more during summer months.

Plate 2.3 Nisargakavi Bahinabai Chaudhary zoo

Plate 2.4 Durga Devi Hill Park

Durgadevi Hill Park: Durgadevi park is a prestigious aspects of this corporation where over 1,60,000 trees such as rain tree, *Pelthohorum*, *Ficus*, Neem, *Glyricidia*, Suru, Sisoo, Kasid, Subabul etc have been planted on an area of 75 ha,. A lawn on over 10 ha of land has been maintained for recreation purposes. A well maintained jogging track of 2.5 km length is an important place for senior citizen and adults for morning exercise. Waterfall and floating fountain are added natural beauties of this hill station.

3. Water Environment

3.1 Water Resources

3.1.1 Surface Water

Approximately 1.13% of PCMC area is covered by surface water bodies. Growing industrialization and urbanization are responsible for rapidly depleting global fresh water reserves. The city is gifted with three rivers viz. Mula, Indrayani and Pawana. In addition to these rivers, there are few lakes, reservoirs, ponds etc. within the PCMC area. Rivers and lakes have been the main source of surface waters. These water bodies are at high risk due to discharge from nallah waters, industrial waste water, anthropogenic activities, dumping of solid wastes etc. Since these water bodies are used for agriculture & aquaculture, in addition to bathing, washing clothes, vehicles and cattle, and cleaning activities by nearby residents, there is a need to evaluate the water characteristics and suggest techno-economically viable mitigation measures. In view of this, studies were undertaken on certain pollution indicating parameters viz. pH, COD, BOD, DO and Total coliform. All samples were collected and analysed by following internationally accepted standard methods.

3.1.1.1 Water characteristics: Rivers

Physico-chemical and microbiological characteristics of water samples, collected from Pawana river in October 2012 and 2 rivers Indrayani (~ 16 km) and Mula (~ 4km) in the month of January 2013 are summarised in **Tables 3.1 and Table 3.2** respectively**.**

Table 3.1 Water characteristics of Pawana River in PCMC Area (Oct 2012)

Sr. No	Location	Parameters					
		pH	DO (mg/l)	BOO (mg/l)	COD (mg/l)	TSS (mg/l)	Total coliform (MPN/100ml)
MPCB Standard(RRZ A-IV Irrigation Standards)		6.5-9.0	Not less than 2	30	150		-
1	Ravet Bandhara	7.1	2.5	26	48	200	3.4×10^4
2	200 m d/s from Ravet Bandhara	6.9	2.4	23	36	206	2.4×10^5
3	600m d/s from Ravet Bandhara	7.3	2.1	20	24	156	1.6×10^5
4	1500 m d/s from Ravet Bandhara	7.1	2.1	26	48	294	3.0×10^4
5	2000m d/s from Ravet Bandhara	7.3	2.0	28	56	236	3.8×10^6
6	100m u/s from Morya Bridge	7	**1.9**	**34**	80	196	3.6×10^4
7	Near Morya Bridge	6.9	**1.7**	24	62	254	2.8×10^4
8	50 m d/s From Morya Bridge	7.5	**1.5**	**32**	72	315	3.4×10^4
9	150 m d/s From Morya Bridge	7.3	**1.4**	**39**	120	324	5.3×10^5
10	Thergaon Smashanbhumi	7.3	**1.1**	**40**	136	386	5.8×10^4

Sr. No	Location	Parameters					
		pH	DO (mg/l)	BOO (mg/l)	COD (mg/l)	TSS (mg/l)	Total coliform (MPN/100ml)
11	500 m d/s of Thergaon Smashanbhumi	7.2	**0.9**	**46**	**160**	422	6.4×10^6
12	Keshavnagar (Kalewadi Bridge)	7.4	**1.5**	30	64	304	3.8×10^6
13	Smashanbhumi Kalewadi	7.1	**0.8**	**58**	**192**	326	4.7×10^4
14	Pawananagar Garden	7.7	**1.8**	**34**	80	308	3.5×10^5
15	Kalewadi	7.4	**1.7**	**42**	104	362	4.8×10^5
16	Gavde colony link road	7.1	**1.9**	**42**	144	420	5.2×10^4
17	100 m d/s From Gavde colony link road	7.1	2.0	**36**	90	336	4.2×10^5
18	Bhatanagar Smashanbhumi	7.6	2.2	**48**	122	354	4.4×10^5
19	Bhatanagar Nallah	6.8	**1.5**	**52**	140	376	5.0×10^5
20	Bhatanagar (slum nallah)	7.1	**1.1**	**60**	**180**	412	5.9×10^4
21	Delux nallah (near Kalewadi Bridge)	7.2	**1.6**	**44**	124	338	4.2×10^5
22	Kalewadi Vijay nagar	7.2	2.1	28	64	322	3.2×10^4
23	Rahatani Smashanbhumi	6.9	**1.7**	**34**	110	360	3.5×10^5
24	Pimple Soudagar (nr. Temple)	7.1	2.0	30	136	84	3.8×10^5
25	Pimpalgaon pump House	6.7	2.3	28	50	212	2.8×10^5
26	Sangavi STP	7.2	**1.8**	**50**	**168**	292	4.4×10^4
27	Khadaki (near Smashan Garden)	7.5	**1.9**	**36**	132	244	4.2×10^4
28	Khadaki Smashanbhumi	7.7	**1.5**	**42**	**160**	256	5.1×10^4
29	200m u/s From Alfa laval	7.2	2	28	54	230	4.0×10^5
30	Kasarwadi (nr. Smashanbhumi)	7.5	2.1	**38**	86	262	4.3×10^5
31	Pimple Gurav (Tuljabhavani Temple)	7.4	**1.6**	**44**	104	280	4.4×10^4
32	Near Pimple Gurav Bridge	7.6	**1.8**	28	96	228	3.7×10^4
33	Sangavi Garden	7.4	3.0	27	56	214	3.4×10^5
34	Dapodi STP	7.8	3.2	**32**	104	324	4.0×10^5
35	Dapodi Smashanbhumi	7.1	2.5	**46**	126	388	4.8×10^4
	Average		1.86	**36**	101		

Source: *Ultra Tech Environmental Consultancy and Laboratory*

- Based on water characteristics, **Pawana River appears to be highly polluted in PCMC area in comparison to Mula and Indrayani rivers**. The river covers a large distance of about 20 km through the city.

- It gets polluted mainly due to discharge of nallah water, untreated sewage, smashanbhumi (cremation) waste, industcrial wastewater etc.

- As per the average values, COD of Pawana river is within the MPCB limit of 150 mg/l.

- **Since** average values of **BOD of Pawana river water is greater than 30 mg/l (MPCB limit), it neither satisfies the requirement for agriculture nor the fishery & wild life propagation**.

- **Excessive levels of total suspended solids (TSS) and Total coliform do not permit the water for human use like bathing, washing utensils, cloths etc.**

- For fish propagation, a minimum DO level of less than 2 mg/l is required throughout the water column. Since lower levels of DO were available in surface waters of rivers during day time, there is a possibility of development of anaerobic condition during night hours due to absence of photosynthesis by phytoplankton resulting in no production of oxygen. **Such condition in bottom as well as surface water leads to mass mortality of fish**.

Table 3.2 Water characteristics of Indrayani & Mula Rivers in PCMC Area (Jan 2013)

#	Location	Parameters					
Indrayani River							
		pH	**DO (mg/l)**	**BOD (mg/l)**	**COD (mg/l)**	**TSS (mg/l)**	**Total Coliform (MPN/100ml)**
	MPCB Standard (RRZ A-IV Irrigation Standards)		**Not less than 2 mg/l**	**30 mg/l**	**150 mg/l**		
1	Talwade (East)	7.4	3.0	**36**	62	292	3.8×10^5
2	Talwade (West)	7.9	4.0	30	58	268	3.2×10^4
3	Before Chikhli Bridge (0.37 km)	7.9	3.0	**34**	54	322	4.2×10^5
4	Chikhali Bridge	6.5	3.1	**32**	60	316	3.8×10^5
5	Moshi	6.9	3.6	**34**	60	284	4.2×10^4
6	Alandi	6.8	3.0	**32**	62	348	4.2×10^4
7	Chikhali STP Outlet	6.7	3.4	30	58	310	3.4×10^5
	Average		**3.3**	**33**	59		
Mula River							
1	Wakad Bandhara	7.4	3.0	**32**	64	324	3.5×10^4
2	Balewadi	7.7	2.8	**35**	68	310	3.5×10^4
3	Pimpli nallah (up- stream)	7.3	2.2	30	62	384	3.5×10^5
4	Pimple nallah (Down- stream)	7.4	3.0	**36**	70	428	3.8×10^5
5	Pimple STP	7.3	2.0	**34**	66	315	2.1×10^4
	Average		**2.6**	**33**	**66**		

Source: *Ultra Tech Environmental Consultancy and Laboratory*

Note 1: u/s: Upstream; d/s: Downstream.

- As per the average values, COD of Indrayani and Mula river is within the MPCB limit of 150 mg/l.

- **Since** average values of **BOD of Indrayani and Mula river water is greater than 30 mg/l (MPCB limit), it neither satisfies the requirement for agriculture nor the fishery & wild life propagation**.

- **Total suspended solids (TSS) and Total coliform levels exceeded the permissible limits due to anthropogenic activities** like bathing, washing of utensils, clothes, cattle bathing etc. and sewage contamination through nallahs.

- For fish propagation, a minimum DO level of less than 2 mg/l is required throughout the water column. Since higher levels of DO were observed in Indrayani and Mula river the water is suitable for fish propogation.

3.1.1.2 Water characteristics: Lakes

Physico-chemical and microbiological characteristics of water samples, collected from 4 most important lakes (**Plate 3.1**: A to D) in the month of January 2013 are summarised in **Tables 3.3.**

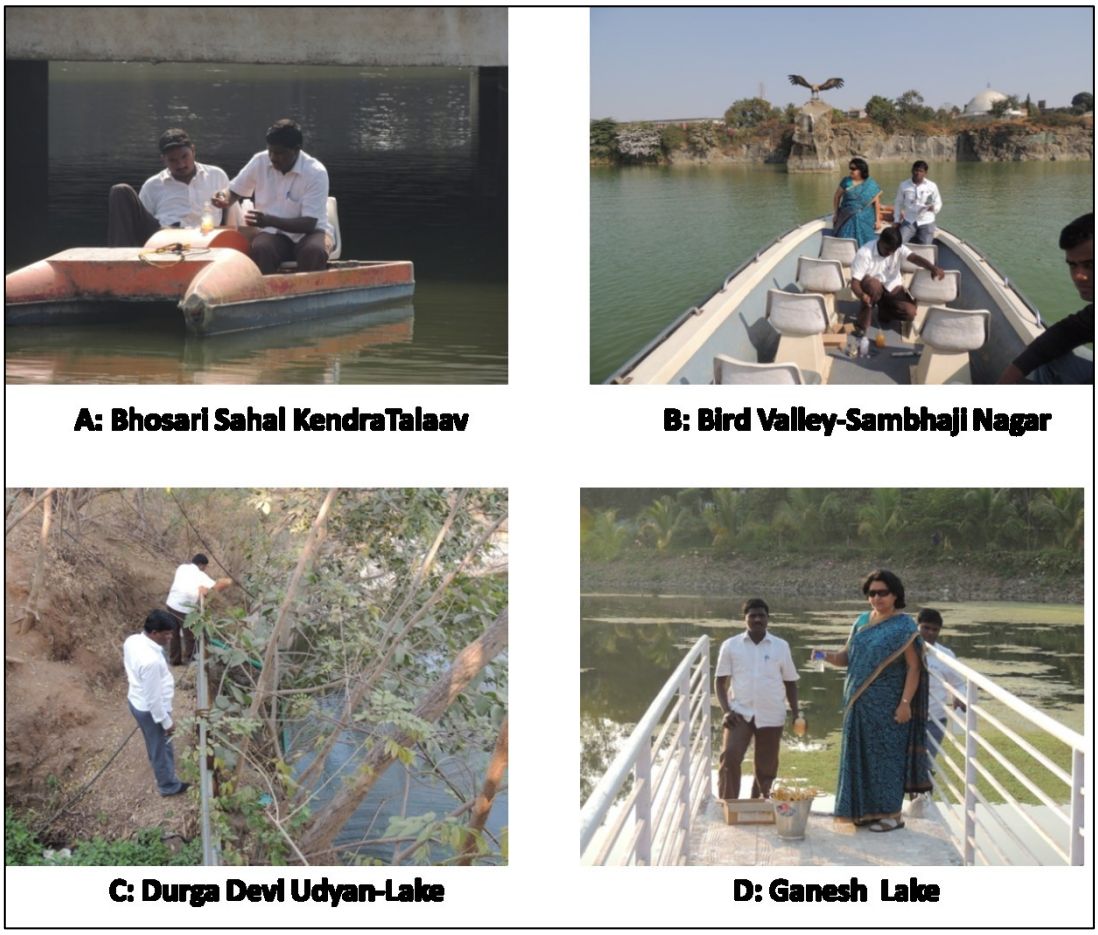


Plate 3.1 (A to D): Water sampling at different lakes in PCMC area

Table 3.3 Water characteristics of Lakes in PCMC Area (Oct 2012)

#	Lake	Parameters					
	Location	**pH**	**DO**	**BOD**	**COD**	**TSS**	**Total Coliform (MPN/100ml)**
1	Bhosari Tale	7.2	7.1	5	18	30	4.2×10^2
2	Bird Valley	7.1	8.5	3	16	12	3.5×10^2
3	Ganesh Talav, Pradhikaran	7.5	4.2	8	22	49	4.3×10^3
4	Durgadevi Tale, Nigadi	7.3	6.4	6	20	38	3.8×10^3

Source: *Ultra Tech Environmental Consultancy and Laboratory*

Note: All the parameters except pH are expressed in mg/l, if not mentioned

- BOD of lake water which is measured below 30.0 mg/l, satisfies the requirement for fishery and wild life propagation. However, higher levels of Total coliform do not permit for anthropogenic use.
- Since DO levels of above lakes is more than 2 mg/l is it fit for fishery and wild life propagation.

3.1.1.3 Water characteristics: Open nallah

Studies were undertaken on certain pollution indicating parameters viz. pH, TSS, COD, BOD, DO, Total coliform etc. for 23 nallahs (**Table 3.4**). All samples were collected and analysed following internationally accepted standard methods.

Physico-chemical and microbiological characteristics of water samples, collected from selected major nallahs (**Plate 3.2**: A to D) in the month of January 2013 are summarised in **Tables 3.4.**

Plate 3.2: (A to D) Water sampling at different open nallahs in PCMC area

Table 3.4 Water Characteristics of Different Nallahs in PCMC Area (Jan 2013)

#	Location	Parameters					
		pH	DO	BOD	COD	TSS	Total Coliform (MPN/100ml)
1	Delux Nallah	7.5	0.5	36	92	358	8.8×10^6
2	Graware Nallah	7.3	0.3	48	120	410	7.6×10^6
3	Kuki Chinchwad	7	1.1	38	108	380	5.4×10^7
4	SKF Nallah	7.4	0.2	38	100	450	6.5×10^6
5	Rawet Nallah	7.2	0.8	36	98	410	7.2×10^6
6	Kivale Nallah	7	0.6	38	88	398	8.1×10^8
7	Thergaon MM high school	7.1	0.6	42	108	400	6.5×10^6
8	Thergaon Smshanbhumi	7.3	0.5	41	104	512	4.2×10^7
9	Birla Hospital	7.6	1.6	38	86	388	5.8×10^6
10	Kaspatevasti	6.9	1.3	42	98	316	8.4×10^6
11	Jagtap Dairy Smashanbhumi	7	0.8	45	104	392	4.6×10^7
12	Pimple Nillakh	7.2	1.5	39	102	398	7.2×10^6
13	Mantri Housing Dapodi	6.8	1.4	40	94	410	5.4×10^6
14	Fugewadi Smashanbhumi	6.9	1.8	36	86	498	4.8×10^6

15	Bopkhel Nallah	7.1	0.3	46	92	384	6.7×10^7
16	Harris Bridge 'C' ward	7	1.9	41	110	396	5.8×10^6
17	Nashik Phatta	6.8	2.2	35	84	416	4.9×10^6
18	Sandvik Nallah	7.1	0.4	40	116	368	7.5×10^7
19	Moshi 'C' ward(I)	6.9	0	46	134	456	5.3×10^6
20	'A' ward Chikhali	7	0	42	120	500	5.1×10^6
21	'A' ward Akurdi	6.7	1.8	35	40	460	4.8×10^8
22	'A' ward Akurdi Gurudwara	7	1.6	38	54	384	5.4×10^6
23	'C' ward Kasarwadi STP	7.8	1.9	45	72	426	6.4×10^6
	Average		**1.0**	**40**	**96**		

Source: *Ultra Tech Environmental Consultancy and Laboratory*

Note: All the parameters except pH are expressed in mg/l, if not mentioned

- Nallah waters in PCMC area are highly polluted, primarily due to discharge of domestic wastes and industrial waste water.

- Desirable level of **DO** in surface water is 2.0 mg/l & above. Due to discharge of waste water it **dropped down even up to anaerobic condition at certain locations**. BOD levels in nallah waters were also high and such conditions are unfit even for fish culture.

- In general, most of the parameters viz. **Total coliform, TSS, DO and BOD were also exceeded in all nallah samples**.

- **Discharge of such nallah waters to receiving rivers/lakes causes eutrophication leading to unhealthy condition and fish mortality**.

3.1.2 Ground Water

Ground water has emerged as an important source to meet the water requirements of various sectors. Demand for groundwater resources is ever increasing and competition amongst users has intensified.

The occurrence, storage and movement of ground water are quite complex, being governed by several factors like geology, geomorphology, hydrogeology, meteorology and above all the anthropological activities. All these factors are subjective when it comes to urban and peri-urban domains and makes the precise assessment of ground water very difficult. As it stands today, there is no direct technique for precise assessment of ground water resources in urban areas. Ground water Surveys and Development Agency (GSDA), Govt. of Maharashtra did a scientific investigation report to study the shallow ground water. The

aim of study was to understand and examine the natural and anthropogenic factors that affect the quantity and quality of ground water in the shallow aquifers.

Pimpri Chinchwad Municipal Corporation(PCMC) has dug up 527 bore wells in the past eight years out of which a total of 283 borewells are in usable condition while the remaining 244 borewells are not in usable condition.PCMC has made Rain Water Harvesting mandatory for plots above 300 sq m area which will help to recharge the ground water.

3.2 Water Supply

Pimpri Chinchwad city gets water supply from Pawana River. The present annual requirement of the city is about 5.48 TMC and the total storage capacity of the Pawana dam amounts to 10.77 TMC. The concerned department has set up benchmarks for the volume of water that can be drawn from the river, quantity to be treated at the Water Treatment Plants (WTPs) and distributed through the main pipelines and elevated storage reservoirs (ESR). Taking into consideration the increasing population and demand for water in Pimpri-Chinchwad, there is a need to identify new water sources. PCMC has demanded to lift 100 MLD from Andhra Dam and 200 MLD from Bhama Askhed Dam to the Irrigation Department. This additional water will be used to safeguard the water supply of the newly added villages in the Municipal Corporation.

The PCMC draws 432 million litres per day (MLD) water from the Pawana River at the Ravet bund and after treatment, distributes it to the entire city. There are four main water treatment plants at Nigdi, from where seven pipelines supply water across the city. The civic body has constructed 81 ESRs at various places, while 4 nos. are under testing.

In order to evaluate water balance, the corporation has installed flow meters at different stages, viz.raw water pumping stations (Ravet), the WTPs at Nigdi, the main water pipelines and the 81 ESRs.

According to 2011 Census, the population of Pimpri Chinchwad city was 17.29 lakh. Presently, the water supply is about 460.928 MLD, of which 20% is lost during distribution. Out of the remaining 368.74 MLD, 3% is supplied to commercial area, resulting in availability of 179 lpcd to residential area of the city, which is much higher than the CPHEEO standard of 135 lpcd **(Table 3.5)**.

24X7 water supply project: Under Jawaharlal Nehru National Urban Renovation Mission (JNNURM), PCMC is working on various projects. A project to supply water to the city 24X7 is certainly the important one. To ensure 24X7 water supply for the city, PCMC is in the process to check the capacity of the existing pipelines by hydraulic modelling, update the pipeline network using GIS, reduce the non-revenue water usage and carry out water audits. The activities would be completed in next two years. Since July 2012 the Municipality has started 24X7 water supply to Yamuna Nagar covering an area of 0.8 sq. km. As a result 2347 families receive uninterrupted water supply. Citizens have welcomed

the change and surprisingly it has been observed that the water usage has decreased by 10% in this area.

As per DPSIR, 'Sources of drinking water' indicator is used. This indicator has no unified objective and it differs from city to city. The sources of drinking water indicate exploitation of local aquifers and as well the quality of the drinking water that can influence human health. In some cases, water can be imported that shows dependence on different sources.

Table 3.5 Details for Water Supply

Population as per 2011 census	17.29 lakhs
Total Water Supply	432 MLD + 28.928 MLD
Water supply losses	Approximately 20%
Net Water Supply (Residential)	368.74 MLD
Commercial water supply	3% of total water supplied
Avg. per capita/day Supply	179 lit per capita / day

Source: *PCMC Website.*

'Water consumption' is a DPSIR indicator. Objective of this indicator is to harmonise water consumption with water resources. Consumption of water per person depends on the availability and price of water, climate and the uses to which water is customarily put by individuals (drinking, bathing, washing, and gardening). It is derived from the ratio of total annual water consumption for all domestic uses to total number of inhabitants connected to supply system.

The PCMC area is well connected with pipeline network. Salient features are delineated below.

- The total length of water supply pipelines in the city is 1150 km.
- There are four water treatment plants in the city at Sector -23, Nigdi, Pune 44 for Phase I to IV.
- There are total 98 ESR and GSR in the city and 4 ESRs are under testing.
- Total nos. of domestic connection within city is 1,33,857 nos.Details of total water supply for the city are given under **Table 3.6.**

Table 3.6 Supply network in the city

Particulars	Details
No. of distribution zones (nos.)	47
Total length of pipelines (Km)	1805
No. of Water Treatment Plants	4
No. of Pumping Stations	26
No. of Chlorinators and Capacity (Area wise)	6 (Capacity-20 kg/hr)
No. of ESR (Elevated Service Reservoir)	ESR - 81 Under Testing- 4
No. of GSR (Ground Storage Reservoir)	17
Consumer Connections (Inclusive of cantonment connections in nos.)	1,33,857 nos.
Average supply (hours/day)	3 Hrs
Proposed treatment Plants (Location and capacity in MLD)	Chikhali, 100 MLD

Source: *Water Supply Department, PCMC.*

*To minimize the level of dissatisfaction of an urban population is the objective of 'percentage of household connections'-**DPSIR** indicator. The quality and reliability of local services are taken for granted in highly industrialized countries, but limited access to, or poor quality of, infrastructure services in developing countries can be major impediments to business productivity, and major sources of frustration to the population. It is expressed in percentage of households that are connected to piped water.*

Water Treatment plants

Various Water Treatment Plants (WTP) of Pimpri Chinchwad city are presented in **Table 3.7**. The City has four major waterworks in Sector 23, Nigdi (Phases I to IV). The future expansion of waterworks is expected according to city's demand. Further, a 100 MLDwater treatment plant project is under consideration at Chikhali area.

Table 3.7 Water Treatment Plants in Sector -23, Nigdi and their Capacities

WTP	Workingat (MLD)	Treatment Method	Commissioning Year
Phase I	114	Conventional	1989
Phase II	114	Conventional	1999
Phase III	100	Conventional	2006
Phase IV	100	Conventional	2010

Source: *Water Supply Department, PCMC.*

Drinking water quality:

The four water treatment plants in PCMC treat the raw water pumped from Ravet dam and purified water is further supplied to the city. These water treatment plants are operated and maintained by the PCMC to make sure that the citizens of Pimpri Chinchwad get potable quality of water to drink. A number of water quality parameters like various metals, pH,

TDS, hardness, fluorides, coliform bacteria are measured in incoming and outgoing water from these WTPs. The inlet and outlet parameters of the water treatment plant are given in **Appendix 1**.

Quality of Drinking water is used as an indicator in DPSIR. The objective of this indicator is to reduce the percentage of measurements exceeding the recommended WHO guidelines. The microbiological and chemical quality of water is of prime importance to the health of human communities. It is extremely important to ensure that water supplies are free from pathogenic bacteria and not contaminated by sewage. The chemical parameters of water quality are nitrates, fluorine, benzene and chlordane. PCMC is following CPHEEO and IS standards which are compatible with WHO.

