

Report On Action Plan for Air Quality Improvement of Dehradun City



Sponsored By:



**Uttarakhand Environment Protection
Pollution Control Board, Dehradun.**

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CHAPTER - 1

1.1 Introduction

Urbanization in India is more rapid around the major cities in India. Increase in industrial activities, population both endemic and floating and vehicular population etc. have led to a number of environmental problems, one of them being air pollution. Various contaminants continuously enter the atmosphere through natural and man-made processes and these contaminants interact with the environment to cause disease, toxicity, environmental decay and are labeled as pollutant. Air Pollutants means any solid, liquid or gaseous substance (including noise) present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment.

Environment: includes water, air and land and the interrelationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organisms and properties. Air pollution is basically the presence of air pollutants in the atmosphere.

The air has a relative constant composition of gases and is utilized by most of the living organisms in respiration to liberate chemical energy for their survival. This composition determines its quality and is being changed in the recent past due to emission of large amount of un-natural materials in the atmosphere by industries and automobiles. This changed quality became a great threat to survival of life, properties, materials and ecosystem as a whole.

In order to arrest the deterioration in air quality, Govt. of India has enacted Air (Prevention & Control of Pollution) Act in 1981. The responsibility has been further emphasized under Environment (Protection) Act, 1986. The National Ambient Air Quality Standards have been



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more strengthen in November 2009. It is necessary to assess the present and anticipated air pollution through continuous air quality survey/monitoring programs.

An inventory of air pollutants is a necessary first step towards control of air pollution. Air pollutants can be natural or may be the result of various anthropogenic activities like industrial emissions. Further the air pollutants can be primary or secondary depending upon their formation mechanism. Primary pollutants are directly emitted from the source and secondary pollutants are formed in the atmosphere.

Meteorological factors play a critical role in ambient concentrations of air pollutants. Even though the total discharge of air pollutants into the atmosphere may remain constant, the ambient concentrations of air pollutants may vary depending upon the meteorological conditions.

Air (Prevention and Control of Pollution) Act 1981 Government of India enacted the Air (Prevention and Control of Pollution) Act 1981 to arrest the deterioration in the air quality. The act prescribes various functions for the Central Pollution Control Board at the apex level and State Pollution Control Board at the state level. The main functions of the Central Pollution Control Board are as follows:

- To advice the Central Government on any matter concerning the improvement of the quality of the air and the prevention, control and abatement of air pollution.
- To plan and cause to be executed a nation-wide programme for the prevention, control and abatement of air pollution.
- To provide technical assistance and guidance to the State Pollution Control Board.
- To carry out and sponsor investigations and research related to air pollution prevention, control and abatement of air pollution.
- To collect, compile and publish technical and statistical data related to air pollution; and
- To lay down standards for the quality of air and emission quantities.



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The main functions of the State Pollution Control Board are as follows:

- To plan a comprehensive programme for prevention, control or abatement of air pollution and to secure the execution thereof;
- To advise the State Government on any matter concerning prevention, control and abatement of air pollution.
- To collect and disseminate information related to air pollution.
- To collaborate with Central Pollution Control Board in programme related to prevention, control and abatement of air pollution; and
- To inspect air pollution control areas, assess quality of air and to take steps for prevention, control and abatement of air pollution in such areas.

1.2 National Ambient Air Quality Standards (NAAQS): The ambient air quality objectives/standards are pre-requisite for developing management programme for effective management of ambient air quality and to reduce the damaging effects of air pollution. The objectives of air quality standards are: -

- To indicate the levels of air quality necessary with an adequate margin of safety to protect the public health, vegetation and property.
- To assist in establishing priorities for abatement and control of pollutant level;
- To provide uniform yardstick for assessing air quality at national level;
- To indicate the need and extent of monitoring programme; and

The revised National Ambient Air Quality Standards are depicted in Annexure-I. These standards are based on the land use and other factors of the area.

Air Quality Monitoring Ambient air quality monitoring is required to determine the existing quality of air, evaluation of the effectiveness of control programme and to identify areas in need of restoration and their prioritization. National Air Quality Monitoring Programme is described in this chapter alongwith details on pollutants measured and their frequency.

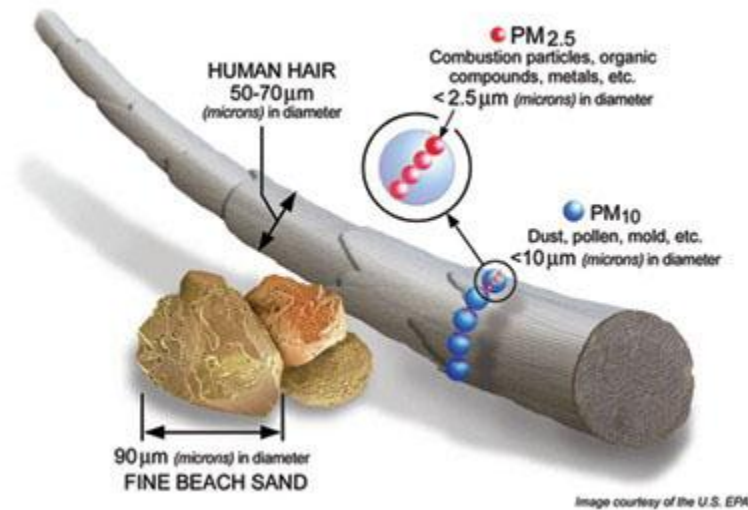


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In urban areas – both in commercial and tourist places, it is predominately vehicular pollution that contributes to air quality problem. The worst thing about vehicular pollution is that it cannot be avoided as the vehicular emissions are emitted at the near-ground level where we breathe. Dehradun attracts a large number of visitors, both business and tourists respectively. What matters is not the large number of visitors, but the type of visitors, their vehicles, emission from these vehicles, the quality of traffic management to achieve compatibility between vehicle movement & parkings undertaken by the visitors and the commercial / tourists area objectives. Pollution from vehicles gets revealed through symptoms like cough, headache, nausea, irritation of eyes, various bronchial problems and visibility. This is due to discharges like CO, unburned HC, NO_x, & particulate matter (PM₁₀ & PM_{2.5}). PM₁₀ is particulate matter 10 micrometers or less in diameter, PM_{2.5} is particulate matter 2.5 micrometers or less in diameter. PM_{2.5} is generally described as fine particles. By way of comparison, a human hair is about 100 micrometres, so roughly 40 fine particles could be placed on its width.

Particle pollution, also called particulate matter or PM, is a mixture of solids and liquid droplets floating in the air. Some particles are released directly from a specific source, while others form in complicated chemical reactions in the atmosphere.

Particles come in a wide range of sizes. Particles less than or equal to 10 micrometers in diameter are so small that they can get into the lungs, potentially causing serious health problems. Ten micrometers is less than the width of a single human hair.



PM_{2.5} Particles in air

Particle pollution is a mixture of solid particles and liquid droplets. It monitors the air for two categories of particle size: PM_{2.5} and PM₁₀. These particles are very small and are measured in micrometers (μm).

PM_{2.5} particles are smaller than 2.5 micrometers (0.0025 mm) in diameter. Often described as fine particles, they are up to 30 times smaller than the width of a human hair.

The PM_{2.5} data on our website is reported as a mass per volume of air – micrograms per cubic meter ($\mu\text{g}/\text{m}^3$). At some air monitoring stations we also measure particles in terms of visibility reduction.

Health effects of PM_{2.5} particles

PM_{2.5} particles are small enough to be breathed deep into the lungs. This can cause health effects. Children, people over 65, pregnant women and people with existing heart or lung



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conditions (including asthma) are more sensitive to the effects of breathing in fine particles. Symptoms may include wheezing, chest tightness and difficulty breathing.

For more information see Effects of smoke.

Sources of PM_{2.5} particles

PM_{2.5} particles result from the burning of fossil fuels (such as coal), organic matter (including wood and grass) and most other materials, such as rubber and plastic. Motor vehicles, power plant emissions and bushfires are all major sources of fine particles.

Monitoring of PM_{2.5}

The levels of PM_{2.5} particles in the air is measured using different types of air monitors. Most of PM_{2.5} air monitors produce data that goes on this website. This includes data from some portable air monitors.

The portable mobile monitors allows to monitor air quality at a greater variety of sites. Although they are less accurate than other types of PM_{2.5} monitors, they provide a good indication of local air quality and complement the data from other particle monitors.

One-hour average and 24-hour rolling average

The 24-hour rolling average is the average of the hourly readings of PM_{2.5} over the previous 24-hour period.

- Data collected by air monitors that meet Australian Standards is shown using health categories.
- Data collected by portable air monitors is shown using air quality categories.

PM_{2.5} Health Categories

Department of Health and Human Services (DHHS, US), have developed a system of seven categories for smoky air . The categories are based on the concentrations of PM_{2.5} in the air. Each category has practical health advice that members of the community can follow in the event of smoky conditions.

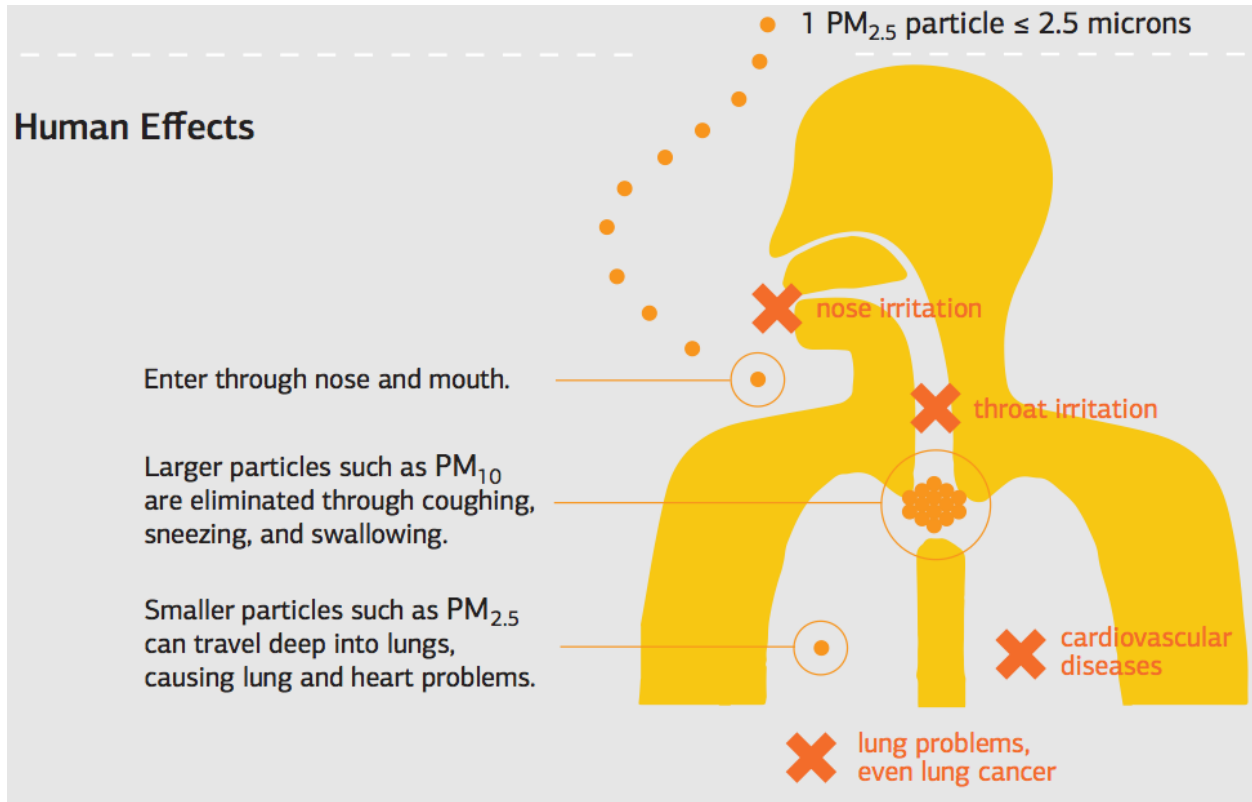


Figure: Health Effects of PM_{2.5}

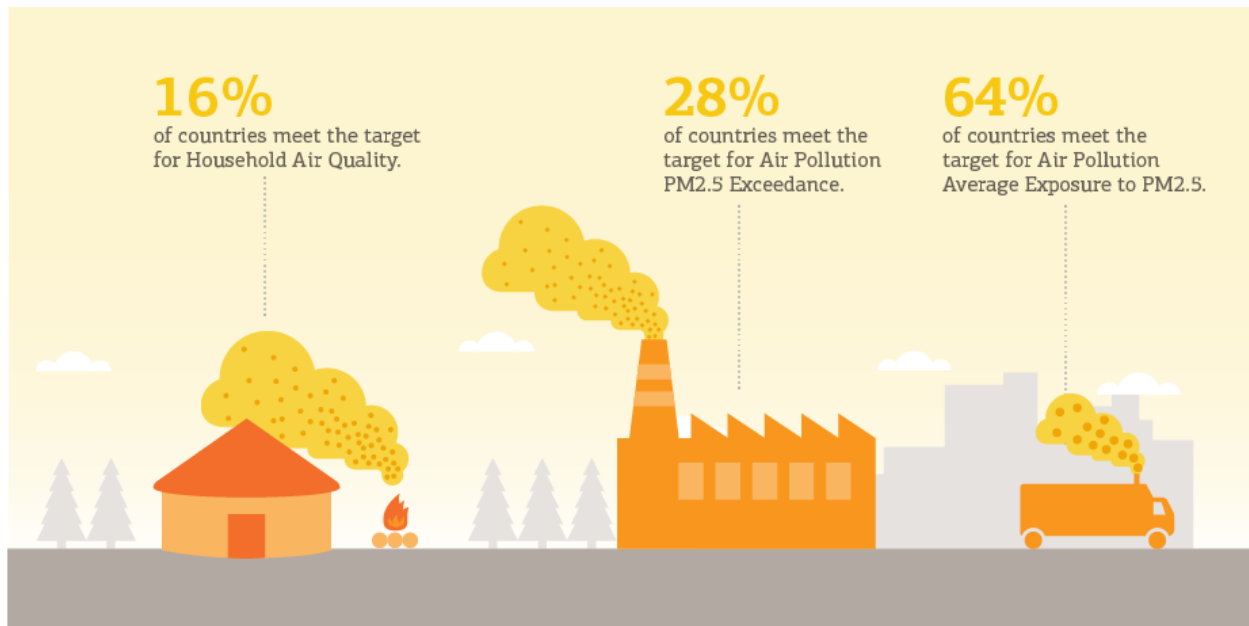


Figure: Emission Sources

Coarse dust particles (PM₁₀) are 2.5 to 10 micrometers in diameter. Sources include crushing or grinding operations and dust stirred up by vehicles on roads.

Fine particles (PM_{2.5}) are 2.5 micrometers in diameter or smaller, and can only be seen with an electron microscope. Fine particles are produced from all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes.

A compelling reason for controlling air pollutants such as suspended particulate matter (SPM) or respirable suspended particulate matters (RSPM) or sulphur dioxide (SO₂) is their damaging effect on human health. Of all air pollution constituents, the WHO has identified SPM as the most sinister in terms of its effect on health. The **Sulphur Dioxide (SO_x)** is a Colourless Gas (Diesel-driven vehicles) which causes Bronchitis, frequent colds, emphysema, lung cancer. The **Nitrogen Oxide (Nox)** is a Yellowish gas (Diesel-driven) which causes Bronchitis, low lung function in children, high incidence of asthma. NO_x combines with



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oxygen to form ozone, which causes progressive lung damage. The **Carbon Monoxide (CO)** is a invisible gas (Petrol-driven vehicles) which impairs oxygen-carrying capacity of blood. It affects central nervous system, causes high blood pressure, & heart disease. More than 3% concentration by volume in respired air can lead to sudden death.

The Hydrocarbons (HC) is a sweet smelling, colourless or whitish gas (emitted by two-three wheelers) which causes Bronchitis, eye irritation, cataracts, cancer of skin & liver.

The Respirable suspended particulate matter (RSPM or PM₁₀) is a bits of carbon, ash and oil emitted specially from diesel-driven vehicles. 20% vehicles are diesel powered. The fine particulate matter (PM_{2.5}), affects the worst, as range in size from 1.5 to 2.5 micrometers and are fine enough to be deeply respirable.

In tourist/commercial places, the growing influx of visitors have increased the vehicles entry in the area tremendously. The floating population of vehicles plying in these places effects the air quality. All types of vehicles (irrespective of their age) - motor cycles, scooters, auto rickshaws, cars, trucks & lorries ply in the town and highways. The parking for the vehicles is also not adequate in the areas and therefore these are parked along the roads. The tourist places and commercial places are greatly affected due to non – conformity of the Vehicular Pollution norms, old technology vehicles, use of mixed fuel / adulterated fuel used by three wheelers.

Fuel quality is also very important as the transport sector is single largest user of oil and oil products, 57 % per cent of total consumption (112 Million MT/annum). Personal transport uses almost all of petrol. Road transport consumes more than 62 per cent of diesel.

ADB estimates have estimated that in India, consumption of fuels by vehicles in 2035 could be five times that of the 2005 level.



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A compelling reason for controlling air pollutants such as suspended particulate matter (SPM) or respirable particulate matters (RPM) or carbon monoxide (CO) is their damaging effect on human health.

Presently, we do not have any assessment of vehicular pollution problems due to the influx of devotees / tourists coming to commercial / tourist places. Also, no Management plan for vehicular pollution control and ambient air quality has been developed for these places. Therefore, UEPPCB, Dehradun has awarded a project on Action Plan for ambient Air Quality Improvement of Dehradun City to **Pollution Control Research Institute, BHEL Haridwar**, as Dehradun is an important tourist place because of pilgrimage due to holy Ganga River.



CHAPTER - 2

SCOPE OF WORK FOR ACTION PLAN FOR AMBIENT AIR QUALITY IMPROVEMENT OF DEHRADUN CITY

2.1 Objectives of Study:

1. To measure baseline pollutants and air toxic levels at different locations of Dehradun city which includes residential, industrial, background (reference), commercial and sensitive areas.
2. To inventories various pollutants in Dehradun city.
3. Identification and inventorization of emission sources (industry, traffic, power plants, local power generation, small scale industries etc.), source appointment in Dehradun city.
4. Application of mathematical model to assess the dispersion of modeling of PM₁₀ and NO_x over some locations of the city from various sources at existing and future scenarios.
5. To assess some mitigating options for reductions of air pollutants in the Dehradun city.
6. Preparation of action plan for ambient Air Quality Management for Dehradun city.

2.2 Scope Of Work for the study:

1. Development of detailed emission inventory in the grid around the air quality monitoring stations for pollutants (such as SO₂, NO_x, CO, PM₁₀ and PM_{2.5}) will be established throughout the Dehradun city.
2. Development of software for emission database and information/data retrieval system.
3. The study will include monitoring ambient air quality for 30 days continuously in each season (summer, post-monsoon and winter) at each seven identified locations.



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4. Air monitoring stations were installed at locations such as near roadside, residential, industrial, outskirts (reference), commercial and sensitive areas or downwind of the city. There will be 7 air monitoring stations in Dehradun city for the purpose of this study.
5. In each station 24 hrs. Average monitoring of ambient air quality for thirty days continuously in each season (summer, post-monsoon and winter) with total of 90 sampling days in year. Monitoring of the pollutants such as: SO₂, NO_x, CO, SPM, PM₁₀ and PM_{2.5} shall be carried out. The monitoring and analysis of the above mentioned parameters will be done as per CPCB/MoEF methods.
6. In order to get a wider cross section of vehicles in-use/on-road, a systematic survey of vehicle population shall be undertaken in the city.
7. Automotive Research Association of India (ARAI) developed emission factors for each representative vehicle considering vehicle technology, age, traffic and conditions including influence of fuel quality with or without tail pipe treatment will be used.
8. The emission factors will be used to estimate the emission load.
9. The meteorological data obtained from weather monitoring stations will be used for air quality modeling. Permanent weather monitoring station will be installed at the representative location throughout the period of ambient air monitoring; the weather monitoring will be installed at one particular location.
10. Applicability of receptor modeling technique and their applicability in India context e.g. fingerprinting, chemical mass balance, multivariate analysis).
11. Source apportionment analysis will be carried out for the components of PM using receptor model.
12. Dispersion modeling and source apportionment of air pollutants.
13. Application of suitable dispersion models like- ISCST3, the critical air pollutants levels (NO_x, PM₁₀ etc.) in ambient air would be predicted under different scenarios based on actual measurement.



CHAPTER – 3

Methodology of Study

3.1 Methodology

The ambient air quality measurement has been done during summer and winter season of tourist influx of vehicles and commercial places. The study has been carried out as per the method of Indian Standards (IS 5182) and CPCB guidelines. The topography, city map and weather data will consider to select the monitoring stations for ambient air quality assessment. The other areas like parking areas, entry points in tourist and commercial places and main roads in the town will be considered.

The vehicular pollution load is calculated based on the emission factors of various types of vehicles, kilometer run in the tourist place, number of vehicles and average of vehicles.

3.1.1 Proposed Methodology, Objectives and Scope of Work:

1. Identification and inventorization of emission sources (industry, traffic, power plants, local power generation, small scale industries etc.) in Dehradun city;
2. To measure baseline air pollutants and air toxic levels at different parts of Dehradun, which includes “hot spots” on kerbside as well;
3. To project emission inventories using mathematical models taking into account of vehicle population/ improvements in vehicle technology, fuel quality changes and other activities having impact on ambient air quality thereof;
4. Application of receptor modeling to PM10 levels in ambient air to arrive at source apportionments.
5. Application of ISCST3 modeling to assess the dispersion of PM10 and NO_x over some locations of the city from various sources at existing and future scenarios.



6. To assess some control options for reductions of air pollutants in the Dehradun city after studying the results from emission inventory, dispersion modeling, CMB modeling and factor analysis.

3.1.2 The overall methodology & scope for this study is summarized below:

1. Development of detailed emission inventory in the grid of 2×2 sq-km around the air quality monitoring stations for pollutants (such as: SO₂, NO_x, CO, SPM, PM₁₀ and PM_{2.5}) are being established throughout the city of Dehradun.