3.3 Sewage Management

Sewage collection and disposal systems transport sewage through the city and other inhabited areas towards sewage treatment plants to protect public health and prevent spread of diseases. At sewage treatment plants, domestic sewage is treated to control water pollution before discharging it into surface waters.

Sanitary work starts at a point where water supply engineering ends. It starts with the collecting system and ends after the streams or other bodies of receiving water have been returned to the condition of relative purity desired for them.

3.3.1 Sewerage Network

Total sewage generated in Pimpri-Chinchwad city is 277.2 MLD, which is collected from sewer lines and transferred to respective pumping stations through collection chambers. For treatment, the collected sewage then goes to STPs that are constructed with various advanced technologies; such as Sequential Batch Reactor (SBR), Activated Sludge Process (ASP), Bio-towers, Fluidised Aerobic Bioreactor (FAB) etc. as per details presented in **Tables 3.8 and 3.9 & Plates 3.3 and 3.4.** The operation & maintenance of the same are being executed through private contractors. Sewage treated by PCMC is discharged into river after desired treatment. PCMC has also proposed three new sewage treatment facilities at different locations, as given in **Table 3.10**.

Table 3.8 Basic details of Sewage system in PCMC

Particulars	Details
Total population (2011)	17.29 lakh
Estimated population (2013)	20 lakh
Total sewage generation	277.2 MLD
Total length of sewer line	1250.0 km
No. of STPs	13
Total capacity of STPs	338 MLD
Types of Treatment	Combi Treat Improved S.B.R., Activated Sludge Process, S.B.R. Technology,FAB,Bio Tower

Source: *Environment Engineering Department, PCMC*

Table 3.9 Details of Sewage Treatment Plants (April 2013 to June 2013)

#	STP	Capacity (MLD)	Average Sewage Pumped (MLD)	Method
1	Chikhali 1	16	--	ASP, Under Modification
2	Chikhali 2	16	12.90	ASP
3	Akurdi	30	25.60	Combi Treat (ISBR)
4	Ravet	20	6.00	SBR
5	Chinchwad Phase I (Bhatnagar)	30	12.40	ASP
6	Chinchwad Phase II	30	26.60	SBR
7	Kasarwadi Phase I	40	--	ASP, Under Modification
8	Kasarwadi Phase II	40	35.00	ASP
9	Kasarwadi Phase III	40	30.10	SBR
10	Charholi	21	7.80	SBR
11	Sangvi Phase I	15	6.10	FAB
12	Sangvi Phase II (Dapodi)	20	9.40	SBR
13	Pimple Nilakh	20	15.90	Bio Tower

Source: *Environment Engineering Department, PCMC*

SBR: Sequential Batch Reactor; ISBR: Improved Sequential Batch Reactor; ASP: Activated Sludge Process, FAB: Fluidised Aerobic Bioreactor, UC: Under Construction

Table 3.10 Details for Proposed Sewage Treatment Plants

Sr.No.	Name and Location STP	Designed Capacity (MLD)	Method Of Treatment
1	Charholi Phase II	20	Combi Treat (ISBR)
2	Bopkhel	5	SBR
3	Pimple Nilakh Phase II	20	SBR

Source: *Environment Engineering Department, PCMC*

ISBR: Improved Sequential Batch Reactor**;** SBR: Sequential Batch Reactor

'Waste Water Treatment' is used as indicator in the DPSIR indicator system. The objective of this indicator is to reduce urban pollution by waste water. This indicator includes % of dwelling connected to sewage system and % of waste water treated. The percentage of wastewater that is treated is a key indicator of the level of water quality management. A reliable wastewater treatment system is a major indicator of the level of local development and of community.

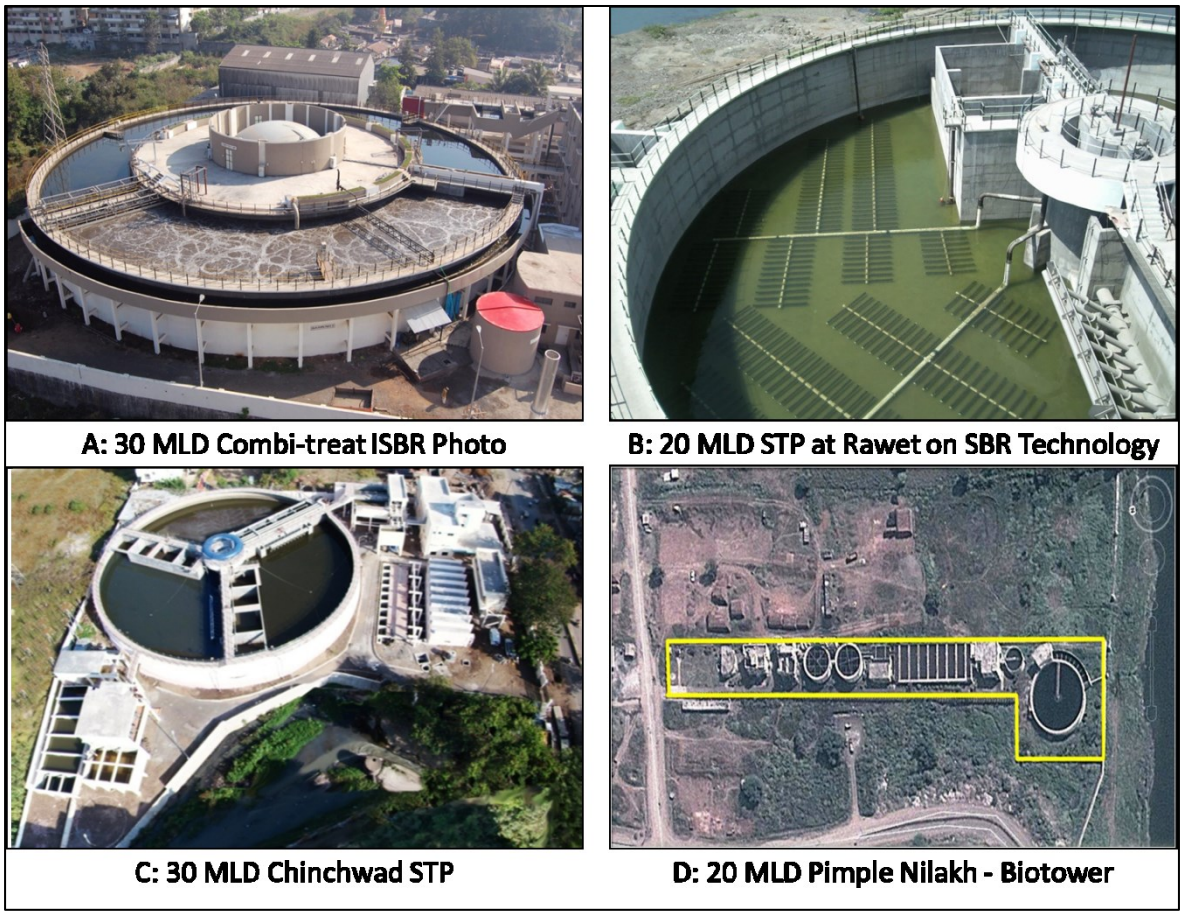


Plate 3.3 Selected STPs in PCMC jurisdiction

3.3.2 Analysis of Sewage Treatment

All sewage treatment plants in the PCMC area are measuring incoming and outgoing sewage quality parameters. Such measurements ensure that the quality of water leaving the treatment plant is within the MPCB limits. The waste water parameters are measured in a water quality laboratory located at each STP on a daily basis. The detailed results in the form of monthly average are shown in **Appendix 2**.

3.3.3 Energy production from Sewage Treatment Plants

Improved Sequential Batch Reactor (ISBR) technology at Akurdi STP (30 MLD) has enabled PCMC to generate biogas and hydro-electricity. The plant has generated 1,36,524 kW biogas and 15, 955 kW of hydro-electricity between July 2012 to June 2013. This energy has been used internally to run the sewage treatment plant and thereby helped the

PCMC to reduce the electricity demand from MSEDCL by 50% during the above mentioned period.

Programmable Logic Controller (PLC) - Supervisory control and data acquisition (SCADA) System

Main objective of SCADA System project is

- Implementation of online monitoring system for sewage quantity and quality
- Enhancement of system for achieving following benchmarks
- Quantification of pumped sewage
- Identifying non-compliance to existing system by centralised monitoring
- Efficient pumping from sewage pumping station without overflow
- Effective utilization of sewage treatment plant capacity
- Pump efficiency & energy monitoring.

PLC SCADA system has been installed at 21 sewage pumping stations and 11 Sewage treatment plants operational are under PLC automation that has enabled PCMC to carry out online observation of various parameters such as residual chlorine, pH , conductivity, dissolved oxygen, pumped flow, energy consumed etc.

3.4 River Improvement Programme (Nadi Sudhar Yojana)

Three rivers namely Pawana, Mula and Indrayani flow through Pimpri-Chinchwad municipal jurisdiction. While the Indrayani River flows along the north-western outskirts and Mula River on south side, forms a boundary of Pune and Pimpri Chinchwad Cities; Pawana River traverse through the heart of the city (~20 km) and its width reaches 70-80 m in some locations. The 4 weirs constructed on the river are used to fulfil the water requirement of the city. There are 7 major and 25 minor nallahs discharging untreated water into rivers.

The water analysis of rivers in PCMC reveals that the degree of pollution especially in Pawana is significantly high. This is due to discharge of untreated domestic and industrial waste waters, municipal wastes and improper usage of river water by washing clothes, vehicles and animals.

In light of above,

- To control River pollution
- To provide green & healthy environment to the citizens
- To control flood situations like July 2006
- To save environment
- To make sure that rivers flows freely and naturally without any pollution
- To control encroachment on banks;

Pimpri-Chinchwad is taking a leap forward to rejuvinate rivers viz. Indrayani and Mula through National River Conservation Directorate. PCMC has prepared a feasibility report

for Pawana River conservation considering its pollution level and stretch within the city limits.

The action plan involves:

- Increasing public awareness
- To stop direct sewage entering into River
- To Provide natural filter or treatment system at end of the Nallah before entering into the River
- To restrict direct entry of solid waste by providing nets(*Jali)* on bridges, controlling access.
- To manage public activities & functions in view of waste Management
- Regular monitoring of water bodies in the city
- To avoid "bypass" from STPs

The River Improvement Programme aims at cleaning the stretches, strengthening the riverbanks and providing for permanent treatment facilities for the river Pawana. The Programme further includes:

- Construction of retaining wall
- Development Riparian zone
- Development of Morya Gosavi temple (pilgrimage centre)
- De-silting
- Widening of bridge on Chinchwad-Thergaon road.
- Widening of Pimpri Saudager Gaothan bridge
- Strengthening & upgradation of Ravet K.T. Wier
- Public park at boat club Thergaon
- Public Buddha park at confluence of Pavana Mula river
- Upgradation of old crematorium
- New crematorium at Kalewadi bridges
- New crematorium at Pimpri Waghere
- Development of open market area for seasonal & festive time
- Upgradation of sewage treatment plants to increase the quality of water being discharged.

4. Air Environment

Air pollutants can be in the form of chemicals, particulate matter or biological materials that cause harm to plants and animals and interfere with their normal functioning. The major sources of pollutants in urban areas are transportation (predominantly automobiles) and fuel combustion in stationary sources, including residential, commercial, with industrial heating and cooling also coal-burning power plants. Motorized vehicles produce high levels of carbon monoxides (CO), carbon dioxide ($C0_2$) hydrocarbons (HC) and nitrogen oxides (NOx).

4.1 Air Quality Standards

The national air quality standard prescribed by the Central Pollution Control Board (CPCB) under different categories are summarised in the **Table 4.1**.

Table 4.1 National Ambient Air Quality Standards, Schedule-VII Rule-3(3B)

Sr. No.	Pollutants	Time Weighted Average	National Ambient Air Quality Standards	
			Industrial, Residential, Rural and Other Area	Ecological Sensitive area (Notified by Central Government)
1.	SO_2	24 hours	80	80
2.	NOx	24 hours	80	80
3.	RSPM (PM_{10})	24 hours	100	100

Source: *CPCB*

4.2 Air Quality

Air quality data (**Tables 4.2-4.4 and Figures 4.1-4.3**) are available from monitoring carried out by MPCB for two different locations representing residential (PCMC building) and industrial (Maratha Chamber of Commerce building terrace, Bhosari) areas in the city. Sampling frequency was twice a week for a period of 12 Months. Subsequently studies were undertaken by Ultra-Tech environmental consultancy and laboratory for a period of three months between November 2012 and January 2013 (**Plate 4.1**). The results are presented in **Tables 4.5 and 4.6**

Plate 4.1 Air Monitoring Stations in Residential (A) and Commercial (B) Areas

Table 4.2 Overview of RSPM Levels in Pimpri Chinchwad city for Residential & Industrial Areas

Month	PCMC 2010	MCCB 2010	PCMC 2011	MCCB 2011	PCMC 2012	MCCB 2012
Standard	**100**	**100**	**100**	**100**	**100**	**100**
Jan	**163.00**	**166.00**	**170.00**	**154.00**	**181.44**	**213.37**
Feb	**136.30**	**167.60**	**150.50**	**155.80**	**167.88**	**204.22**
Mar	**116.62**	**106.40**	**129.00**	**138.90**	**151.21**	**115.50**
April	81.23	78.00	78.92	**108.60**	78.58	**111.00**
May	53.00	53.33	55.30	71.13	60.82	69.22
June	41.42	32.90	--	72.67	39.55	45.00
July	40.73	36.22	57.58	76.00	34.94	39.87
Aug	35.74	32.63	43.21	86.56	25.64	34.11
Sept	38.96	42.22	61.92	72.43	40.87	54.11
Oct	74.36	89.11	**113.60**	**104.20**	64.47	85.56
Nov	80.04	94.75	**175.00**	**170.60**	**119.00**	**131.75**
Dec	**143.22**	--	**208.60**	**256.88**	**114.81**	**145.50**

Source: *MPCB, Pune.*

Note: Maratha Chamber of Commerce Building (MCCB), All values are in µg/m^3

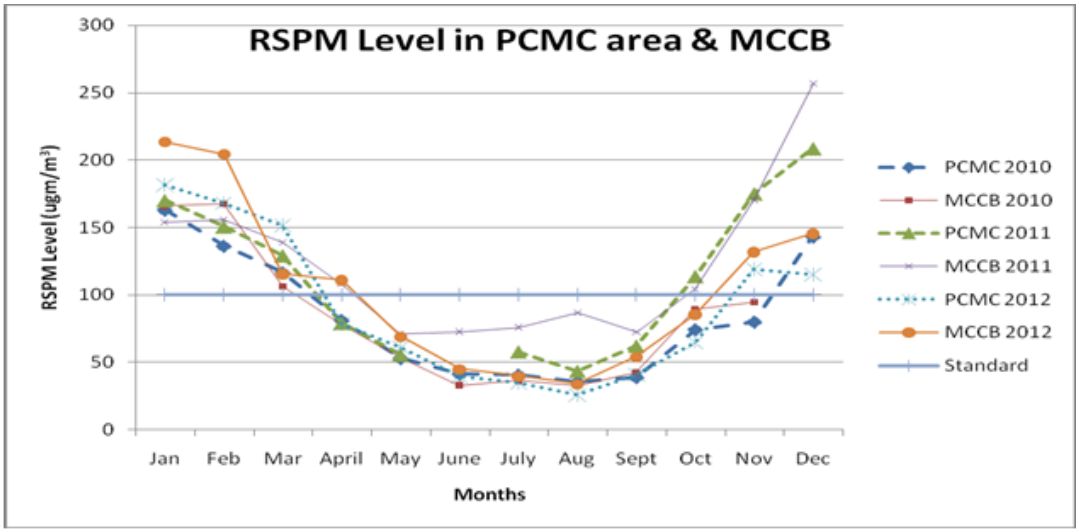


Figure 4.1 Overview of ambient air quality in Pimpri Chinchwad city for residential & industrial areas

Source: *MPCB, Pune*

- The concentrations of RSPM exceeded from 11 to 113 % over the threshold value at Bhosari Station. The values increased in the month of Jan., February, March, April, November and December (between 111 and 214 µg/m^3).

- The concentration of RSPM exceeded between 14 and 81 % than the threshold value at PCMC terrace Building. The values increased in the month of Jan., February, March, November and December (between 114 and 181 µg/m^3).

Table 4.3 Overview of SO_2 level at PCMC building terrace & MCC building terrace

	PCMC 2010	MCCB 2010	PCMC 2011	MCCB 2011	PCMC 2012	MCCB 2012
Standard	**80**	**80**	**80**	**80**	**80**	**80**
Jan	25.00	46.00	11.00	11.00	29.44	40.00
Feb	48.00	67.12	18.85	23.00	27.04	35.22
Mar	45.96	57.25	35.28	38.56	30.75	24.25
April	22.12	29.00	28.84	30.00	30.18	34.00
May	25.18	28.11	22.43	23.00	24.09	25.78
June	20.65	20.20	--	40.44	21.10	21.56
July	15.58	17.00	49.19	53.22	16.65	17.50
Aug	32.33	35.87	50.96	55.00	15.40	16.00
Sept	22.20	22.55	33.64	30.00	15.96	17.00
Oct	25.48	34.66	19.69	22.67	19.08	29.11
Nov	29.65	38.37	31.17	45.33	16.78	25.37
Dec	29.62	--	36.73	46.00	19.85	33.33

Source: MPCB, Pune.

Note: Maratha Chamber of Commerce Building (MCCB), All values are in µg/m^3

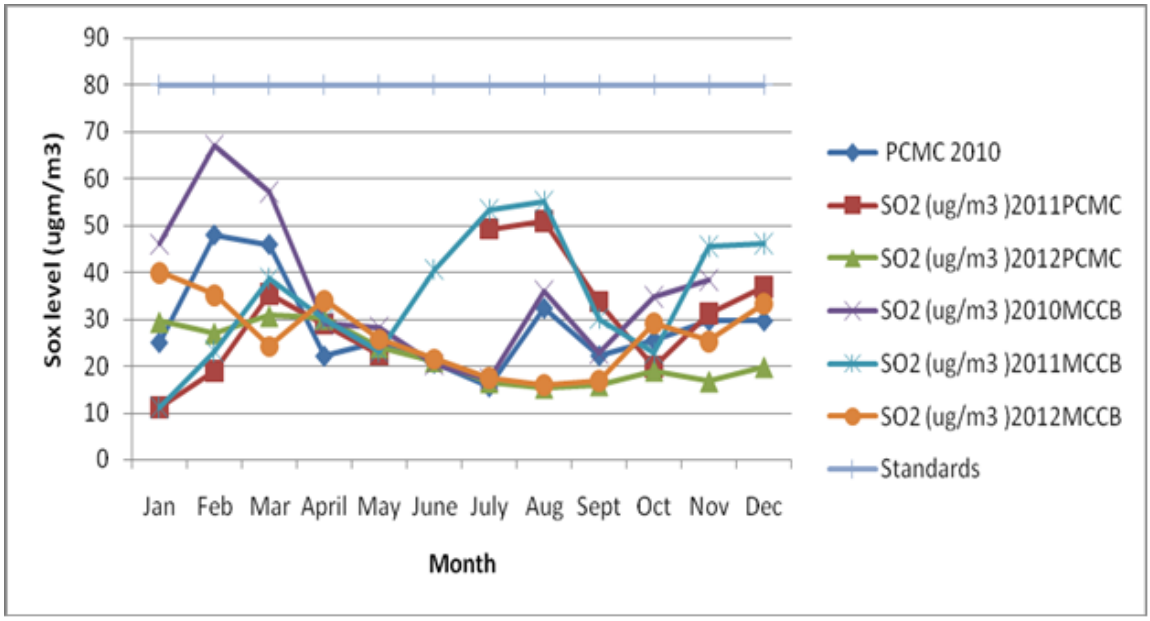


Figure 4.2 Overview of SOx level at PCMC building terrace & MCC building

Source: *MPCB, Pune*

- Concentrations of SOx varied between 15 and 40 µg/m^3. SOx concentrations for all the locations were within threshold values as per standards set by CPCB (Central Pollution Control Board).

Table 4.4 Overview of NOx level at PCMC building terrace & MCC building terrace

	PCMC 2010	MCCB 2010	PCMC 2011	MCCB 2011	PCMC 2012	MCCB 2012
Standard	**80**	**80**	**80**	**80**	**80**	**80**
Jan	48.00	46.00	76.00	74.00	62.12	59
Feb	55.38	48.75	**81.1**	60.38	62.84	52.89
Mar	45.07	37.88	72.28	44.00	63.25	46.25
April	37.38	32.89	69.52	52.22	48.23	37.11
May	31.36	22.67	49.83	33.75	33.22	24.67
June	32.38	24.80	--	47.56	26.75	24.00
July	26.35	20.56	62.65	56.33	33.24	22.75
Aug	28.89	27.88	60.33	52.56	30.24	22.67
Sept	32.84	32.33	40.56	35.43	36.09	29.56
Oct	48.04	44.33	38.81	32.78	45.04	36.78
Nov	51.42	42.75	56.96	52.56	59.70	48.00
Dec	67.19	--	66.43	64.00	64.52	56.33

Source: *MPCB, Pune.*

Note: Maratha Chamber of Commerce Building (MCCB), All values are in µg/m^3

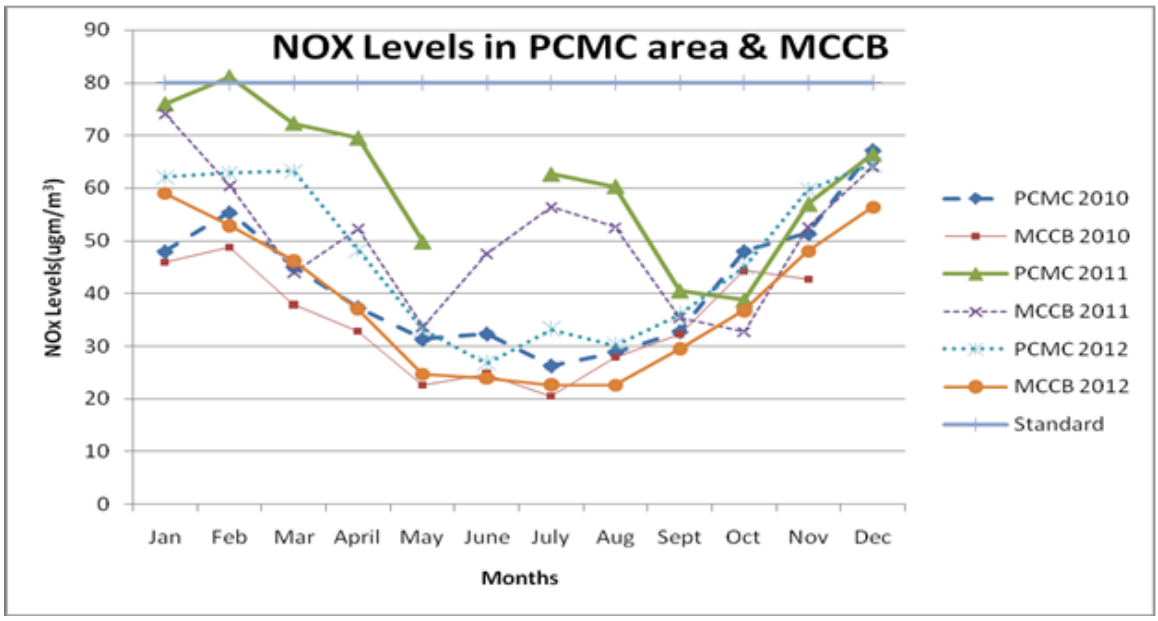


Figure 4.3 Overview of NOx level at PCMC building terrace & MCC building terrace

Source: MPCB, Pune

- Concentrations of NOx varied between 22 and 64 µg/m^3. NOx concentrations for all the locations were within threshold values as per standards set by CPCB (Central Pollution Control Board).

Table 4.5 Overview of Ambient Air Quality in Pimpri Chinchwad City for Residential, commercial and Industrial areas.