2. Development of software for emission database and information/data retrieval system.

3. The study has been carried out by monitoring ambient air quality for thirty days continuously in each season (summer, post-monsoon and winter) at each identified location.

4. Air monitoring stations were installed at locations such as kerbside, residential, industrial, outskirts (reference), commercial and sensitive areas or downwind of city. There are 7 air monitoring stations in Dehradun city for the purpose of this study.

5. In each station 24 hrs average data were considered by monitoring ambient air quality for thirty days continuously in each season (summer, post-monsoon and winter) with total of 90 sampling days in a year. Monitoring of the pollutants such as: SO₂, NO_x, CO, SPM, PM₁₀ and PM_{2.5} are being carried out.

6. Analyses of the above monitored parameters were done by the recommended methods.

7. Kerbside by definition is site with sample inlets within 1 m of the edge of a busy road and sampling heights are at 3 m elevation. If for reasons, 1 m of the road edge is not possible, declare the site as roadside location, which has the definition of being a site with sample inlets between 1m of the kerbside of a busy road and the back of the pavement. Typical are within 5 m of the kerbside and the sampling height remains at 3 m elevation.



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8. In order to get a wider cross section of vehicles in-use / on-road and the actual distance traveled by each sample vehicle, a systematic survey of vehicle population was undertaken in the city. Also, special emphasis was laid on the emission factors from vehicles of pre Euro / India 2000 as these form higher percentage in total vehicle population for assessing cost effective solutions.

9. Automotive Research Association of India (ARAI) developed emission factors for each representative vehicle considering vehicle technology, age, traffic and conditions including influence of fuel quality with or without tail pipe treatment are being used.

10. For all other sources, the emission factors finalized by the CBCB expert committee are being used to estimate the emissions.

11. The actual meteorological data obtained from weather monitoring stations are being used for air quality modeling. Two permanent weather monitoring stations were installed on two of the locations throughout the year and also at the time of the sampling station, the weather monitoring were installed at that particular station.

12. Review of receptor modeling techniques and their applicability in Indian context (e.g. fingerprinting, chemical mass balance, Multivariate analysis). Adoption of the technique suitable for study area.

13. Source apportionment analyses are being carried out for the components of PM using receptor model. For these purpose, relevant details pertaining to the city were gathered.

14. Further, by the way of application of suitable air dispersion models like ISCST3, the critical air pollutant levels (NO_x, PM₁₀ etc.) in ambient air were predicted under different scenarios on an attempt were made to validate the model based on actual measurements.

The following steps will be followed to fulfill the objectives of the project, which formed the scope of work for this project .



3.2 Preliminary Survey and Collection of Data

The preliminary survey has been carried for Dehradun as a tourist and commercial place.

This is to be carried out from different literature, books on the subject. Reports on the studies already carried out was also referred. This provides input for preparation of guidelines. Preliminary survey of sites was carried out in the city Dehradun. The vehicle entry points at Dehradun was physically inspected and studied. The five vehicle entry points were identified at Dehradun and three at which are described in the forthcoming Chapters. The ambient air quality monitoring points at Dehradun were also finalized during the preliminary site visit. This is essential as each place has some specific places of commercial and tourists important where vehicular congestions occurs at various hot spots. The review and detailed study was carried out. The locations of parking, entry points and movement of vehicles inside the main spots are identified. The data has been collected in the Summer, Post monsoon and winter season.

The road maps, data on type of vehicles entering in the tourist place of Dehradun were collected.

The summer season in Dehradun is from April to July when maximum number of tourists arrive, going to Mussorie and Post monsoon and winter is from October to March. The summer tourist season is from April to July, post monsoon season is from September to November and winter season from December to February. The summer, post-monsoon and winter season will be monitored. Evaluation of number of tourists & tourist vehicles coming in the proposed place during all the three seasons. This is done at all the entry points to the proposed tourist place.

The mode of transportation (Vehicular Mix) used for commuting within the selected study place. The vehicle count has been done at all the major places.

The road infrastructure was also studied for selected / proposed place.



Assessment of the ambient air quality during summer, Post Monsoon and winter period at the representative and prominent places will be carried out using the PM_{2.5}, Respirable Dust Samplers for SPM, RSPM, SO₂, NO_x. The Carbon Monoxide (CO) will be monitored using ambient air analyzer. Equipment used are :

1. PM_{2.5} Sampler
2. Respirable Dust Sampler
3. CO monitor

Methodology for Sampling and Analysis

Respirable Suspended Particulate Matter

The Respirable Suspended Particulate Matter (RSPM) monitoring was carried out as per IS:5182, Part 4. As per requirements of the present study, ambient air monitoring was carried out for 07 Nos. sampling stations in Dehradun city. The ambient air quality monitoring was done continuously for a month in Summer, Post Monsoon and Winter. The gravimetric detection method was used for the analysis of SPM. Respirable dust Sampler was used for sucking the ambient air through a glass fiber filter paper. Initially the blank filter paper was weighed after drying in an oven. The weight of the filter paper after sampling was again taken after drying it.

Respirable Suspended Particulate Matter

The Respirable Suspended Particulate Matter (RSPM) monitoring was carried out at the same seven (07) ambient air monitoring locations. The frequency of monitoring was twice a week per location and twenty four hourly samples per day per location was done. The gravimetric detection method was used for the analysis of SPM. Respirable Particulate Sampler was used for sucking the ambient air through a cyclone and glass fiber filter paper. The larger particles (> 10 microns) were collected in polythene through the cyclone. The

finer particles (Respirable Particle) were collected on the filter paper surface. The gravimetric detection method was used for the analysis of filter paper.



Figure -3.1 Meteorological Monitoring Station Installed



Figure - 3.2 Ambient Air Monitoring Station



Sulphur Dioxide (SO₂)

For the monitoring of SO₂, IS:5182, Part 2 was followed. The ambient air was sucked through a tapping in the exhaust side of the High Volume sampler. The frequency of monitoring was twice a week per location and twenty four hourly sampling per day per location.

SO₂ was absorbed in a solution of Sodium Tetrachloro Mercurate thus forming a stable Dichloro sulphito mercurate. The concentration of SO₂ was then estimated by the colour produced when p-rosaniline hydrochloride was added to the solution. The colour was estimated by using a Spectrophotometer, set at 560 nm wavelength for which a calibration curve was prepared.

Oxides of Nitrogen (NO_x)

For the monitoring of NO_x, IS:5182 Part 6 and Emission Regulation Part 3 were followed. The ambient air was sucked through a tapping in the exhaust side of the High Volume sampler. The frequency of monitoring was twice a week per location and twenty four hourly sampling per day per location was done. For oxides of nitrogen, Sodium hydroxide was used as an absorbing solution. Sodium Arsenite was also added into the absorbing solution to increase the absorbing efficiency. The nitrite ion produced during sampling was determined colorimetrically by reaction of exposed absorbing reagent with Phosphoric Acid, Sulphanilamide & NEDA (Jacobs & Hochheiser method).

Carbon Monoxide

The carbon Oxide was measured using the instrument Environment S.A., based on NDIR principle. The concentration was measured in ppm.

Assessment of vehicular pollution problems during summer and winter periods has been done. Formulation of Vehicular Pollution Control and Ambient Air Quality Management Plan has been done specific to the proposed places & in line considering the objectives of the project.



3.3 Interaction with Civil Authorities & others and detailed data collection

At each of these places civil authorities like Municipal Boards, transport Departments, District Administration authorities, State transport authorities, Private taxi persons, Auto rickshaw persons, Public Health Departments, tourist and commercial authorities have been consulted and ground situation was understood. Such authorities are contacted to understand the problems faced during such mass congestions, existing traffic management, road network and future plans. The probable city plans for vehicular management and control vehicular pollution from Town Planners have been collected to provide input for suggesting future areas for better parking and vehicular management.

Assessment of summer & winter tourist’s period in a considered commercial place (Dehradun) will be done.

Compilation of Information -

Information obtained have been compiled so as to provide details on present status. This data have been used for the Assessment of Vehicular Pollution and development of Vehicular Management Plan at tourist and commercial place and the other requirement of the project as mentioned above.

3.4 Study at Dehradun as a Tourist place during Summer, Post-Monsoon and Winter season

The assessment of vehicular pollution was done by :

1. Carrying out Vehicle Count at four places

- I. Ghanta Ghar - Centre of city
- II. ISBT - Main Bus Terminal of Dehradun
- III. ONGC /FRI - Research Clean area with the vegetation & green area
- IV. Survey Area - Busy area, vehicular pollution



2. Ambient Air Quality Monitoring at seven places

The brief description of sites are given below:

1. Ghanta Ghar
2. ISBT
3. ONGC/FRI
4. Survey Area
5. Rajpur Road
6. Raipur
7. Wildlife Institute of India (WII)

3.4.1 Emission Factors for Calculating the Emission Load

The emission factors taken for two wheelers, three wheelers, four wheelers, MUVs, LCVs, HUVs were based on various factors as given below :

1. Type and Make of Vehicle
2. Load carrying of Vehicles
3. Age of Vehicles
4. Fuel Used
5. Total kilometers Run

It was inferred that after studying the vehicles during vehicle count at various location in Dehradun which are based on above facts that vehicles were not meeting the Bharat 1, 2, 3 & 4 standards. No one standard can be taken for this kind of study.

3.5 Methodology and Emission Factor

In the present studies following methodology has been followed while determining the Emission of pollutant from Traffic:

- 1) The Vehicle Density was determined from the three locations from where Traffic is entering into the Dehradun Town for 3 days
- 2) The following average distances have been considered for each type of vehicles traveling distances within the Total area of Dehradun City. This was done by the actual sample survey by the Vehicle Owners.
 - Two Wheeler = 10 - 15 km/day
 - Three Wheeler = 10 - 50 km/day
 - Four Wheeler (Car) = 25 - 50 km/day
 - Four Wheeler (Truck) = 5 - 15 km/day
 - Four Wheeler (Buses) = 5 - 15 km/day
 - Light Commercial Vehicles = 15 - 20 km/day

Calculation of Vehicles Emission was done by the following way:

Pollutant (CO, HC, NO_x, SO_x, Lead & Particulate) in Kg/day = Total Number of Vehicle which entered in the Town X Emission Factor of respective Pollutant X Average Distance traveled by Vehicle/day.

The vehicles are of mixed type, heavy load of people on the vehicles, vehicles arriving from long distances, the common Emission factors are derived as given below in **Table 3.1:**

Table : 3.1
Emission factors for the Study

S.No.	Type of Vehicle	CO	NOx	HC	Particulates
		gm/km	gm/km	gm/km	gm/km
1.	2 Wheeler, Cars (Petrol), Car (diesel), MUVs, 3 wheelers, LCVs & HUVs	8.3	7.77	1.57	0.275

Based on the above emission factors the emission rates were calculated which are given in **Chapter 5 & 6.**

3.6 Study at Dehradun

The vehicle count was carried out manually from 9.00 a.m to 6.00 p.m (9 hours) for following type of vehicles :

- 2 Wheeler (all makes : Scooter, Mopeds, Motorcycles)
- Cars (Petrol) (all makes : four wheelers)
- Car (diesel) (all makes : four wheelers)
- Medium Utility Vehicles (MUVs) :Tata Sumo, Tavera, Qualis, Mahindra Jeeps etc.
- 3 wheelers (all makes)
- Light Commercial Vehicles (LCVs) : Four Wheelers : Bajaj Tempo, Tata 407, Force etc.
- Heavy Utility Vehicles (HCVs) : Trucks, Lorries and Buses



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The tally mark method was used for counting the vehicles as given in format below in Table 3.2.

The vehicle count during the summer season at Dehradun was carried out manually in the time interval as given below :

- 9.00 a.m to a.m. 12.00 noon
- 12.00 noon to 3.00 p.m.
- 3.00 pm to 6.00 pm

The Incoming Vehicles were counted.

**Table: 3.2
Format for Vehicle Count**

Locations	TIME	Type	Number of Vehicles
	9.00 am to 12.00 noon	2 Wheeler	HH
		3 Wheeler	
		Car	
		Truck	
		Bus	
		LCV	
		TOTAL	
	12.00 noon to 3.00 p.m.	2 Wheeler	
		3 Wheeler	
		Car	
		Truck	
		Bus	
		LCV	
		TOTAL	
	3.00 pm to 6.00 pm	2 Wheeler	
		3 Wheeler	
		Car	
		Truck	
		Bus	
		LCV	
		TOTAL	



Summer, Post Monsoon and Winter Season: The summer season is when the commercial business and tourist visits Dehradun respectively in maximum numbers during May – July every year. The maximum number of commercial and tourists flow in Dehradun is during Summer season. Winter season when the commercial business flow is minimum during winter season esp. from November to January every year due to cold weather conditions.

It is assumed that the vehicle entering the Dehradun will travel approximately 25 kms in the Dehradun.

3.7 Meteorological Monitoring -

A meteorological station was installed at PCRI, BHEL Dehradun to monitor the hourly Wind speed, Wind direction, Temperature and Relative Humidity. The wind rose during summer, post monsoon and winter season is prepared.

3.8 Preparation of Technical Report -

Based on the study conducted, a technical report has been prepared for Action Plan for Air Quality Improvement of Dehradun Cities.

CHAPTER - 4

4.1 Description of Dehradun

Dehradun is made up of two words: 'Dehra' is derived from the word "dera", deriving from griha and **meaning** home. "Doon" is a term for the valley that lies between the Himalayas and the "Shivaliks". In 2000, Uttarakhand state (earlier called Uttaranchal) was created from the northwestern districts of **Uttar** Pradesh under the **Uttar** Pradesh Reorganization Act 2000. Dehradun was made its provisional capital.



Figure - 4.1 Centre of Dehradun City

Dehradun is Located in the **Garhwal** region, it is 236 km **north** of India's capital New Delhi. Dehradun is in the Doon Valley on the foothills of the Himalayas nestled between two of India's mightiest rivers — the Ganges on the east and the Yamuna on the west.

Nestled in the Doon Valley in the foothills of the Great Himalayas and flanked by two very beautiful as well as mighty rivers the Ganges and the Yamuna on its eastern and western side, Dehradun is one of the most ancient cities of India. Serving as the capital city of Uttaranchal, Dehradun got its name by the union of two words 'Dera' and 'Dun' that means Camp in the Valley. It is also stated that the place got its name from 'Guru Dronacharya' of Mahabharata, as the city is also popularly known as the 'Adobe of Drona'.

This place possesses a strong connection with the Hindu mythological characters Rama and Laxmana who are believed to perform an atonement in Doon Valley. According to a popular legend 'Pandava brothers of Mahabharata' took a rest here while they were on the way to the top of the mountains.

The great Mauryan Emperor Ashoka ruled the city during the 1st century BC. Even a rock edict of this ruler still exists just outside the town near Kalsi. Times passed and the rule of the city too passed from one hand to another that included Sikhs, Mughals, Gurkhas and finally to the British. You can easily observe that some of the parts of the city are still British in style in character. Since the British era ended, after independence, the city has drastically changed itself from a small, quiet town to a commercial and educational center that is also a bustling tourist destination from the world over.



Figure - 4.2 Sahastrdhara in Dehradun

4.1.1 Geography

The **geography of Dehradun** shows it as being located at the center of the Doon Valley in the state of Uttaranchal, forming part of the Garhwal Himalayas. The Himalayas lie to its north, the Shivalik range to its south, the Ganges to its east and the Yamuna to its west. It is about 235 kilometers from Delhi.



Figure - 4.3 Eco - Environment

4.1.2 Demographics

As per provisional reports of Census India, **population of Dehradun** in 2011 was 578,420; male and female are 303,411 and 275,009 respectively. The sex ratio of the city is 906 per 1000 males. The number of literates in **Dehradun** city is 463,791, of which 251,832 are males and 211,959 are females.

The Dehradun district has various types of physical geography from Himalayan mountains to Plains. Raiwala is the lowest point at 315 meters above sea level, and the highest points are within the Tiuni hills, rising to 3700 m above sea level. The Doon valley contains the settlements including Dehradun, Doiwala, Herbertpur, Vikasnagar, Sahaspur, Rishikesh, Raiwala and Clement Town. There district contains Rajaji National Park which is home

4.1.3 Commercial festivals and fares

Tapkeshwar Mela in Dehradun. This festival takes place in second week of February. Hosted at the Tapkeshwar Temple where Lord Shiva is the residing deity, an extravagant fair takes place on the day of Shivrati. Celebrated in the memory of Guru Ram Rai the **Jhanda fair** is one of the most popular events celebrated every year five days after Holi. A popular platform for the showcase of art and culture of the Garhwal tribes, Lakhwar fair is a colourful celebration of tribal culture.



Figure - 4.4 Jhanda fair of Dehradun

The **Army Fair** will provide valuable information regarding Army Bharti and employment. Also this fair will also tell the benefits of the NCC camp and how it will be beneficial in the Army Recruitment. Army will also give a tribute to the martyrs and honour their families.

There will be also exhibition stalls of Life Style, Automobiles, Real Estate, Food and Education. The cultural programmes will be perform by artists from Amar Ujala Talent Search. Famous educational institutes like Graphic Era University, Dolphin Institute, Tulas



Institute and Aviral Classes will also provide support in the education and employment of dependents of martyrs.

4.1.4 Transport

Dehradun being the capital of Uttarakhand has an efficient **transport** system that makes traveling to the city by air, road or rail comfortable and cheap. There are Four ways to travel in dehradun, Vikram, Buses, Tata magic and Auto rikshaw. Dehradun is a small beautiful town which can be covered by any of these, buses are the cheapest way to travel and then vikram in the series, third place is given to tatamagic services and the costliest is auto rikshaw services. Auto rickshaw goes any where from their source, we havn't showed their direction because they take different path depending own you, so be smart keep direction on hand, and take them as you want. enjoy travelling in dehradun adn fall in love again with nautre.

Tourist Places

- Robber's Cave
- Sahastradhara
- Lacchiwalla
- Fun Valley
- Buddha Temple
- Malsi Deer Park
- Tapkeshwar Temple

Dehradun is a trendy hilly tourist destination with its impeccable beauty and charismatic sceneries would not let you unimpressed once you step down on its land. Whether you are a traveller, an adventure seeker, looking for romantic escapes or are just in search of a spiritual adobe, the city has a lot to offer to everyone. Along with other tourist spots, famous scientific museums and lush green sprawling parks, Dehradun is adorned with several



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famous historic buildings that have great architectural value and a number of temples that have spell binding beauty and at the same time are considered to be very auspicious. If you visit the city, keep a tourist map at hand, it would prove to be a great boon while travelling within the city. Dehradun has a subtropical climate with cool winters, hot summers and heavy monsoons. The city also receives a good amount of snowfall during winters which is a major attraction for tourists.

Some facts about Dehradun

- State: Uttarakhand
- Area: 3088.00 square km
- Population : 578,420
- Population Density: 549/km²
- Language: English, Hindi and Garhwali
- Latitude: 30°19'00'N
- Longitude: 78°01'59' E
- Literacy Rate: 89.32%
- Altitude: 960m above sea level
- Sex Ratio: 873 females per 1000 males
- Temperature: 27.8 °C (max); 13.3 °C (min)
- Time Zone: IST (UTC+5:30)
- STD Code: 91-135
- Postal Code: 248001
- Vehicle Code: UK 07
- Average Rain fall: 2073.3mm (Annual)
- Religion: Hindus-86%, Muslims -10%, Jains-1.4%, Others-2.6%



The list of Major Industries in Dehradun are :

Food Processing Industry

Encourage the food processing industry, the government of Uttarakhand provides subsidy for industrial projects. Four Agri Export Zones (AEZ) have been declared for leechi, horticulture, herbs, medicinal plants and basmati rice.

Floriculture and Horticulture

The climate of Dehradun is ideal for growing flowers all through the year. Floriculture and Horticulture is one of the major industries in Dehradun, the horticulture industry is one of the largest foreign revenue earners for the Indian government. Floriculture parks are being established to promote the industry.

Biotechnology

Rare Species of plants and animals are found in the Dehradun region. This makes it ideal for biotechnology industry. Biotechnology makes a positive contribution in agriculture, human and animal health care, environment management and process industries.

Information and Communication Technology

Information and Communication Technology (IT) is one of the sunrise industries in Dehradun along with biotechnology. The IT sector is also counted as one of the major industries in Dehradun. A dedicated information Technology park is coming up in Dehradun to further develop the IT scenario in the region.

The city of Dehradun is the capital of Uttarakhand and this is one of the fastest growing cities of India. The growth of the city is noticeable from all aspects, and that makes the city the next



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targeted place for industrialization by the developing companies and the government of the country too.

Ganga and Yamuna, two of the largest rivers of India are located at both sides of the city, and its situated on the foothills of Himalaya. The geographical situation of the city makes it one of the most attractive places for both tourism and migration, and the development of the city encourages more people to come here too.

Culture of Dehradun

Being the home of people from different religions, Dehradun has become a place for communities with different backgrounds, and that has created a unique culture of the city. That influence of it can be seen on their language, cuisines and art. Communication, education and transportation of Dehradun have surely become the most advanced in the state, and the city is very fast becoming one of the most advanced ones of the country. However, even with the constant growth, the city is clean and calm. A clock tower is situated in the center of the city, and has become a landmark.

Apart from agriculture, many of the people from Dehradun are in business, studies or in the military, which are the results of the educational institutes and the military academy of the city. Basmati rice of Dehradun is exported all over India as is very famous.

Location of Dehradun in Uttarakhand in India

Elevation: 435 m

Weather: 27°C, Wind E at 11 km/h, 99% Humidity



Figure 4.5 Location of Dehradun in Uttarakhand

Road Network

In the present study, three categories of network analysis problems were solved using mostly ArcView Network Analyst extension module. They are Network Tracing; Path Analysis; and Tour Analysis. The methodology provides a means to incorporate existing data sources, integrate the data in a useful environment and visualize results.



Figure - 4.6 Road Network of Dehradun

Tourism

Dehradun is everything that a good tourist destination should be. The city has some very beautiful buildings that are famous for their historical, political and architectural values. These buildings are famous tourist spots of Dehradun where the tourists visit for some



pleasant time. There are some great temples in Dehradun which are really beautiful and according to the popular idioms these temples are auspicious. There are parks in Dehradun which are very well maintained and beautifully. The historical monuments and clock tower are also famous tourist spots of Dehradun.

4.2 Interaction with Civil Authorities and Others :

Municipal Corporation Department : The municipal Corporation was contacted for the information for parking areas in Dehradun: The MCD gave the information on the parking areas and widening of road by removing the encroachment along the road. The officer at MCD briefed that the MCD is responsible for planning new roads and identifying roads that need to be widened/strengthened to enhance the carrying capacity. MCD is responsible for execution and addressing key elements for facilitating traffic and transport management. The role of the traffic police is confined to operating traffic implemented by MCD and enforcing traffic regulatory mechanisms formulated by MCD.

MCD has also given the information that the roads need to be widened in order to de-congest them and ensure free flow of traffic. The basis for the have been decided on the basis of subjective decisions. However, none of the widening proposals have been implemented.

CD Traffic : Traffic management initiatives of MCD are implemented by the Traffic Police Department, which is responsible for enforcement of traffic rules, with regard to parking regulation, regulation of truck movement in the city, and ensuring route adherence of public transport operators, Provision of signage's and other transport infrastructure like bus stations, bus stops, shelters, etc. vests with MCD.

Tourist and Commercial authorities: the promotion of tourism in the State in a planned and environmentally sustainable manner..



Private taxi persons : The private taxi has the network to Delhi, Rishikesh, Dehradun, Badrinath, Gangotri , Yamunotri. They charge base on the market fluctuations. The probable city plans for vehicular management and control vehicular pollution form Town Planners have been collected to provide input for suggesting future areas for better parking and vehicular management .

Auto Rickshaw : The auto rickshaw driver told that they do not go for PUC check. Also they told that there is no regulation of maximum number of passengers to be boarded in the Auto rickshaws.

4.3 General Characteristics of the District

Dehra Dun is the capital city of Uttarakhand, a state in the northern part of India. Located in the Garhwal region, it lies 236 kilometres (147 mi) north of India's capital New Delhi and is one of the "Counter Magnets" of the National Capital Region (NCR) being developed as an alternative centre of growth to help ease the migration and population explosion in the Delhi metropolitan area and creation highways to establish a smart city at Dehradun.

Dehradun is in the Doon Valley on the foothills of the Himalayas nestled between the river Ganges on the east and the river Yamuna on the west. Dehradun is also being called as city of love according to a new trend because of its young new generation. The city is famous for its picturesque landscape and slightly milder climate and provides a gateway to the surrounding region. It is well connected and in proximity to Himalayan tourist destinations such as Mussoorie, and Auli and the Hindu holy cities of Haridwar and Rishikesh along with the Himalayan pilgrimage circuit of Chota Char Dham.

Dehradun Tourism is one of the best tourism, a vacationer can ever think of. The hilly town with its pleasant climate, dotted with a number of tourist's spot has made Dehradun Tourism



an exhilarating experience for many. The hill city of Dehradun was traced out by the British and since then it has become a hot tourist destination for Indian vacationers.

4.3.1 Population :

According to reports of Census India, population of Dehradun in the year 2011 was 578,420; male and female are 303,411 and 275,009 individually.

Talking about population, in order to check out the population of Dehradun in 2017, we need to have a look at the population of the past 5 years. They are as per the following:

1. 2012 – 592,889
2. 2013 – 608,443
3. 2014 – 625,449
4. 2015 – 641,891
5. 2016 – 655,356

Taking a look at the population of Dehradun from the year 2012-16, it has been noticed that there has been an increase of 62,467 in the past 5 years. Therefore, it has been seen that every year the population increases by 12,493. Hence, the population of Dehradun in 2017 is forecasted to be $655,356 + 12,493 = 667,849$. So, the population of Dehradun in the year 2017 as per estimated data = 667,849. **Dehradun Population 2017 – 667,849(Estimated).**

4.3.2 Location

In 2000, Uttarakhand state (earlier called Uttaranchal) was created from the northwestern districts of Uttar Pradesh under the Uttar Pradesh Reorganisation Act 2000. Dehradun was made its provisional capital. After becoming the capital, the city has seen continuous development. Located in the Garhwal region, it lies 236 kilometres (147 mi) north of India's capital New Delhi and is one of the "Counter Magnets" of the National Capital Region (NCR) being developed as an alternative centre of growth to help ease the migration and population explosion in the Delhi metropolitan area and creation. Dehradun district is a district of Uttarakhand state in northern India. The *district* headquarters is ...*Dehradun is located* 230 km from the national capital, Delhi. The national Oil and Natural Gas Commission, Survey of



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India. Geographic Location: Uttarakhand, the 27th state of the Republic of India and was carved out of Uttar Pradesh on 9th Nov 2000. Describes here are the *geographical* features of *Dehradun* along with its climate. ... *Located* in the Doon Valley, *Dehradun* is surrounded by two of the most ... *Dehradun district* is bounded by the Himalayas from the North. Describes here are the *geographical* features of *Dehradun* along with its climate. ... *Located* in the Doon Valley, *Dehradun* is surrounded by two of the most ... *Dehradun district* is bounded by the Himalayas from the North.

Topography Temperatures :

- Summers : 16.7° C – 36° C
- Winters : 5.2° C – 23.4° C

The temperature during the summer months ranges from 16.7 C – 36 C while in the winter months the temperature varies within 5.2 C – 23.4 C. Monsoon rains occurs mainly during the summer time in Dehradun District.

4.4 Economy of Dehradun

Majority of the population in Dehradun is dependent on agriculture as their primary occupation. The district enjoys many agriculture advantages like fertile alluvial soil, sufficient drainage, moderate climate and abundant rainfall. Rice, Wheat, sugarcane, Lychees, Maize, Agro forestry and Animal Production are some of the major crops and enterprises engaged in agriculture.

4.4.1 Infrastructure in Dehradun

The infrastructure in Dehradun has greatly improved in the last 20 years due to the rapid growth in the economy. With the establishment of software Technology Parks of India (SPI) and special Economic zones (SEZ) all over Dehradun, the city has become the Industrial hub



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of Uttarakhand. Apart from that, many regional offices of various companies like Genpact, India mart, Spice Digital Serco, Aptara etc have opened up in the city. Several manufacturing units have also opened up in the Selaqui Industrial Area of Dehradun.

Paltan Bazar and Rajpur Road are the centre of economic growth in Dehradun. Moreover, with the introduction of various shopping malls in the city, many new luxury brands have opened their retail outlets over here. Multiplexes like Gilz Cinemas, PVR Cinemas, Big Cinemas etc. have redefined the entertainment industry of Dehradun.

The city also boasts of an efficient transport system with great connectivity to all the major cities in the country. To make commuting between Delhi and Dehradun more comfortable a Delhi – Dehradun four lane highway is being proposed, which will surely further enhance the economic development of the city.

4.4.2 Availability of Minerals:

In Dehradun city the most popular products available are Zinc Sulphate, Sodium Thio sulphate, Magnesium Oxide. According to Geology and Mines Unit, Directorate of Industries, Uttarakhand, Dehradun the revenue from minerals available in District are as under production.

Zinc Sulphate – Anhydrous Zinc Sulphate (in powder form) with zinc contents minimum 33% free flowing powder. Very Useful for Mineral Mixture plants & in pharma Industries. These Zinc Sulphates can be availed at Industrial leading price. Zinc Sulphate product code is $ZnSO_4$.

Sodium Thio Sulphate - Sodium Thio Sulphate minimum 39% free flowing material of very high High Purity. Very useful for mineral mixture manufacturers & in Pharma Industry. These sodium Thio Sulphates are available at Industrial Leading price. Sodium Thio Sulphate product code is STS,

Magnesium Oxide – We are offering our customers a wide range of Magnesium Oxides. Super White, free flowing. Magnesium oxide. Having magnesium minimum 52%. These Magnesium Oxides can be availed at Industrial leading price. Magnesium Oxide product code is mgo.

4.5 Forest in Dehradun :

The Forest Research Institute is an institute of the Indian Council of Forestry Research and Education and is a premier institution in the field of forestry research in India. This Institute is located from FRI and college area of Dehradun. This Institute was established from 1906. The **Forest** Research Institute (FRI) is an institute of the Indian Council of Forestry Research and Education and is a premier institution in the field of forestry research in India. Forest Research Institute (FRI) Dehradun made a humble beginning as forest school established in 1878. Initial named as Imperial forest research Institute. FRI came into being in 1906. Late renamed as forest Research Institute and colleges. With a number of centers located at different places all over in the country. Forest Research Institute, conferred the status of Deemed university in December 1991 on the recommendations of UGC. Ministry of Human Resource Development, Government of India.



Figure - 4.7 Forest Cover and FRI of Dehradun

Forest Survey of India (FSI), is a premier national organization under the union Ministry of Environment and Forests, responsible for assessment and monitoring of the forest resources of the country regularly. In addition, it is also engaged in providing the services of training, research and extension. Established on June 1,1981, the Forest Survey of India succeeded the "Preinvestment Survey of Forest Resources" (PISFR), a project initiated in 1965 by Government of India with the sponsorship of FAO and UNDP. The main objective of PISFR was to ascertain the availability of raw material for establishment of wood based industries in selected areas of the country. In its report in 1976, the National Commission on Agriculture (NCA) recommended for the creation of a National Forest Survey Organization for a regular, periodic and comprehensive forest resources survey of the country leading to creation of FSI. After a critical review of activities undertaken by FSI, Government of India redefined the mandate of FSI in 1986 in order to make it more relevant to the rapidly changing needs and aspirations of the country.



Malsi Deer Park is a major wildlife lovers attraction after Rajaji National Park in Dehradun. Located at 10 km. from Dehradun at Mussoorie Road. This mini zoological park of garden is



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now developed as a famous family picnic spot in Dehradun and flushed with visitors during weekends.

Location	:	Near Dehradun. Dehradun zoo is situated in the foothills of Mussoorie highway. About 10 kms from Rajpur Road.
Distt/ Travel Time	:	15.4 kms/49 Mins from ISBT Dehradun
Entry Type	:	Paid entry INR 10/-
Exploration Time	:	2 hr
Opening Time	:	10:00 am
Closing Time	:	6:00 am

4.6 Administrative set up :

The Academy is headed by its Chief Engineer and Director. All officers and officials of the Academy are under the administrative control of the Director.

There is a provision of an Administrative Advisory committee for the consideration and decision on administrative matters of the Academy. The committee consists of:

Secretary, Irrigation
Secretary, P.W.D
Secretary, Finance or his nominee
Secretary, Planning or his nominee
Special Secretary, Irrigation
Engineer-in-Chief, Irrigation Deptt
Engineer-in-Chief, P.W.D
Director, State Engineers Academy, Kalagarh



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The Director is assisted by an Additional Director and a Deputy Director in administrative matters. All posts in the Academy have been declared as Ex-Cadre vide G.O.No. 1555-2/81-23-Irrigation-2-109/80, dated 4-7-81.

Dehradun divided in six blocks viz Chakrata, Kalsi, Vikas Nagar, Sahaspur, Raipur and Doiwala. The administrative set up comprises of six Tehsils, namely Dehradun, Chakrata, Tuni, Kalsi, Vikas Nagar and Rishikesh and six Community Development blocks. It has 403 Gram Panchayats, 714 habitation revenue villages (out of 735) and 11 towns. Nearly 66% of villages have populations of less than 500. The district has 5.7% of the state’s geographical area and 17% of its population (16.98 lakhs, as per 2011 census). The growth rate of district Dehradun is 17.9 per thousand having significantly higher proportion of urban settlement (56 percent) than the state as a whole (24%). The district has 21.2% of scheduled caste and scheduled tribe population. Little more than half (51 percent) of the total population of the state are living below poverty line. Almost 90 percent households have electricity facility, 76.9% households have access to safe sources of drinking water and 71.2% households have toilet facilities.

Census 2011 indicates a sex ratio of 902 (Census 2011) which is much lower than the state, Uttarakhand (963). The lower sex ratio in the district could probably be due to sex-selective (male) immigration for enhanced employment and educational opportunities. With respect to the literacy rate, the district scenario is better compared to the state as a whole. The overall literacy rate in Dehradun is 85.24% with higher male literates (90.32 %) than females (79.22%).

Table : 4.1 – Profile of District Dehradun

Profile of District Dehradun			
S. No	Background Characteristics	Number	Percent
1	Geographic Area (in sq. kms)	3088	5.7
2	Number of blocks	6	--
3	Number of Villages (2011 Census)	748	
	Size of Villages (2001 Census)		
	1-500	509	65.8
	501-2000	199	25.7
	2001-5000	45	5.8
	5000+	20	2.5
4	Number of census towns	11	
5	Total Population (2011)	16,98,560	15.1
	-Urban	9,49,560	55.90
	-Rural	7,49,000	44.10
	Total Population Male	893222	52.58
	Total Population Female	805338	47.42
	Population (0 to 6 years)	1,96,298	12.28
6	Sex Ratio (F/M*1000)	902	
	Sex Ratio in Urban	884	
	Sex Ratio in Rural	924	
	Child Sex Ratio (0-6 years)	890	
	Child Sex Ratio in Urban (0-6 years)	866	
	Child Sex Ratio in Rural (0-6 years)	915	
7	Decadal growth rate		32.48
8	Population Density- per sq. km.	550	
9	Literacy Rate (6+ Pop)		85.24
	- Among Males	712934	90.32
	- Among Females	567528	79.22
10	Percent of SC/ST population		21.2
11	BPL Families	55199	--
12	Length of road per 100 sq. km.	40	
13	Percentage of villages having access to safe drinking water facility		79.6
14	Percentage HH having access to safe drinking water*		76.9
15	Percentage of households having sanitation facility (latrine)*		74.7

4.7 Dehradun at a Glance

The museums and institutions are also tourist spots in Dehradun. The museum of Dehradun has a lot of great historical and valuable artifacts which the tourists can learn from and enjoy. The educational and research institutes of Dehradun are partly open for the tourists to visit too. A tourism map of Dehradun can really be a great asset for you if you are visiting the city for a vacation. You can plan your Dehradun tour with an accurate map of the city that you can find online.

Table: 4.2 - Dehradun at a Glance

Area	3088.00 square km
Longitude	78.04° E
Latitude	30.19° N
Average Rainfall	2073.3 mm
Temperature	Maximum: 27.8 °C Minimum: 13.3 °C
Population (2001 census)	1025680
Population Density	332 per square km
Literacy Rate	69.50%
Tehsils	4
Villages	764



CHAPTER - 5

DETAILS OF INDUSTRIES IN DEHRADUN

5.1 Brief Industrial Profile of Dehradun District

Dehradun is the capital city of the State of Uttarakhand in northern India. Located in the Garhwal region, it is 236 km north of India's capital New Delhi and is one of the "Counter Magnets" of the National Capital Region (NCR) being developed as an alternative center of growth to help ease the migration and population explosion in the Delhi metropolitan area.

Dehradun is renowned for its natural resources, publishing services and for its prestigious educational institutions. It hosts some of the countries best boarding schools and training institutions of national importance such as the Indian Military Academy. It is also home to national foundations such as the Indian Institute of Petroleum, Oil and Natural Gas Corporation, Survey of India, Indian Institute of Remote Sensing, Wildlife Institute of India and the Forest Research Institute.

As per provisional reports of Census India, population of Dehradun in 2011 is 578,420; of which male and female are 303,411 and 275,009 respectively. The sex ratio of Dehradun city is 906 per 1000 males.

In education section, total literates in Dehradun city are 463,791 of which 251,832 are males while 211,959 are females. Average literacy rate of Dehradun city is 89.32 percent of which male and female literacy was 92.65 and 85.66 percent.



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Total children (0-6) in Dehradun city are 59,180 as per figure from Census India report on 2011. There were 31,600 boys while 27,580 are girls. Child sex ratio of girls is 873 per 1000 boys.

Climate

The Climate of the district is generally temperate. It varies greatly from tropical to severe cold depending upon the altitude of the area. The district being hilly, temperature variations due to difference in elevation are considerable. In the hilly regions, the summer is pleasant, but in the Doon, the heat is often intense, although not to such degree as in the plains of the adjoining district. The temperature drops below freezing point not only at high altitude but even at places like Dehradun during the winters, when the higher peaks are also under snow. The area receives an average annual rainfall of 2073.3 mm. Most of the annual rainfall in the district is received during the months from June to September, July and August being rainiest. Climate Data of Doon Valley for all the months is as under on the basis of mean of last 25 years.

5.2 Existing Status of Climate of Dehradun Month wise

Table 5.1 Climate of Dehradun

Month	Rainfall (mm)	Relative Humidity (%)	Temperature Mean		
			Min	Max	Avg
January	46.9	91	19.3	3.6	10.9
February	54.9	83	22.4	5.6	13.3
March	52.4	69	26.2	9.1	17.5
April	21.2	53	32	13.3	22.7
May	54.2	49	35.3	16.8	25.4
June	230.2	65	34.4	29.4	27.1
July	630.7	86	30.5	22.6	25.1
August	627.4	89	29.7	22.3	25.3
September	261.4	83	29.8	19.7	24.2
October	32.0	74	28.5	13.3	20.5
November	10.9	82	24.8	7.6	15.7
December	2.8	89	21.9	4.0	12.0
Average Annual	2051.4	76	27.8	13.3	20.0



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5.3 Administrative set up.

This district consists of 6 tehsils namely Dehradun, Chakrata, Vikasnagar, Kalsi, Tjonee and Rishikesh, 6 Community Development Blocks namely Vis, Chakrata, Kalsi, Vikashnagar, Shaspur, Rajpur and Doiwala, 17 towns and 764 villages. Out of these 746 villages are inhabited whereas 18 villages are uninhabited.

5.4 IMPORTANT PHONE NUMBERS OF DISTRICT ADMINISTRATION

Table 5.2 Some Important Phone Numbers of Dehradun Administration

DESIGNATION	PHONE - 1	PHONE - 2	FAX
District Magistrate	2622389	2659975 (Camp)	272005
Addl. District Magistrate (Establishment)	2623819	-	-
Addl. District Magistrate (Finance)	2628893	2623199	-
Chief Development Officer (C.D.O)	2712697	2712825	2712569
Chief Conservator of Forest	2747669	-	-
D.F.O. – Dehradun	2627612	-	-
D.F.O. – Shivalik	2620972	-	-
D.F.O. – Chakrata	275078	-	-
District Judge	2623781	-	-
Addl. District Judge	2620812	-	-
S.D.M. – Sadar	2625220	-	-
S.D.M. – Mussoorie	2722797	-	-
S.D.M. – Vikasnagar	250880	-	-
S.D.M. – Chakrara	2272598	-	-
S.D.M. – Rishikesh	2430421	2430421	-



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Chief Medical Officer	2724506	2658104	-
Chief Medical Superintendent	2714762	-	-
Chief Medical Superintendent (Female)	2659236	-	-
Chief Veterinary Officer	2712891	-	-
Chief treasury Officer	2627205	-	-
Asst. Director – Small Savings	2679039	-	-
P.D. – D.R.D.A	2712591	-	-
District Election Officer	2624216	-	-
District Election Office (Panchyat)	2726732	-	-
Dist Panchyati Raj Officer	2656327	-	-
District Supply Officer	2653724	-	-
D.S.T.O.	2652319	-	-
District Development Officer (D.D.O)	2712481	-	-
G.M.- district Industries Centre	2724903	-	-
B.D.O. - Chakrata	272322	-	-
B.D.O.- Kalsi	25021	-	-
B.D.O – Vikas Nagar	250905	-	-
B.D.O – Sahaspur	2697632	-	-
B.D.O – Raipur	2781673	-	-
B.D.O – Doiwala	2695020	-	-
District Social Welfare officer (Samaj Kalyan)	268099	-	-
District sales Tax Officer	2653737	-	-



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District Excise Officer	2628695	-	-
District Entertainment Officer	2728032	-	-
D.I.O.S	265563	-	-
B.S.A	2679513	-	-
G.M. Garhwal Mandal Vikas Nigam	2743346	2747898	-
G.M. Sugar Mill, Doiwala	2695709	2695796	-
District Horticulture Officer	2724146	2711530	-
District Homeopathic Officer	2742890	-	-
District Agriculture Officer	2727368	-	-
District Fisheries Officer	2640636	-	-
P.O. – N.E.D.A	2679429	-	-
M.D.D.A Office	2672506	2763344	-
Secretary, Mandi Samiti	2020253	-	-
Mukhya Nagar Adhikari	2714074	-	-
Nagar Nigam Health Officer	2658204	-	-
Govt. I.T.I. Niranjanpur	2626288	-	-
Govt. I.T.I. (Women)	2650897	2657132	-
District Home Guards	2655555	-	-
District Sugarcane Officer	2722492	-	-
District Soldier Welfare Dept. (Sainik Kalyan)	2626091	-	-
SSP	2716202	2716203	-
Chief Agriculture Officer	2727368	-	-

Table: 5.3 District at a Glance

5.5 District at a Glance

S. No.	Particular	Year	Unit	Statistics
1	Geographical features			
(A)	Geographical Data			
	i) Latitude			29° 57' 'N and 31° 24' N
	ii) Longitude			77° 35'E and 79 20' E
	iii) Geographical Area	2010	Sq. Km	3088
(B)	Administrative Units			
	i) Sub divisions	2010	NOs	0
	ii) Tehsils	2010	NOs	6
	iii) Community Development Block	2010	NOs	6
	iv) Nyay Panchyat	2010	NOs	40
	v) Gram Panchyat	2010	NOs	370
	vi) Revenue villages	2010	NOs	738
	vii) Non-inhabitated Villages Nagar Palika	2010	NOs	21
	viii) Nagar Nigam	2010	NOs	1
	xi) Nagar Palika	2010	NOs	3
	xii) Nagar Panchyat	2010	NOs	2
	xiii) Cantonment Aea	2010	NOs	1
	ix) Development Authority	2010	NOs	1
	x) Lok Sabha Area	2010	NOs	2
	xi) Rajya Sabha Area	2010	NOs	1
	xii) Vidha Sabha Area	2010	NOs	10
2.	Population			
(A)	Total population	2011	Nos.	1698560
	i) Male	2011	Nos.	893222
	ii) Female	2011	Nos.	805338
(B)	Rural Population	2011	Nos.	749000
3.	Agriculture			
A.	Land utilization			
	i) Total Area	2010-11	Hectare	371223
	ii) Forest cover	2010-11	“	204692
	iii) follow Land	2010-11	“	14058
	iv) Barren & Unculturable Land	2010-11	“	63438
	v) Land under Non-agricultural uses	2010-11	“	3617
	vi) Permanent Pasture & other	2010-11	“	204