Location: Morwadi, Pimpri (Residential)
Location: Sidhivinayak Ginger Co-Operative Soc., Pimple Saudagar (Residential)
Location: Rakshak Society, Pimple Nilakh (Residential)
Location: Near Auto Line Industry Ltd., Bhosari (Industrial)

Month	Pimpri			Pimple Saudagar			Pimple Nilakh			Bhosari		
	RSPM	**SO_x**	**NOx**	**RSPM**	**SO_x**	**NOx**	**RSPM**	**SO_x**	**NOx**	**RSPM**	**SO_x**	**NOx**
Std	**100**	**80**	**80**	**100**	**80**	**80**	**100**	**80**	**80**	**100**	**80**	**80**
Nov 12	89.5	26.5	31.2	**102.5**	27.5	32.6	78.7	29.4	36.3	79	26.8	43.8
	92.7	24.2	26.4	98.48	23.2	37.3	86.9	25.6	29.8	89.3	22.5	37.2
Dec 12	**133.7**	23.4	41.9	78.13	29.7	43.9	95.6	22.8	33.2	**142.9**	29.2	52.8
	127.6	31.2	38.3	**113.6**	26.5	46.9	**104.6**	33.4	38.4	**120.5**	21.9	36.9
Jan 13	**156.8**	24.8	63.6	68.7	28.3	49	**112.6**	25.7	31.2	**168.9**	30	39.5
	122.3	33.5	54.2	**128.6**	24.3	40.3	**132.9**	31.5	40.6	**143.2**	31.7	34.6

Source: *Ultra-Tech environmental consultancy and laboratory*
Note: values in bold exceeded standards

Table 4.6 Overview of Ambient Air Quality in Pimpri Chinchwad City for Residential, commercial and Industrial areas.

Location: Krishna Nagar, Chikhli (Commercial)
Location: Awale Bandhu Estate, Moshi (Commercial)
Location: Near Pawar Stock Yard, Ravet (Commercial)
Location: Kalpataru Harmony, Wakad (Industrial cum Commercial)

Month	Chikhli			Moshi			Ravet			Wakad		
	RSPM	**SO_x**	**NOx**	**RSPM**	**SO_x**	**NOx**	**RSPM**	**SO_x**	**NOx**	**RSPM**	**SO_x**	**NOx**
Standard	**100**	**80**	**80**	**100**	**80**	**80**	**100**	**80**	**80**	**100**	**80**	**80**
Nov 12	62.9	24.6	33.5	78.4	26.5	35.6	82.4	23.5	29.0	69.4	22.2	33.21
	70.2	22.7	29.9	69.1	21.1	28.5	88.3	26.4	32.2	74.2	19.7	25.68
Dec 12	84.3	33.3	41.3	96.9	29.6	42.6	73.9	31.5	40.9	91.2	22.5	39.86
	78.2	28.5	38.1	**112.6**	23.5	31.4	83.8	22.7	36.6	**110.6**	31.4	42.56
Jan 13	92.5	35.3	46.2	71.7	33.7	53.5	91.5	32.4	42.8	99.5	28.7	38.79
	96.8	28.5	34.8	**103.8**	29.5	40.8	83.7	35.9	45.7	**132.6**	33.6	46.82

Source: *Ultra-Tech environmental consultancy and laboratory*

- Concentration of SOx and NOx varied between 19 and 36 & 25 and 63 µg/m^3 respectively. SOx and NOx concentrations for all the locations are within threshold values as per standards set by CPCB (Central Pollution Control Board).

- RSPM values increased over threshold level by 34 to 46% at Moshi, Pimpri, Wakad Pimple Nilakh and Pimple Saudagar location. (**Table 4.5**).

- RSPM, SOx and NOx values in the month of Dec 2010 and June 2011 have not been published on MPCB website (**Fig. 4.3**).

Indian Institute of Tropical Meterology (IITM) in collaboration with PCMC is carrying out the air monitoring at Sector No. 53 and Growth Lab, Bhosari in Pimpri Chinchwad area since March 2013. Two LED display boards installed at Pimpri Chowk and Chaphekar Chowk continuously exhibit the online monitoring data. The results of the same are displayed in **Figure 4.4 - 4.7 & Plate 4.2**

Plate 4.2 SAFAR Air Quality Monitoring System installed by IITM, Pune

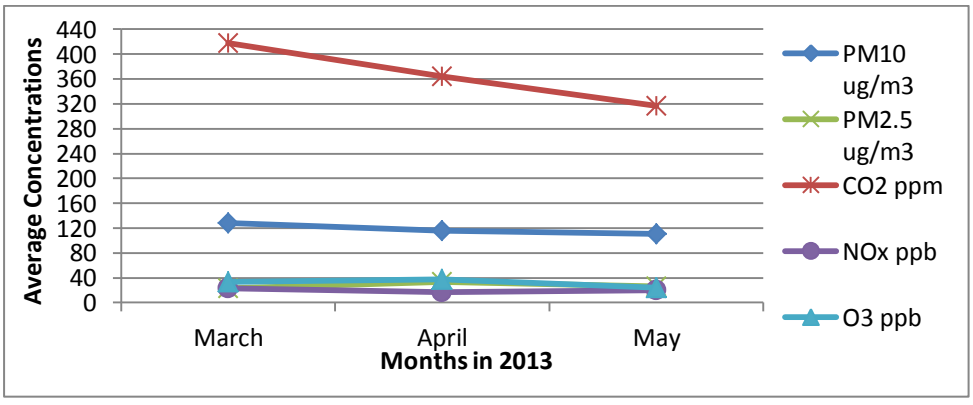


Figure 4.4 Average concentrations of selected air quality parameters measured in Bhosari

Source: *IITM, Pune*

- The concentrations of all parameters, specially CO_2,decreased gradually from March to May

- All the values, except PM10 are within desired limits (Threshold Value-100 µg/m_3 for PM_{10})

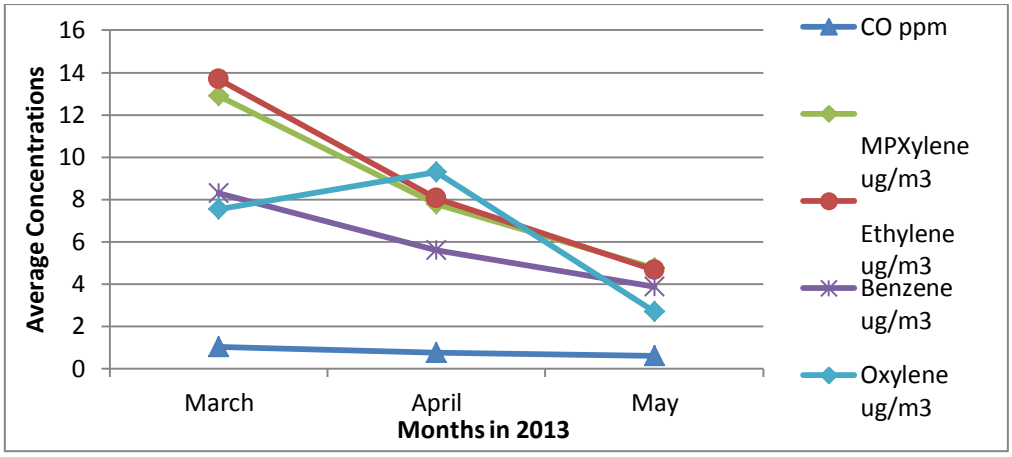


Figure 4.5 Average Concentrations of CO & VOCs parameters measured in Bhosari

Source: *IITM, Pune*

- Sizable decrease of VOC levels was noticed in May as compared to March, while CO level was marginally reduced in May.

- The concentration of benzene exceeded from the threshold value (5 µg/m^3) in March and April.

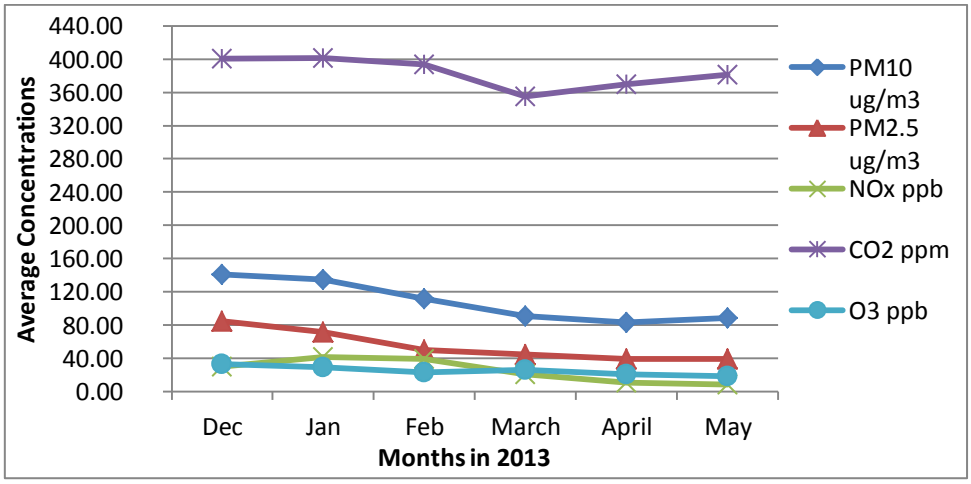


Figure 4.6 Average concentrations of selected air quality parameters measured in Nigadi

Source: *IITM, Pune*

- The concentrations of all parameters, specially PM_{10} and $PM_{2.5}$, decreased gradually from December '12 to May '13

- The values of PM10 exceeded in December, January and February from the threshold value (100 µg/m^3), other parameters were within the desired limits.

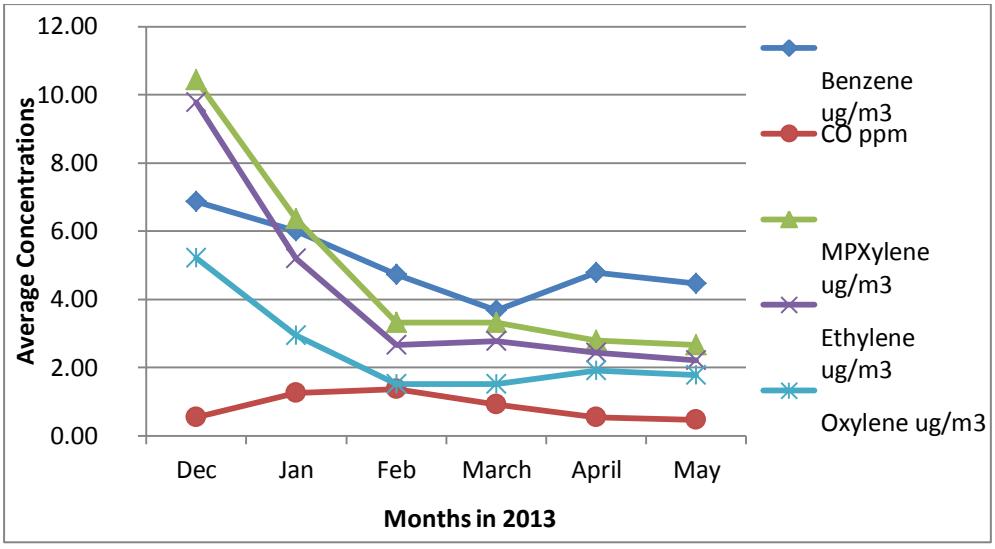


Figure 4.7 Average Concentrations of CO & VOCs parameters measured in Nigadi

Source: *IITM, Pune*

- Sizable decrease of VOC levels was recorded in May as compared to March.
- CO levels were within desired limits and varied marginally during the study.
- The values of benzene parameter were exceeded from the threshold value (5 µg/m^3) in month of Dec. 12 and Jan. 13.

4.3 Impact of Air Pollutants:

Pollutants can be classified as either primary or secondary. Usually, primary pollutants are substances directly emitted from a natural or man-made process, e.g. Nitrogen dioxide from vehicles. Secondary pollutants are formed when primary pollutants undergo chemical reactions, e.g. photochemical smog. Major air pollutants and their impacts on human health are listed in **Table 4.7.**

World Health Organization (WHO) states that **24 lakh** people all over the world die each year from causes directly attributable to air pollution, with **15 lakh** of these deaths attributable to indoor air pollution. Direct causes of air pollution related deaths include aggravated asthma, bronchitis, emphysema, lung and heart diseases, and respiratory allergies.

According to DPSIR"Air Quality" indicator is used. To minimize air pollution and its harmful effects on health, vegetation, water and soil is the objective of this indicator. Air quality is negatively affected by emissions from mobile and point sources; these are directly linked to energy consumption, environmental policy, city density and transport by motor vehicles and concentration of industries. Assessments of the impacts of air pollution are usually divided into categories such as human health, ecosystems and building materials.

Table 4.7 Major air pollutants and their associated health hazards

Name of pollutant	Source	Key health impact
(Primary pollutant)		
Respirable Suspended Particulate Matter (RSPM)	Volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Burning of fossil fuels in vehicles, power plants and various industrial processes.	Respiratory illness, chronic bronchitis, Asthma, heart diseases
Oxides of Sulphur (Sox)	Volcanoes, industrial processes, coal and petroleum acid rain	Heart diseases, respiratory problems including pulmonary emphysema, cancer, eye burning, headache
Oxides of Nitrogen (NOx)	High temperature combustion.	Lung irritation, viral infection, airway resistance, chest tightness
Suspended Particulate Matter (SPM)	Volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Burning of fossil fuels in vehicles, power plants and various industrial processes.	Pneumoconiosis, restrictive lung diseases, asthma, cancer
VOCs	Solvent and hydrocarbon	Immuno-toxicity, carcinogenicity, asthma, anemia, unconsciousness
(Secondary pollutant)		
Ozone	NOx and VOCs	Impaired lung function, chest pains, coughing, and irritation of eyes.
CO	Incomplete combustion of natural gas, coal or wood Vehicular exhaust.	Unconsciousness, death by asphyxiation.

According to DPSIR, "Emissions of acidifying substances" indicator is used. The objective of this indicator is to reduce emissions from stationary and mobile sources to meet requests of air quality standards. Sulphur dioxide (SO2), nitrogen oxides (NOx) and ammonia are examples of acidifying substance that are emitted into the air. Emissions from stationary and mobile sources place pressures on the air quality in a city. SOx, NOx and ammonia lead to acid rain and to changes in the chemical composition of soil and surface water after they are deposited. In addition, they affect flora and fauna.

5. Noise Environment

5.1 Background

Noise pollution is one of the major environmental pollutants that are encountered in daily life and has direct effects on human performance. The noise level, if increased, can have certain implications on the human body as mentioned in **Table 5.1**. Noise is measured by noise meter and expressed in units of decibel dB(A)Leq. Internationally accepted method was used for noise measurement. Studies were conducted in the PCMC area (Plate 5.1: A and B) to study the existing status of noise levels (**Table 5.2)** by recording the noise intensity at various locations (Residential, Commercial, Industrial & Silence Zones) during day and night time.

A: Manghnmal Commerce College

B: Pimple Gurav Bus depot

Plate 5.1 (A and B): Noise monitoring at Silence and Commercial zones

Table 5.1 Impact of Noise levels on human body

Sr .No	Noise levels in dB	Health Hazards
1	80	Annoying
2	90	Hearing Damage
3	95	Very annoying
4	110	Stimulation of skin
5	120	Pain Threshold
6	130-135	Dizziness, Vomiting
7	140	Pain in ear
8	150	Significant change in heart pulse rate

5.2 Noise monitoring in PCMC area

Table 5.2 Noise levels at different zones in PCMC Area (Values are mean of 7 consecutive days)

Sr.No	Monitoring stations	Day	Night
	A. Residential Zone *(CPCB Standards:Day:55,night 45 dB(A)Leq)*		
1	Mayur Nagari-Pimple Gurav	**63.41**	44.5
2	Bhiravnath Nagar-Pimple Gurav	**65.54**	44.27
3	Kokane Chowk- Pimple Saudager	**69.57**	**45.78**
4	Kate Mala- Pimple Saudager	**67.83**	44.62
5	Navale Vasti,Talwade	50.69	43.98
6	Near Temple, Aalandi	**67.41**	**47.17**
7	Krishna Nagar-Chikhli	**66.00**	44.55
8	Awale Bandhu Estate-Moshi	**59.61**	44.55
9	Rakshak Sociey,Pimple Nilakh	**64.57**	43.22
10	Shastri Nagar.Pimple	**65.58**	44.15
	B. Commercial Zone *(CPCB Standards:Day:65,night 55 dB(A)Leq)*		
1	Sahal Kendra (Garden)- Bhosari	64.21	52.00
2	Bank of Maharashtra-Pimple Gurav	**66.9**	53.11
3	Khandoba Mandir (Bhalekar Nagar)- Pimple Gurav	**72.02**	54.82
4	Lakshadweep Plaza- Pimple Saudager	**66.48**	52.54
5	Rainbow Plaza- Pimple Saudager	**69.07**	53.47
6	PMC Health Clinic Road- Aakurdi	**66.46**	53.54
7	Koyna Nagar-Chikhli	**68.44**	53.44
8	Kai.Madhukar Pawle Bridge	**73.44**	54.75
9	Sambhaji Raje Chowk,Tahtwade	**73.58**	52.94
10	Bhujbal Chowk	**68.84**	52.97
	C. *Silence zone (CPCB Standards:Day:50,night 40dB(A)Leq)*		
1	Nav Maharashtra Vidyalaya, Pimpri Gaon Pimple Nilakh	**59.07**	**45.58**
2	Chetna Hospital-Chinchwad	**64.85**	**48.21**
3	Lande wadi School,Bhosari	**57.20**	**45.44**
4	Jai Hind High School,Pimpri	**66.47**	**52.27**
5	4 no. School,Aalandi	**60.47**	**46.98**
6	Pimpri Court	**64.4**	**49.11**
7	Mrs. Shewantabai Sahadu Kashid Dawakhana-Pimple Gurav	**65.92**	**51.2**
8	Pimpri Chinchwad Prathamic Vidyalay-Pimple Gurav	**65.57**	**54.3**
9	Sudarshan Hospital-Pimple Gurav	**67.15**	**52.41**
10	Healing Touch Hospital-Pimple Nilakh	**72.47**	**52.92**
	D. Industrial zone *(CPCB Standards:Day:75,night 70dB(A)Leq)*		
1	Badve Autocomps-Chakan	**75.65**	59.24
2	Sahal Kendra- Bhosari	69.97	63.21
3	Ashtech,Bhosari	**75.16**	62.88
4	Sunny Enterprises,-Bhosari	67.34	61.4
5	Bhosari Chowk	75	60.9
6	Bajaj Auto-Near Pune Mumbai Highway	71.91	66.1
7	Suzlon Industry	69.3	59.45
8	Auto Line Industry. Ltd.-Bhosari.	69.51	63.15
9	Maratha Chamber of commerce Building terrace, Bhosari	**76.67**	58.44
10	MSEDCL ,Bhosari	68.4	58.92

Source: Ultra-Tech Environmental Consultancy & Laboratory

*Day:6.00a.m to 10.00p.m. & night 10.00 p.m. to 6.00a.m, Values in bold exceed CPCB standard

- According to monitoring data, during 90% of all incidences noise levels in the r***esidential area*** **increased from 8 to 26% over the prescribed standards during day time**, however, only on 20% occasions the values were increased by 2 to 5% during night time. Increased noise levels during day time attributed to consistent human activities, music shops and vehicular movement.

- In the ***commercial area*** there was **an increase of 3 to 14% in the noise levels on 90% occasions over the standard during day time**, while at night time the same were within the desired limits. The buzzling human activities and traffic congestion contributed to higher noise levels during day time.

- The ***silence zone*** also **showed an increase from 3 to14% during day time** and 14% to 35% at night time over the prescribed limits on all the occasions.

- In ***Industrial area,*** the noise levels increased from 1 to 3% during the day time on 30% occasions. The same during night time were well within the prescribed limit. The noise levels were measured in industrial areas where there was not much sound generated due to specific activities. Accordingly the noise levels were within the desired limits.

Objective of DPSIR indicator for 'Noise' is that no one should be exposed to noise levels that endanger health or decrease the quality of life. Noise is an intense factor affecting human health both physiologically and psychologically. In large urban agglomerations, the effect of noise is further aggravated by high concentrations of people living together.

6. SOLID WASTE

6.1 Background

Municipal Solid Waste includes commercial and residential wastes generated in a municipal or notified area in either solid or semi-solid form excluding industrial hazardous wastes but including treated biomedical wastes.

PCMC is responsible for the proper and scientific collection, segregation, and disposal of municipal solid waste within the limits of its jurisdiction, in compliance with:

1. Government of India Municipal Solid Waste (Management and Handling) Rules 2000.
2. Maharashtra Non-biodegradable Garbage Control Act, 2006.
3. Maharashtra Government Resolution no. Gha. Ka. Vya.1001/ Pra. Kra 546/ Papu-22 dated 5 January 2002 to municipalities concerning waste-pickers and allotting them the works of picking wastes and garbage from houses, shops and market places.
4. The E-waste (Management and Handling) Rules, 2011.

6.2 Waste Characterisation

6.2.1 Quantitative

The Health and Environment Departments of PCMC are looking after the functioning related to solid waste management in Pimpri Chinchwad. PCMC area is generating approximately 646 Metric Tons per Day (MTD) solid waste as given in **Table 6.1**. While National Building Code (NBC) estimates average per capita per day generation of solid waste as 400 gm, the same generated in PCMC area is 350 gm.

Total quantity of waste generation varies seasonally and is affected by several factors. These include moisture content (higher during monsoon), garden waste proportion (higher during leaf fall), materials used during events (wedding, festival seasons) etc.

Most of the generated solid waste comes from household activities followed by commercial area and hotels **(Table 6.2)**. Thus, for minimizing the overall waste, these areas should be targeted.

Table 6.1 Overview of Solid Waste

Population of PCMC area (2011)	17.29 lakh		
Area of dumping site	81 Acre		
Total waste generation	646 MTD		
Per capita generation	350 gm (NBC criteria 400 gm)		
Total waste collection	646 MTD		
Waste dumped	646 MTD		
Mode of treatment of solid waste	Vermi Compost Capacity: 30 MTD Treated: 12-15 MTD	Plastic Fuel Plant Capacity: 5 MTD Treated: 1.5 MTD	Mechanized Compost Capacity: 500 MTD Treated: 250-300 MTD
Staff for Solid Waste Management	2798 nos.		
No. of vehicles used for disposal of Solid waste to facilities	Primary: 362 Secondary: 66		

Source: *Solid Waste Management Department, PCMC.*

Table 6.2 Sector-wise generation of solid waste

Sector	**Sector wise Generation in percentage**			
	A Ward	**B Ward**	**C Ward**	**D Ward**
Vegetable Market	2.04	3.04	3.65	4.04
Household	84.24	82.04	82.11	86.59
Commercial	2.48	3.12	3.55	2.45
Hotel & Restaurant	10.12	10.39	10.69	6.92
Slaughter house waste	--	1.41	--	--

Source: *Health and Environment Department, PCMC.*

'Solid Waste Recycling Rate' is the DPSIR indicator which deals with recycling and reducing the amount of the wastes contaminated in landfills. Recycling means an efficient use of material and a decrease in pressures to the environment. If left unsegregated, the waste rots and generates environmentally hazardous gases under the conditions of compact landfills. The recycling categories may be: (a) paper, (b) glass, (c) aluminum (d) plastic and (e) mixed disposed. Objective of this indicator is, to increase the percentage of segregated and recycled waste. If the amount (in tonnes or m3) of waste fraction (paper, glass, aluminum, plastic and mixed waste) is known, the result can be showed as a percentage of waste.

6.2.2 Qualitative

There are different types of solid wastes depending on their sources. The characteristics of generated garbage are dependent on the type of activities prevalent in that area. Thus, the waste generated from residential area contains high moisture and organic matter, while office-dominated areas produce dry wastes.

Usually, the wet waste consists of biodegradable matter coming from the kitchen. Dry waste consists of recyclable materials like paper, rubber, glass, ferrous-nonferrous metals, cardboard etc., which are estimated to be 40 and 60% in the residential and commercial areas respectively **(Table 6.3).** Detailed characteristics of untreated (**Plate 6.1**) and composted biodegradable wastes (**Plate 6.2**) collected from PCMC area are shown in **Table 6.4**.

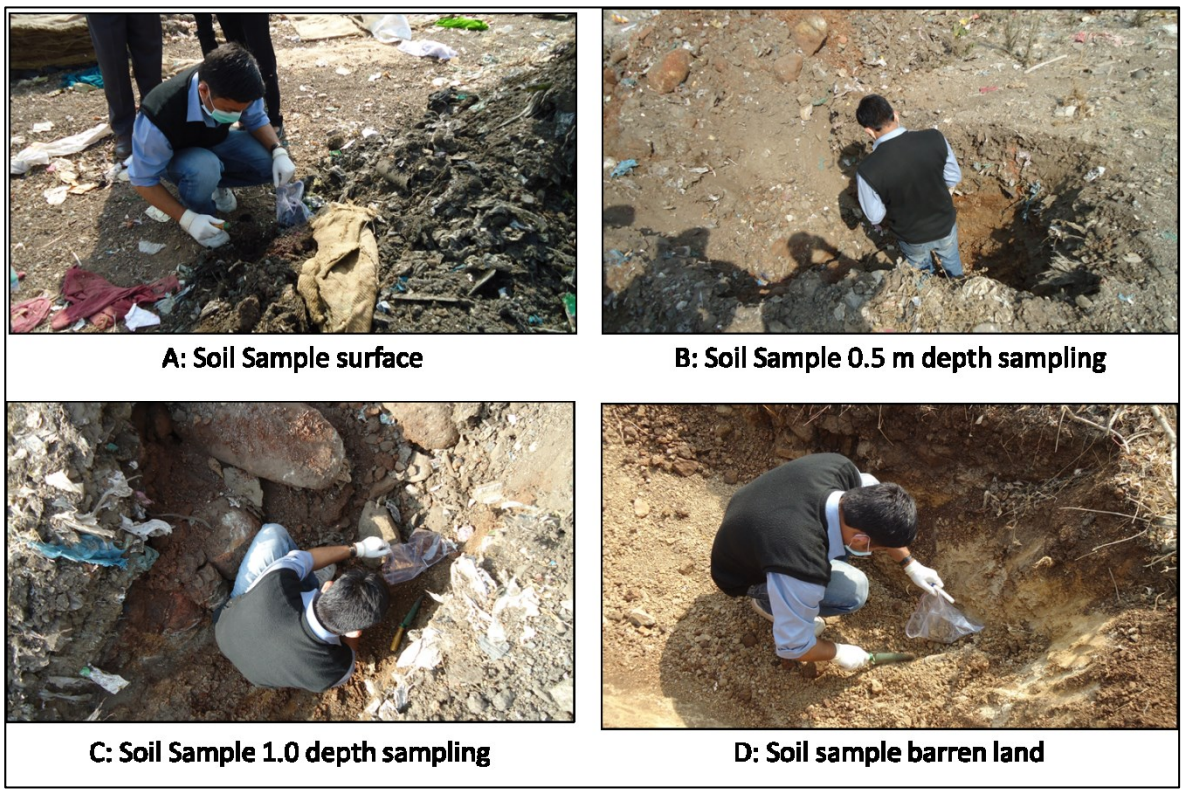


Plate 6.1 Soil Sampling at dumping (A to C) and barren (D) sites

A: Moshi Kachara Depo.-Solid Waste Sampling

B: Moshi Kachara Depo.-Crushing Solid Waste

Plate 6.2 (A and B): Solid waste sampling location in PCMC area

A: Moshi Kachara Depo.-Untreated Leachate

B: Moshi Kachara Depo.-Treated Leachate

Plate 6.3 (A and B): Leachate sampling at Moshi site.

Table 6.3 Percentage wise distribution of municipal solid waste

Sr. No.	Component	Percentage
1.	Food waste	62.9
2.	Garden waste	18.65
2.	Paper	1.85
3.	Plastic & Rubber	1.23
4.	Glass	0.001
5.	Metal	0.01
6.	Wood	0.04
7.	Miscellaneous (textile, dirt, bricks, stones)	15.33
	TOTAL	**100**

Source: *PCMC Website*

'Waste Production' is a DPSIR indicator. The objective is to reduce the amount of waste for disposal. Waste production increases annually due to population growth, non-sustainable lifestyles. 'Waste Production' is calculated by the amount of waste generated per capita and the total number of inhabitants.

'Recycling' is a DPSIR indicator used to measure the amount of percentage of recycled waste fractions. Wastes are substances or products that are a result of consumption and are designed for either final disposal (for instance, as domestic garbage to landfill) or recycling. Recycling involves using the same material more than once; therefore, recycling saves resources and reduces contamination. Pollution from contaminated wastes may affect the quality of drinking water and the level of air pollution; human health may be impacted in turns.

Table 6.4 Physico-chemical characteristics of Biodegradable MSW, compost and sub soil of compost plant in PCMC area (Jan 2013)

#	Parameter	MSW	Compost (10-20 days)	Control Soil(0.2 to 1.2 m depth)	Soils at depths in pits (m)								
					Pit 1			Pit 2			Pit 3		
					0.2	0.7	1.2	0.2	0.7	1.2	0.2	0.7	1.2
1	pH	8.20	8.54	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	Colour	Black		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3	Conductivity (µmhos/cm)	980	1200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4	Chlorides (mg/kg)	216	308	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5	Sulphates (mg/kg)	74	88	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6	Moisture content at 108°C (%)	38.2	22.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7	Total organic carbon (%)	30.3	16.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8	Phosphorous (mg/kg)	38	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
9	Iron (%)	1.5	2.2	2.0	2.3	2.8	3.1	2	2.5	2.9	2.6	2.8	3.4
10	Manganese (mg/kg)	32	67	2	15	21	28	11	15	18	24	32	38
11	Calcium (mg/kg)	486	514	542	584	624	680	61	638	694	586	624	688
12	Magnesium (mg/kg)	234	288	218	246	288	324	312	340	386	248	308	326
13	Total Nitrogen (%)	1.10	1.50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14	Sodium (mg/kg)	60.0	72.0	15.0	64.2	68.4	72.3	60.5	72.4	75.6	65.3	69.4	72.8
15	Potassium (mg/kg)	54.0	57.2	11.0	55.4	58.6	62.0	56.2	58.4	60.2	54.3	59.4	62.1

16	Nickel (mg/kg)	12.5	14.6	5.8	22.6	20.4	18.2	27.6	23.4	21.2	24.5	21.5	18.9
17	Zinc (mg/kg)	80.2	88.5	12	21.2	24.6	28.5	22.4	27.5	30.6	25.4	29.6	32.8
18	Cadmium (mg/kg)	1.0	1.4	BDL	0.7	0.5	0.5	0.8	0.6	0.4	0.8	0.6	0.2
19	Cobalt (mg/kg)	10.4	12.8	2.4	8.2	6.8	5.4	9.2	8.1	5.8	9.4	8.9	6.2
20	Lead (mg/kg)	12.7	13.8	BDL	9.1	8.7	6.8	9.4	8.5	6.3	10.3	9.6	8.2
21	Copper (mg/kg)	NA	NA	0.5	3.7	6.4	6.8	4.2	6.2	7.3	4.5	6.8	7.0
22	Chromium (mg/kg)	NA	NA	BDL	4.5	3.5	3.2	5.8	5.2	5.0	4.9	4.6	4.4

Source: *Ultra-Techenvironmental consultancy and laboratory*

Note: All values are based on dry weight basis, BDL: Below Detectable Limit,
NA: Not Applicable

- Different ionic concentrations including heavy metals were substantially increased (5.7 – 109%) in compost sample over biodegradable MSW.

- **Surface soil, below the compost at dumping site acquired higher concentrations (15 – 800 %) of different pollutants from those of control soil.**

- **Leachability rates of certain pollutants viz. Na, K, Zn, Cu, Mn, Mg were remarkably high (7 – 83%) from surface soil to a level up to 1.2 m downward.** However a reverse trend was observed exhibiting poor leachability rate of the metals Co, Cr, Pb & Ni was observed, where the concentration were more (11 – 75%) at surface soils then those at soils below 1.2 m deep. Further the levels of Ca and Fe were apparently same in all the three vertical layers of soils.

6.3 Waste management

6.3.1 Segregation

Due to municipal efforts, segregation of waste has started at the most convenient point, namely the household. Currently it is limited to a few numbers of households, but soon will be extended to large areas. Municipality is looking forward to providing dustbins for segregation of waste at source under JnNURM. Residents segregate dry and wet waste along with recyclable materials like glass and metal at household level.

PCMC area generates about 646 MTD of solid waste. Presently, Bharat Vikas Group Kshitij Waste Management Services Pvt. Ltd. in B and C ward are undertaking door to door garbage collection. Subsequently, PCMC entrusted this activity to 3 NGOs, viz. Sant Gadge Maharaj & Ramabai Swayamrojgar Seva Sanstha for ward A, and Mahalaxmi Swayam Rojgar Seva Saha Sanstha for ward D. Accordingly PCMC standing committee approved Rs75 lakhs for Ward A and Rs 89 lakhs for Ward D for a period of six months.

Zero Garbage ward initiative

Zero Garbage ward is a concept wherein maximum municipal solid waste generated within the ward is supposed to be treated there itself and minimal residue to be sent out for scientific dumping. It is an ethical, economical and efficient goal to guide people in changing their lifestyles and practices to emulate sustainable natural cycles, where all discarded materials are designed to become resources for others to use. This needs designing and managing products & processes so as to systematically avoid and eliminate the volume & toxicity of wastes and materials, conserve and recover all resources. Under Zero Garbage ward scheme, PCMC provides proper systems for house to house collection, segregated transportation, treatment and disposal of garbage by means of various methods within the ward. Janwani will act as a facilitator for this project in cooperation with SWaCH. PCMC is further planning to expand the project in more wards in future.

In response to Maharaashtra Non-biodegradable Garbage Ordinance, 2006, Pimpri Chinchwad municipal corporation has banned manufacturing, stocking, distribution or selling and use of carrybags (made from virgin or recycled plastic) having thickness less than 50 micron in its jurisdiction. PCMC Ward officers and Health Executive Officers are looking after the implementation of the above said ordinance. This will have a positive impact on reducing proportion of plastic waste in MSW.

6.3.2 Collection

The PCMC has also introduced a "Ghanta-Gadi" (Belled Waste Carriage) to collect waste from households. The housewives preferred this arrangement, as it does not involve any cost, whereas, disposal of waste through rag pickers meant an expense of Rs. 10 every month per household.

Roadside dustbins have been placed in the city for primary collection of the waste at a distance 80-100m. People find this distance reasonable. A sizable portion of such waste is collected by designated PCMC representatives.

PCMC has setup ramps at various locations in the city. The solid waste from each collection point is brought to these ramps by dumper placers and other small collection vehicle (**Table 6.5**), it is further transformed in compactors and then the waste is moved to Moshi landfill site.

Table 6.5 Municipal solid waste collection vehicles

Sr.No.	Type of Vehicle	Total
1	Compactor	31
2	Dumper Placer	20
3	TATA ACE	302
4	Rikshaw Hopper	60
5	TATA 407	1
6	TATA 709	5
7	Open Truck	4

Source: *Health Dept., PCMC.*

6.3.3 Transportation

Waste is transported from the collection points to the landfill site every day. The corporation has engaged 250 personnel to transport collected waste using municipal vehicles. In addition to this, private contractors have also been engaged for this purpose. The waste is transported to various treatment facilities and projects for treatment at Moshi.

6.3.4 Disposal

The corporation uses various treatment facilities and landfill site near Moshi to dispose the collected waste.

6.3.4.1 Rag-pickers

A parallel system of rag-pickers helps in recycling of valuable waste material at source as well as at the disposal level. In search of more valuable waste such as better quality plastic, the rag-pickers used to shove their hands and feet in the waste, exposing themselves to the stink and to the skin diseases. Under the programme of waste segregation and collection from households, this health hazard has been reduced significantly. Under the new arrangement, the work of the rag-pickers has become more organized, reducing their hardship. Owing to identity cards issued by the PCMC, the suspicion about the rag-pickers has been drastically declined, leading to a better social status.

Rag pickers are the bottom rung in the waste trade ladder and are often neglected. Generally they are not known to public and their role is unnoticed by the society. They are negating carbon footprint by collecting, segregating and recycling the MSW. Approx. 30 tonne of dry waste is collected by around 1100 rag pickers in PCMC.

The school board of PCMC, along with the NGOs, World Wide Fund for Nature (WWF) and the Abhiyan Foundation, has launched a project to collect plastic and paper wastes from municipal schools in the area. The Abhiyan Foundation, which works for the welfare of rag pickers, has selected 16 children who are being benefited from the project. The children visit all 116 PCMC primary schools from where they collect plastic and paper wastes in sacks at least once a week. While the plastic wastes are being taken to a recycling

unit at the PCMC's Moshi garbage depot, the paper waste is handed over to paper industries. The Abhiyan Foundation is making arrangements for the transportation of the waste to recycling centres. Through this process all the earnings are credited to the rag pickers.

Rag picker's health is on high risk as they directly get exposed to deacayingand other hazardous wastes including all kinds of noxious gases. There are many rag pickers who do not have any idea of protection and they go barefoot and work without gloves. Even if become sick, they are not realized the reason behind the diseases.

6.3.4.2 Land filing

Landfilling is the most common practice in many countries that involve burying the waste. It is comparatively inexpensive technique of waste disposal that avoids serious threat to community health represented by open dumping. A sanitary landfill is more hygienic and built in a methodical manner. The sanitary landfills are lined with materials that are impermeable such as HDP liners. Waste deposited in sanitary landfills is normally compacted to increase its density and stability.

In landfill, the organic waste undergoes natural decomposition and generates a fluid, which is known as leachate, and is very harmful to the ecosystem. PCMC treats the leachate produced from the landfills and the results are shown in **Table 6.6**

PCMC staff is maintaining sanitary landfill at the Moshi site. Two phases of sanitary landfill namely Phase I and Phase II. Phase I is completed and Phase II is in planning stagein an area of 5.14 and 3.10 ha respectively.

Table 6.6 Characteristics of leachates generated from Moshi landfill site as well as mechanical composting

Sr no.	Parameters		Concentration	
		MSW Standard MSW (M&H) 2000 Standard	Untreated leachate	Treated leachate
1	pH	5.5	8.9	9.3
2	COD (mg/l)	-	23200	3840
3	BOD, at 27^{o}C, 3 days (mg/l)	100	6960	1100
4	TSS (mg/l)	200	2584	1272
5	Total dissolved solids (mg/l)	2100	2926	1854
6	Chloride (mg/l)	600	4448	2524

Source: *ULTRA-TECH consultancy and laboratory (January 2013)*

Note: Characteristics of processed lechate are presently higher than MSW Standards. However, PCMC has undertaken a project to further treat the lechate chemically and biologically.

- The treated leachate showed substantial decrease in COD and BOD by 83.4 and 84.2% respectively, whereas, moderate reductions were observed in characters like TSS (50.8%), TDS (36.6%) and chlorides (43.2%). The pH of treated leachate increased from 8.9 to 9.3.

- Higher levels of pollutants in treated leachate need further treatment before discharging it into open land/surface water.

6.3.4.3 Composting

Decomposition and stabilization of organic matter under controlled condition is known as composting. Organic waste materials are recycled using biological composting and digestion processes. In composting, micro-organisms, mainly fungi and bacteria, convert degradable organic waste into humus like substance. The resulting organic material is then used for agricultural or landscaping purposes. It increases the soil's ability to hold water and makes the soil easier to cultivate.

At the Moshi landfill site, a mechanical composting unit is operational in the area of 6.48 ha. The mechanical compost unit, having the capacity to treat 500 MTD of waste, presently treats 250-330 MTD of solid waste.

6.3.4.4 Vermi-compost

Vermi-composting is a successful waste disposal technique followed at community level. In order to address the organic waste management in the city, PCMC called for a meeting. The meeting addressed to solve the overall problem of the City's Waste Management was attended by NGOs and other agencies. Vermicomposting plant having the capacity of 30 MTD is operational at the Moshi site in an area of 2.02 ha. Presently, the plant treats 12-15 MTD of collected wasteas well as the STP sludge.

6.4 Biomedical waste management

The Biomedical Waste Act 1998 defines medical waste as “Any solid waste that is generated in the diagnosis, treatment or immunization of human beings or animals in research pertaining to, or in the production or testing of biological”.

Biomedical waste (Management and Handling) Rules 1998 makes it mandatory to all hospitals and dispensaries to segregate the biomedical waste from other solid waste and to set up an effective collection, treatment and disposal infrastructure for managing the waste.

With a view to provide a major facility for hospital waste management, the PCMC has installed a central incineration plant at Yashawantrao Chavhan Municipal Hospital (Y.C.M.H.) in an area of 2266 sq. ft. The objectives of the initiative are:

a) Segregation of hospital waste generated at the city's hospitals.

b) Disposal of hospital waste through the PCMC incineration plant.

The Nursing Homes collect the infectious and non-infectious hospital wastes in separate colour code containers. The waste is segregated & collected in yellow and red bags from 216 collection points from where it is transported to YCMH and incinerated by Passco Environmental Solutions Pvt. Ltd. on behalf of PCMC. Everyday 950-1050 kg of Biomedical Waste is collected from 358 nursing homes, 55 pathological laboratories, 2 blood banks and 676 clinics in the city. A new incinerator site (40,000 sq ft) is proposed at Moshi Kachara Depot.

Following disposal methods are used at the Biomedical Waste treatment facility

- Incineration ash – Hazardous facility Maharashtra Enviro Power Ltd., Ranjangaon
- Treated solid waste – Municipal landfill
- Plastic waste after disinfection and shredding – recycling or municipal landfill
- Sharps, after disinfection (if encapsulated) – Municipal Landfill or Recycling
- Treated wastewater – Sewer/drain or recycling
- Oil & grease – incineration.

The PCMC has asked the Nursing Homes to segregate and dispose-off the waste in the following way:

1. Infectious waste (dissected parts of human body, placenta, infectious blood, infectious water drawn out of the body, infectious saliva, swab, dressing material etc.) must be incinerated. Such waste must not be dumped in the municipal garbage containers.
2. Recyclable waste (used saline bottles, saline bags, plastic boxes, paper boxes, plastic syringes) is collected in Black-coloured containers, and is handed to rag pickers bearing identity cards issued by the PCMC. Such waste is not dumped in the municipal garbage bins or in the containers which are meant for infectious waste. The nursing homes are free to dispose-off the recyclable waste independent of rag pickers
3. Other waste (food, vegetable peels) is collected in Yellow-coloured containers, and is dumped in the municipal garbage bins.
4. Used and discarded injection needles are cut and sterilized by the Nursing Homes. They or any other metallic articles are not accepted for incineration. The senior medical officers of the PCMC supervise whether the Nursing Homes are following the above pattern of waste management, and whether the rag pickers are collecting the waste regularly.

The PCMC has also initiated and maintained an effective dialogue with the professional organization of the doctors in the city. The central incineration plant at YCMH has been installed by Thermax India Pt. Ltd. The plant also provides training and guides the municipal staff, in addition to its responsibility for maintenance of the plant for a period of five years.

6.5 E-waste management

E-waste means waste electrical and electronic equipment, whole or in part or rejects from their manufacturing and repair process, which are intended to be discarded.

The E-waste (Management and Handling) Rules, 2011 makes it mandatory to all electronic waste sources to segregate the e-waste from other solid waste and set up an effective sorting, dismantling, and recovery of valuable material and disposal infrastructure for managing the waste.

There's a need to dispose e-waste responsibly in Pimpri-Chinchwad. The Pimpri Chinchwad along with Pune is the second highest generator of e-waste after Mumbai in Maharashtra. The state is the highest generator of e-waste in the country, pilling up 20,000 tonnes of e-waste every year. The IT companies of Pune and PCMC at Hinjewadi and other areas contribute to the generation of e-waste.

The 2007 MPCB-PCMC joint study calculated e-waste generation from the Pimpri Chinchwad and Pune as 1,032 tonnes and 2,584 tonnes, respectively. Experts believe that e-waste is growing at a rate of 15% per year across India. In future, PCMC is planning to scientifically treat the E-waste generated in the city.

6.6 Waste to Energy

PCMC is one of the leading municipalities in India that produces hydrocarbon fuel from plastic, collected from MSW at Moshi Kachara Depot. The city based Bharat Vikas Group Waste Management Ltd. (BVG) has developed a technological process for producing fuel from all types of plastic wastes. While the plant has a capacity to treat 5 MT of plastic waste per day, presently it treats 1.5 MT each day. Depending on the quality of plastic, the plant is capable of producing 600-700 litre of hydrocarbon fuel from 1 MT of waste plastic. Although Liquefied Petroleum Gas (LPG) is also being produced in the plant, presently it is not tapped. Between February 2009 and February 2013 the waste to fuel plant has produced 74,361 litre of furnace oil. This particular waste to fuel plant is of extreme importance towards finding the solution to the ever-worsening problem of plastic waste.

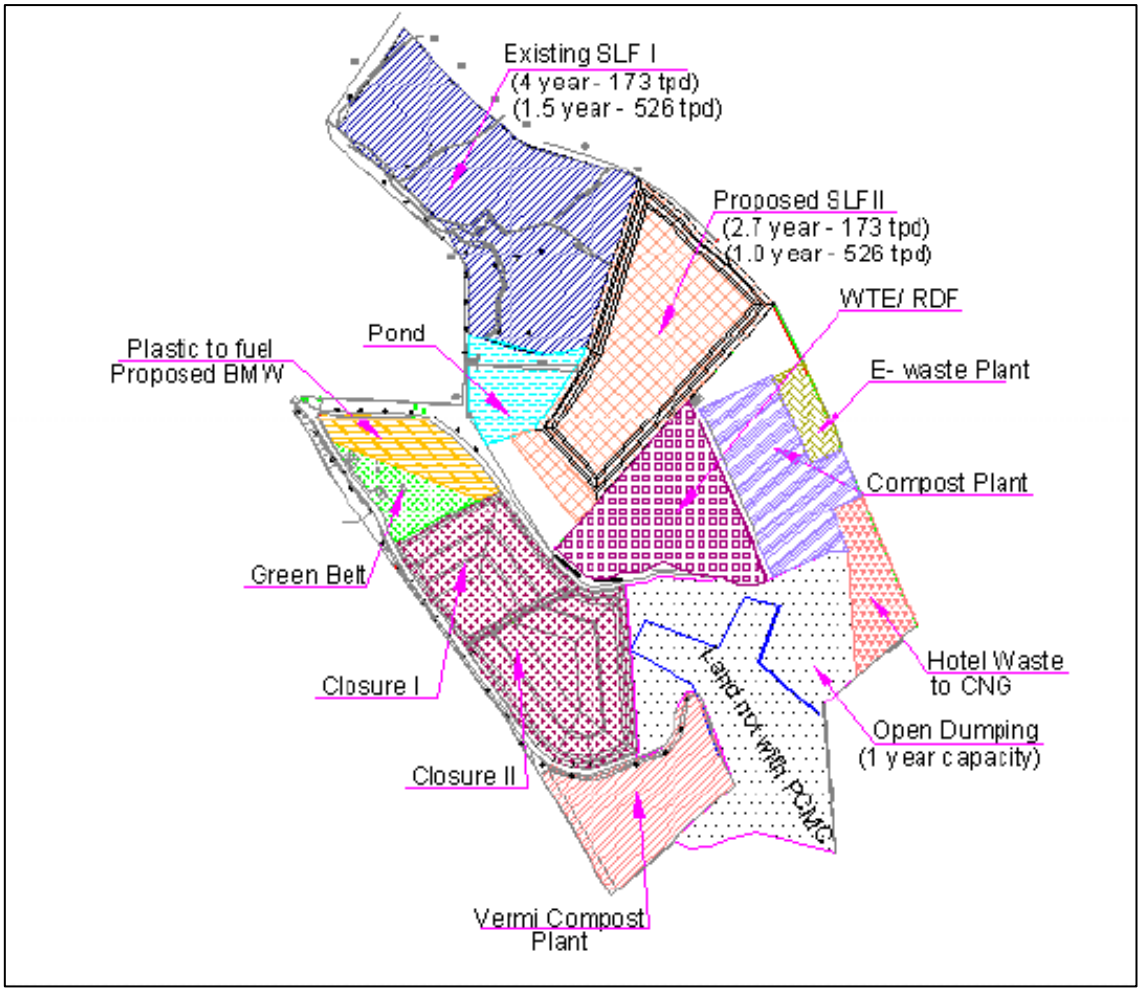


Figure 6.1 PCMC Landfill site at Moshi

7. Biodiversity

7.1 Terrestrial

7.1.1 Garden

Pimpri Chinchwad city has 154 gardens with a total area of 142.93 ha. The Garden Department of PCMC works towards maintaining and increasing the open and green spaces of the city. Additionally, 24 new gardens are proposed to be supplemented within the city. This Garden department has also undertaken road beautification and 45 km road side plantation projects on various roads and additional 26 km of avenue plantation or median beautification is under construction. The Garden department is also responsible for the plantation on no-development zones.

The location, area and quality of green spaces in urban centres influence the quality of urban environment for residents. Urban green spaces are significant for enrichment of biodiversity; these green spaces offer recreational opportunities and contribute to the city aesthetics. Some specialized and popular gardens in the city; such as, Bahinabai Choudhari Zoo, Bird Valley, Rajershi Shahu Udyan, Bhakti Shakti Udyan, Thergaon Boat Club, Bhosari Tourism Centre, Durgadevi Park, Veer Sawarkar Udyan and Nana Nani park are some of the ornamental assets of the city. Brief outlines of selected water/land based parks/gardens are delineated hereunder.