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	grazing land			
	vii) Net area Sown	2010-11	“	32075
4.	Forest			
	i) Forest	2010-11	Sq. km.	1451.67
	ii) Reserved Forest	2010-11	Sq. km.	56.74
5.	Livestock & Poultry			
A	Cattle			
	i) Cows	2003	Nos.	336025
	ii) Buffaloes	2003	Nos.	71685
B.	Other livestock			
	i) Goats	2007	Nos.	116672
	ii) Pigs	2007	Nos.	7273
	iii) Dogs & Bitches	2007	Nos.	41618
	iv) Railways			
	i) Length of rail line	2010-11	Kms.	57
	V) Roads	2010-11		
	(a) National Highway	2010-11	Kms.	200.55
	(b) State Highway	2010-11	Kms.	397.55
	(c) Main District Highway	2010-11	Kms.	399.15
	(d) Other district & Rural Roads	2010-11	Kms.	1399.74
	(e) Rural road / Agriculture Marketing Board Roads	2010-11	Kms.	749.02
	(f) Kachacha Road	2010-11	Kms	-
	(VI) Communication			
	(a) Telephone Connection	2010-11		78479
	(b) Post Offices	2010-11	Nos.	246
	(c) Telephone center	2010-11	Nos.	62
	(d) PCO Rural	2010-11	Nos.	-
	(e) PCO STD	2010-11	Nos.	2512
	(f) Mobile	2010-11	Nos.	610823
	(VII) Public Health			
	(a) District level Hospital	2010-11	Nos.	2
	(b) District level Female Hospital	2010-11	Nos.	1
	(c) Allopathic Hospital	2010-11	Nos.	24
	(d) Beds in Govt. Hospitals	2010-11	Nos.	1318
	(e) Ayurvedic Hospitals	2010-11	Nos.	82
	(f) Unani Hospitald	2010-11	Nos.	1
	(g) PHC/Additional PHC	2010-11	Nos.	22
	(h) T.B. hospital/clinic	2010-11	Nos.	2
	(i) Family welfare centre	2010-11	Nos.	190
	(j) Community Health Centre	2010-11	Nos.	7
	(k)Homeopathic Hospitals	2010-11	Nos.	15
	(VIII) Banking commercial			
	(a) Nationalized Banks Bank	2010-11	Nos.	246



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	(b) Regional Rural Bank	2010-11	Nos.	24
	(c) Other Private Banks	2010-11	Nos.	35
	(d) Distt. Co-operative Bank	2010-11	Nos.	1
	(e) Branches of Co-operative Banks	2010-11	Nos.	16
	(f) Agro – rural Bank	2010-11	Nos.	1
	(IX) Education			
	(a) Primary School	2010-11	Nos.	1498
	(b) Middle schools	2010-11	Nos.	768
	(c) Secondary & senior secondary schools	2010-11	Nos.	234
	(d) Colleges	2010-11	Nos.	17
	(e) Technical University	2010-11	Nos.	1

5.6 Existing Status of Industrial Areas in the District Dehradun.

Table: 5.4 Existing Status of Dehradun

S. No.	Name of Ind. Area	Land acquired (In hectare)	No of units established	Capital Investment (In Lacs)	Employment
1.	Govt. Industrial Estate, Patel Nagar, Dehradun	10	13	447.51	160
2.	Govt. Industrial Estate Vikasnagar, Dehradun	4	6	171.04	77
3.	Govt. Mini Industrial Estate, Ranipokhari., Dehradun	2.55	2	47.46	15
4.	Govt. Mini Industrial Estate, Patel Nagar, Dehradun	2,55	2	82.00	26
5.	Co-operative. Industrial Estate, Patel Nagar, Dehradun	-	24	689.78	259
6.	Industrial Area, Camp Road, Selakui Dehradun	79.15 HA	44	10119.91	1853
7.	Industrial Area, Camp Road, Selakui Dehradun	-	50	11573.16	2357
8.	Industrial Area, Central hope town, Selakui	-	59	15937.16	2382
9.	Industrial Area, UPSIDC, Selakui Dehradun	257	156	19072.65	5472



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10.	Industrial Area, Mohobewala, Dehradun	50.71 HA	35	6656.29	1435
11.	Industrial Area Laltappar, Dehradun	39.60	28	8179.67	1681
12.	Industrial Area Kuanwala, Dehradun	-	10	1558.95	316
13.	Sara Industrial Estate, Shankarpur, Dehradun	60	22	8507.62	984
14.	SIDCUL, Pharmacity, Selaqui, Dehradun	50	24	12059.62	1245
15.	SIDCUL IT Park, Sahastradhara Road, Dehradun	50	9	851.34	246
16.	Other Industrial Area (thrust Sector), Dehradun	-	57	8263.03	1688

5.7 INDUSTRIAL SCENARIO OF DEHRADUN

Industry at a Glance

Table: 5.5 Industrial Scenario of Dehradun

S.No.	Head	Unit	Particulars
1.	REGISTERED INDUSTRIAL UNIT	NO.	5883
2.	TOTAL INDUSTRIAL UNIT	NO.	5943
3.	REGISTERED MEDIUM & LARGE UNIT	NO.	60
4.	ESTIMATED AVG. NO. OF DAILY WORKER EMPLOYED IN SMALL SCALE INDUSTRIES	NO.	34733
5.	EMPLOYMENT IN LARGE AND MEDIUM INDUSTRIES	NO.	4471
6.	NO. OF INDUSTRIAL AREA	NO.	8
7.	CAPITAL INVESTMENT OF SMALL SCALE IND.	IN LACS.	79779
8.	TURNOVER OF MEDIUM & LARGE SCALE INDUSTRIES	IN LACS.	240603

5.8 YEAR WISE TREND OF UNITS REGISTERED

Table: 5.6 Year Wise Units Registered in Dehradun

YEAR	NUMBER OF REGISTERED UNITS	EMPLOYMENT	INVESTMENT (lakh Rs.)
2000-01	247	529	115.71
2001-2002	219	561	179.83
2002-03	224	452	72.40
2003-04	172	485	249.42
2004-05	244	950	661.02
2005-06	278	1421	976.70
2006-07	354	2298	2935.65
2007-08	202	3811	8795.37
2008-09	216	3023	8771.13
2009-10	299	6013	14185.00
2010-11	290	3025	15141.06
2011-12	299	2260	5803.96
Total	3044	24828	57887.25

5.9 DETAILS OF EXISTING MICRO & SMALL ENTERPRISES AND ARTISAN UNITS IN THE DISTRICT

Table : 5.7 Details Existing Micro & Small Enterprises

NIC CODE NO.	TYPE OF INDUSTRY	NUMBER OF UNITS	INVESTMENT (Lakh Rs.)	EMPLOYMENT
11	Extraction of crude petroleum and natural gas: service activities	3	-	-
15	Manufacture of food products and beverages	105	-	-
17	Manufacture of textile products	19	-	-
18	Manufacture of wearing apparel, dressing and dyeing products	269	-	-
19	Manufacture of leather & leather products	32	-	-
20	Manufacture of wood & wood products	43	-	-
21	Manufacture of paper & paper products	25	-	-
22	Publishing, printing & reproduction of recorded media	20	-	-
23	Manufacture of coke refined petroleum products	09	-	-
24	Manufacture of chemicals & Chemical products	84	-	-
25	Manufacture of rubber & plastic products	56	-	-
26	Manufacture of other non metallic mineral products	7	-	-
27	Manufacture of basic metals	2	-	-
28	Manufacture fabricated metal products	53	-	-
29	Manufacture of machinery and equipments	5	-	-
31	Manufacture of electrical machinery and apparatus	67	-	-
32	Manufacture of radio, television and communication equipment and apparatus.	19	-	-
33	Manufacture of medical precision and optical	10	-	-



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	instruments, watches and clocks			
35	Manufacture of other transport vehicles	10	-	-
36	Manufacture of furniture manufacturing	5	-	-
41	Collection, purification and distribution of water	1	-	-
50	Repair & maintenance of motor vehicle, retail sale of automotive fuel	35	-	-
52	Repair & maintenance of personal & household goods related trade	81	-	-
55	Hotel & Restourants	19	-	-
64	Post & telecommunication	3	-	-
72	Computer & related activities	152	-	-
73	Research & Development	8	-	-
74	Other business activities	42	-	-
92	Recreational, cultural and sporting activities	1	-	-
93	Other service activities	129	-	-

Large Scale Industries / Public Sector undertakings

Status of Large scale Industries

Table: 5.8 Status of Public Sector Industries

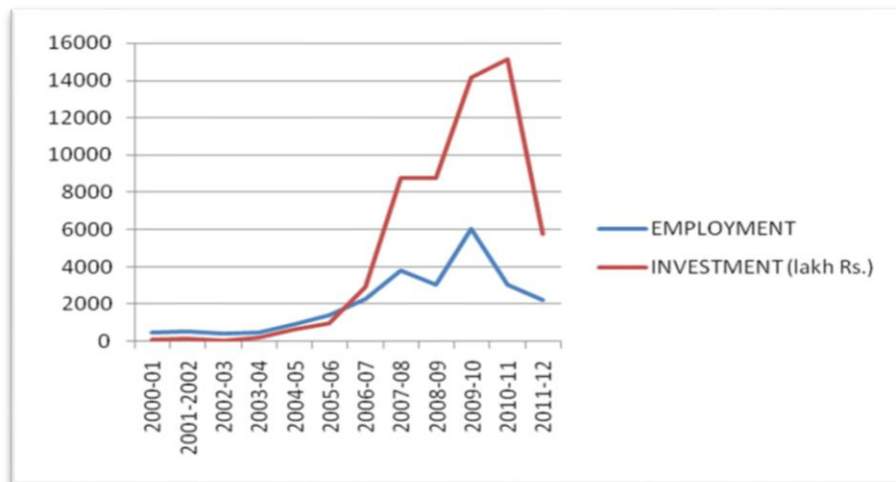
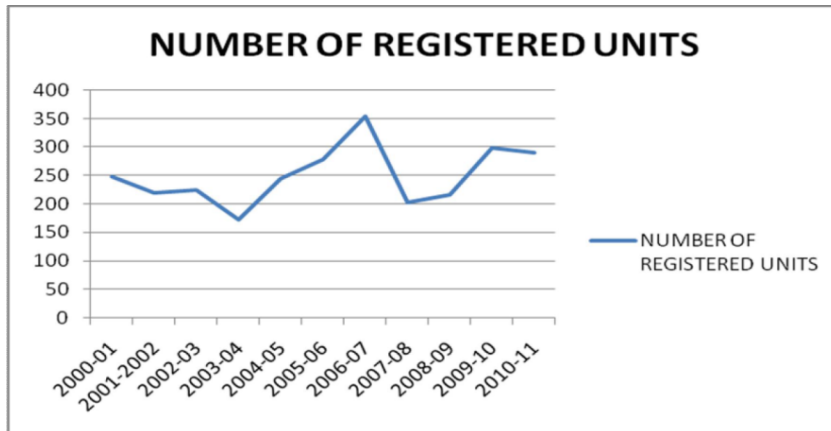
Total established units				Units in Production			
No. of Units	Capital investment	Annual production	Employment	No. of Units	Capital investment	Annual production	Employment
13	290.04	737.16	3589	13	290.04	732.16	3309

5.10 List of Large Scale Industries in Dehradun District:

Table 5.9 – List of Industries in Dehradun District

S.No.	Unit	Product manufactured	Capital investment	Production capacity	Employment
1.	M/s Doiewala Sugar Co Ltd., Doiewala, Dehradun	Sugar	22.00	250 TGD	595
2.	M/s Flex Foods Limited, Laltappar, Dehradun	Freeze dried vegetables	17.30	200 MT	350
3.	M/s Sara Services & Engineers (P) Ltd., Dehradun	Oilfield equipments	10.27	1500 Cr.	176
4.	M/s Birla Yamaha Ltd., Laltappar, Dehradun	Portable gen set	10.27	75000 nos.	880
5.	M/s Ovens Broakway (Built) Limited, Gumaniwala, Rishikesh	Glass bottles	26.35	9000 MT	665
6.	M/s Eveready Industries (India)	Steel Torch	38.73	4.00 cr. Nos.	73
7.	M/s Videocon Industries Limited, Selakui, Dehradun	AC, Colour TV	10.00	10.00 cr. Nos.	110
8.	M/s Entas Pharmaceuticals Camp Road, Selakui, Dehradun	Tablet, capsules	10.00	20000 Lac. Nos.	45
9.	M/s Indian Drugs & Pharmaceuticals Ltd., Veerbhadra, Rishikesh	Life saving Drugs	63.46	16.00 Cr. Nos.	210
10.	M/s Epka Laboratories Limited, Sara Industrial Estate, Shankarpur, Hukmatpur	Pharmaceutical formulations	14.03	1100.542 Lac nos.	79
11.	M/s Traika Pharmaceuticals Limited, Sara Industrial Estate, Shankarpur, Hukmatpur	Pharmaceutical formulations	14.85	50 Cr. Nos.	43
12.	M/s Seron Biomedicine Limited, Camp Road, Selakui, Dehradun	Pharmaceutical formulations	19.15	5 Cr. Nos.	83
13.	M/s Apachi Footwear Pvt. Ltd. Central Hope Town, Dehradun	Sport shoes	33.60	84 lac pairs	280

5.10.1 Growth Trend of Industries



Medium Scale Enterprises

Status of Medium scale Industries

Table: 5.10 Status of Medium Scale Industries

Establishment Units				Units in Production			
No. of Units	Capital Investment	Annual Production	Employment	No. of Units	Capital Investment	Annual Production	Employment
52	1398.00	2990.00	9900	18	282.85	1721.03	1354

Major Exportable Item

Freeze Dried Foods, Mashroom, Herbs. Spices, Swords, Khukri, Knives Musical Instrument Oil Field Equipment, Rly. Halical Suspansion Tape Adopters, Holders Soft Drinks Bottles Cluch, New metal clutch, Sword, Khukri, Helmets, Wood Crafts Herbal Cosmetics, Electronic Calculator Alopathic Medicine Glass Bottle, Medicines etc.

Service Enterprises

Status of Service Industries

Amount in Lakhs

S.No.	Sector	Units established	Capital Investment	Annual Production	Employment
1.	Service Industries	77	481.60	872.82	426

Potentials areas for service industry

- TRANSPORTATION
- COMPUTER & RELATED ACTIVITIES,
- IT SECTOR,
- CYBER CAFFE,
- CONSTRUCTION ACTIVITIES (Real Estate)
- OTHER SERVICE ACTIVITIES

5.11 Potential for new MSMEs

Major Strengths:

Table 5.11 Potential for new MSMEs

Major Rivers	Yamuna(west),Ganga(East),Song,Bindal
Major Valley	Doon Valley
Major Trees	Deodar,Banj, Bans,Panang,Shisham,Semal,Sal, Coniferous
Important Crops	Wheat,Rice,Maize, Mustered, Groungnut, Oilseeds,sugar cane,Barley,Tobaco
Important Fruits	Mango,Papaya,Lichi,Guava, Peach,Grapes,Strawberry
Important Vegetables	Potato,Onion,Peas,Tomato,Cauliflower, Cabbage,Tea
Important Cereals	Soyabean,Urd,Arhar,Masoor,Rapseeds,Rajma,Masoor,Rapseads
Major Minerals	Lime stone,Sand, Marbles, Gypsum, Phosphori Cell,Roc phosphate,Phosphite,Dolomite
Major Tourist Places	Rishikesh,Tapovan,,Shri Guru Ramrai,Darbara sahib,Tapkeshwar Mahadev,Laxman sidh, Lachhiwala,Chandrabani,Rajaji National Park,Sahastradhara,Mussoorie,Kharanga Smarak,Lakha Mandal

Food items, Pharmaceutical products, IT have great potential in the district. State Government has several schemes for the development of these Industries. Essential oil industry has also scope in the district. A few such industries are already in operation. Other areas as under:

- Forest based products-Lisa, wood carving, Ti,, wax, bamboo
- Herbs & Medicinal Plants
- Fabrication
- Pre cast Building Material
- Wool Based Industry
- Bee Keeping
- Sericulture
- Nursery Development

5.12 Existing Cluster of Micro & Small Enterprise

Pharmaceutical Products and formulations

5.12.1 Details for Identified cluster

Table 5.12 Existing Cluster of Micro & Small Enterprises

S. No.	Name of the cluster	SIDBI-BDS DEHRADUN PHARMA CLUSTER (Districts Dehradun & Haridwar)																																										
1	Principal Products Manufactured in the cluster	Allopathic formulation in various dosage forms such as Tablets, Capsules, and Liquid Orals, Ointments and Injectables.																																										
2	Name of the SPV	M/s. Shivalik Research and Analytical Services (P) Ltd., Dehradun																																										
3	No. of functional units in the cluster	<p align="center">Composition of units in Dehradun Pharma Cluster</p> <table border="1"> <thead> <tr> <th>District / Location</th> <th>Location</th> <th>No. of units</th> <th>Total No. of Units</th> <th>No. of Small enterprises</th> <th>No. of medium enterprises</th> </tr> </thead> <tbody> <tr> <td rowspan="4">Dehradun</td> <td>UPSIDC</td> <td>22</td> <td rowspan="4">55</td> <td rowspan="4">35</td> <td rowspan="4">20</td> </tr> <tr> <td>Pharmacy</td> <td>20</td> </tr> <tr> <td>Sara Industrial Estate</td> <td>09</td> </tr> <tr> <td>Mobhiwala Estate</td> <td>04</td> </tr> <tr> <td rowspan="2">Haridwar</td> <td>Integrated industrial Estate, SIDCUL</td> <td>39</td> <td rowspan="2">42</td> <td rowspan="2">30</td> <td rowspan="2">12</td> </tr> <tr> <td>BHEL industrial Estate</td> <td></td> </tr> <tr> <td>Roorkee</td> <td>Bhagvanpur Industrial Area, Devbhoomi Industrial Area and other places</td> <td>85</td> <td>85</td> <td>78</td> <td>7</td> </tr> <tr> <td align="center" colspan="2">Total</td> <td></td> <td>182</td> <td>143</td> <td>39</td> </tr> </tbody> </table> <p>Source : DSR The main stakeholders of the cluster are 182 SMEs, 3 BMOs (DMA Dehradun, APM Haridwar & PMA Roorkee), 2 testing Labs, Raw Material suppliers, packing material suppliers, BDSPs, Banks and Pharma Institutions.</p>					District / Location	Location	No. of units	Total No. of Units	No. of Small enterprises	No. of medium enterprises	Dehradun	UPSIDC	22	55	35	20	Pharmacy	20	Sara Industrial Estate	09	Mobhiwala Estate	04	Haridwar	Integrated industrial Estate, SIDCUL	39	42	30	12	BHEL industrial Estate		Roorkee	Bhagvanpur Industrial Area, Devbhoomi Industrial Area and other places	85	85	78	7	Total			182	143	39
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Total			182	143	39																																							
4	Turnover of the clusters	Rs. 3248 crores.																																										
5	Value of Exports from the cluster	Rs. 700 crores.																																										
6	Employment in cluster	18074 persons.																																										



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7	Average investment in Plant Machinery	Rs. 1,117 Crores (Investment in Small enterprises Rs. 445 Crores & Investment in Medium enterprises Rs. 672 Crores)																														
8	Major Issues/ requirement	<p>Major issues identified APITCO has identified the following issues during the diagnostic study. To address these issues. Annual action plans were prepared under BDS Project and approved by SIDBI</p> <table border="1" data-bbox="540 443 1461 1310"> <thead> <tr> <th data-bbox="540 443 634 478">S.No.</th> <th data-bbox="634 443 889 478">BDS Area</th> <th data-bbox="889 443 1461 478">Key issues</th> </tr> </thead> <tbody> <tr> <td data-bbox="540 478 634 583">1</td> <td data-bbox="634 478 889 583">Quality</td> <td data-bbox="889 478 1461 583">Inadequate adoption of GMP practices by majority of the firms due to which they were unable to initiate exports.</td> </tr> <tr> <td data-bbox="540 583 634 653">2</td> <td data-bbox="634 583 889 653">HRD</td> <td data-bbox="889 583 1461 653">Restricted availability of Skilled manpower resulting in low productivity.</td> </tr> <tr> <td data-bbox="540 653 634 758">3</td> <td data-bbox="634 653 889 758">Marketing</td> <td data-bbox="889 653 1461 758">Limited access to export market primarily due to non compliance of the quality standards.</td> </tr> <tr> <td data-bbox="540 758 634 827">4</td> <td data-bbox="634 758 889 827">Finance</td> <td data-bbox="889 758 1461 827">Poor credit facility to tide over any urgent/short term financial requirements.</td> </tr> <tr> <td data-bbox="540 827 634 896">5</td> <td data-bbox="634 827 889 896">Pollution & waste management</td> <td data-bbox="889 827 1461 896">Problem in disposal of hazardous waste and effluents.</td> </tr> <tr> <td data-bbox="540 896 634 966">6</td> <td data-bbox="634 896 889 966">Energy Management</td> <td data-bbox="889 896 1461 966">Inadequate adoption of energy saving measures leading to high operating cost.</td> </tr> <tr> <td data-bbox="540 966 634 1071">7</td> <td data-bbox="634 966 889 1071">Information Communication Technology (ICT)</td> <td data-bbox="889 966 1461 1071">Lack of awareness on usage of advanced software.</td> </tr> <tr> <td data-bbox="540 1071 634 1241">8</td> <td data-bbox="634 1071 889 1241">Raw Material (RM)</td> <td data-bbox="889 1071 1461 1241">Few basic raw material and recipients sourced from other states are very costly. Low quality raw materials being used & its untimely delivery resulting in less than desired production efficiency levels.</td> </tr> <tr> <td data-bbox="540 1241 634 1310">9</td> <td data-bbox="634 1241 889 1310">Infrastructure</td> <td data-bbox="889 1241 1461 1310">Non availability of suitable/full – fledged Testing Laboratories and Training Canters</td> </tr> </tbody> </table> <p data-bbox="540 1310 703 1346">Source : DSR</p> <p data-bbox="540 1346 1469 1795">With a view to enable BDS market development and make Indian SMEs to enhance their competitiveness, SIDBI has initiated a Project to provide need-based and demand driven BDS in the areas of technology, markets, skills, ICT, energy, environment etc. in select clusters. The project funded jointly by World Bank, DFID, KFW and GTZ, aims at providing BDS through professional organizations with proven track record in extending demand driven BDS and implementing cluster development of BDS markets in the Dehradun Pharmaceutical cluster. The planned project finalize for project implementation was 32 months. It had 4 phases viz. a) pre Implementation, b) implementation, c) sustainability and d) exit. Foundation for MSME clusters (FMC) was appointed as a monitoring and evaluating agency APITCO adopted 4 Phase strategy and implemented the project in 32 months.</p>	S.No.	BDS Area	Key issues	1	Quality	Inadequate adoption of GMP practices by majority of the firms due to which they were unable to initiate exports.	2	HRD	Restricted availability of Skilled manpower resulting in low productivity.	3	Marketing	Limited access to export market primarily due to non compliance of the quality standards.	4	Finance	Poor credit facility to tide over any urgent/short term financial requirements.	5	Pollution & waste management	Problem in disposal of hazardous waste and effluents.	6	Energy Management	Inadequate adoption of energy saving measures leading to high operating cost.	7	Information Communication Technology (ICT)	Lack of awareness on usage of advanced software.	8	Raw Material (RM)	Few basic raw material and recipients sourced from other states are very costly. Low quality raw materials being used & its untimely delivery resulting in less than desired production efficiency levels.	9	Infrastructure	Non availability of suitable/full – fledged Testing Laboratories and Training Canters
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Phase	Activity
Phase - 1 Pre Implementation Phase	Establishment of Project Office with necessary infrastructure Preparation of Diagnostic Survey Report Preparation of Action Plan MoUs with Network Partners
Phase - II Implementation Phase	Implementation of the activities as per the action plan
Phase - III Sustainability Phase	Assuring sustainability of interventions Setting - up of National and International regulatory requirement through current Good Manufacturing Practices (cGMP), Systems & Processes in - place.
Phase - IV Exit Phase	Formation and strengthening of Governance mechanisms for sustainability of interventions Project Impact Assessment & preparation of End of Project Report (EOR).