Veer Sawarkar Garden (Ganesh Lake)

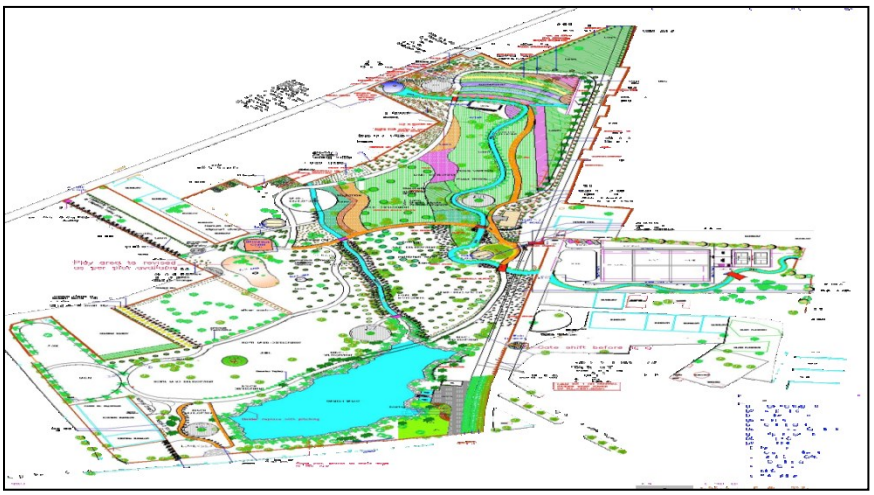


Plate 7.1 LAyout of Veer Sawarkar Garden (Ganesh Lake)

Ganesh Lake, situated in Sector 26 of Nigdi Pradhikaran, is an emerging picnic spot in Pimpri Chinchwad. Recently, PCMC carried out beautification work of the lake as well as its surroundings and opened it for the public. Developed on a turnkey basis, the garden, known as Veer Savarkar Udyan, is spread over 7.65ha. A Japanese garden has been developed on the open land that comprises a waterfall, seating arrangements for senior citizens, play area for children and a pavilion for tourists.

Small zones of different varieties of common and rare plants, viz. cactus and jasmine would be developed and trees to be planted for attracting birds to this garden.

Primarily, the Ganesh lake was used for immersing Ganesh idols during the Ganesh festivals. Subsequently PCMC constructed two permanent tanks in recent years for immersion of Ganesh idols. The residents of Pradhikaran were keen to develop Ganesh lake as a beautiful spot for which Pradhikaran's Senior Citizens' Club members kept following up the project. The Ganesh lake has always been famous for the rare birds that congregate around it. A few years ago, it was a favourite spot for bird watchers. The surrounding residents are protecting the lake.

Bird Valley Park

The Bird Valley Park, developed by the PCMC in Chinchwad, displays a large lake with boating facilities, also a jogging track of 1.4 km and bird watching facilities.This park has been developed at an abandoned quarry along the Telco road on reserved land no 302, occupying an area of 10.53ha. It is being developed on a Build-Operate-Transfer (BOT) basis. The park has a bamboo gate with models of birds like cockatoos, parrots, an eagle and an owl perched on it. There is a '*Deep Stambha*', a tower with lamps. A pavilion gives a view of the large lake formed in the abandoned quarry. The lake also has a small jetty for anchoring boats. A model of an eagle with a six-feet-wide wingspan adorns the top of a rocky Pinnacle inside the quarry.

A floating mist fountain has been created for the first time in Pimpri Chinchwad township that has a nozzle with 450 holes. The water is sprayed in the form of a mist up to a height of 15 m and width of 7.5 m. It also serves the purpose of aerating the lake water. Around 15 to 20 coconut trees have been transplanted along the lake in the quarry and an artificial beach spread over 3,500 sq m has been created in the park.

A children's park, amphitheatre, skating ground and a 1.4 km long jogging track are among the other attractions of the park. Migratory birds regularly take a halt at the lake. The visitors are able to observe them in their natural habitat.

Durgadevi Hill Park

Durgadevi park is a prestigious location within Pimpri Chinchwad corporation limit. Over 1,60,000 trees have been planted on an area of 75 ha. Plants such as rain tree, Copper pod, Pipal, Neem, Glyricidia, Suru, Sisoo, Kasid, Subabul etc. have been planted. Lawn on over 1.21 ha of land has been maintained for recreation purposes. Recently 59,805 trees have been planted on an area of 92 ha land. Waterfall and floating fountain in the quarry add to the natural beauty of this hill park.

Bhosari Lake Picnic Spot

Before transformation into a picnic spot this was a wetland area where cattle used to graze and bathe. The entire ecosystem was in bad condition. Water in the lake was extremely polluted. This 10.5 ha area has been developed in a picnic spot by the PCMC. Huge lawn patches, various flowering plants and trees add to the beauty of the recently developed garden. Replica of various animals models placed in the garden attracts small children. In this garden 595 trees of 15 species have been planted and 1875 ornamental plants belonging 10 different species make it more attractive. A lawn over 8000 sq. m. is developed in this garden. ***Queen's Fort*** (*Ranicha Killa)* in addition to a mini train covering a track of 700 m long are major attractions. Adults enjoy boating in this lake and a meditation centre developed in the centre of lake is also popular.

Ganesh Lake, Pimple Gurav | Shiv Srushti Garden, Sangvi

Plate 7.2 Ganesh lake Garden and Shiv Srushti Gardens in PCMC area

7.1.1.1 Comparative analysis of gardens

Number of exotic species are more as compared to indigenous species in all the gardens. Such tendency may destroy the naturalness of the gardens. A section of local people feel that the idea of landscaping with native plantation should be adopted while enhancing the future green spaces. The canopy of the garden is getting affected by planting exotic species which provide comparatively lesser shade. Use of lawns, in landscaping of gardens, affects the micro-environment of the green spaces as they act as cooling areas that create microhabitat for insects, frogs, toads, lizards and snakes, maintaining food chain.

Lack of vegetation cover in cities might be a reason why city is often several degrees hotter than surrounding country sides. Trees can modify micro climatic conditions by their shade.

The biodiversity of Bird Valley Park is comparatively good because of the plant diversity, large space with variety of indigenous species; that attract a large number of insects on which insectivorous birds feed. Thus, Bird Valley Park can be a bench mark for developing future green spaces. Development can have adverse effect on biodiversity. Earlier, Bird

Valley area used to host more number of birds species. The number of bird species have reduced because of the absence of shallow water and wild shrubs.

Table 7.1 Important gardens in PCMC area

#	Name of the garden	Salient features
1	Durgadevi Garden, Nigdi	Mini Mahabaleshwar, 3 km jogging track, lawn
2	Veer Sawarkar Garden, Pradhikaran	Waterfall, lawn, sketing ground, Statue of Svatantryaveer Sawarkar, natural spring and lake
3	Bhosari Tourism Centre	Jpgging track, *Ranicha Killa,* Railway for kids (*Zuk-zuk gadi),* lawn
4	Shahu Udyan, Shahunagar, Chinchwad	Railway for kids (*Zuk-zuk gadi),* Gajebo, lawn, extremely innovative layout
5	Bahinabai Chaudhari Garden, Sambhaji Nagar, Chinchwad	Presence of birds, snakes etc.
6	Pimple Gurav Garden	Impressive layout, Dinosaur model, lawn, jogging track and waterfall
7	Thergaon Boat Club, Thergaon	Impressive layout, Railway for kids (*Zuk-zuk gadi),* lawn, waterfall, Gajebo
8	Laxmibai Barne Udyan	Lawn and jogging track
9	Yashawantrao Chavhan Gulab pushp Udyan	Railway for kids (*Zuk-zuk gadi)* and variety of rose species
10	Dnyanjyoti Savitribai Phule Uyan, Wakad	Impressive layout, undulated lawn
11	Sant Dnyaneshwar Garden, Nakshtra Garden	Nakshatra vatika
12	Bird Valley Garden	Lake, boating, 1450 m jogging track
13	Sai Udyan, Sambhaji Nagar	Lawn, hall
14	Bhakti Shakti Garden	Shivaji Maharaj and Tukaram Maharaj statues
15	Late Tanajirao Shitole Garden, Sangavi	19 statues based on important events in Shivaji Maharaj's life

Source: Garden Department, PCMC

7.1.2 Tree Plantation

According to Maharshtra (Urban Area) Tree Protection and Preservationof Trees Rules, 2009, Article 16, Municipal Corporations are expected to plant at least 10,000 trees each year. During the last year 69,828 tree saplings in different gardens (**Table 7.1, 7.2 and 7.3**) were planted by both the PCMC and private developers. Permissions to cut trees during road widening and other private developments are given subject to plantation of specified number of new saplings.Pimpari Chinchwad Tree Authority has laid down following guidelines for tree plantation by private developers.

- For constructions on plots up to 500 sq m area, 1 tree is to be planted every 100 sq m.
- One tree is to be planted at every 60 sq m for a proposed construction on a plot of 500 sq m to 2000 sq m.

- For proposed construction on plots greater than 2000 sq m., 1 tree is to be planted for every 80 sq m.
- Specifications for planting only indigenous species of saplings, as well as minimum distance from roads are also specified amongst others.

Standards for tree plantation along road side as well as under various land use pattern has been developed in Annex 1 Article 7 (H) of Maharshtra (Urban Area) Tree Protection and Preservationof Trees Rules, 2009. The standards are given below:

- Along roadside:
    - Breadth of the road 24m and more: 1 tree at 10 m interval & table hedge on both sides of median, if possible
    - 12 m to 24 m: On both sides of the road 1 tree after every 10 m
    - 6 m to 12 m: 1 tree at 20 m interval
- Gardens, Sea Shores, Hill Slope, Green Area, Green Belt, River Banks, bank of water body: 1 tree per 10 sq m area
- Garden: 1 tree per 20 sq m
- Layout open space: 1 tree per sq m
- Stadium, mini stadium, playgrounds, tot lots, Development plan open spaces: 1 tree per 100 sq m of area of such amenity

Central, State Government, Semi Government Organisations, Corporate offices or institutions: 1 tree per 100 sq m of plot area

Table 7.2 Tree plantation in different gardens

#	**Types of Garden / Corridor**	**Total**	**Area (Ha)**
1	A. Public Gardens	128	130.79
	B. Other Garden	26	12.14
	Total	154	142.93
2	Developing Gardens	24	14.87
3	Developed Corridor/*BETE*	34	14.965/45 Km
4	Developing Corridor/*BETE*	11	3.23/26 Km

Source: *Garden Department, PCMC*

Table 7.3 Tree plantation schemes by PCMC in 2011-12

#	Tree plantation location	Trees proposed to plant	Trees planted
1	Trees planted in open space	9019	10831
2	Trees planted in garden	11868	10003
3	Durgadevi udyan project	5000	4517
4	Side of roadline	5000	1212
5	Sr.no.131, kachra depot	5000	5004
6	Moshi kachara depot	10000	10000
7	Chikhli nursery & barren land	3000	3500
8	Tree plantation in residential project within PCMC premises	10000	10441
9	Sale & distribution in nursery	11113	14320
	Total trees (nos.)	**70000**	**69828**
	Percent total trees	**100**	**99.75**

***Source**: Garden Department, PCMC*

Details of tree plantation activities that took place during 2011-12 are enlisted in **Appendix 3.**

7.1.3 Flora in Different Gardens

Table 7.4 Summary of Flora in different gardens

Total number of trees	4146
Total number of exotic trees	1356
Total number of indigenous trees	1444

Note: Detailed checklist of flora in different gardens is given in Appendix 4

DPSIR Indicator for 'Green Spaces' illustrates that green parks, green lands, open areas and playgrounds, play an important role for the city environment. Green spaces symbolize peace, minimal stress and a cleaner environment for many people.
An objective of this indicator is to provide as many parks, green lands, open areas and playgrounds in a city as possible. Green spaces in urban areas are important for recreational purposes and for generally enhancing the quality of life of people who live in urban areas.

7.1.4 Terrestrial Fauna

Being a significant part of the ecosystem, fauna has a great role towards control and balance of the environment. If any of the species become extinct, the whole ecosystem may be in danger. Field observations of representative fauna, particularly avifauna and butterflies, were undertaken in PCMC area during January 2013 (**Appendix 5 & 6**).

Butterfly

Butterflies contribute to ecosystem restoration by acting as a pollinating agents as well as a source of food for other insects. The larvae of butterflies, also known as caterpillars, are important to farmers and gardeners to control plant growth. Since butterflies are sensitive to ecological changes, they indicate health of the ecosystem. As per the study conducted in January 2013, 16 species of butterflies were recorded in PCMC area. None of them except Common Indian crow (*Euploea core*) are enlisted as per the Wildlife (Protection) Act, 1972. Common Indian crow is enlisted under schedule IV of the Wildlife (Protection) Act, 1972. A detailed list of species can be seen as **Appendix 5**.

From the study carried out in January 2013 following inference were made:

- In this area the diversity of butterfly appears to be good. The varieties are common in most parts of the Western Ghats of India. Increased butterfly populations indicate good plant diversity and other pollinator groups within the area.
- None of the butterfly in PCMC area is endangered (Schedule I) as per Wildlife (Protection) Act, 1972.

DPSIR indicator for "Quality of Urban Wildlife" illustrates that the number of bird species is an indicator of biodiversity in urban areas.
Objective of indicator is to increase the number of species in an urban environment. The pressure on biodiversity comes from many interconnected sources, principally land use change, pollution and the introduction of alien a species, the area available for natural and semi natural habitats and indigenous species is forseen to decrease, due to the ongoing spread of urban development.

Birds

Birds are one of the most populous life forms of the biodiversity that indicate a richness of life and beauty. Changes in living birds, both individuals and populations, are evidence of climate change. The incredible number of bird species demonstrate amazing evolutionary adaptations. Since a fully diverse ecology is needed to support a healthy number and range of species, a lower than expected number or range of species in an environment, clearly indicates a lower ecological diversity. Attempts have been made to evaluate types of food items usually preferred **(Fig 7.1)** by the birds.

A detailed study on availability of avifauna in PCMC area was carried out in January 2013. Detailed observations of the study are shown in **Appendix 6**. Following conclusions were made from the study:

- A total of 33 bird species, including aquatic birds (**Plate 7.3**) were recorded. None of these birds are endangered (Sch I) as per Wildlife (Protection) Act, 1972.
- The birds like blue rock pigeon, cattle egret, common swallow and pond heron were recorded in all the seven locations surveyed.
- Flocks of black winged stilt, little cormorant and cattle egret were spotted around Chikhali and Moshi Bandhara which is good ecological niche for birds (**Plate 7.4**).

- Migratory birds like yellow headed wagtail and black winged stilt were observed around Chikhali bridge

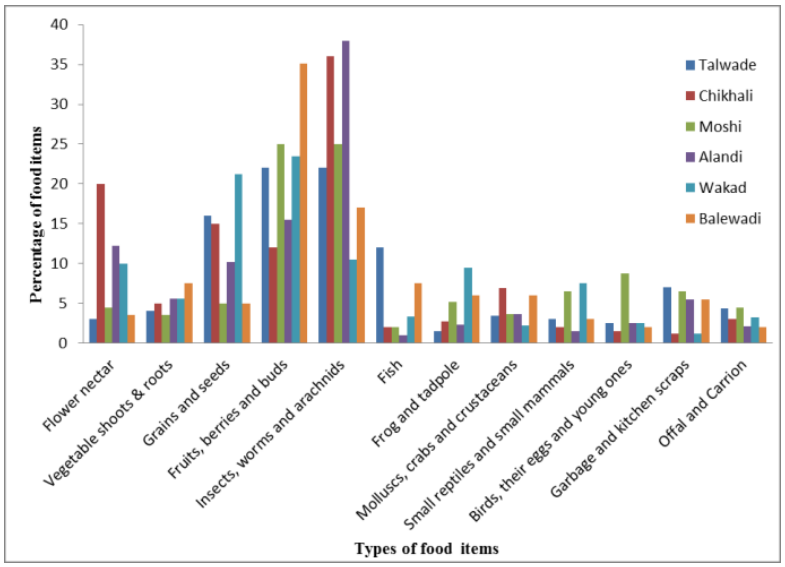


Figure 7.1 Preference of food items by birds in PCMC area

Source: *Ultra-Tech Environmental Consultancy and Laboratory*

- Altogether 12 groups of foods were preferred by the birds in PCMC area. Majority of birds (30.32%) were insectivorous in habit preferring insects, worms and arachnids as their food.
- Certain varieties of birds like egrets, herons, ducks, cormorants, kingfishers etc. are fish eaters. As the water bodies within the area do not favour healthy fish propagation, as a result of deficiency of dissolved oxygen, the percentage of fish eating birds was very less.

Plate 7.3 Common aquatic birds observed in and around Mula river

Plate 7.4 Flocks of black winged stilt and cattle egret around Chikhali and Moshi Bandharas

7.2 Aquatic Environment

7.2.1 Plankton and Benthos

Plankton are important components of ecosystem that respond to ecosystem alterations rather rapidly. It is due to the fact that planktonic organisms, which react to different types of water pollution, play a key role in turnover of organic matter and energy through the ecosystem. Chlorophyll in the plant leaves or phytoplanktons that carry out the bulk of energy fixation in the process of photosynthesis. Its concentration indicates the state of nutrient load in the water body. Similarly zooplankton, also a very important group in the aquatic ecosystem, act as the primary consumer and ultimately serve as the natural food source for many aquatic organisms, including fishes. Benthos, the bottom dwelling animals, are significant contributors in ecosystem trophic levels. Samples were collected in **Jan 2013** from ten stations of Indrayani and Mula rivers for phytoplankton (**Tables 7.5-7.6, Figures 7.2 & 7.3, Plate 7.5**), chlorophyll state (**Fig. 7.4**), zooplankton (**Tables 7.7-7.9**, **Figs.7.5, 7.6 & Plate 7.8**) and benthos (**Tables 7.10 & 7.11**) analysis. All samples were collected and analysed following internationally accepted standard methods.

Plate 7.5 Water sampling at different locations along Indrayani and Mula rivers

Plate 7.6 Collection of sediment samples and benthos from Mula and Indrayani rivers

Table 7.5 Enumeration of Phytoplankton in Indrayani River during January 2013

Sr. No.	Name	Secchi Disc reading (cm)	Depth	Count (No/ml)	Composition of algal groups (%)			SWI	PPI
					Chloro-phyceae	Bacillario-phyceae	Cyano-phyceae		
1	**Talwade (east side)**	40	S	3830	45	18	37	1.67	14
2	**Talwade (west side)**	60	S	3494	45	16	39	1.55	18
			B	3371	41	19	40	2.07	17
			Mean	**3432**	**43**	**18**	**39**	**1.81**	**18**
3	**Talwade (near nallah)**	40	S	3113	60	19	21	1.41	15
4	**Chikhlibridge**	10	S	1411	84	10	6	2.08	19
5	**Moshi**	30	S	3124	35	22	43	2.11	18
			B	2240	61	22	17	1.15	20
			Mean	**2682**	**48**	**22**	**30**	**1.63**	**19**
6	**Alandi**	40	S	1825	51	21	28	1.82	21

Source: *Ultra-Tech Environmental consultancy and laboratory*

Ranges of Shannon Wiener Diversity Index (SWI)
<1: Indicate poor productive water
1-3 Indicate medium productive water
>3 Indicate good productive water

- Samples collected at Chikhali bridge and Talwade (east side) showed lowest and highest counts respectively.Chlorophyceae (52.75%), followed by Cyanophyceae (28.88%) dominated all the samples while Bacillariophyceae (18.37%) was rarely present in a few sampling points. Dominance of former 2 groups clearly indicates tendency towards organic pollution.

- Light penetration (Secchi disc transparency), an indicator of water quality, was medium, varrying from 10 to 60 cm. This is due to higher turbidity of water that inhibits light penetration, therby phytoplankton growth.

- Shannon Wiener Diversity Index (SWI) values varied between 1.15 and 2.11 indicating medium productive water; while average scores of PPI (14-21) indicate probable organic pollution.

Table 7.6 Enumeration of Phytoplankton in Mula River during January 2013

No	Name	Secchi Disc reading (cm)		Count (No/ml)	Percent composition of algal groups				SWI	PPI
					Chlorophyceae	Bacillariophyceae	Cyanophyceae	Euglenophyceae		
1	**Wakad Bandhara**	40	S	2753	32	21	57	-	1.91	19
2	**Balewadi (Near nallah)**	20	S	3494	29	17	50	4	1.53	18
			B	2836	24	7	69	-	1.23	14
			Mean	**3165**	**27**	**12**	**59**	**2**	**1.38**	**16**
3	**Pimple Nilakh (Upstream)**	30	S	1340	38	6	56	-	0.79	15
4	**Pimple Nilakh (Downstream)**	5	S	675	35	9	56	--	0.96	22

Source: *Ultra-Tech Environmental consultancy and laboratory*

Ranges of Palmer's Pollution index (PPI)
<15: Indicate absence of organic pollution
15 - <20: Indicate presence of organic pollution
>20: Indicate presence of high organic pollution

Ranges of Shannon Wiener Diversity Index (SWI)
<1: Indicate poor productive water
1-3 Indicate medium productive water
>3 Indicate good productive water

- Samples collected at Pimple Nilakh (downstream) and Balewadi near nallah showed lowest and highest counts respectively. Cyanophyceae (57.75%), followed by Chlorophyceae (31.5%) dominated all the samples while Bacillariophyceae (9.75%) and Euglenophyceae (1%) were rarely present. Dominance of former 2 groups clearly indicates tendency towards organic pollution. Also, emergence of Euglenophyceae denotes enrichment of organic pollutants.

- Light penetration(Secchi disc transparency) was poor, varrying from 5 to 40 cm. This is due to excessive turbid (black) water coming from nallahs. In such condition phytoplankton growth was drastically reduced.

- Shannon Wiener Diversity Index (SWI) values (0.79 to 1.38) indicate poor productive water, while Palmer's Pollution Index (PPI) values (14 to 22), imply organic pollution.

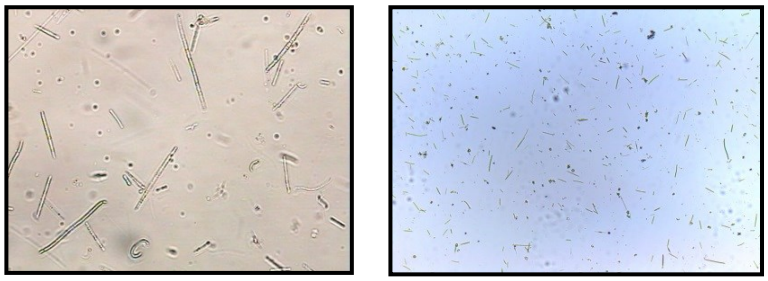
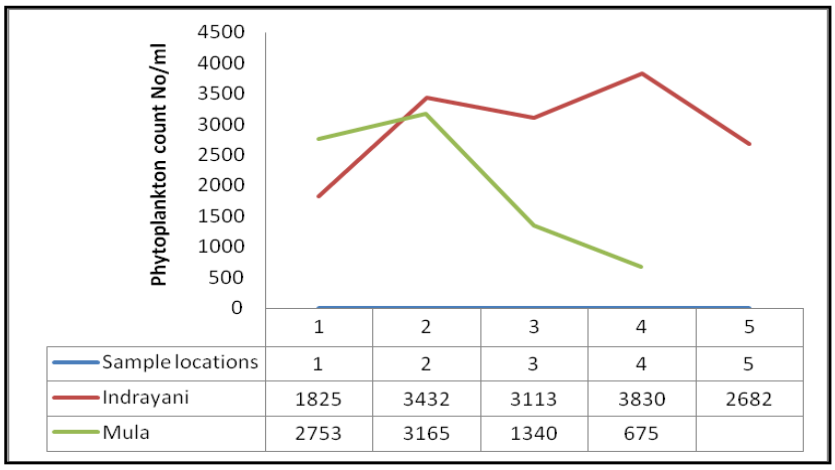


Plate 7.7 Diversity of microscopic Phytoplankton from Mula river



	1	2	3	4	5
Sample locations	1	2	3	4	5
Indrayani	1825	3432	3113	3830	2682
Mula	2753	3165	1340	675	

Figure 7.2 Phytoplankton counts observed in Indrayani and Mula rivers during January 2013

Figure 7.2 shows limited number of phytoplankton due to unfavourable conditions like high turbidity and low oxygenin Mula river

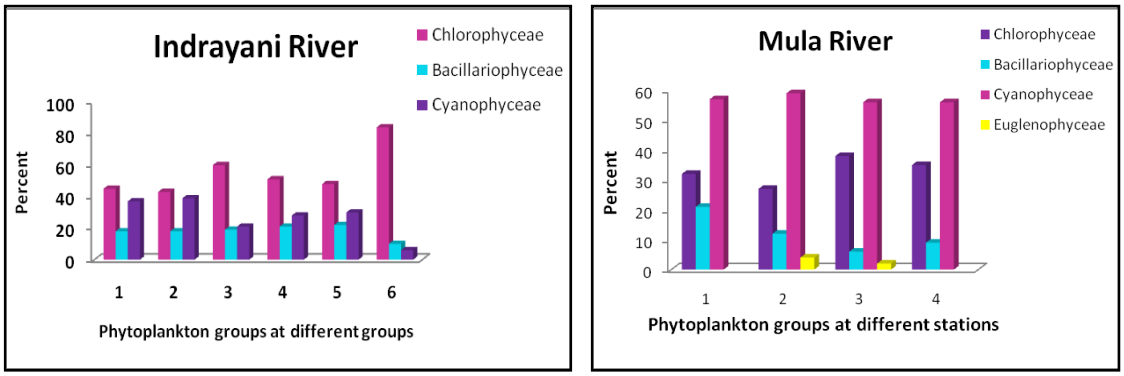


Figure 7.3 Average percent composition of Phytoplankton groups in Indrayani and Mula rivers during January 2013

- Chlorophyceae, followed by cyanophyceae groups, dominating over bacillariophyceae, generally indicates enrichment of organic pollutants in the river water.

- Euglenophyceace, being a high pollution indicator group, was observed only in Mula river, which also suggested that water quality of Mula river was poorer than Indrayani river

A detailed list of Phytoplankton genera observed in Indrayani and Mula Rivers is given in **Appendix 7**. Important observations of the study are as given below:

- In Mula river, occurrence of high pollution indicator species is more.
- The algae like *Anabena, Microcystis,Aphanocapsa* and *Oscillatoria,* that were recorded primarily in Mula river, are prone to form dense surface water blooms and excreting organic compounds that impart bad odour, thereby creating serious problems in the river.
- The known clean water algae like *Chromulina*, *Agemehellum*, *Chrysococcus* were totally absent in Indrayani and Mula rivers.

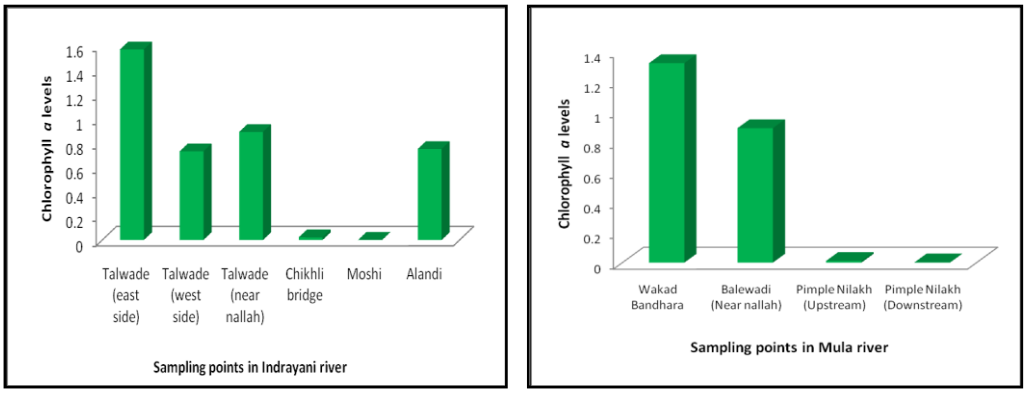


Figure 7.4 Chlorophyll-a in different sampling stations of Indrayani and Mula rivers

- Chlorophyll is the green molecule in plant cells that carries out the bulk of energy fixation in the process of photosynthesis. The highest and lowest *chlorophyll-a* from surface waters of Indrayani water samples varied from 0.0021µg/l (Moshi bridge) to 1.57 µg/l at Talwade (east side)**,** while at Mula river the samefluctuated from 0.0019 µg/l at Pimple Nilakh (downstream) to 1.32 µg/l at Wakad Bandhara.
- It appears that chlorophyll levels are less in surface waters of both the rivers. This may be correlated to polysaprobic states and turbidity of the waters, which prevented proper growth of algae, inspite of excessive nutrients in waterbodies**.**

Table 7.7 Enumeration of Zooplankton in Indrayani River during January 2013

Sr. No.	Name	Count No/m^3	Percent composition of zooplankton groups			SWI
			Rotifera	Copepoda	Cladocera	
1	**Talwade (east side)**	3840	40	14	46	1.53
2	**Talwade (west side)**	4080	31	20	49	1.28
3	**Talwade (near nallah)**	2480	16	32	52	2.42
4	**Chikhli bridge**	2080	31	31	38	2.12
5	**Moshi**	3760	30	23	47	1.12
6	**Alandi**	3920	24	27	49	1.76

Source: *Ultra-Tech Environmental Consultancy and Laboratory*

- Density of zooplankton, varied between 2080 and 4080 N/m^3 representing 14 genera.
- Samples collected at Chikhli and Talwade (west side) showed lowest and highest counts respectively.
- Cladocera (46.83%) dominated over Rotifera (28.66%) indicating enrichment of organic matters.
- SWI values varied between 1.12 and 2.42, which also suggest medium productive water.

Table 7.8 Enumeration of Zooplankton in Mula River during January 2013

Sr. No.	Name	Count No/m^3	Composition of zooplankton groups (%)			SWI
			Rotifera	Copepoda	Cladocera	
1	**Wakad Bandhara**	2570	40	40	20	1.51
2	**Balewadi (Near nallah)**	3520	36	36	28	1.54
3	**Pimple Nilakh (Upstream)**	1760	19	45	36	0.74
4	**Pimple Nilakh (Downstream)**	1360	33	36	31	1.01

Source: *Ultra-Tech Environmental Consultancy and Laboratory*

Ranges of Shannon Wiener Diversity Index (SWI)

<1: Indicate poor productive water
1-3 Indicate medium productive water
>3 Indicate good productive water

- Density of zooplankton is apparently good representing 11 genera of which Copepoda dominated over Cladocera.
- Water samples at Balewadi and Pimple Nilakh dounstream showed highest and lowest counts respectively.
- Shannon Wiener Diversity Index (SWI) values varied between 0.74 and 1.54 indicating comparatively poor productive water.

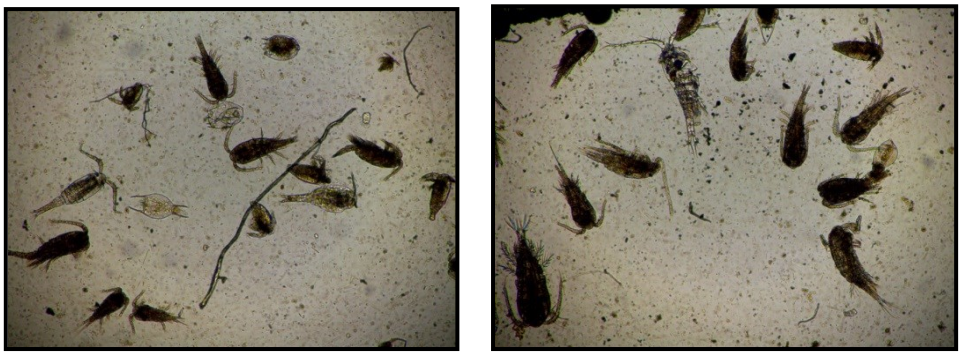
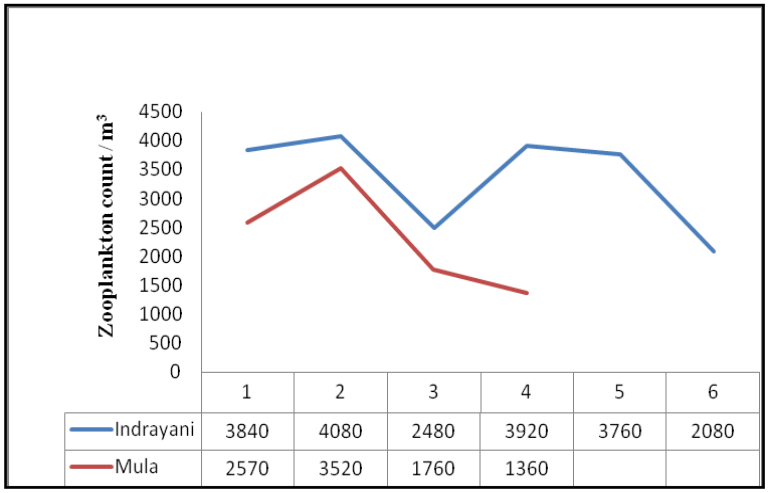


Plate 7.8 Dominant microscopic zooplankton in Mula river during January 2013



	1	2	3	4	5	6
Indrayani	3840	4080	2480	3920	3760	2080
Mula	2570	3520	1760	1360		

Figure 7.5 Distribution of Zooplankton in Indrayani and Mula rivers during January 2013

- In Pimple Nilakh (downstream) of Mula river, the count was less due to black coloured water and mixing of Nallah water at the river confluence.

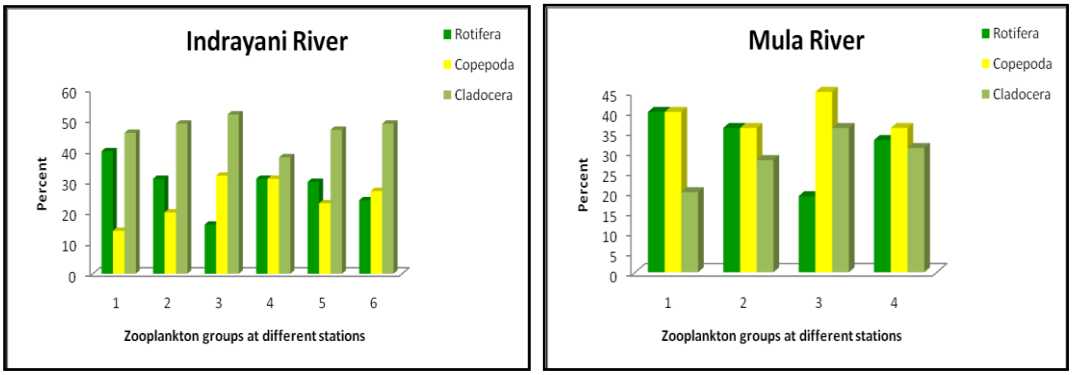


Figure 7.6 Percent composition of Zooplankton groups at different stations of the rivers in January 2013

- While Cladocera dominated in Indrayani river, Copepoda overnumbered others in Mula river
- Clean-water indicating ciliates were absent in both the rivers. This implies that the river waters are deficient in DO

Table 7.9 Zooplankton genera recorded in Indrayani and Mula Rivers during January 2013

Sr. No.	Zooplankton	Indrayani	Mula
Rotifera			
1	*Asplanchna* sp.	+	+
2	*Brachionus* sp.	-	+
3	*Dicanthophorus* sp.	-	+
4	*Keratella* sp.	+	+
5	*Monostyla* sp.	+	_
Copepoda			
1	Nauplius larva	-	+
2	*Cyclops* sp.	+	+
3	*Diaptomus* sp.	+	_
Cladocera			
1	*Alonella* sp.	+	+
2	*Bosmina* sp.	+	+
3	*Chydorus* sp.	+	+
4	*Daphnia* sp.	+	+
5	*Moina* sp.	+	+

Source: *Ultra-Tech Environmental Consultancy and Laboratory*

- High pollution indicator genera, like *Brachionus*, *Bosmina* and *Daphnia* were represented in Mula river, while later 2 were also available in Indrayani river.

- None of the rivers are represented by protozoa during the study. It may be mentioned that the presence of genera like *Litonotus* and *Paramecium* indicates clean water having desired level of DO.

Table 7.10 Benthic fauna recorded at different sampling points in Indrayani and Mula rivers during January 2013

Sr. No.	Name	Macrobenthos (No/m^2)	Percent composition of Macrobenthos			SWI
			Terebridae	Bithyniidae	Chironomidae	
Indrayani						
1	**Talwade (east side)**	90	47	32	21	0.59
2	**Talwade (west side)**	40	32	26	42	0.69
3	**Talwade (near nallah)**	50	56	12	32	1.0
4	**Chikhli bridge**	50	50	-	50	0.86
5	**Moshi**	30	52	-	48	0.61
Mula						
1	**Wakad Bandhara**	60	72	12	16	0.23
2	**Balewadi (Near nallah)**	20	80	-	20	0.75
3	**Pimple Nilakh (Upstream)**	Nil	-	-	-	-
4	**Pimple Nilakh (Downstream)**	Nil	-	-	-	-

Source: *Ultra-Tech Environmental Consultancy and Laboratory*

- The SWI values varying from 0.23-1.00 indicate poor water quality.Chironomidae are normally associated with degraded waterbodies. They are adapted to virtually anoxic conditions and are dominant in organically polluted waters.

- Bottom sediments of Mula river at Pimple Nilakh (both upstream and downstream) appeared to be unfit for proper growth of benthic fauna. Water in this region was black having negligible DO.

Table 7.11 Different types of Benthic fauna recorded in two rivers during January 2013

Sr. No.	Family	Organisms	
		Indrayani	**Mula**
1.	Terebridae	*Turritella communis*	*Turritella communis*
2.	Chironomidae	*Chironomus* larva	*Chironomus* larva
3.	Bithyniidae	*Bithynia tentaculata*	*Bithynia tentaculata*

Source: *Ultra-Tech Environmental Consultancy and Laboratory*

- Pollution indicator groups like Terebridae, followed by Chironomidae, dominated the samples.

- Low DO usually have negative effect on infauna while trophic transfer of secondary production to predators in hypoxia condition.

7.2.2 Fisheries

Fishes, because of their relatively large size and ease of identification, have long been used as indicators of environmental change. The mobility and sensory perception of many species allow them to avoid environmental perturbations, and thus they can show a rapid response to environmental changes. Fish stock is often defined as resilient if they are able to withstand environmental change without noticeable fluctuations. Different types of nets having definite meshes, made of nylon twines are commonly used as gears for fish harvesting. Based on passive netting operation, the nets are classified as 1) Gill nets and drift nets, 2) Trammel nets, 3)Screens, 4) Fixed bag nets etc. Most commonly used gear is gill net (**Plate 7.5**) in PCMC area.

Plate 7.9 Gill net being installed and removed in Indrayani river (Talwade east) in January 2013

Preliminary investigation with local fishermen revealed that there are four different varieties of fishes, viz. *Oreochromis mossambicus*(Tilapia), *Catla catla* (Catla), *Labeo*

rohita (Rohu), *Cirrhinus mrigala* (Mrigal)and *Ompak bimaculatus* (Pabda), normally harvested in the Indrayani river. The most dominant fish is *Oreochromis mossambicus* (Tilapia) **(Plate 7.6)**. It may be mentioned that Tilapia is an exotic hardy fish, breed profusely throughout the year and can tolerate low DO state of water. Since its market price is comparatively less, mostly people from economically weaker sections like this fish.

Plate 7.10 Oreochromis mossambicus (Tilapia) found in Indrayani river

Fish fauna of Mula, Pawana and Indrayani rivers

Extensive survey was undertaken by Hora and Mishra (1942), Wagh and Ghate (2002), Chandanshive *et al.* (2007) and Dahanukar *et al* (2012)towards fresh water fish fauna of Mula, Pawana and Indrayani rivers within Pune city. While evaluating the temporal variations of species composition, these four survey reports reveal that diversity of fish fauna was less in Pawana as compared to other two rivers.A change of fish varieties was noticed in Mula river during two surveys after a few decades. The reasons towards change in fish population can be attributed to uncontrolled discharge of domestic and industrial wastes. Although Indian major carps were recorded in all the three rivers *Channa striatus*, a carnivorous fish having accessory respiratory organ, andalso having the habit of setting for a while in the bottom mud of the water bodiesin absence of DO, was not recorded earlier to 2007 **(Appendix 8)**.

7.3 Trophic levels of selected water bodies

While classifying water bodies on the basis of quality, there are two concepts, viz. Water Quality Index (based on 9 parameters) and Trophic levels (based on 3 principal parameters). Considering scarcity of data for the water bodies of PCMC area, priority is given to the later one, associated with Secchi disk transparency, total phosphorus and chlorophyll-a; besides DO in water of Mula and Indrayani rivers.

Water clarity is measured with Secchi disk (circular white and black), attached to a measured rope that is lowered through the water to a depth where it disappears from view.

In desired oligotrophic water (clear) the Secchi depth may be greater than 10 metres while in undesired eutrophic waters with low visibility, the Secchi depth can be less than a metre.

Phosphorus is the major nutrient that often limits the concentrations of algae in a lake; the higher the P concentration, the more eutrophic water. In large quantities, they can encourage the growth of nuisance aquatic weeds.

Concentrations of algae are also a measure of trophic status though it is difficult to measure algae directly. Chlorophyll-a concentration is used to give an indirect measure of algal concentrations. It is the pigment present in plants that makes them appear green and allows them to obtain energy from the sun (photosynthesis).

Levels of oxygen provide an indirect measure of lake trophic status. Eutrophic water bodies often have little or no oxygen during late night and also in bottom waters during day time.

In order to evaluate the trophic status of the river waters, the values of transparency, chlorophyll-aand phosphorus were considered with available standards. Based on these parameters the Indrayani and Mula rivers appear to be Hypereutrophic (**Table 7.12**).

Table 7.12 Trophic Status of Indrayani and Mula Rivers

Status	**Secchi Disc transparency (m)**	**Chlorophyll-a (µ/L)**	**Total Phosphorus (µg/L)**
Oligotrophic	> 4	< 2	< 10
Mesotrophic	1.6 to 4	2 to 10	10 to 30
Eutrophic	0.7 to 1.6	10 to 30	30 to 60
Hyper eutrophic	< 0.7	> 30	> 60
Indrayani	**0.4-1.0**	**0.0021-1.57**	**900-1600**
Mula	**0.1-1.0**	**0.011 – 1.32**	**1400-2000**

Source: *Ultra-Tech Environmental Consultancy and Laboratory*

- A healthy water body (Oligotrophic) demands high secchi disc transparency, and low phosphorous content & algal growth

- Data clearly indicates that Indrayani and Mula rivers fall under the category hyper eutrophic due to poor transparency and excessive phosphorous concentrations. Discharge of domestic sewage through Nallahs into the rivers and other anthropogenic activities such as cattle bathing, car washing, clothes & utensil washing etc. causes increased turbidity and phosphorous content.

- Although phosphorous enhances growth of algae, thereby *chlorophyll-a* content; such condition did not prevail in Mula and Indrayani rivers due to saprobicity and near-anoxic conditions. River waters need sufficient time for mineralization of organic nutrients leading to profuse growth of algae and other aquatic biota. In view of this *chlorophyll-a* content was negligible in these river waters.

8. Action Plan

Ecological survey reveals that environmental status of different components within PCMC area is mostly in alarming condition. PCMC in cooperation with private firms, NGOs etc. should take special efforts to combat these problems as delineated hereunder:

8.1 Socio-economic structure

- In order to encourage cycling and walking practices among the citizen, PCMC should develop dedicated pedestrian pathways (footpath) and separate cycling tracks.

- PCMC should make arrangements to provide basic amenities like clean drinking water, collection of solid waste, sanitation facilities like '*Sulabh Shauchalay'*, toilets for women to improve the living standards in the slum areas.

- Taking into account the increasing number of HIV cases in the city, PCMC should make provisions of counselling and testing for the citizen. In addition, family planning and supplying free contraceptives are also necessary to keep the population under control.

- **Due to development of automobile, education and IT sectors population of PCMC area is increasing rapidly resulting in depletion of natural resources like hills, lakes, ground water, forest areas and agriculture land etc. The presentuncontrolled and unsustainable growth pattern of the cityis affecting the quality of life. Considering available resources and future demands PCMC should develop a sustainable development plan for the city which should be strictly followed.**

8.2 Surface water

Commensurate to prevailing environmental status of the rivers, as delineated in earlier chapters, and present & anticipated future anthropogenic pressures, suggested comprehensive mitigation measures are.

- Demarcation of boundaries to protect the areas of rivers & lakes, and preventing the encroachments
- Identification of non- point sources of pollutants, including chemicals from agriculture runoff and city sewage, entering the river

- Identification of domestic wastewater sources and other point sources of pollution into rivers from the habitations
- Issuing a separate GO for prohibition of bathing, washing, mining and related anthropogenic activities with due consideration of social aspects of the issue
- Introduction of specific types of fishes which helps in cleansing the water

It is also suggested that the Action Plan for improvement of rivers could be under short-term plan, in which the issues relating to growth of trees, fish, and other human related activities could be addressed.

- Existing water characteristics of Mula, Indrayani and Pawana rivers appear to be unsuitable for aquaculture, or any other human use. Excessive pollutants in river waters are the result of disposal of solid wastes (**Plate 8.1**) on river banks and liquid wastes through nallahs (**Plate 8.2**). In order to avoid deterioration of surface waters PCMC should take the above mentioned measures.

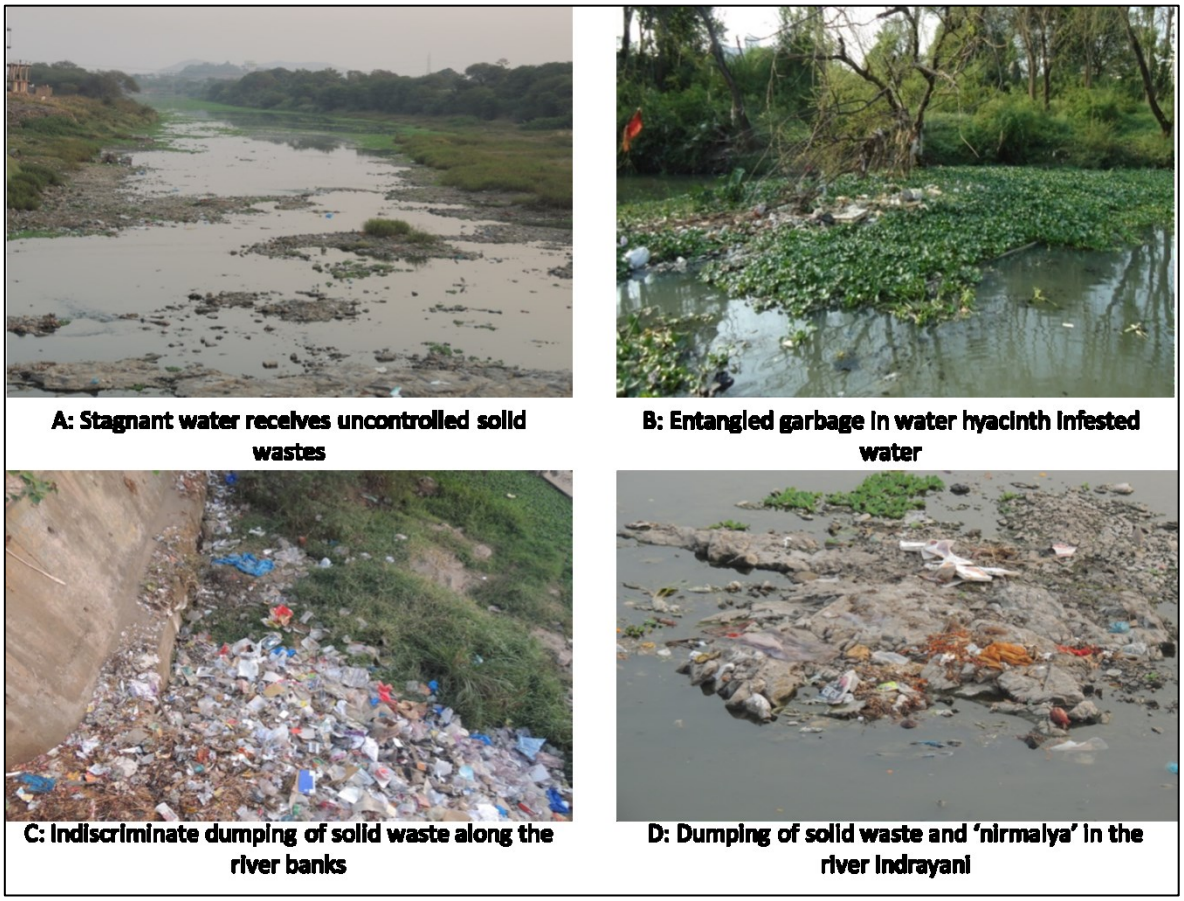


Plate 8.1 (A to D): Disposal of solid waste into river water in PCMC area

A: Confluence of a typical Nallah with Pawana river

B: Polluted nallah water entering Indrayani river at Chikhli bandhara

Plate 8.2 (A and B): Polluted Nallah water entering river water

Cattle entering river water

Plate 8.3 Cattle-bathing in Mula river

- It is documented that rivers and majority of the lakes in the PCMC area are in extremely poor condition due to solid waste intrusion in the river/lake, accumulation of toxic sediments in river / lake beds and profuse growth of aquatic weeds, particularly water hyacinth. Solid wastes and deposited sediments result in DO depletion, release of GHG emissions, eutrophication and obnoxious odour. Further, excessive nutrient load, received through polluted nallahs and waste water, boost the growth of aquatic weeds that reduce the light penetration capacity by covering the surface water, thereby, reducing the algal photosynthesis and DO. The problem aggravates when these aquatic weeds gradually die and sink to the bottom causing additional nutrient accumulation and increasing the volume of the bottom sediments (humus). Such eutrophic conditions are harmful to aquatic life. As a partial management, **even if the incoming allochthonous nutrients are arrested to enter the water bodies, the earlier deposited (if not removed) autochthonous nutrients and greenhouse gases will gradually be released from the bottom through natural biogeochemical processes, resulting in eutrophication of waters for decades.** In view of this, PCMC should take following actions:

- **Water bodies should be apparently free from aquatic weeds and deposited sediments.** Specific tools are available for application. For example, the Water Master is a multi-purpose machine that can excavate settled garbage on river/ lake bed and dredges out toxic sediments. It also cuts and disposes unwanted wild vegetation. The machine is shown in plate (**Plate 8.4**). PCMC can avail services from this or similar companies **to clean the river beds and remove aquatic weeds on priority basis**.