At Cluster Level The particulars of Cluster level achievements by APITCO are as follows:

S.No.	Target	Achievements
1.	CGMP certification for an additional 10% to 15% of the manufacturing firms	45 units got CGMP compliance. 20 units got COPP-WHO certification. Other 2 units submitted their applications for Copp-WHO certification. Another 5 units ready to submit the Applications.
2.	Enhanced exports by 5% to 8% for 20 small firms and 10 medium firms.	Presently 20 small firms are Exporting (Regulatory & Non regulatory) countries. 21 medium firms exporting the products to Regulated enhanced exports by 5%.
3.	Increase in cluster turnover of 75-100 firms by 5 to 10%	Cluster turnover enhanced 10% in 80 firms.
4.	Increase in number of strategic BDS providers by 15 to 20 numbers	Introduced 40 BDSPs in 9 Key areas (Quality-8, Energy-4, ICT-4, HRD-12, Safety-2, Environment-2, Marketing-2,



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		sustainably	CFC-2, IPR-3, Lean-1). In each area, more than 2 BDSPs were linked. 15 BDSPs became sustainable with established linkage with cluster firms
	5.	Introduce 10 to 15 strategic BDS	Introduced 20 strategic BDS Minimum 2 BDS were introduced in 9 areas
	6.	In Increase business of BDSPs in cluster 5% to 10%	BDSPs turnover was increased more than 10% 25% of the firms engaged their services.
	7.	Increase average profitability of BDSPs by 5%	The average profitability of the BDSPs have been Increased more than 5%
	8.	Achieving customer satisfaction index of 3.0 (on scale of 5) of BDS	Achieved average customer satisfaction index 4.0
	9.	Natural Fas get equipped to promote BDS	2 Natural FAs got equipped to 3 promote BDS (DMA, 4 Dolphin Institute, Shivalik 5 Research analytical services)
	<p>Sustainability of interventions</p> <p>APITCO has strengthened the BMOs, Institutions and BDSPs to continue the BDS interventions even after completion of the project. As a Natural Facilitating Agency, Drug Manufacturers Association (DMA) Uttarakhand could establish BDS Help Desk for continuation of BDS activities (Quality, Energy, ICT, LEAN and Financial Linkage). Dolphin group of Educational Institutions will continue the Industry Institutional Linkage. The SPV (Shivalik Research & Analytical Services) in association with DMA will provide the practical oriented trainings and analytical Laboratory services.</p>		

5.13 Development of village population in 2011 according to basic data survey year 2016

Table: 5.13 Development of village population in 2011

Development Section	Number of villages according to population 2011			Number of villages according to the situation of 31-03-2016			After the 2011 census, the number of villages transferred in the Nagar area and their names	Remarks
	Populated	Non Populated	Total	Populated	Non Populated	Total		
1	2	3	4	5	6	7	8	9
Chakrata	154	0	154	154	0	154	0	
Kalsi	203	1	204	203	1	204	0	
VikasNagar	67	2	69	67	2	69	0	
Sehspur	103	8	111	103	8	111	0	
Raipur	110	3	113	110	3	113	0	
Doilwala	75	1	76	75	1	76	0	
All Development Section	712	15	727	712	15	727	0	
Forest	19	3	22	19	3	22	0	
Yoga district	731	18	749	731	18	749	0	

(District statistical book 2016)

5.14 Progress of industrialization in the district

Table: 5.14 Progress of Industrialization

S.No.	Item	2013-14	2014-15	2015-16
1.	2	3	4	5
1	Registered factory	555	341	365
2	Working factory	555	341	365
3	Factories from which returns were received	-	-	-
4	Average daily working workers and number of employees	77000	13660	2467
5	Production value	548976	689095	21521.90

(District statistical book 2016)



5.15 Present status of the cluster :-

The interventions implemented by APITCO as per the approved Action Plans in the Dehradun Cluster have shown visible results in the areas of quality, ICT, Energy savings, exports etc. For instance, Quality compliance in 88 SMEs has been increased and it resulted in these firms getting additional 15% of the business from the Contract firms. The Cluster turnover has increased by 12% per annum. Around 720 existing technical and non technical staff were trained in GMP, GLP through theoretical and practical oriented trainings. These interventions resulted in reduction of internal rejections by 50%, external rejections by 40% and rework & reprocess by 60%. In the area of ICT, well developed ERP solutions along with Business intelligence tools were introduced in 10 SMEs which has resulted in increased efficiency and productivity by 25%. The interventions in the area of Energy have resulted in savings of Rs.1.2 crores in Pharma Industry. Out of 40 BDSPs introduced, 25 BDSPs have generated new business in the industry without project support. Pharma institutions were linked with the Pharma industry and MoUs signed with the BMOs, to fulfill the needs of the industry as well as enhance employability of fresh graduates. 20 small units entered into the international market (Both regulatory & non regulated countries). The exports of 22 Medium units have increased by 5%. Infrastructure development has been initiated by forming 2 SPVs and prepared Detailed Project Report for establishing Common Facility Centre for M/s. Shivalik Research and Analytical Services (P) Ltd., Dehradun formed by Drug Manufacturers Association Dehradun, and submitted to Director of Industries, Uttarakhand a copy of DPR is submitted to SIDBI for wetting. Presently the file is pending with SIDCUL for allotment of land though it has given oral consent to allot land in Pharma City, SIDCUL, Selaqui, Dehradun.

General issues raised by industry association during the course of meeting

- Infrastructure and connecting roads needs to be improved
- Lack of Entrepreneurship
- Shortage of skilled manpower
- Transportation

- Technology
- Non availability of training facilities in internal location in the state
- Shortage of Bank Credit
- Poor availability of power.

5.16 STEPS TO SET UP MSMEs

Following are the brief description of different agencies for rendering assistance to the entrepreneurs.

Table 5.15 Brief Description of different agencies in Dehradun

S.No	Type of assistance	Name and address of agencies
1.	Provisional Registration Certificate (EM-1) & Permanent Registration Certificate (EM-II)	District Industries Centre, Patel Nagar Industrial Estate, Dehradun
2.	Identification of Project Profiles, techno-economic and managerial consultancy services, market survey and economic survey reports.	MSME-Development Institute,Kham Bangla,Kaladhungi Road, Haldwani (Nainital)
3.	Land and Industrial shed	Directorate of Industries Patel Nagar Industrial Estate, Dehradun,DIC Dehradun,SIDCUL,1- New Cantt Road,Dehradun
4.	Financial Assistance	SIDBI,Nationalised banks
5.	For raw materials under Govt. Supply	Directorate of Industries,Patelnagar,Dehradun
6.	Plant and machinery under hire / purchase basis.	The National Small Industries Corporation limited, 132,HIG-II,Indirapuram ,Dehradun
7.	Power/ Electricity	Uttarakhand power corporation, Dehradun



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8.	Technical Know –how.	MSME-Development Institute,Kham Bangla,Kaladhungi Road, Haldwani (Nainital)
9.	Quality & Standard	MSME-Development Institute Haldwani (Nainital),BIS,Shashtri Nagar, Dehradun
10.	Marketing /Export Assistance	MSME-Development Institute Haldwani,DIC Dehradun.
11.	Other Promotional Agencies	KVIC,GMS Road, Dehradun, Directorate of Industries, Patelnagar,Dehradun,Uttarakhand Khadi & Village Industries, Dehradun,DGFT,Patelnagar,Dehradun



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() Additional Information:

5.17 INDUSTRIAL SCENERIO OF UTTARAKHAND

Table: 5.16 Scenario of Uttarakhand

District	Registered units			After formation of State			Total Registered MSMEs		
	From formation of State			(9.11.2000 to March,2012) Registered MSMEs					
Nainital	618	3513	158.36	1836	6856	219.645	2652	10369	378.005
U S Nagar	804	4899	233.71	3553	34596	2440.134	4357	39495	2673.844
Almora	904	1846	17.78	2013	3713	27.596	2917	5559	45.376
Pithoragarh	534	1013	5.85	1519	3350	25.873	2053	4363	31.723
Bageshwar	387	607	2.04	630	1296	13.854	1017	1903	15.894
Champawat	147	322	4.95	669	1483	13.737	816	1805	18.687
Dehradun	2321	7232	88.01	3562	27501	709.789	5883	34733	797.799
Pauri	1720	4196	28.39	2330	6391	111.669	4050	10587	140.059
Tehri	1025	2413	1444	2068	5200	65.745	3093	7613	80.185
Chamoli	844	1154	5.45	1509	3117	34.620	2353	4271	40.070
Uttarkashi	1734	2364	10.60	1440	2700	27.375	3174	5064	37.975
Rudraprayag	394	737	7.20	743	1823	22.883	1137	2560	30.083
Haridwar	2533	8213	123.51	4014	41080	2799.050	6547	49293	2922.560
TOTAL	14163	38509	700.29	25886	139106	6511.970	40049	177615	7212.260

CHAPTER - 6

6.1 Assessment of Vehicular Pollution at Dehradun

The vehicle count was carried out at the five locations where vehicles are entering in the Dehradun city. The average of vehicles count Emission Rate for CO, HC, NO_x and Particulates are as given below in Table 6.1 :

Table : 6.1
Vehicle Count in Post Monsoon Season in Ghanta Ghar

Location	TIME	Type	Number
Ghanta Ghar	9.00 am to 12.00 noon	2Wheeler	149
		3Wheeler	20
		Car	133
		Truck	37
		Bus	37
		LCV	38
		TOTAL	415
	13.00 am to 15.00 pm	2Wheeler	68
		3Wheeler	12
		Car	76
		Truck	19
		Bus	26
		LCV	13
		TOTAL	215
15.00 pm to 18.00 pm	2Wheeler	154	
	3Wheeler	25	
	Car	142	
	Truck	48	
	Bus	41	
	LCV	35	
	TOTAL	444	
Per Day Density	9:00 am to 6:00 pm	2Wheeler	3874
		3Wheeler	2789
		Car	4399
		Truck	3377
		Bus	3019
		LCV	2687
		TOTAL	20144

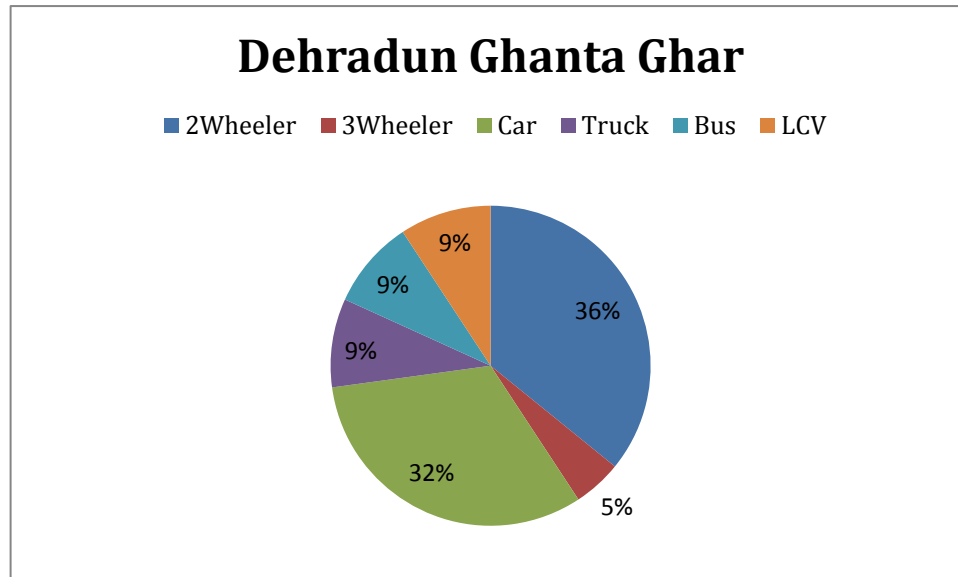


Figure 6.1 - Pie chart for Vehicle Count in Post Monsoon Season

Table : 6.2
Vehicle Count in Post Monsoon Season in ISBT

Location	TIME	Type	Number
ISBT	9.00 am to 12.00 noon	2Wheeler	146
		3Wheeler	24
		Car	132
		Truck	50
		Bus	36
		LCV	5
		TOTAL	394
	13.00 am to 15.00 pm	2Wheeler	132
		3Wheeler	1.2
		Car	84
		Truck	38
		Bus	23
		LCV	6
	TOTAL	284	
15.00 pm to 18.00 pm	2Wheeler	192	
	3Wheeler	1.2	
	Car	132	
	Truck	48	
	Bus	40	
	LCV	8	
	TOTAL	421	
Per Day Density	9:00 am to 6:00 pm	2Wheeler	1086
		3Wheeler	149
		Car	198
		Truck	428
		Bus	254
		LCV	139
	TOTAL	2255	

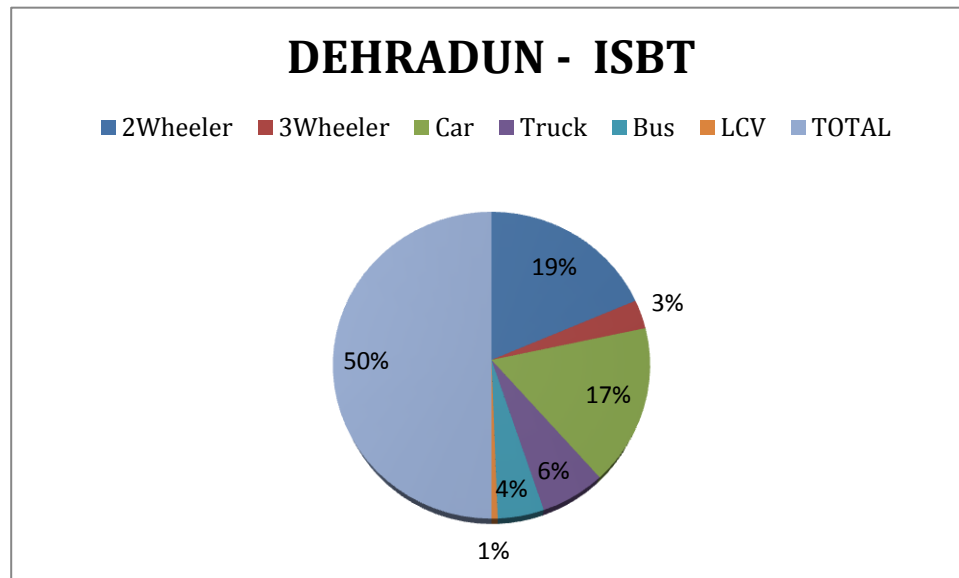


Table 6.2 - Pie chart for Vehicle Count in Post Monsoon Season

Table: 6.3
Vehicle Count in Post Monsoon Season at ONGC/FRI Dehradun

Location	TIME	Type	Number
ONGC/FRI	9.00 am to 12.00 noon	2Wheeler	145
		3Wheeler	159
		Car	150
		Truck	14
		Bus	80
		LCV	87
		TOTAL	636
	13.00 am to 15.00 pm	2Wheeler	82
		3Wheeler	67
		Car	124
		Truck	22
		Bus	62
		LCV	18
	TOTAL	374	
15.00 pm to 18.00 pm	2Wheeler	96	
	3Wheeler	41	
	Car	78	
	Truck	17	
	Bus	36	
	LCV	10	
	TOTAL	277	
Per Day Density	9:00 am to 6:00 pm	2Wheeler	1532
		3Wheeler	1072
		Car	1608
		Truck	1192
		Bus	752
		LCV	498
	TOTAL	6654	

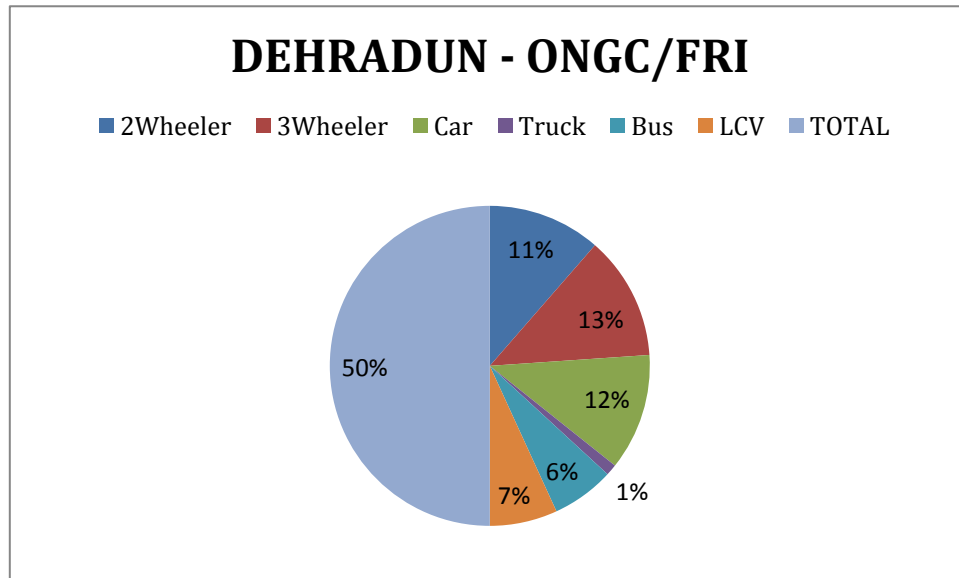


Figure 6.3 - Pie chart for Vehicle Count in Post Monsoon Season

Table: 6.4
Vehicle Count in Post Monsoon Season at Survey Area Dehradun

Location	TIME	Type	Number
Survey Area	9.00 am to 12.00 noon	2Wheeler	136
		3Wheeler	48
		Car	181
		Truck	23
		Bus	88
		LCV	29
		TOTAL	504
	13.00 am to 15.00 pm	2Wheeler	102
		3Wheeler	50
		Car	222
		Truck	18
		Bus	91
		LCV	18
		TOTAL	501
	15.00 pm to 18.00 pm	2Wheeler	136
		3Wheeler	38
		Car	107
		Truck	22
		Bus	31
		LCV	16
		TOTAL	349
Per Day Density	9:00 am to 6:00 pm	2Wheeler	2209
		3Wheeler	1150
		Car	2809
		Truck	1769
		Bus	984
		LCV	924
		TOTAL	9845

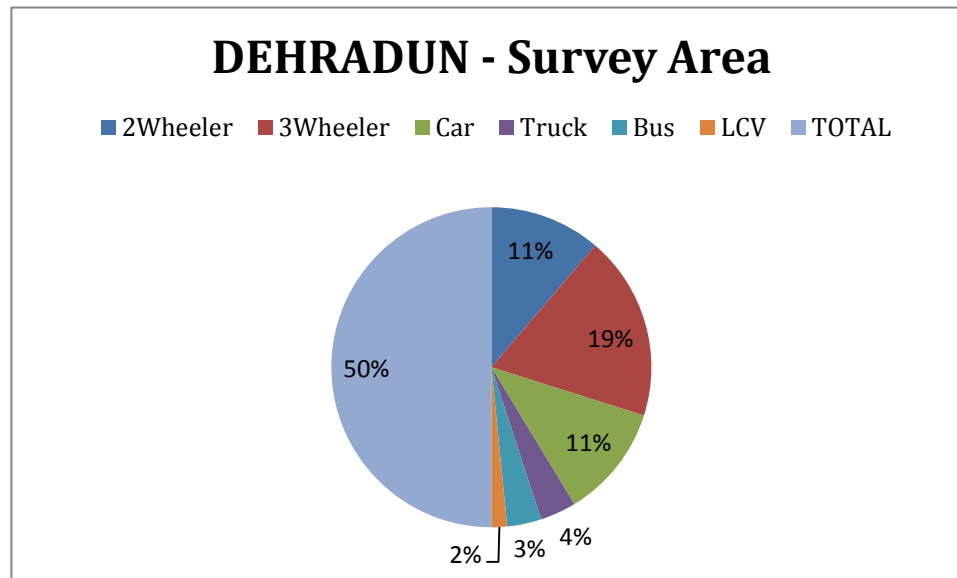


Figure 6.4 - Pie chart for Vehicle Count in Post Monsoon Season



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**Table: 6.5
Vehicle Count in Summer Season at Ghanta Ghar Dehradun**

Location	TIME	Type	Number
Ghanta Ghar	9.00 am to 12.00 noon	2Wheeler	174
		3Wheeler	23.8
		Car	155.4
		Truck	43.4
		Bus	43.4
		LCV	44.8
		TOTAL	484
	13.00 am to 15.00 pm	2Wheeler	80
		3Wheeler	14
		Car	88
		Truck	22
		Bus	31
		LCV	15
	TOTAL	251	
15.00 pm to 18.00 pm	2Wheeler	179	
	3Wheeler	29	
	Car	165	
	Truck	56	
	Bus	48	
	LCV	41	
	TOTAL	518	
Per Day Density	9:00 am to 6:00 pm	2Wheeler	4519
		3Wheeler	3254
		Car	5132
		Truck	3940
		Bus	3522
		LCV	3135
	TOTAL	23502	

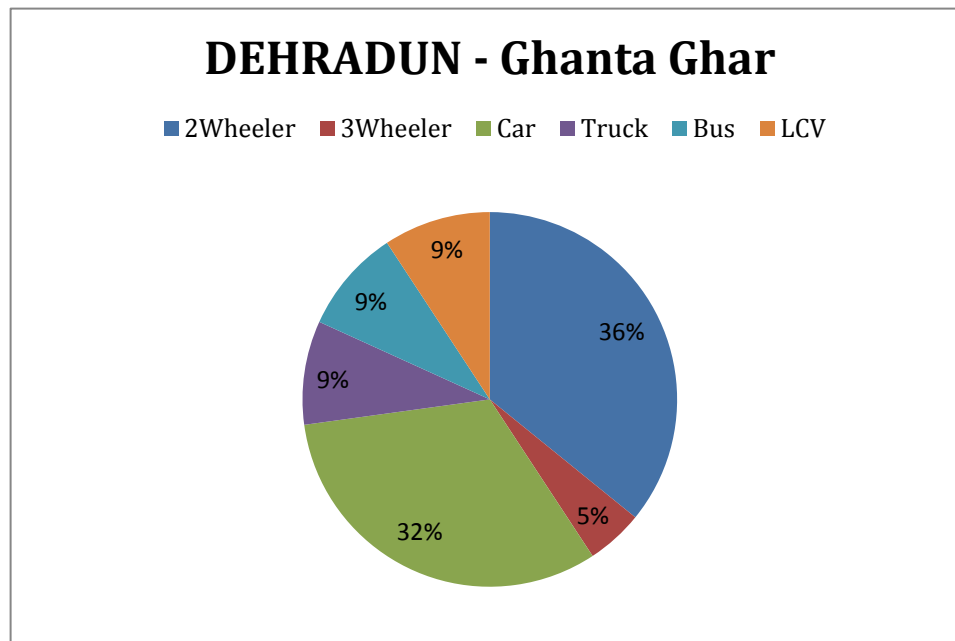


Figure 6.5 - Pie chart for Vehicle Count in Summer Season

**Table: 6.6
Vehicle Count in Summer Season at ISBT Dehradun**

Location	TIME	Date	Type	Number	
ISBT	9.00 am to 12.00 noon	12.02.2017	2Wheeler	171	
			3Wheeler	1	
			Car	154	
			Truck	59	
			Bus	42	
			LCV	6	
			TOTAL	433	
	13.00 am to 15.00 pm			2Wheeler	154
				3Wheeler	1
				Car	98
				Truck	45
				Bus	27
				LCV	7
			TOTAL	332	
	15.00 pm to 18.00 pm			2Wheeler	224
				3Wheeler	1
				Car	154
				Truck	56
				Bus	46
LCV				10	
		TOTAL	491		
Per Day Density	9:00 am to 6:00 pm		2Wheeler	1267	
			3Wheeler	174	
			Car	231	
			Truck	500	
			Bus	297	
			LCV	162	
		TOTAL	2631		

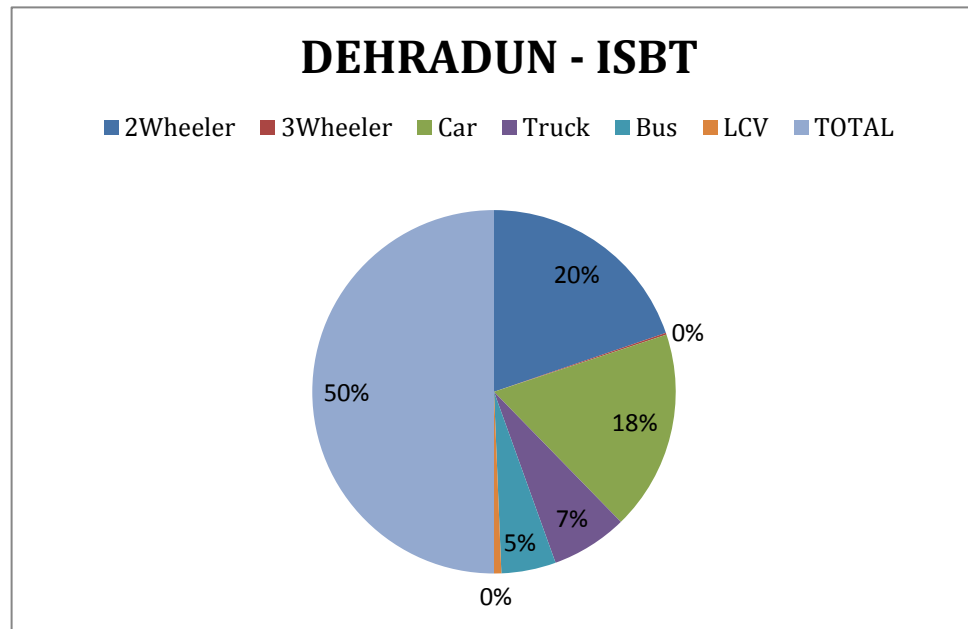


Figure 6.6 - Pie chart for Vehicle Count in Summer Season

Table: 6.7
Vehicle Count in Summer Season at ONGC/FRI Dehradun

Location	TIME	Type	Number
ONGC/FRI	9.00 am to 12.00 noon	2Wheeler	169
		3Wheeler	159
		Car	175
		Truck	17
		Bus	94
		LCV	87
		TOTAL	701
	13.00 am to 15.00 pm	2Wheeler	95
		3Wheeler	78
		Car	144
		Truck	25
		Bus	73
		LCV	21
	TOTAL	437	
15.00 pm to 18.00 pm	2Wheeler	112	
	3Wheeler	48	
	Car	91	
	Truck	20	
	Bus	42	
	LCV	11.2	
	TOTAL	323	
Per Day Density	9:00 am to 6:00 pm	2Wheeler	1788
		3Wheeler	1250
		Car	1876
		Truck	1390
		Bus	878
		LCV	581
		TOTAL	7763

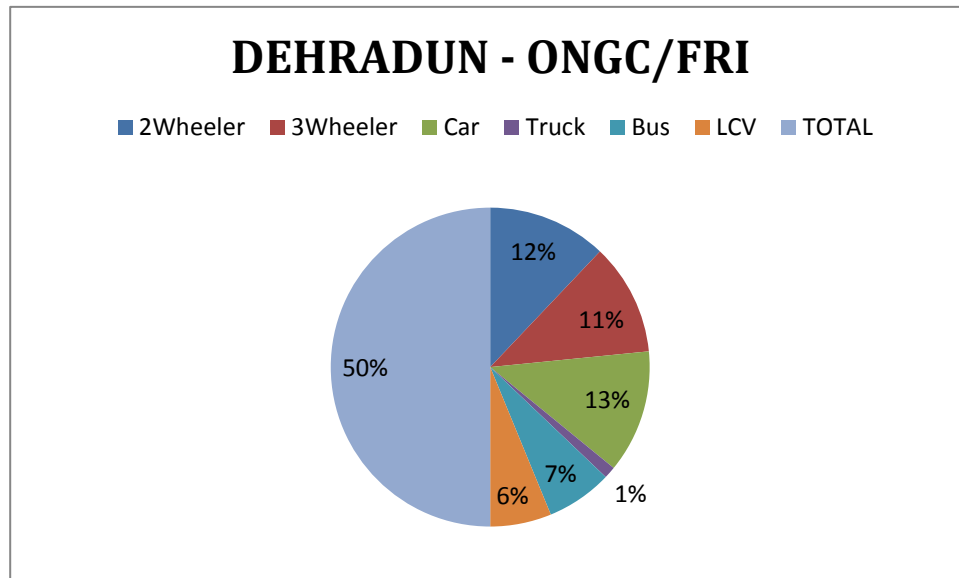


Figure 6.7 - Pie chart for Vehicle Count in Summer Season

Table: 6.8
Vehicle Count in Summer Season at Survey Area Dehradun

Location	TIME	Type	Number
Survey Area	9.00 am to 12.00 noon	2Wheeler	158
		3Wheeler	56
		Car	211
		Truck	27
		Bus	102
		LCV	34
		TOTAL	588
	13.00 am to 15.00 pm	2Wheeler	119
		3Wheeler	59
		Car	259
		Truck	21
		Bus	127
		LCV	21
	TOTAL	606	
15.00 pm to 18.00 pm	2Wheeler	158	
	3Wheeler	45	
	Car	125	
	Truck	25	
	Bus	36	
	LCV	18	
	TOTAL	407	
Per Day Density	9:00 am to 6:00 pm	2Wheeler	2577
		3Wheeler	1341
		Car	3277
		Truck	2064
		Bus	1148
		LCV	1078
	TOTAL	11486	

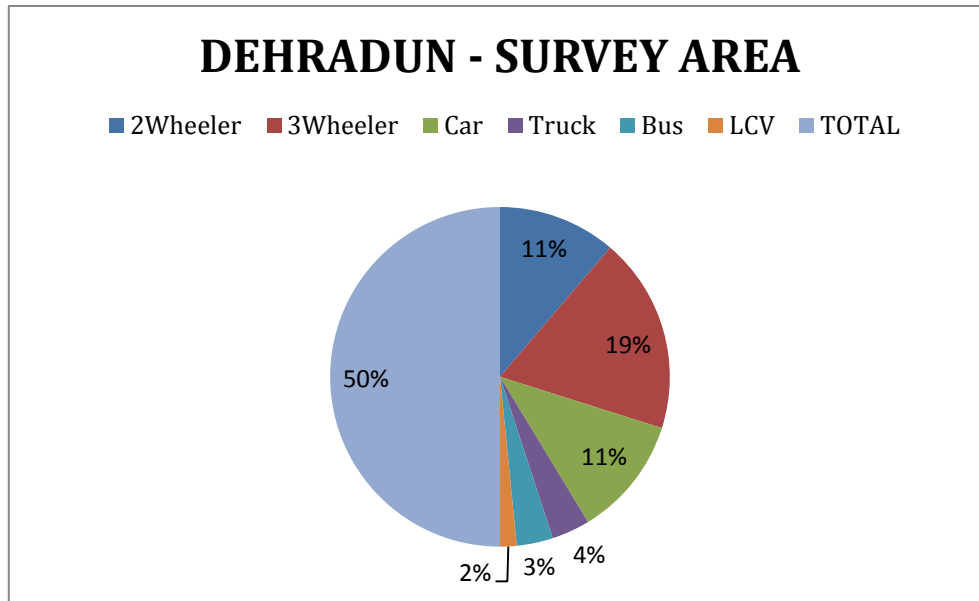


Figure 6.8 - Pie chart for Vehicle Count in Summer Season

Table: 6.9
Vehicle Count in Winter Season at Ghanta Ghar Dehradun

Location	TIME	Type	Number		
Ghanta Ghar	9.00 am to 12.00 noon	2Wheeler	130		
		3Wheeler	18		
		Car	117		
		Truck	33		
		Bus	33		
		LCV	34		
		TOTAL	363		
		13.00 am to 15.00 pm		2Wheeler	60
				3Wheeler	11
				Car	66
Truck	17				
Bus	23				
LCV	19				
TOTAL	195				
15.00 pm to 18.00 pm		2Wheeler	134		
		3Wheeler	22		
		Car	124		
		Truck	42		
		Bus	36		
		LCV	30		
		TOTAL	389		
Per Day Density	9:00 am to 6:00 pm	2Wheeler	3389		
		3Wheeler	2440		
		Car	3849		
		Truck	2955		
		Bus	2642		
		LCV	2351		
		TOTAL	17626		

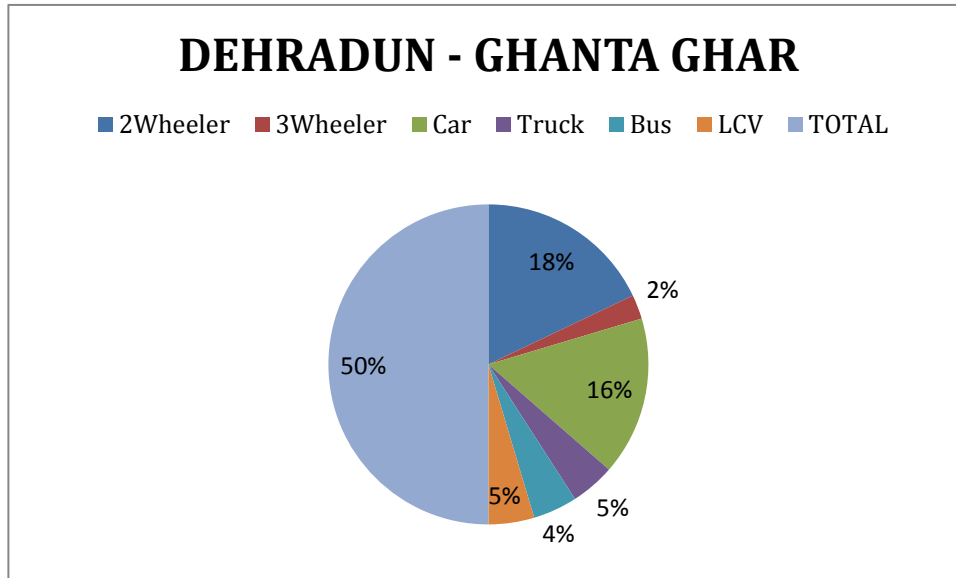


Figure 6.9 - Pie chart for Vehicle Count in Winter Season

Table: 6.10
Vehicle Count in Winter Season at ISBT Dehradun

Location	TIME	Type	Number		
ISBT	9.00 am to 12.00 noon	2Wheeler	128		
		3Wheeler	1		
		Car	116		
		Truck	44		
		Bus	32		
		LCV	4		
		TOTAL	324		
		13.00 am to 15.00 pm	13.00 am to 15.00 pm	2Wheeler	116
				3Wheeler	1
				Car	74
Truck	34				
Bus	20				
LCV	5				
TOTAL	249				
15.00 pm to 18.00 pm	15.00 pm to 18.00 pm	2Wheeler	168		
		3Wheeler	1		
		Car	116		
		Truck	42		
		Bus	35		
		LCV	7		
		TOTAL	369		
Per Day Density	9:00 am to 6:00 pm	2Wheeler	950		
		3Wheeler	130		
		Car	173		
		Truck	375		
		Bus	223		
		LCV	122		
		TOTAL	1973		

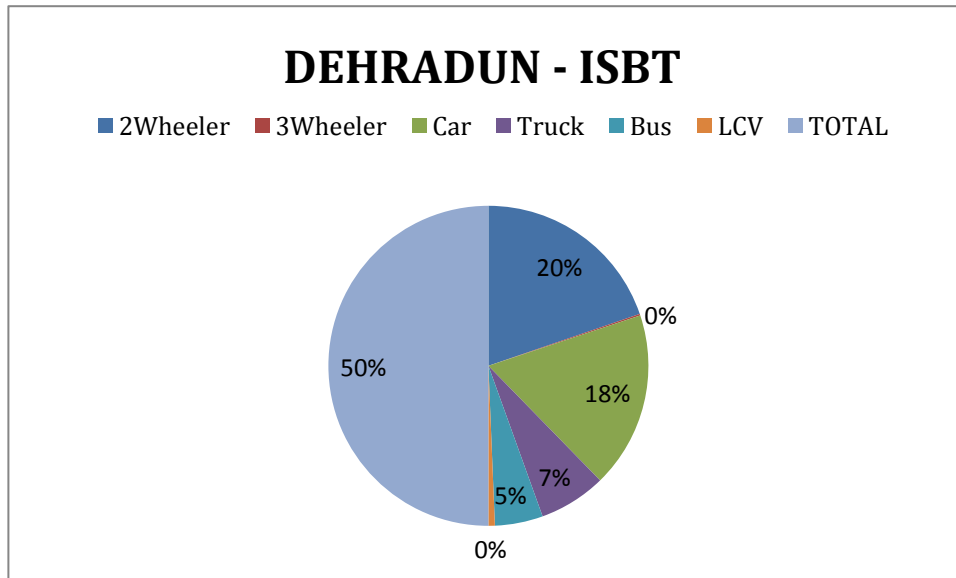


Figure 6.10 – Pie chart for Vehicle Count in Winter Season

Table: 6.11
Vehicle Count in Winter Season at ONGC/FRI Dehradun

Location	TIME	Type	Number	
ONGC/FRI	9.00 am to 12.00 noon	2Wheeler	127	
		3Wheeler	159	
		Car	131	
		Truck	13	
		Bus	70	
		LCV	87	
		TOTAL	587	
		13.00 am to 15.00 pm	2Wheeler	71
			3Wheeler	59
			Car	108
Truck	19			
Bus	55			
LCV	16			
TOTAL	328			
15.00 pm to 18.00 pm	2Wheeler	84		
	3Wheeler	36		
	Car	68		
	Truck	15		
	Bus	32		
	LCV	8		
	TOTAL	243		
Per Day Density	9:00 am to 6:00 pm	2Wheeler	1341	
		3Wheeler	938	
		Car	1407	
		Truck	1043	
		Bus	658	
		LCV	436	
		TOTAL	5822	

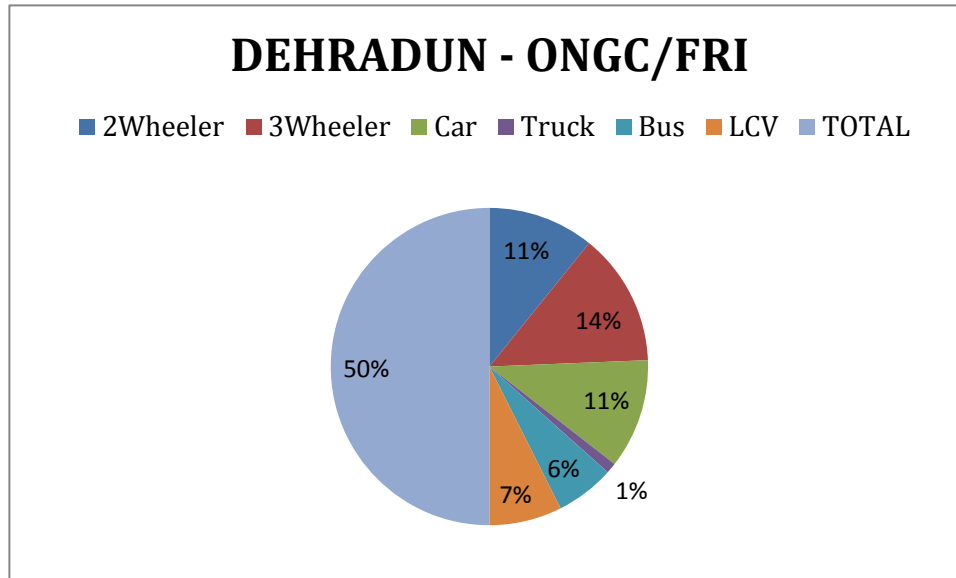


Figure 6.11 - Pie chart for Vehicle Count in Winter Season

Table: 6.12
Vehicle Count in Winter Season at Survey Area Dehradun

Location	TIME	Type	Number
Survey Area	9.00 am to 12.00 noon	2Wheeler	119
		3Wheeler	42
		Car	159
		Truck	20
		Bus	77
		LCV	25
		TOTAL	441
	13.00 am to 15.00 pm	2Wheeler	89
		3Wheeler	44
		Car	194
		Truck	16
		Bus	96
		LCV	16
		TOTAL	455
	15.00 pm to 18.00 pm	2Wheeler	119
		3Wheeler	34
		Car	93
		Truck	19
		Bus	27
		LCV	14
		TOTAL	306
Per Day Density	9:00 am to 6:00 pm	2Wheeler	1933
		3Wheeler	1006
		Car	2458
		Truck	1548
		Bus	861
		LCV	809
		TOTAL	8614

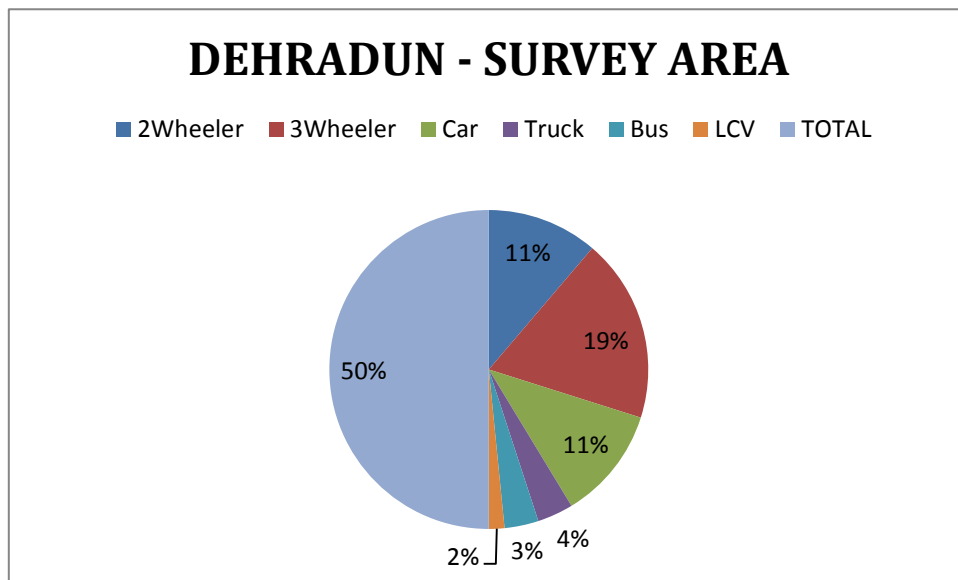


Figure 6.12 - Pie chart for Vehicle Count in Winter Season

6.2 Emission rates of Incoming Vehicles to Dehradun

The average vehicle count and emission rate for Incoming vehicles for Three dates at four places as mentioned above have been calculated in given in Tables below :