Plate 8.4 Water master from Sai Water Technologies, Mumbai

- Treatment of nallah water before releasing it into the river/lake for which various techniques are available. **The PhytoRid system has been applied by using select varieties of plants to clean surface water bodies** (**Plate 8.5**). The technological details are available with NEERI, Mumbai Zonal Laboratory. This technology has earlier been implemented at Chakan Industry, CIDCO Panvel, Delhi Municipal Corporation etc.

Plate 8.5 Application of PhytoRid system to clean Nallah water

- **Artificial Floating Island (AFI) technology** can be adopted on surface water bodies including nallahs. The AFI is prepared from coconut coir as plant growth & anchorage medium, nutrient stripping plant species, bamboo for making tough buoyant skeleton and a supporting coir matrix (**Plate 8.6**). The technology, developed by Prof. S. K. Billore from Vikram University, Ujjain, has been successfully implemented on River Kshipra in Ujjain.

Plate 8.6 Installation of Artificial Floating Island (AFI) in River Kshipra

- **Sewage treatment plants** should be given additional weightage since these can be used to **produce biogas as well as electricity**. Encouragingly, the plant at Akurdi is currently producing hydroelectricity from the wastewater and the biogas generated from the anaerobic digestion is converted into electricity. Akurdi STP can be used as a model and the technology can be replicated in other STPs to produce biogas and electricity. This will reduce the energy consuption of the plant and contribute in tapping greenhouse gas like methane. In addition to modifying the existing STPs for this purpose, **PCMC should also encourage STP operators to increase the efficiency of the plant** so as to reduce the energy consumption without compromising the sewage treatment.
- Immersion of Ganesh idols into the water body causes water pollution and affects aquatic ecosystems adversely. Although PCMC has constructed **artificial immersion tanks at various locations** where people are supposed to immerse Ganesh idols and 'Nirmalya' during festival, still there are cases of violations. In order to completely stop the immersion into the natural water bodies, PCMC should remain vigilant during the festivities.
- Once the rivers / lakes are cleaned, in order to protect the water bodies from storm water intrusion, it is necessitated to **have a filtering buffer zone as a long term solution**. Besides developing green belt zones in catchment areas, a technique known as Geogreen blanket is available for bank management (**Plate 8.7**). The Geogreen blanket helps in river / lake / pond rejuvenation (**Plates 8.8 and 8.9**), wherein the green blanket is installed on the barren slopes and seeds of some plant species are spread. The technique is beneficial towards erosion control of water body embankments, protection of water channels, shoreline protection, slope protection, vegetation establishment, green belt development in areas surrounding water bodies, rain water harvesting etc. The technology has been successfully implemented at various locations.

Plate 8.7 GeoGreen Blanket

Lake stabilisation

A lake of five ha had problem of heavy siltation due to surface runoff from the slopes of the lake. The geogreen blanket was installed on these barren slopes and seeds of some exotic plant species were spread. This was followed by adequate watering for a few days and within four months a beautiful green belt had developed around the lake. Thus, GeoGreen blanket not only solved the problem of siltation but also added a green edge to the lake.

Plate 8.8 Lake Rejuvenation (Courtesy: Sri Venkateshwara Fibre Udyog, Bangalore)

River-bank stabilisation

The river bank beside a resort was prone to severe erosion and the land was continuously being drifted to the river water. The rising water level during floods was a big threat to the nearby buildings. The river bank was easily eroded since it was completely barren without any vegetation. SVFU installed the GeoGreen blanket followed by seeds of some locally available plant species. Within two months lush green vegetation covered the banks completely and the once lost land was restored completely.

Plate 8.9 River Bank Stabilization (Courtesy: Sri Venkateshwara Fibre Udyog, Bangalore)

- Over exploitation of ground water is inevitable due to urbanization and thus, the groundwater potential is getting reduced. Hence, a strategy to implement groundwater recharge, in a major way, need to be launched to build up the water table and make the groundwater resource a reliable and sustainable source for supplementing water supply needs of the urban dwellers. Considering present and future demands, coupled with shortage of rainfall, there is a **need for provision of rain water harvesting** in PCMC

area. Recharge of groundwater through storm runoff & roof top water collection, besides diversion & collection of runoff into dry tanks, play grounds, parks and other vacant places are to be implemented. The Geogreen blanket technology is one of the options that can be used for protecting the slopes and base of the storage tanks dug on the ground to store rainwater (**Plate 8.10**).

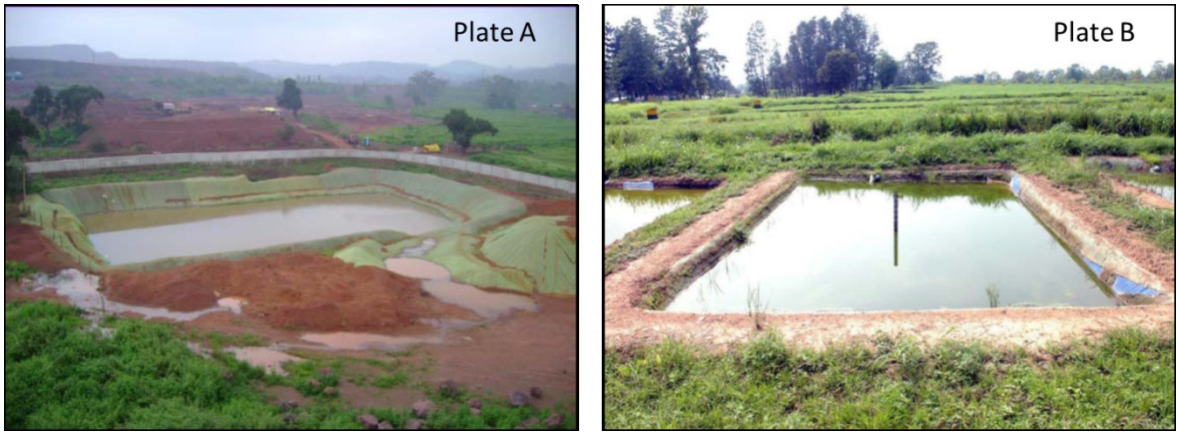


Plate 8.10 (A and B): The Geogreen blanket used for protecting the slopes and base of the storage tanks dug on the ground to store rainwater (Courtesy: Sri Venkateshwara Fibre Udyog, Bangalore)

- **Monitoring:**
  - All surface water bodies should be monitored at designated sampling points for parameters likes (DO, transparency, phosphorous, Chlorophyll-a) at least once a week. Further, DO of selective stations at surface and bottom must be measured prior to sunrise at least once in a month.
  - In order to evaluate trophic status of all the water bodies in PCMC area, which is prerequisite to undertake restoration programmes, necessary parameters (DO, transparency, phosphorous, Chlorophyll-a) should be monitored on bi-monthly basis.

8.3 Air pollution mitigation

- An individual can help in controlling air pollution by using alternate means of transportation like carpooling, walking, and riding bicycleto travel to nearby places so as to reduce air pollution.
- Minimising the need to travel helps to reduce the number of vehicles on road resulting in minimising air pollutants and decreasing travel time. The **PCMC should continue encouraging E-governance** described in section 1.8 that can help to avoid physical travelling.
- A number of crossing points inside the city increase the congestion and air pollutants. The **PCMC should identify the possibilities to develop flyover bridges within the city and ring roads from the outskirts** of the city area in order to improve the mobility.

- Use of **lower emission vehicles**, such as vehicles meeting specified Euro-class or Bharat emission standards **should be promoted**. Alternative fuels such as CNG, LPG, biogas etc., as implemented in city like Delhi, should be popularised in PCMC jurisdiction.
- As a long term measure, **PCMC should introduce mass transit systems** such as monorail or metro to reduce the number of private vehicles.
- Proper permissions should be given to construction activities and measures should be taken to avoid excessive dust in the surround area.
- Eutrophic water bodies continuously emit greenhouse gases like methane and CO_2 that contribute to global warming. **An action plan should be developed to limit the entry of nutrients into water bodies and clean the existing water bodies**.
- **Citizen of PCMC area should be discouraged to burst firecrackers** in densely populated residential areas. Open areas should be identified for communal firecracker bursting.
- **Monitoring:** Parameters like SOx, NOx, RSPM ($PM_{10}$and $PM_{2.5}$) should be measured at least twice in a week in residential, commercial and industrial zones.

8.4 Noise reduction measures

- PCMC needs to come up with a policy to abate noise emanating from vehicular movements, such as charging fine for high decibel horns in silence zone. 'No vehicle zones' should be encouraged in the city.
- According to noise Pollution (Regulation and Control) Rules, 2000, an area not less than 100 m around hospitals, educational Institutions, and Courts is declared as silence area or zone. Loud speakers and vehicular horns should not be allowed in silence zone. **While conducting survey of noise pollution in silent zones, it was recorded that noise levels exceeded the CPCB standards both during day and night at all the 10 locations identified.**PCMC should undertake strict vigilance, so as to maintain the desired noise levels in **silence zones**.
- In order to maintain the noise levels in residential zones, loud speaker or public address systems shall not be used at night (between 10.00 pm and 6.00 am), even during festival days. Use of loud speaker during the day time should only be allowed after obtaining written permission from the concerned authority and even if the permission is obtained, the limit should not be crossed.
- Noise complaints from citizens should be accepted directly to the local police stations even with a phone call.
- Attempt should be made to reduce the roadway noise through different means. There are a variety of strategies that can be used to mitigate roadway noise such as, use of noise barriers, limitation of vehicle speeds, alteration of roadway surface texture, limitation of heavy duty vehicles, use of traffic controls that smooth vehicle flow to reduce braking and acceleration, and tire design.

- The students of educational institutions and children should be discouraged to burst firecrackers to control air and noise pollution during festival days. These firecrackers also cause fatal injuries and initiate fires.
- Citizen should be motivated to avoid use of high sound producing equipments at home or during festivals, religious and social functions which contribute to noise pollution.
- Vegetation cover also helps to reduce the noise at considerable levels.

- **Monitoring**:
  - PCMC should make provisions to measure levels of noise at least once a week during day and night time at various stations spread across residential, industrial, commercial and silence zones.
  - In general, noise is measured near the source, where it is at alarming state in most of the PCMC areas. In order to **demarcate impact zones, there is a need to measure noise levels at vertical (terrace of surrounding tall buildings) and horizontal distances from the sources.**

8.5 Solid Waste Management

- Unregulated waste dumping is a crucial contributor to social and environmental problems. Precaution should be taken out to regulate or minimize the problems caused due to unregulated waste dumping.
- Dumping of waste should be undertaken in different batches so as to reduce the load on dumping site & accumulation of toxicants in specific location. Waste should be dumped over a non-permeable layer to avoid leaching of metals & other toxicants directly into the soil. A separate collection point can be made to collect the leachate and it can be processed separately and disposed of following specific guidelines.
- Presently, a landfill site of 10 ha area, at the north end of the city near Moshi, is being used for dumping / land filling of waste, collected from PCMC jurisdiction. Since the site is located at one side of the city, PCMC needs to consider other sites to avoid contamination of air and soil due to dispersion of solid wastes while transporting the same across the city. The effort will be benefitted by reducing CO_2, emitted by the vehicles used and transportation cost incurred.
- A detailed study at different layers of soil at land-filling site clearly indicated that **certain pollutants e.g. zinc, copper, manganese etc. are penetrating vertically in soil layers which may result in severe ground water pollution in due course of time.** In order to avoid such serious problem there is an urgent need to reduce the waste that is transported to the land-filling site. This can be done by encouraging segregation and treatment of waste at source. PCMC should provide incentives to encourage rag-pickers to remove recyclable wastes like metal, plastic etc. effectively and also to promote composting and vermicomposting of organic waste at local or Ward level.

- The segregation and collection of municipal solid waste is most important. Citizen should be encouraged and incetivised to segregate the waste at source. The segregated organic fraction of the waste can be treated at ward level to produce biogas. Such decentralisation of waste management will help to reduce the burden on Moshi Kachara Depot and also contribute to minimise the energy used for street lightening.
- As being given special attention in Delhi, major focus should be towards composting of organic wastes. It may be mentioned that the composting plant of South Delhi Municipal Corporation in Okhla, New Delhi became **the first in India to receive the carbon credits from the United Nations Framework Convention on Climate Change. In March 2013, the civic body was given Rs 25 lakh as an advance against the Carbon Emission Reduction (CER) earnings from this plant.** The Okhla plant became operational in 2008. Since then, around two lakh tonnes of waste has already been processed. In future, the capacity would be increased. The South Delhi Municipal Corporation has outsourced this operation to IL&FS (Infrastructure Leasing & Financial Services Ltd), which in turn is also working on the programme for upgradation of this plant (***Knowledge 17, March 24, 2013***).
- PCMC should make an effort to organize rag-pickers by providing registered I Card, comprehensive health insurance and basic protective equipments to improve their health condition. Proper uniform and identity card will encourage them, if PCMC, along with organizations like World Wide Fund for Nature (WWF), Abhiyan Foundation etc. who work for the welfare of rag pickers.
- It may be mentioned here that the neighbouring PMC initiated a financial aid for health and accident insurance scheme for 6000 rag pickers who collect 300-350 tonnes of dry waste per day (Clean India Journal, Jan 2011). The New India Insurance Company proposed a policy for them and PMC contributed Rs.5, 16,260 for the same. Considering the services of rag pickers, PCMC should also adopt similar steps.
- There is a need to consider safe and scientific disposal of hazardous waste generating form the residential area such as mercury from thermometer, heavy metals like nickel, cadmium from batteries etc.
- **E-Waste:** PCMC should provide convenient collection points for gathering electronic waste and arrange a scientific disposal system to avoid environmental degradation. This will avoid entry of e-waste into municipal solid waste.
- A separate collection bin for e-waste such as incandescent bulbs, electronic equipment, machines, computer accessories etc. should be installed at convenient locations in residential area. People should also be sensitized through paper and electronic media to avoid mixing e-waste with municipal solid waste.
- **Monitoring:** PCMC should make arrangements to regularly measure the contaminants from vertical and horizontal soil profile; a check on leachate produced from the dumping site need to be measured by testing ground water at least quarterly.

8.6 Biodiversity

8.6.1 Terrestrial

- In order to combat dust pollution there is a need for massive plantation programme. The CPCB has recommended the varieties of plants suitable for the purpose. The shrubs like Copper leaf (*Acalypha hispida*), Beshram (*Ipomea nil*), Bougainvillea (*Bougainvillea glavara*), etc. and trees like Poplar (*Populus* sp), Bottle Brush (*Callistemon citrinus*), Arjun (*Terminalia arjuna*), Peepal (*Ficus religiosa*), Banyan Tree (*Ficus bengalensis*), Kadam (*Anthosephalus cadamba*), Neem (*Azardirachta indica*), Amaltas (*Cassia fistula*) etc. can be planted for control of dust pollution.

- Noise pollution is suppressed by certain woody plant species like Gulmohar (*Delonix regia*), Saag (*Tectona grandis* Linn), Silver Oak (*Grevillea robusta*), Bakain (*Melia azadirerch*), Kadamba (*Anthoephallus cadamba*), Peepal (*Ficus religiosa*), Mango (*Mangifera indica*), Udumbara (*Ficus glomerata*), Devdaru (*Cedrus deodara*) etc. Amongst these species sound absorption coefficient of Udumbara wood is greater. In general, spongy wood tree is most useful to reduce noise pollution.

- In order to enhance biodiversity by attracting caterpillars, butterflies, other animals, including avifauna in the area, there is a need to plant certain varieties of plants under green belt development scheme. Accordingly, depending on preference, it is recommended to plant *Butea monosperma,* a larval host plant for common pea blue, *Cassia fistula* for spotless grass yellow, *Ficus retusa* for common Indian crow etc. To attract beneficial honeybees and other insects through sweet scent, common nectar and pollen rich plants like *Areca catechu, Alianthus excelsa, Azadarichta indica, Putranjiva roxburghii* etc. are suggested to include in green belt area.

- In order to reduce adverse effects of air pollutants on biota, vehicles having 'pollution under control' certificate should be allowed to ply within the city. There should be compulsorily use of covering sheets to prevent dust dispersion from the vehicles used for carrying loose materials.

- **Monitoring:** Vegetation enumeration must be carried out once a year covering herbs, shrubs, trees and medicinal plants during post monsoon season. Avifauna, insect, butterflies should be monitored quarterly. Special attention must be given on migratory birds.

8.6.2 Aquatic

- Presently the surface water bodies are in eutrophic states that are incompatible for biological growth at desired level. In view of this, there is an urgent need to remove excess nutrients deposited in bottom sediments, unwanted aquatic weeds and to arrest discharge of sewage through nallahs.

- Proper growth of fish and fish food organisms can only be maintained at minimum DO of 4mg/l throughout the water column during day & night times, and low nutrient levels (P: 0.02mg/l; NO_3: 0.2mg/l).
- Quarterly **monitoring** of zooplankton, phytoplankton, benthos, Chlorophyll-a concentration and fishing activities must be arranged.

8.7 Reducing light pollution

Light pollution is the result of excess or obtrusive light created by humans. Among other effects, it disrupts ecosystems, triggers accidents, can cause adverse health effects besides it's wastageof energy. The sources include lighting of building interiors and exteriors, advertising boards, commercial properties, head lights of vehicles, street light, illuminated sporting events etc. Energy audit data demonstrates that about 30-60% of the energy consumed for lighting goes wasted.

- PCMC should judiciously give permission to advertising boards that use energy. Switching to energy efficient lighting options like CFL and LED for interior and exterior illumination purposes can help to save the energy.
- Switching off road lights during day light when not needed either manually or using timers can save energy for PCMC.
- Using low beam while driving at night will add to the road safety.

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List of Abbreviations

°C: Degree Celsius
°F: Degree Fahrenheit
AIDS: Acquired Immuno Deficiency Syndrome
BDL: Below Desirable Limit
BOD: Biochemical Oxygen demand
BRT: Bus Rapid Transit
BSUP: Basic Services to the Urban Poor
CDP: City Development Plan
CH_4: Methane
CI: Chlorides
CO: Carbon Monoxide
COD: Chemical Oxygen Demand
CPCB: Central Pollution Control Board
CPHEEO:Central Public Health and Environmental Engineering Organisation
dB: Decibel
DO: Dissolved Oxygen
DPSIR: Driving forces-Pressures-State of Environment- Impacts- Response
E -Waste: Electronic Waste
ESR: Environmental Status Report
FRL: Full Reservoir Level
FSI: Floor Space Index
HC: Hydrocarbons
HFL: High Flood Level
HIV: Human Immuno Virus
Hrs: Hours
ICDS: Integrated Child Developmental Scheme
IIT: Indian Institute of Technology
IITM: Indian Institute of Tropical Metrology
IMD: Indian Meteorological Department
INTACH : Indian National Trust for Art and Cultural Heritage
IPPI: Indoor Plus Polio Immunization
IS: Indian Standards
ISI: Indian Standard Institution
ITS: Intelligent Transportation System
JNNURM: Jawaharlal Nehru National Urban Renewal Mission
Km: kilo meters
KWh: Kilo Watt
Leq: The equivalent continuous Sound Pressure Level (SPL) for a particular duration.
MCCIA: Mahratta Chamber of Commerce, Industries and Agriculture
Mcum/TMC: Million Cubic meter per
mg/1: milligram/liter
Mg/g: milligram/gram
MIDC: Maharashtra Industrial Development Corporation
MLD: Million Liters per Day IT (Information Technology)
mm: milli meters
MNGL: MaharashtraNatural Gas Limited

MPCB: Maharashtra Pollution Control Board
MSEDCL: Maharashtra State Electricity Distribution Company Limited
MT: Metric Ton
MTD: Metric Tons per Day
NASSCOM: The National Association of Software and Services Companies
NBC: National Building Code
NEERI: National Environmental Engineering Research Institute
NGO: Non Government Organization
NMT: Non Motorized Transport
NMVOC: Non Mobile Volatile Organic Carbon
NOx: Nitrogen Oxides
NTU: Naphelometric Turbidity Unit
NUTP: National Urban Transport Policy
OPD: Out Patient Department
PCMC: Pimpri Chinchwad Municipal Corporation
PCNTDA: Pimpri Chinchwad New Town Development Authority
PM_{10}: Particulate Matter 10
PMPML: Pune Mahanagar Palika Parivahan Mahamandal Limited
PO_4^2: Phosphates
ppm: Parts Per Million
RC: Residual Chlorine
RSPM: Respirable Suspended Particulate Matter
RTO: Regional Transport Office
$S0_4$: Sulphates
SEA: Strategic Environmental Assessment
SOP: Standard Operating Procdure
SOx: Oxides of Sulphur
SPM: Suspended Particulate Matter
Sq km: square kilometer
Sq m: Square meter
SRA: Slum Rehabilitation Authority
STD: Sexually Transmitted Disease
STP: Sewage Treatment Plant
SWaCH: Solid Waste Collection and Handling
TDS: Total Dissolved Solids
TH: Total Hardness
TMC: Thousand Million Cubic Feet
TSS: Total Suspended Solids
U/O : Unobjectionable
ug/m^3: microgram per meter cube
us/cm:Microsimence per centimeter
VOC: Volatile Organic Carbon
WHO: World Health Organization
WTP: Water Treatment plant

Appendix

Appendix 1 Characteristics of Raw and Treated Water at Survey No. 23, Nigdi from January 2012 to January 2013

Month	Turbidity (NTU)		Total Hardness (mg/l)		Total Dissolved Solids (ppm)		Dissolved Oxygen (mg/l)		Fluoride (mg/l)		MPN/100ml	
IS Standard	5 NTU max		300 mg/l max		500 ppm max		5 mg/l min		1 mg/l max		nil	
	Raw	Treated	Raw	Treated	Raw	Treated	Raw	Treated	Raw	Treated	Raw	Treated
Jan 12	4.9	2.1	56	44	57.2	56	6.3	6.9	0.68	0.51	350	0
Feb 12	5.1	2.2	64	52	56.9	53.4	5.9	6.2	0.63	0.49	550	0
Mar 12	4.2	2.2	52	44	55.3	52.6	6.2	6.2	0.49	0.33	1600	0
Apr 12	4.2	2.4	52	48	55.6	54.7	7.9	8.0	0.8	0.7	900	0
May 12	5.7	2.2	52	48	56.5	55.7	6.8	7.0	0.9	0.7	900	0
June 12	7.9	2.6	56	52	57.2	56.7	7.8	8.1	0.9	0.7	900	0
July 12	6.4	2.3	76	68	87.1	85.7	7.2	7.8	0.19	0.11	900	0
Aug 12	41.1	2.2	104	100	113	114	7.7	7.7	0.46	0.33	1600	0
Sep 12	13.1	1.9	108	100	110	111	7.9	8.0	0.11	0.10	1600	0
Oct 12	13.7	1.8	144	140	143	142	7.2	7.6	0.2	0.1	1600	0
Nov 12	4.67	2.40	56	51	58.2	55	9.6	9.6	0.02	0.1	1600	0
Dec 12	5.09	3.6	64	60	59	58.3	7.4	7.8	0.17	0.1	1600	0
Jan 13	6.30	2.10	72	64	60	52	10.5	12.5	0.75	0.62	900	0

Source: Water Department, PCMC

Appendix 2 Removal (percent) efficiencies of STPs in PCMC area during 2012-13

Season	STPs / Para-Meters	Chikhli Phase 1	Chikhli Phase 2	Rawet	Pimple Nilakh	Chinchwad (SBR)	Charholi	Chinchwad (ASP)	Aakurdi	Sangvi (SBR)	Sangvi (FAB)	Kasarwadi Phase II	Kasarwadi Phase III
S	SS	NA	87.3	NA	97.2	93.8	NA	77.7	95.9	NA	86.0	95.4	96.5
	COD	NA	77.8	NA	97.1	93.6	NA	91.8	95.3	NA	87.5	94.5	94.8
	BOD	NA	93.0	NA	96.2	90.4	NA	86.1	92.6	NA	86.8	94.2	93.6
M	SS	NA	86.2	74.9	95.6	95.6	NA	87.4	96.0	NA	77.0	90.7	92.2
	COD	NA	85.3	74.9	95.9	94.1	NA	91.7	93.0	NA	85.2	92.1	92.1
	BOD	NA	82.5	57.5	94.6	92.3	NA	86.7	90.3	NA	80.7	91.9	91.7
PM	SS	85.2	88.0	70.0	95.8	96.2	NA	89.7	94.3	89.7	82.5	91.7	93.2
	COD	86.4	88.2	82.0	96.3	94.3	NA	91.2	91.6	90.9	87.9	92.0	94.2
	BOD	78.0	84.2	77.8	94.8	93.0	NA	88.9	90.8	89.5	86.6	91.3	91.4
W	SS	82.0	87.9	69.9	NA	96.7	94.3	91.3	94.0	94.2	NA	93.5	94.9
	COD	83.0	88.5	84.7	NA	94.9	42.0	92.6	90.5	95.4	NA	93.0	94.9
	BOD	72.6	83.6	86.3	NA	94.2	53.4	86.0	88.3	92.4	NA	92.6	91.3

S: Summer(March, April, May)**, M:Monsoon**(June, July, August)**, PM:Post Monsoon** (September, October, November)**, W:Winter** (December, January,February), **SS:** Suspended Solid, **COD:** Chemical Oxygen Demand, **BOD:** Biochemical Oxygen Demand
NA: Data not available

STP Inlet and Outlet readings for certain parameters.

		S.S.		B.O.D.		C.O.D	
		Inlet	**Outlet**	**Inlet**	**Outlet**	**Inlet**	**Outlet**
Chikhali Phase I	**S**	NA	NA	NA	NA	NA	NA
	M	NA	NA	NA	NA	NA	NA
	PM	198.0	29.0	389.0	23.0	389.0	87.0
	W	150.0	17.0	142.0	24.0	353.0	96.0
Chikhali Phase II	**S**	NA	NA	NA	NA	NA	NA
	M	217.0	30.0	169.0	25.0	474.0	83.0
	PM	123.0	23.0	160.0	8.0	400.0	63.0
	W	145.0	17.0	140.0	16.0	336.0	55.0
Rawet	**S**	57.0	22.0	47.0	13.0	78.0	28.0
	M	70.0	16.0	42.0	9.0	76.0	19.0
	PM	47.0	16.0	45.0	7.0	104.0	12.0
	W	45.0	21.0	39.0	7.0	88.0	19.0
PimpleNilakh	**S**	181.0	5.0	170.0	5.0	523.0	20.0
	M	129.0	5.7	122.0	5.0	368	20.0
	PM	119.0	5.0	109.0	4.0	343	18.0
	W	148.0	5.0	137.0	4.0	435	18.0
Chinchwad(SBR)	**S**	142.0	6.6	107.0	6.4	259	21.0
	M	153.0	6.7	107.0	6.5	240	18.0
	PM	189.0	6.3	119.0	6.3	263	16.8
	W	211.0	7.2	125.0	6.7	277	18.2
Charholi	**S**	NA	NA	NA	NA	NA	NA
	M	NA	NA	NA	NA	NA	NA
	PM	423.2	13.2	18.2	10.1	59.38	27.0
	W	49.0	11.0	31.0	8.9	80	29.5

Chinchwad (ASP)	**S**	124.0	20.0	104.0	8.3	255	34.0
	M	119.0	12.5	106.0	9.4	238	29.0
	PM	124.0	11.0	114.0	9.0	272	35.0
	W	120.0	13.2	116.0	9.2	304	47.0
Aakurdi	**S**	143.0	6.0	122.0	7.8	348	32.0
	M	169.0	9.0	104.6	9.0	332	30.5
	PM	156.0	9.7	104.0	9.4	325	35.3
	W	153.5	8.1	98.5	8.1	287	30.5
Sangvi (SBR)	**S**	NA	NA	NA	NA	NA	NA
	M	152.0	22.5	151.0	24.3	482.4	71.5
	PM	241.0	14.0	146.3	7.4	464	36.0
	W	321.6	18.1	130	4.3	444	31.5
Sangvi (FAB)	**S**	159.0	22.3	170.5	21.4	361.5	47.7
	M	143.8	31.7	212.1	20.7	251.1	52.9
	PM*	166.0	29.0	165.0	20.0	352.0	47.0
	W	282.4	60.6	144.2	42.8	269.6	79.6
Kasarwadi Phase III	**S**	126.0	7.2	125.0	8.0	385	25.0
	M	98.4	9.0	99.0	7.3	288	27.0
	PM	123	7.2	121	6	350	31
	W	203	7.6	143.5	6.6	416.5	30.8
Kasarwadi Phase II	**S**	95	5.8	106	6.5	315	22.4
	M	98.3	9.6	101.5	8	312	25
	PM	87	7	81	6.5	238	21
	W	113	7	105	7	300	22

Note: Summer (S):- March, April and May, Monsoon (M):-June, July and August, Post Monsoon (PM):- September, October and November, Wnter (W):-December, January and February, *= Data available for october month

Appendix 3 Tree plantation schemes by PCMC in 2011-12

Sr.No.	Tree plantation location	Trees proposed to plant	Trees planted
1	**Trees planted in open space**	**3**	**4**
1	A Ward	3621	4211
2	B Ward	1820	2279
3	C Ward	1963	2415
4	D Ward	1615	1926
	Total	**9019**	**10831**
	Trees planted in garden		
5	A Ward	4146	4792
6	B Ward	2957	1564
7	C Ward	933	913
8	D Ward	3832	2734
	Total	**11868**	**10003**
9	Durgadevi udyan project	5000	4517
10	Side of roadline	5000	1212
11	Sr.no.131, kachra depo	5000	5004
12	Moshi kachara depo	10000	10000
13	Chikhli nursery & barren land	3000	3500
14	Tree plantation in residential project within PCMC premises	10000	10441
15	Sale & distribution in nursery	11113	14320
	Total trees (nos.)	**70000**	**69828**
	Percent total trees	**100**	**99.75**

Appendix 4 Checklist of flora in different gardens

Sr.No.	Name of the garden	Total	Indigenous species	Exotic species
1	Indira Gandhi Udyan	25	0	25
2	Vajra Lok Budhvihar	8	0	8
3	Sidarth Gautam Budha Udyaan	30	0	30
4	Shivaji Park peth	85	55	30
5	Sai Krushna Udyaan	195	175	20
6	Vighna harta Udyaan	11	0	11
7	Mhatma Phule Udyaan	78	78	0
8	Bhinabai Udyan Choudhari Snake Park and Bird ----	42	7	35
9	Shree Sai Udyan	332	147	185
10	Aa. Kra.60, Sambhajinagar	49	49	0
11	Rajshri Shahu Udyaan	610	310	300
12	Ahilyadevi Holkar	32	2	30
13	Vishwa Karma Udyan	34	4	30
14	Nana Nani Udyan	70	15	55
15	Muktai Udyan	207	122	85
16	Shri Sadgure Datta Udyan	115	-	-
17	Aanna Bhau Sathe Nanagar	45	45	0

	Udyan			
18	Bhakti Shakti Udyan	150	0	150
19	Vahtuk Nagari Udyan	20	0	20
20	Shri Vitthal Rukmini Mandir Udyan	20	0	20
21	Maruti Mandir Udyan	10	0	10
22	Someshwar Udyan	10	0	10
23	Radhakrushna Udyan	25	0	25
24	Shri Dakshinmukhi Maruti Udyan	75	35	40
25	Ganesh Bag	33	0	33
26	Swami Samarth Udyan	10	0	10
27	Dada Dadi Udyan	60	0	60
28	Pandharkar Udyan	10	0	10
29	Gangai Balodyan Udyan	10	0	10
30	Vijay Colony Ganganagar Udyan	10	0	10
31	Sant Dnyaneshwar Udyan	60	60	0
32	Sant Tukaram Udyan	28	0	28
33	Mauli Udyan	20	0	20
34	Rambag Udyan	06	0	6
35	Gajanan Mharaj Udyan	15	0	15
36	Thermax Chowk to KSB Chowk	202	127	75
37	Sewage Treatment Centre-Chikhli	225	-	-
38	Nigdi Smashanbhumi	20	20	0
39	Aa. 520 (Gharkul Yojna)	310	-	-
40	Kladalan Udyan	10	10	0
41	Mhetrevasti	219	219	0
42	Jadhavvadi	395	-	-
43	Khandoba Mandir	225	-	-
		4146		

Appendix 5 Checklist of butterflies recorded in the PCMC area

Sr. No.	Common Name	Scientific Name	Conservation status as per Wildlife (Protection) Act 1972
1	Blue Mormon	*Papilio polymnestor*	Not enlisted
2	Blue tiger	*Tirumala limniace*	Not enlisted
3	Blue pansy	*Junonia orithy*a	Not enlisted
4	Common evening brown	*Melanitis leda*	Not enlisted
5	Common grass yellow	*Eurema hecabe*	Not enlisted
6	Small grass yellow	*Eurema brigitta*	Not enlisted
7	Common Indian crow	*Euploea core*	Sch – IV
8	Common leopard	*Phalanta phalantha*	Not enlisted
9	Common mormon	*Papilio polytes*	Not enlisted
10	Gray pansy	*Junonia atlites*	Not enlisted

11	Lime butterfly	*Papilio demoleus*	Not enlisted
12	Plain tiger	*Danaus chrysippus*	Not enlisted
13	Dark pierrot	*Tarucus ananda*	Not enlisted
14	Red pierrot	*Talicada nyseus*	Not enlisted
15	Pointed line blue	*Ionolyce helicon*	Not enlisted
16	Long-branded bushbrown	*Mycalesis visala*	Not enlisted

Appendix 6 Availability of avifauna in PCMC areas during January 2013

#	Common name	Scientific name	Observation in areas						Conservation status as per Wildlife (Protection) Act 1972	Status in IUCN Category
			Talwade	Chikhali	Moshi	Alandi	Wakad	Balewadi		
1	Bar-headed geese	*Anser indicus*	+	-	+	-	-	-	Sch – IV	Least concern
2	Black kite	*Milvus migrans*	++	+++	-	++	-	+	Not enlisted	Not enlisted
3	*Black winged stilt	*Himantopus himantopus*	-	+++	-	+	-	+	Sch – IV	Least concern
4	Blue rock pigeon	*Columba livia*	+++	++	+	+	++	++	Sch – IV	Least concern
5	Cattle egret	*Bubulcus ibis*	+++	+++	+++	+	+	+	Sch – IV	Least concern
6	Common babbler	*Turdoides caudatus*	++	++	-	-	+	-	Sch – IV	Least concern
7	Common swallow	*Hirunds rustica*	++	+++	++	++	+	++	Sch – IV	Least concern
8	Crow pheasant	*Centropus sinensis*	+	++	-	-	-	-	Sch – IV	Least concern
9	*Yellow headed wagtail	*Motacilla citreola*	-	+	-	-	-	-	Sch – IV	Least concern
10	Grey heron	*Ardea cinerea*	-	+	++	-	++	++	Sch – IV	Least concern
11	House crow	*Corvus splendens*	+++	++	++	-	++	-	Sch – V	Least concern
12	House sparrow	*Passer domesticus*	+++	++	++	-	++	+	Sch – IV	Least concern

13	House swift	*Apus affinus*	+++	++	+	+	+	+	Sch – IV	Least concern
14	Indian baya	Ploceus philippinus	-	++	+		+	+	Sch – IV	Least concern
15	Indian black drongo	*Dicrurus adsimilis*	++	++	+	+	++	-	Sch – IV	Least concern
16	Indian cuckoo	Cuculus micropterus	-	+	+	-	-	-	Sch – IV	Least concern
17	Indian myna	*Acridotheres tristis*	+++	+++	-	++	+	++	Sch – IV	Least concern
18	Indian plover	*Charadrius dubius*	-	++	+	-	+	-	Not enlisted	Not enlisted
19	Indian reef heron	*Egretta gularis*	-	+	-	-	-	+	Sch – IV	Least concern
20	Indian robin	*Saxicoloides fulicata*	++	+++	-	+	++	+	Sch – IV	Least concern
21	Indian roller	*Coracias benghalensis*	+	++	-	+	-	-	Sch – IV	Least concern
22	Jungle crow	*Corvus macrorhynchus*	+++	++	-	++	-	+	Sch – V	Least concern
23	Little cormorant	*Phalacrocorax niger*	+++	+++	-	-	-	++	Sch – IV	Least concern
24	Magpie robin	*Copsychus saularis*	++	++	-	-	+	-	Sch – IV	Least concern
25	Pond heron	*Ardeola grayii*	+++	+++	+	++	+	+++	Sch – IV	Least concern
26	Purple sunbird	*Nactarinia asiatica*	++	+++	++	-	+	+	Sch – IV	Least concern
27	Redvented bulbul	*Pycronotus cafer*	++	+++	-	-	++	-	Sch – IV	Least concern
28	Redwattled lapwing	*Vanellus indicus*	++	++	-	-	++	-	Sch – IV	Least concern
29	Redwhiskered bulbul	*Pycnonotus jocosus*	++	++	++	-	-	++	Sch – IV	Least concern
30	Roseringed parakeet	*Psittacula krameri*	++	+	-	++	-	-	Sch – IV	Least concern
31	Small blue kingfisher	*Alcedo atthis*	+	+	+	-	-	-	Sch – IV	Least concern

32	Small green bee eater	*Merops orientalis*	++	+++	-	-	-	++	Sch – IV	Least concern
33	White breasted kingfisher	*Halcyon smyrnensis*	-	+	-	+	-	+	Sch – IV	Least concern

Note: +++: Found in flocks, ++: frequently found, +: rarely found, -: Absent, *: Migratory

Appendix 7 Phytoplankton genera observed in Indrayani and Mula Rivers

Sr. No.	Genera	Indication of Pollution	Indrayani	Mula
Chlorophyceae				
1	*Ankistrodesmus* sp.	high	+	+
2	*Chaetophora* sp.	NR	+	-
3	*Chlamydomonas* sp.	medium	+	+
4	*Chlorella* sp	medium	+	+
5	*Chlorococcum* sp.	NR	+	+
6	*Cosmarium* sp.	NR	+	+
7	*Eudorina* sp.	NR	+	+
8	*Pediastrum* sp.	NR	-	+
9	*Phacotus* sp.	NR	+	-
10	*Scendesmus* sp.	medium	-	+
11	*Ulothrix* sp.	NR	+	-
Bacillariophyceae				
1	*Cyclotella* sp	NR	-	+
2	*Cymbella* sp.	medium	+	+
3	*Diatoma* sp.	NR	+	+
4	*Melosira* sp.	NR	+	+
5	*Navicula* sp.	medium	+	-
6	*Nitzschia* sp.	medium	+	-
7	*Surirella* sp.	NR	+	+
8	*Synedra* sp.	NR	+	+
Cyanophyceae				
1	*Aphanocapsa*	high	-	+
2	*Anabena*	high	-	+
3	*Chroococcus* sp.	NR	+	+
4	*Merismopedia* sp.	NR	+	+
5	*Microcystis* sp.	high	-	+
6	*Oscillatoria* sp.	high	+	+
7	*Phormidium* sp.	NR	+	+
Euglenophyceae				
1	*Lepocinclis* sp.	NR	+	-
2	*Phacus* sp.	NR	+	-

Appendix 8 List of fishes recorded in Mula, Pawana and Indrayani Rivers

No.	Fish recorded by various authors	Family	Authors (1-4)		
Osteoglossiformes			**Mula**	**Pawana**	**Indrayani**
1	*Acanthocobitis botia*	Balitoridae	-	3	-
2	*Acanthocobitis moreh*	Balitoridae	1,2	-	-
3	*Acanthocobitis sinatus*	Balitoridae	-	3	-
4	*Amblypharyngodon mola*	Cyprinidae	2	-	4
5	*Aorichthys seenghala*	Bagridae	1,2	-	-
6	*Barilius bendelisis*	Cyprinidae	1,2	-	-
7	*Catla catla*	Cyprinidae	2	3	4
8	*Chanda nama*	Ambassida	2	3	4
9	*Channa marulius*	Channidae	1,2	3	4
10	*Channa orientalis*	Channidae	1,2	-	-
11	*Channa striatus*	Channidae	-	3	-
12	*Chela cachius*	Balitoridae	-	-	4
13	*Cirrhinus fulungee*	Cyprinidae	1,2	3	4
14	*Cirrhinus mrigala*	Cyprinidae	2	-	-
15	*Cirrhinus reba*	Cyprinidae	1,2	3	4
16	*Clarias gariepinus* (Burchell, 1822)	Claridae	-	-	4
17	*Crossocheiluslatius latius*	Cyprinidae,	1,2	3	-
18	*Cyprinidae danioniae*	Cyprinidae	1,2	-	-
19	*Cyprinus carpio*	Cyprinidae	2	-	-
20	*Danio aequipinnatus*	Cyprinidae	1,2		
21	*Danio devario*	Cyprinidae	2	-	-
22	*Garra mullya*	Cyprinidae,	1,2	3	4
23	*Glossogobius giuris*	Gobiidae	1,2	3	
24	*Glyptothorax madraspatanum*	Sisoridae	1,2	-	-
25	*Glyptothorax poonaensis* (Hora, 1938)	Sisoridae	-	-	4
26	*Gonoproktopterus curmuca*	Cyprinidae		-	4
27	*Gonoproktopterus kolus*	Cyprinidae	1,2	-	-
28	*Gonoproktopterus thomassi*	Cyprinidae	2	-	-
29	*Heteropneustes fossilis* (Bloch, 1794)	Heteropneustidae	2	3	4
30	*Labeo ariza*	Cyprinidae	2	3	4
31	*Labeo boggut*	Cyprinidae	1,2	3	4
32	*Labeo calbasu*	Cyprinidae	1,2	3	4
33	*Labeo porcellus*	Cyprinidae	1,2	3	4
34	*Labeo rohita*	Cyprinidae	2	3	4
35	*Lepidocephalus guntea*	Cobitidae,	1,2	3	4
36	*Mastacembelus armatus*	Mastecembalidae	1,2	3	4
37	*Mystus bleekeri*	Bagridae	1,2	3	4
38	*Mystus cavasius*	Bagridae	1,2	-	-
39	*Mystus malabaricus*	Bagridae	-	3	4
40	*Mystus montanus*	Bagridae	-	3	-
41	*Mystus seengtee* (Sykes,	Bagridae	-	-	4

No.	Fish recorded by various authors	Family	Authors (1-4)		
	1839)				
42	*Nangra itchkeea*	Sisoridae	1,2		
43	*Nemacheilus anguilla* (Annandale)	Balitoridae	1,2	3	-
44	*Nemachilichthys ruppelli*	Balitoridae	1,2	-	-
45	*Neolissochilus hexagonolepis*	Cyprinidae	-	3	-
46	*Neotropius khavalchor (*Kulkarni, 1952)	Schilbeidae	-	-	4
47	*Notopterus notopterus* Pallas	Notopteridae	2	-	-
48	*Ompok bimaculatus* (Bloch, 1794)	Siluridae	1,2	-	4
49	*Oreochromis mossambicus*	Cichlidae	2	-	4
50	*Oreonectes* (*Indoreonectes evezardi*)	Balitoridae	1	-	-
51	*Osteobrama cotio peninsularis*	Cyprinidae	2	3	4
52	*Osteobrama neilli*	Cyprinidae	1,2	-	4
53	*Osteobrama vigorsii*	Cyprinidae	1,2	-	4
54	*Osteochilichthys nashii*	Cyprinidae	1,2	-	-
55	*Parambassis ranga*	Ambassidae	2	-	-
56	*Parapsilorhynchus tentaculatus annandale*	Parapsilorhy-nchidae	1,2	-	-
57	*Poecilia reticulata*	Poeciliidae	2	-	4
58	*Proeupropiichthys taakree*	Schilbeidae	1,2	-	-
59	*Puntius amphibius*	Cyprinidae	1,2	3	-
60	*Puntius chola*	Cyprinidae	1,2	3	-
61	*Puntius conchonius* (*Hamilton,* 1822)	Cyprinidae	-	3	-
62	*Puntius jerdoni*	Cyprinidae	1,2	3	4
63	*Puntius sarana subnasutus*	Cyprinidae	2	3	4
64	*Puntius sophore*	Cyprinidae	2	3	4
65	*Puntius ticto*	Cyprinidae	1,2	3	4
66	*Puntius vittatus*	Cyprinidae	-	3	-
67	*Rasbora daniconius*	Cyprinidae	1,2	3	4
68	*Rita gogra* (Sykes, 1839)	Bagridae	-	-	4
69	*Rita pavimentatus*	Bagridae	1,2		
70	*Rohtee ogilbii* (Sykes,1839)	Cyprinidae	1,2	-	4
71	*Salmophasia balookee* (Sykes, 1839)	Cyprinidae	-	-	4
72	*Salmostoma acinaces*	Cyprinidae	-	3	-
73	*Salmostoma boopis*	Cyprinidae	1,2	3	-
74	*Salmostoma novacula*	Cyprinidae	1,2	-	-
75	*Schistura denisoni*	Balitoridae	2	3	4
76	*Sperata seenghala* (Sykes, 1839)	Bagridae	-	-	4
77	*Wallago attu* (Bloch &Schneider, 1801)	Siluridae	1,2	3	4
78	*Xenentodon cancila* (Hamilton, 1822)	Belonidae	2	3	4

*** 1:** Hora -Mishra (1942), **2**: Wagh and Ghate (2002); **3**: Chandanshive *et al.* (2007); **4**: Dahanukar *et al* (2012)

Appendix 9 PCMC Recognising Citizen's Efforts towards Environment

1) Mr. Vikas Patil, Environmental Specialist, member of Maharashtra State Environment committee, Pune; CVTC Pune:
   Since 1975 after voluntary retirement from Telco he is involved in various activities for conservation and development of good environment in PCMC area.
2) Mr. Suhas Joshi, Wakad:
   Woods society of 300 flats in Wakad area is treating their household solid waste in their own premises. The compost is used for garden and hence the load and cost of transportation and treatment of solid waste by PCMC is reduced.
3) Mr. Umesh Waghela (Ornithologist):
   He is an architect by profession and he likes to study regarding birds and their nests. On this topic he has given presentation at various places and has created interest and awareness regarding birds among the society.
4) Mr. ManikDharmadhikari:
   In near-by village and in PCMC area he has planted about 2500 trees and has been active in promoting tree plantation and solid waste management.
5) Goel Ganga Group:
   Ganga Skies, VallabhnagarPimpri, a building constructed by M/S.Goel Ganga group has been rated 3-star by Griha-a group of building rating system developed by MNRE and TERI, which will lead us to sustainable development of PCMC.
6) Mr. Somnath Marne:
   Since 2007 to 2012, he has planned and implemented total 1237 rain water harvesting projects in PCMC area.
7) Mr. Naveen Punawale:
   He has developed a terrace garden on his own terrace and is using vermi-compost developed by him from the kitchen waste.
8) Mr. VasudevShirsat:
   He is a PCMC employee working at WTP sector no.23, Nigadi. Since last 12 years he himself has developed saplings, planted and nourished about 350 fruit trees in the water treatment plant premises.
9) Mr.DhananjayShedbale, Nigadi:
   He works with Nisarg Mitra and Group. He has distributed 10000 plants in the near-by area. He prefers using bicycle and public transport for travelling.
10) Mr. AbasahebJangale, Sangavi:
    He has developed a terrace garden in his own house and uses the compost developed from household kitchen waste. He has used broken plastic bottles and scraps for plantation.