Table: 6.13 Vehicle Count and emission rate for vehicles during Post Monsoon Season

Location	TIME	Type	Number	CO (kg/h)	HC (kg/h)	Nox (kg/h)	SO2 (kg/h)	Particulate (kg/h)
Ghanta Ghar	9:00 am to 6:00 pm	2Wheeler	3873.60	89.31	83.61	16.89	0.31	0.10
		3Wheeler	2788.80	64.30	60.19	12.16	0.22	0.07
		Car	4399.20	101.43	94.95	19.19	0.35	0.11
		Truck	3376.80	77.85	72.88	14.73	0.27	0.08
		Bus	3019.20	69.61	65.16	13.17	0.24	0.08
		LCV	2686.80	61.95	57.99	11.72	0.22	0.07
		TOTAL	20144.40	464.44	434.78	87.85	1.62	0.50
ISBT	9:00 am to 6:00 pm	2Wheeler	1086.00	25.04	25.04	23.44	4.74	0.09
		3Wheeler	148.80	3.43	3.43	3.21	0.65	0.01
		Car	198.00	4.57	4.57	4.27	0.86	0.02
		Truck	428.40	9.88	9.88	9.25	1.87	0.03
		Bus	254.40	5.87	5.87	5.49	1.11	0.02
		LCV	139.20	3.21	3.21	3.00	0.61	0.01
		TOTAL	2254.80	51.99	51.99	48.67	9.83	0.18
ONGC/FRI	9:00 am to 6:00 pm	2Wheeler	1532.40	35.33	33.07	6.68	0.12	0.04
		3Wheeler	1071.60	24.71	23.13	4.67	0.09	0.03
		Car	1608.00	37.07	34.71	7.01	0.13	0.04
		Truck	1191.60	27.47	25.72	5.20	0.10	0.03
		Bus	752.40	17.35	16.24	3.28	0.06	0.02
		LCV	498.00	11.48	10.75	2.17	0.04	0.01
		TOTAL	6654.00	153.41	143.62	29.02	0.54	0.17
Survey Area	9:00 am to 6:00 pm	2Wheeler	2209.20	50.93	47.68	9.63	0.18	0.06
		3Wheeler	1149.60	26.50	24.81	5.01	0.09	0.03
		Car	2809.20	64.77	60.63	12.25	0.23	0.07
		Truck	1768.80	40.78	38.18	7.71	0.14	0.04
		Bus	984.00	22.69	21.24	4.29	0.08	0.02
		LCV	924.00	21.30	19.94	4.03	0.07	0.02
		TOTAL	9844.80	226.98	212.48	42.93	0.79	0.25



**“Action Plan for Ambient Air Quality Improvement of Dehradun City”
Uttarakhand Environment Protection Pollution Control Board, Dehradun.**

Table :6.14 Vehicle Count and emission rate for vehicles during Summer Season.

Location	TIME	Type	Number	CO Kg/h	HC Kg/h	NOx kg/h	So2 kg/h	Particulate Kg/h
Ghanta Ghar	9:00AM TO 6:00PM	2Wheeler	4519.0	104.2	97.5	19.7	0.4	0.1
		3Wheeler	3254.0	75.0	70.2	14.2	0.3	0.1
		Car	5132.0	118.3	110.8	22.4	0.4	0.1
		Truck	3940.0	90.8	85.0	17.2	0.3	0.1
		Bus	3522.0	81.2	76.0	15.4	0.3	0.1
		LCV	3135.0	72.3	67.7	13.7	0.3	0.1
		TOTAL	23502.0	541.8	507.2	102.5	1.9	0.6
ISBT	9:00AM TO 6:00PM	2Wheeler	1267.0	29.2	27.3	49.7	918.6	0.3
		3Wheeler	173.6	4.0	33.7	6.8	125.9	0.0
		Car	231.0	5.3	44.9	9.1	167.5	0.1
		Truck	499.8	11.5	97.1	19.6	362.4	0.1
		Bus	296.8	6.8	57.7	11.6	215.2	0.1
		LCV	162.4	3.7	31.5	6.4	117.7	0.0
		TOTAL	2630.6	60649.9	292.2	103.3	1907.2	0.6
ONGC/FRI	9:00AM TO 6:00PM	2Wheeler	41.2	38.6	7.8	0.1	0.0	41.2
		3Wheeler	28.8	27.0	5.5	0.1	0.0	28.8
		Car	43.3	40.5	8.2	0.2	0.0	43.3
		Truck	32.1	30.0	6.1	0.1	0.0	32.1
		Bus	20.2	18.9	3.8	0.1	0.0	20.2
		LCV	13.4	12.5	2.5	0.0	0.0	13.4
		TOTAL	179.0	167.6	33.9	0.6	0.2	179.0
Survey Area	9:00AM TO 6:00PM	2Wheeler	2577.0	59.4	55.6	11.2	0.2	0.1
		3Wheeler	1341.0	30.9	28.9	5.8	0.1	0.0
		Car	3277.0	75.6	70.7	14.3	0.3	0.1
		Truck	2064.0	47.6	44.5	9.0	0.2	0.1
		Bus	1148.0	26.5	24.8	5.0	0.1	0.0
		LCV	1078.0	24.9	23.3	4.7	0.1	0.0
		TOTAL	11486.0	264.8	247.9	50.1	0.9	0.3

Table: 6.14 Vehicle Count and emission rate for vehicles during Winter Season.

Location	TIME	Type	Number	CO Kg/h	HC Kg/h	NOx kg/h	So2 kg/h	Particulate Kg/h
Ghanta Ghar	9:00AM TO 6:00PM	2Wheeler	3228.0	74.4	69.7	14.1	0.3	0.1
		3Wheeler	2324.0	53.6	50.2	10.1	0.2	0.1
		Car	3666.0	84.5	79.1	16.0	0.3	0.1
		Truck	2814.0	64.9	60.7	12.3	0.2	0.1
		Bus	2516.0	58.0	54.3	11.0	0.2	0.1
		LCV	2239.0	51.6	48.3	9.8	0.2	0.1
		TOTAL	16787.0	387.0	362.3	73.2	1.4	0.4
ISBT	9:00AM TO 6:00PM	2Wheeler	905.0	20.9	19.5	3.9	0.1	0.0
		3Wheeler	124.0	2.9	2.7	0.5	0.0	0.0
		Car	165.0	3.8	3.6	0.7	0.0	0.0
		Truck	357.0	8.2	7.7	1.6	0.0	0.0
		Bus	212.0	4.9	4.6	0.9	0.0	0.0
		LCV	116.0	2.7	2.5	0.5	0.0	0.0
		TOTAL	1879.0	43.3	40.6	8.2	0.2	0.0
ONGC/FRI	9:00AM TO 6:00PM	2Wheeler	1277.0	29.4	27.6	5.6	0.1	0.0
		3Wheeler	893.0	20.6	19.3	3.9	0.1	0.0
		Car	1340.0	30.9	28.9	5.8	0.1	0.0
		Truck	993.0	22.9	21.4	4.3	0.1	0.0
		Bus	627.0	14.5	13.5	2.7	0.1	0.0
		LCV	415.0	9.6	9.0	1.8	0.0	0.0
		TOTAL	5545.0	127.8	119.7	24.2	0.4	0.1
Survey Area	9:00AM TO 6:00PM	2Wheeler	1841.0	0.0	0.0	0.0	0.0	0.0
		3Wheeler	958.0	0.0	0.2	0.0	0.0	0.0
		Car	2341.0	0.1	0.5	0.0	0.0	0.0
		Truck	1474.0	0.0	0.3	0.0	0.0	0.0
		Bus	820.0	0.0	0.2	0.0	0.0	0.0
		LCV	770.0	0.0	0.1	0.0	0.0	0.0
		TOTAL	8204.0	189.1	1275.7	35.8	0.7	0.2

Emission Rates in kg/day of Incoming Vehicles to Dehradun during Summer Season

It can be seen from above that the incoming emission rates of CO, HC, NOx and Particulate during summer season at Dehradun – Haridwar Road near ISBT was observed highest in comparison to other location in Dehradun. The vehicles coming from Dehradun and Rishikesh at ISBT were found to be the maximum at this location.

Table :6.15 : Emission Rates of Incoming Vehicles in Kg/day at Dehradun during Post Monsoon

Location	CO	HC	NOx	Particulate
Ghanta Ghar	464.44	434.78	87.85	0.50
ISBT	51.99	51.99	48.67	0.18
ONGC/FRI	153.41	143.62	29.02	0.17
Survey Area	226.98	212.48	42.93	0.25
Total kg/day	896.82	842.87	208.47	1.1

Table: 6.16 : Emission Rates of Incoming Vehicles in Kg/day at Dehradun during Summer

Location	CO	HC	NOx	Particulate
Ghanta Ghar	541.8	507.2	102.5	0.6
ISBT	60649.9	292.2	103.3	0.6
ONGC/FRI	179.0	167.6	33.9	179.0
Survey Area	264.8	247.9	50.1	0.3
Total kg/day	61635.5	1214.9	289.8	180.5

Table: 6.17: Emission Rates of Incoming Vehicles in Kg/day at Dehradun during Winter


Location	CO	HC	NOx	Particulate
Ghanta Ghar	387.0	362.3	73.2	0.4
ISBT	43.3	40.6	8.2	0.0
ONGC/FRI	127.8	119.7	24.2	0.1
Survey Area	189.1	1275.7	35.8	0.2
Total kg/day	747.2	1798.3	141.4	0.7

6.2.1 Vehicle Registration Details

देहरादून कार्यालय में पंजीकृत वाहनो का मासिक विवरण एवं क्रमिक विवरण, एस-4
 माह जनवरी 2017

कार्यालय	ट्रक एवं लारी	4 पहिया भार वाहन	4 पहिया सवारी वाहन	3 पहिया वाहन	मिनी बस/ बस	2 पहिया वाहन	4 पहिया वाहन प्राइवेट	अन्य	योग
देहरादून	मल्टी एक्सल, एचजीवी, एमजीवी ट्राली, टैकर (ट्रैटोल, मिल्क/वाटर)	एल जी वी	मैक्सी, टैक्सी, यूटिलिटी	विक्रम, आटो, शिवैन	मिनी बस, बस सरकारी/अधिसरकारी, पॉनिंग, स्कूल बस, एम्बुलेंस	स्कूटर, मोटर साईकल, मोपेड	कार जीप ओमिनी बस, ट्रैक्टर		
	1	2	3	4	5	6	7	8	9
मासिक	29	60	93	27	12	3448	1863		5532
क्रमिक	323	601	855	316	516	33586	14947	-	51144

नोट: उक्त विवरण पत्र एनआईसी दिल्ली द्वारा उपलब्ध कराये गये आकड़ो के आधार पर संकलित किया गया है।
 कालम सं०: 1- में मल्टी एक्सल, एचजीवी, एमजीवी ट्राली, टैकर (ट्रैटोल, मिल्क/वाटर) का डाटा संकलित है।
 कालम सं०: 3- में मैक्सी, टैक्सी यूटिलिटी, का डाटा संकलित है।
 कालम सं०: 4 में आटो विक्रम व शिवैन का डाटा संकलित है।
 कालम सं०: 5- में मिनी बस बस सरकारी/अधिसरकारी, पॉनिंग, स्कूल बस, एम्बुलेंस का डाटा संकलित है।
 कालम सं०: 6- में स्कूटर, मोटर साईकल, मोपेड का डाटा संकलित है।
 कालम सं०: 7- में कार, जीप, ओमिनी बस, ट्रैक्टर का डाटा संकलित है।


 डी. पी. सिंह, अधिकारी
 मोटर वाहन विभाग
 देहरादून (उत्तराखण्ड)

Vehicle Registered upto January 2017



**“Action Plan for Ambient Air Quality Improvement of Dehradun City”
Uttarakhand Environment Protection Pollution Control Board, Dehradun.**

**Table : 6.18
On Road Vehicles in Uttarakhand (as on 31-Mar-2015)**

VEHICLE CATEGORY	NUMBER OF VEHICLES
TWO WHEELERS	1387457
CARS / JEEP	311908
BUSES	10227
TRUCKS	26827
4 WHEELER LOADER / DELIVERY VAN	34983
TAXI / MAXI	34449
AUTO TEMPO	18293
TRACTOR	65953
TRAILORS	6525
OTHERS	4340
TOTAL	19,00,962



**“Action Plan for Ambient Air Quality Improvement of Dehradun City”
Uttarakhand Environment Protection Pollution Control Board, Dehradun.**

Table: 6.19 VEHICLES REGISTERED IN UTTARAKHAND DURING PREVIOUS YEAR

ANNUAL REGISTERED VEHICLES IN UTTARAKHAND											
VEHICLE TYPE	YEAR										
	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2010-11	2011-12	2012-13	2013-14	2014-15
TWO WHEELER	32306	54042	58090	67974	67850	65391	109363	126025	125082	132679	149936
CARS / JEEP	7956	9163	10323	12031	16471	16385	29367	36125	36490	33608	36896
BUSES	361	670	1096	387	544	348	650	723	664	700	483
TRUCKS	1215	1042	3426	1411	1146	850	1669	2117	1554	1491	1589
4 WHEELER LOADER/DELIVERY VAN	1270	1401	3436	1524	2866	3066	3881	4151	3758	3667	3469
TAXI / MAXI	899	1038	2953	1824	2405	2486	3427	4364	3826	3300	3056
AUTO / TEMPO	577	291	1271	949	1512	2220	2527	1865	1289	1066	2087
TRACTORS	1418	1686	2168	3417	2994	2372	3348	2864	2790	3529	3011
TRAILERS	190	295	529	902	581	215	189	507	634	1222	162
OTHERS	175	462	103	635	536	118	245	373	587	414	510
TOTAL	58533	70090	83395	91054	96905	93451	1,54,666	1,79,114	1,76,674	1,81,676	2,01,199



6.3 METEOROLOGICAL ASPECTS OF AIR AND CLIMATE IN DEHRA DUN

The Dehra Dun district is situated in the North West corner of the state. It is located between the latitudes 29 °58' N and 31°2' N and longitudes 77° 34' E and 78° 18'E. The district is located on the foothills of the Himalayas. The district is bordered by the Himalayan range to the north, the Shivaliks to the south the Ganges to the east and the Yamuna river to the west. The Dehra Dun district has varied physical geography from Himalayan Mountains to plains.

Dehra Dun – The capital of Uttarakhand lies on the foot hills of the Himalayas . The distance from the sea gives Dehra Dun an extreme type of continental climate with the prevalence of continental air during major parts of the year.

Seasons in India are classified as Winter Season (January to February), Summer Season (March to May), Monsoon or South-West Season (June to September) and Post-monsoon Season (October-December).However, for the study of climate of Dehra Dun season are classified as:

1. Winter Season (December to February)
2. Summer Season (March to May)
3. Monsoon or South-West Season (June to September)
4. Post-monsoon Season (October-November).

The summers in Dehra Dun are moderately hot and winters very cold. The temperature may rise up to about 41 degrees Celsius in summers with all time high of 43.9 degree Celsius, though the average temperature is around 35-36 degree Celsius. There are about 1-2 days of heat wave when the maximum temperature of a day rises to 4-6 degree Celsius above the normal values. Though the winters are not bitterly cold on most of the days, the temperatures may fall to 1-2 degree Celsius for a few days in winters when the cold winds from the nearby Himalayan Mountains makes the winters severe. The all time low minimum



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temperature for the city is -1 degree Celsius. The winters are also marked by mist and fog on few days especially during night and early in the mornings and rarely till forenoon with bright Sun shine during the day.

The historical data of meteorology for Dehradun was referred and taken from Meteorological Observatory which is functioning at the Geodetic and Research Branch campus of the Survey of India since 01 January, 1867 and represents the city condition of DehraDun. Daily meteorological data of this observatory have been used to arrive at the climatology for DehraDun.

The maximum temperatures are at their peak during the months of May and June. Though the temperatures start falling in the month of July, the fall is gradual till October. Both the maximum and the minimum temperatures decrease sharply from the month of October with January being the coldest month. The rainfall increases from the month of June with the onset of pre-monsoon rainfall activity. July and August are the rainiest months. Monsoon withdraws towards the end of September. The rainfall decreases drastically from the month of October with November being the driest month of the year.

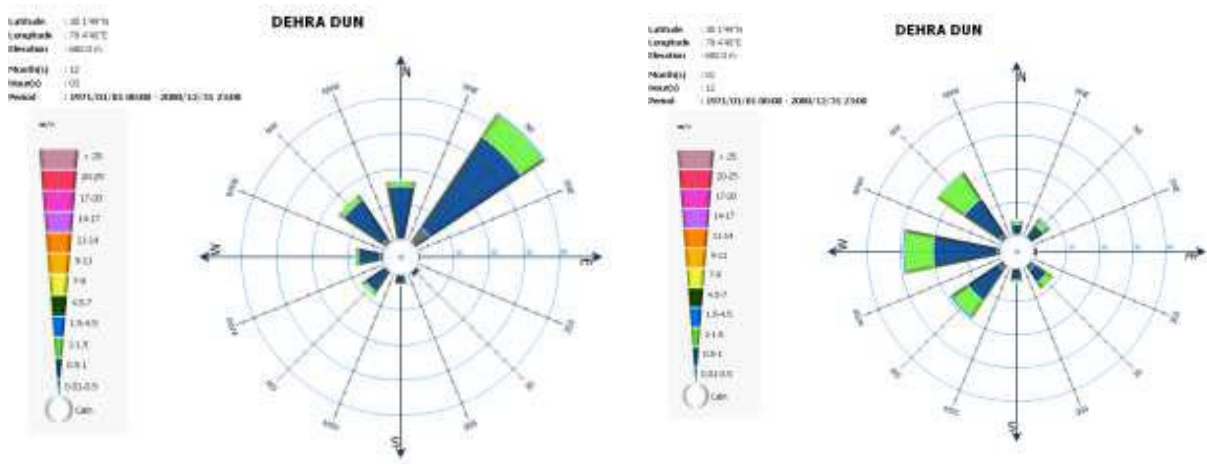
Winter

The winter season in Dehra Dun starts from the month of December and lasts up to February. India celebrates its Republic Day during this season on 26 January to Commemorate the date on which the Constitution of India came into force in 1950 replacing the Government of India Act 1935 as the governing document of India.

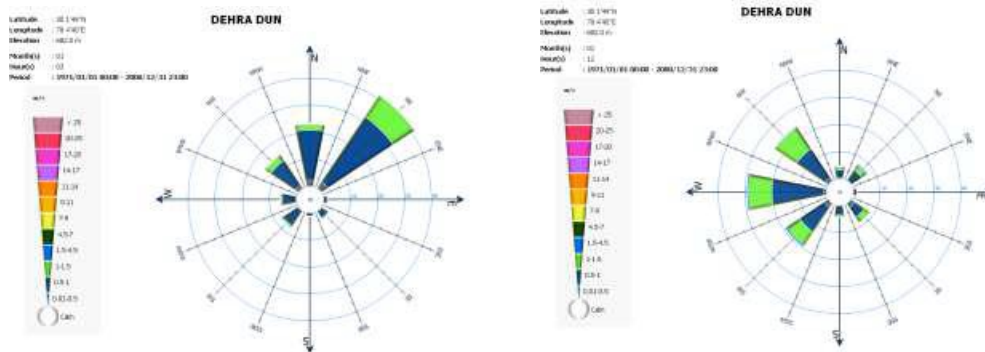
Though the winters are not bitterly cold on most of the days, the temperatures may fall to 1-2 degree Celsius for a few days in the season when the cold winds from the adjoining Himalayan mountains affect the region making the winters chilly. The winters are also marked by mist and fog and sometimes frost in the mornings with bright sunny days.

Wind

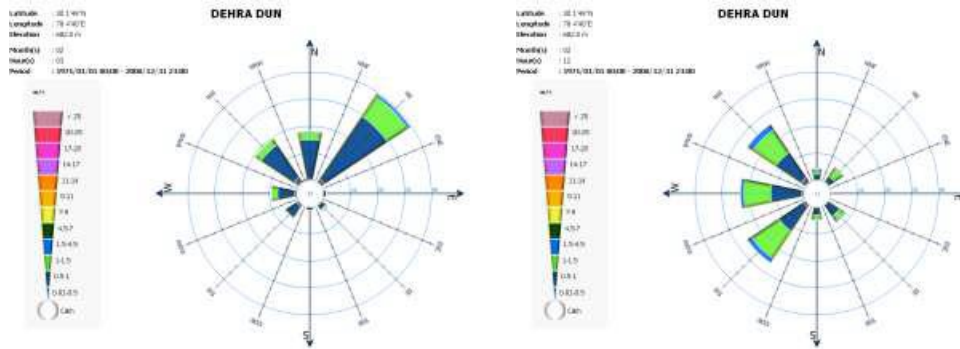
Winter is not a very windy season for Dehra Dun. Round the clock wind pattern and maximum wind could not be presented due to absence of Dynes PT instrument. The mean monthly wind roses for morning (0830 IST) and evening (1730 IST) show that the most prominent wind direction during the season is northeast in the morning and west to northwest in the evening. The frequencies of calm winds, both in the morning and evening are highest in the month of December and the lowest in February. Prominent wind speed varies between 1.8 to 3.6 Kmph during the season



December



January



February

Summer Season

The month of March, April and May constitute the summer season. The season is characterized by dry and hot weather in Dehra Dun. Increasing insolation and rise in temperatures with high incidence of convective weather phenomena (thunderstorms / duststorms, hailstorms and squalls) are the main weather features of the season. The WDs continue to affect through the season. Any incursion of moisture, and/ or operation of any trigger mechanism /orography create conditions conducive for explosive convective phenomena.

Wind

Increased insolation and, on occasions, steep pressure gradient over northwest India makes summer a relatively windy season for DehraDun. In fact, it is the windiest season for DehraDun.

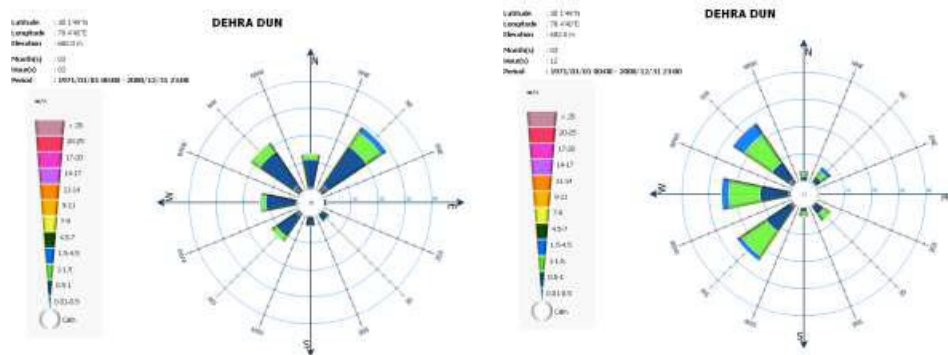
The mean monthly wind roses for morning (0830 IST) and evening (1730 IST) given in Figure indicates that for the month of March in the morning (0830 IST) most prominent wind direction is northeast and in the evening (1730 IST) northwest. Where as in the month of April, most prominent wind direction is northwest in the morning and southwest in the

evening whereas in the month of May both morning and evening wind directions are south easterly.

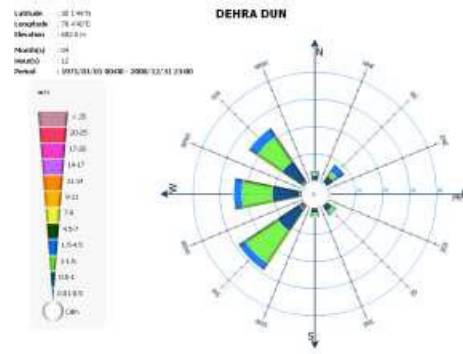
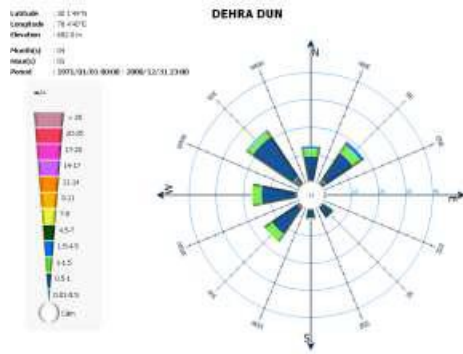
During the entire season in the morning prominent wind speed is 1.8-3.6 kmph where as in the evening prominent wind speed is 3.6-5.4 kmph. The frequencies of calm winds, both in the morning and evening are highest in the month of March and the lowest in May. Increased insolation and, on occasions, steep pressure gradient over northwest India makes summer a relatively windy season for Dehra Dun. In fact, it is the windiest season for Dehra Dun.

The mean monthly wind roses for morning (0830 IST) and evening (1730 IST) given in Figure 28 indicates that for the month of March in the morning (0830 IST) most prominent wind direction is northeast and in the evening (1730 IST) northwest. Where as in the month of April, most prominent wind direction is northwest in the morning and southwest in the evening whereas in the month of May both morning and evening wind directions are south easterly.

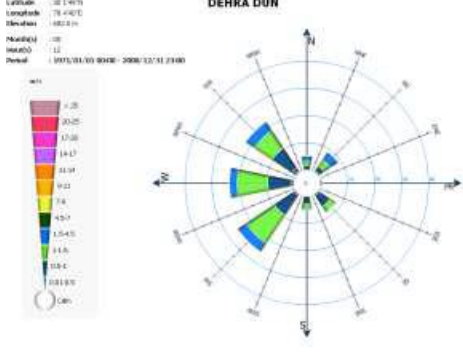
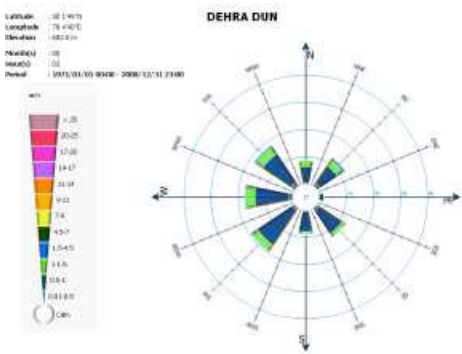
During the entire season in the morning prominent wind speed is 1.8-3.6 kmph where as in the evening prominent wind speed is 3.6-5.4 kmph. The frequencies of calm winds, both in the morning and evening are highest in the month of March and the lowest in May.



March



April



May

Wind Roses for Summer Season

Post monsoon season :

The post monsoon season (October-November) is a transit season between monsoon and winters. The season is characterized by generally dry and pleasant weather with a constant decrease in both day and night temperatures. With the retreat of southwest monsoon from the region in the latter half of September, weather becomes fairly dry.

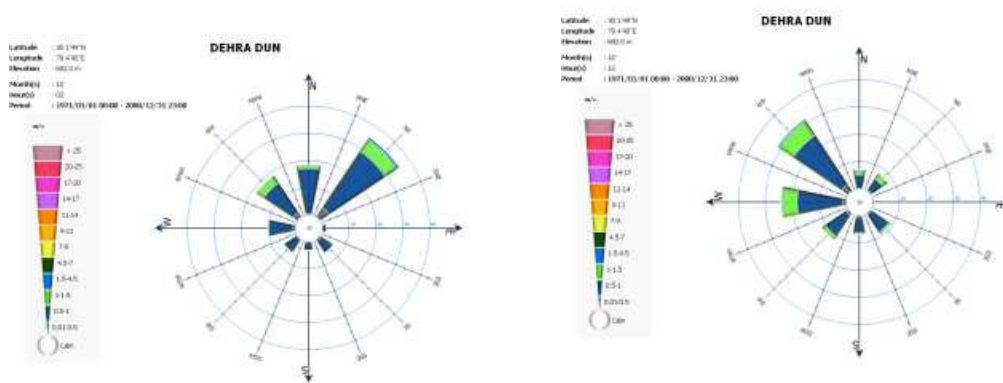
Temperature :

The season is marked by decreasing temperatures (Figure 42) due to continued south ward march of the sun. The mean maximum temperatures fall from 30° C in the beginning of October to 24° C towards end of the season. The mean minimum temperatures fall from 18° C in the beginning of the season to 8° C by its end. The decrease in both maximum and minimum temperatures is relatively smooth through the season.

Wind

Winds generally are not very strong during the season. The mean monthly wind roses for morning (0830 IST) and evening (1730 IST) given in Figure 53 indicates that during the entire season in the morning (0830 IST) most prominent wind direction is northeast and in the evening (1730 IST) is Northwest while in the month of July & August, the most prominent wind direction is southeast in the morning and northwest in the evening. In the month of September most prominent wind direction is northeast in the morning and northwest in the evening. In both the months the prominent wind speed in the morning as well as in the evening is 1.8-3.6 kmph.

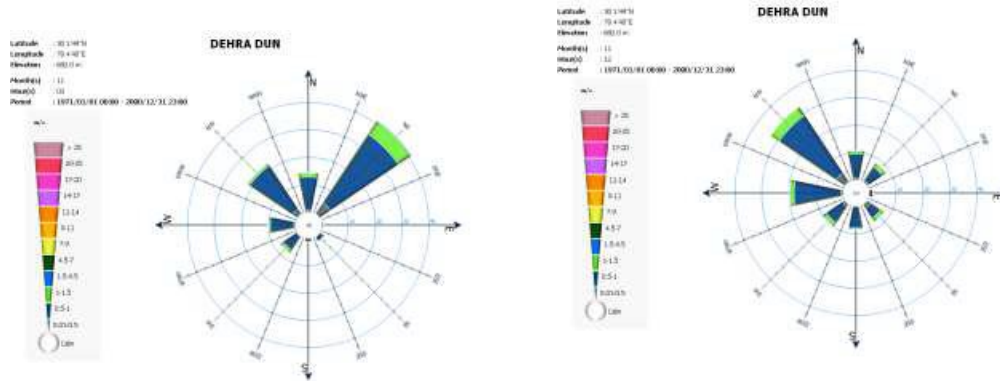
The frequencies of calm winds both in the morning and evening are highest in the month of November and the lowest in October.



October



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November



6.4 Ambient Air Monitoring at Dehradun

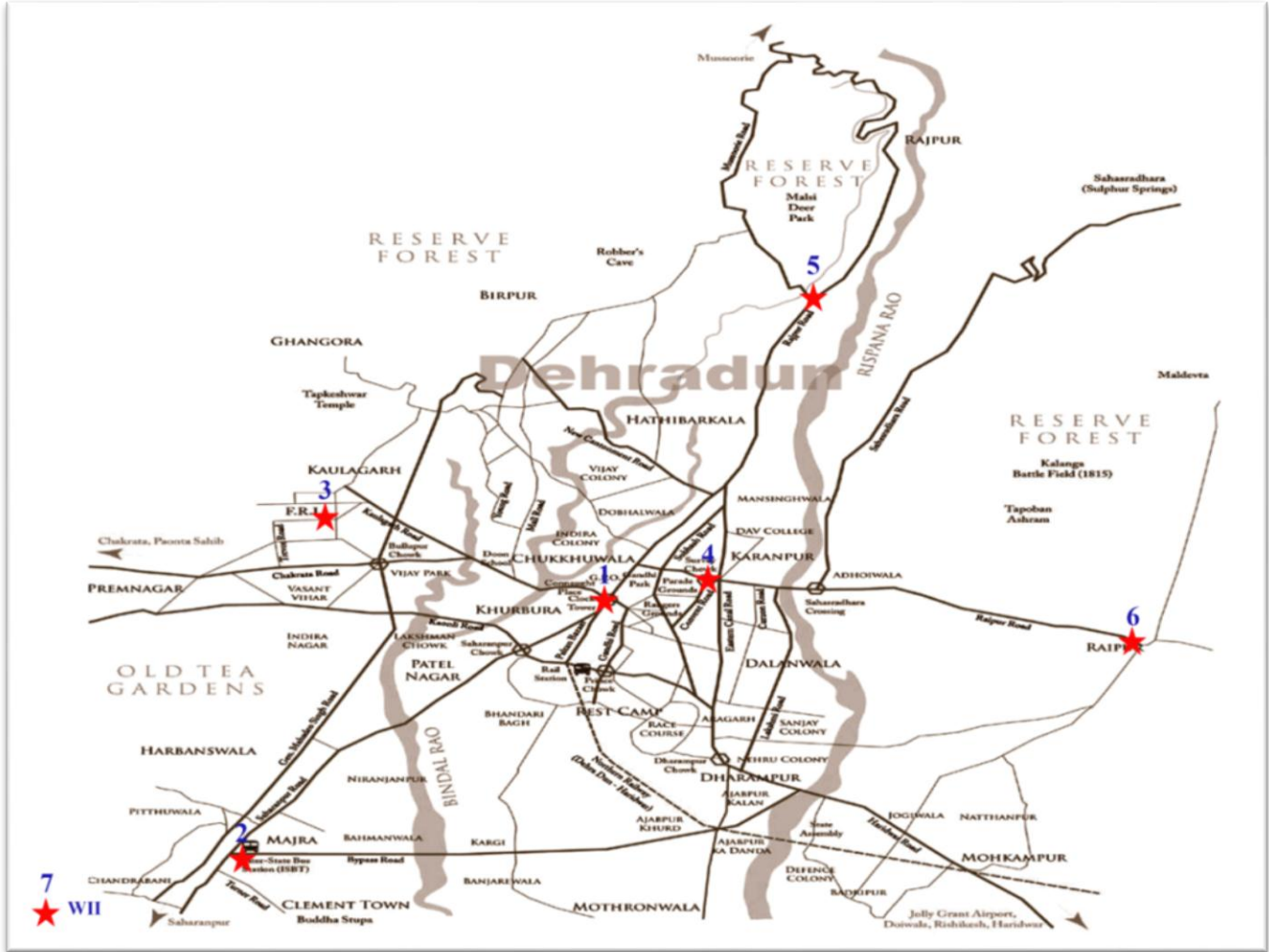
1. The study has been carried out by monitoring ambient air quality for thirty days continuously in summer, winter & post monsoon season at identified locations. The summer season study was carried out from 15-06-2016 to 14-07-2016. The post monsoon season study was carried out from 1-11-16 to 30-11-16 and winter season was carried out from 9-12-16 to 28-01-17.

The brief description of sites are given below:

- I. Ghanta Ghar
- II. ISBT
- III. ONGC/FRI
- IV. Survey Area
- V. Rajpur Road
- VI. Raipur
- VII. Wildlife Institute of India

The locations of proposed Ambient Air Quality of Dehradun City are shown on the map.

Seven ambient air monitoring stations were installed in the summer, post monsoon and winter season at locations such as near roadside, residential, industrial, outskirts (reference), commercial and sensitive areas. The monitoring of the above monitored parameters is being done as per CPCB/MoEF methods.



Seven Ambient Air Monitoring Locations at Dehradun.

6.4.1 Description of Ambient Air Monitoring Locations:

I. **Ghanta Ghar** : A prominent landmark of Dehradun city, Clock Tower of Dehradun is located at Rajpur Road. Names of the freedom fighters of Dehradun are engraved in a gold plaque on the Clock Tower. Clock tower also marks the centre of Dehradun city and all major commercial centre are easily accessible from here. Chakrata Road, Paltan Bazar Rd, Rajpur Rd and Haridwar Road meets at Clock Tower. Unfortunately, the impressive clocks are not working now. Previously chime of the clock was audible from far-off places of the hill city.



II. **ISBT** : Dehradun Inter State Bus Terminal (ISBT) is unique in the sense that it is the first ISBT in the country to be operated on BOT basis. The ISBT will be run through a joint venture entered into between MDDA and the Ramky Group. The project was planned and conceived by MDDA, which will receive Rs 30 crore as revenue over the period of BOT, that is, 20 years. MDDA has not incurred any expenditure on the project.

III. **ONGC/FRI** : FRI Dehradun is one of the oldest institutions of its kind and acclaimed the world over. The Institute’s history is virtually synonymous with the evolution and development of scientific forestry, not only in India, but over the entire sub-continent. Set in a lush green estate spread over 450 hectares, with the outer Himalaya forming

its back drop, the institute’s main building is an impressive edifice, marrying Greco-Roman and Colonial styles of architecture, with a plinth area of 2.5 hectares. The Institute has a developed infrastructure of all equipped laboratories, library, herbarium, arboreta, printing press and experimental field areas for conducting forestry research, quite in keeping with the best of its kind anywhere in the world. It is 7 Kms from Clock Tower, on the Dehradun-Chakrata motorable road and is of the biggest forest based training institute in India. Most of the forest officers are a product of this institute. The F.R.I. with its majestic building also houses a Botanical Museum for the attraction of tourists.



IV: Survey Area : Under state law, before a redevelopment effort can be initiated within an area, the Board of Supervisors must adopt a resolution designating the area as a "survey area." This provides a legal framework by which the Agency can determine and document the nature of the economic and physical problems in the area, to work with the community to develop a plan aimed at eliminating these problems and determine whether redevelopment should be one of the methods of addressing such problems.

In many cases, a concept plan is prepared with the involvement of the Agency, the Planning Department and other City departments that will be involved in an area's revitalization. A concept plan addresses a broad range of issues that are important to an area's revitalization. Among them may be redevelopment.



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Should it be determined that redevelopment is appropriate, there are several basic steps required to move a project from the survey area stage to the full implementation stage. After the Board of Supervisors has declared a survey area and determined the boundary for the area, the Agency must conduct the necessary surveys and analyses to assist in development of a preliminary plan. This plan must be approved by the Planning Commission. The development of this preliminary plan is a collaborative effort with the community and its citizen advisory committee.

Once the preliminary plan is approved, this plan and alternatives to it must then be subjected to the required environmental review process. Simultaneously, the preliminary plan is refined and further detailed in an effort to move toward approval of a final plan. Since the Planning Commission must approve the final plan with respect to its conformity with the City's General Plan, it may be necessary to process General Plan amendments while the final plan is being developed.

After the final plan has been developed, the General Plan conformity finding made by the Planning Commission is completed, the plan can be forwarded to the Board of Supervisors for its consideration. It can accept, modify or reject the plan. The final plan may have boundaries smaller than the original survey area, but may not be larger.

V. Rajpur Road : Rajpur Road strats from Ghanta Ghar and it passes through commercial, schools and cantonment areas.



VI. Raipur : Raipur is a census town in Dehradun district in the Indian state of Uttarakhand. Raipur is located at 30°18'22"N 78°05'53"E 30.306°N 78.098°E. It has an average elevation of 663 metres (2,175 feet). Raipur is a Town in Raipur Tehsil in Dehradun District of Uttarakhand State, India. It is located 8 KM towards East from District head quarters Dehradun. Raipur has Indian Ordnance Factory, OFIL and others.



VII. Wild Life Institute of India : The Wildlife Institute of India (WII) is an autonomous institution under the Ministry of Environment Forest and Climate change, Government of India.

WII carries out wildlife research in areas of study like Biodiversity, Endangered Species, Wildlife Policy, Wildlife Management, Wildlife Forensics, Spatial Modeling, Ecodevelopment, Habitat Ecology and Climate Change. WII has a research facility which includes Forensics, Remote Sensing and GIS, Laboratory, Herbarium, and an Electronic Library. WII has also popularized wildlife studies and careers.

The institute is based in Dehradun, India. It is located in Chandrabani, which is close to the southern forests of Dehradun.



Wildlife Institute of India

Table: 6.1

Ambient Air Monitoring at Dehradun for Summer Season
Average, Cumulative Percentile, Maxima & Minima
Respirable Suspended Particulate Matter (RSPM) PM₁₀

All values in $\mu\text{g}/\text{m}^3$

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	205	26	155	250	172	186	205	228	248
A2	Survey Area	302	30	256	363	269	277	299	323	358
A3	ONGC/FRI	206	16.4	187	241	198	203	215	221	239
A4	ISBT	191	15	171	241	182	189	193	204	240
A5	Rajpur Road	191	19.9	159	230	166	178	187	212	227
A6	Raipur	353	38	292	413	302	315	358	389	409
A7	Wildlife Institute of India	168	17.7	144	209	148	155	165	183	206

Table : 6.2

Average, Cumulative Percentile, Maxima & Minima
Particulate Matter PM_{2.5} (PM2.5)

All values in $\mu\text{g}/\text{m}^3$

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	123	16	93	150	103	112	123	137	149
A2	ISBT	196	20	164	229	169	175	188	204	228
A3	ONGC/FRI	106	9	107	137	115	118	125	118	139
A4	Survey Area	119	9	107	143	109	113	116	122	141
A5	Rajpur Road	115	12	95	138	100	107	112	127	136
A6	Raipur	209	23	172	249	181	189	215	212	247
A7	Wildlife Institute of India	96	11	76	121	90	93	99	110	119

Table: 6.3
Average, Cumulative Percentile, Maxima & Minima
Sulphur-Dioxide (SO₂)

All values in µg/m³

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	5	1	3	6	4	4	5	5	6
A2	ISBT	4	1	4	6	3	3	4	5	6
A3	ONGC/FRI	4	1	3	6	3	4	4	4	5
A4	Survey Area	4	1	3	6	4	4	4	5	6
A5	Rajpur Road	4	1	3	6	4	4	4	5	6
A6	Raipur	4	1	3	5	4	4	4	5	6
A7	Wildlife Institute of India	4	1	BDL	5	3	3	4	4	5

BDL : Below Detectable Limit

Table : 6.4
Average, Cumulative Percentile, Maxima & Minima
Oxide of Nitrogen (NO_x)

All values in µg/m³

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	15	1	14	14	14	15	15	17	20
A2	ISBT	15	1	14	14	14	15	17	19	23
A3	ONGC/FRI	15	1	14	14	14	14	15	16	18
A4	Survey Area	15	1	14	14	14	14	15	16	18
A5	Rajpur Road	20	1	17	22	18	19	20	16	22
A6	Raipur	20	1	17	22	18	19	20	20	22
A7	Wildlife Institute of India	15	1	14	14	14	14	15	15	16

Table : 6.5
Average, Cumulative Percentile, Maxima & Minima
Ozone (O₃)

All values in µg/m³

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	36	3	30	41	33	35	37	38	41
A2	ISBT	35	2	30	39	32	32	35	36	39
A3	ONGC/FRI	34	2	29	38	30	32	34	35	38
A4	Survey Area	32	2	29	38	30	30	34	34	38
A5	Rajpur Road	32	2	31	39	30	34	34	34	39
A6	Raipur	32	2	28	37	30	31	34	35	36
A7	Wildlife Institute of India	33	2	30	30	30	32	34	35	36

Table: 6.6
Average, Cumulative Percentile, Maxima & Minima
Carbon Monoxide (CO)

All values in mg/m³

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	0.84	0.07	0.70	1.40	0.98	0.77	0.84	0.91	0.97
A2	ISBT	0.63	0.07	0.49	1.20	0.84	0.55	0.63	0.70	0.85
A3	ONGC/FRI	0.56	0.14	0.42	1.20	0.84	0.53	0.56	0.70	0.84
A4	Survey Area	0.91	0.21	0.70	1.60	1.12	0.84	0.91	1.00	1.11
A5	Rajpur Road	0.42	0.07	0.35	0.80	0.56	0.39	0.42	0.50	0.55
A6	Raipur	0.63	0.04	0.49	1.10	0.77	0.55	0.63	0.71	0.77
A7	Wildlife Institute of India	0.14	0.01	0.06	0.30	0.21	0.10	0.14	0.18	0.21

The average, minimum & maximum concentration of SPM, RSPM, SO₂, NO_x and CO for above data is as given in Table below:-

Table: 6.8
Ambient Air Monitoring at Dehradun for Post Monsoon Season
Average, Cumulative Percentile, Maxima & Minima
Respirable Suspended Particulate Matter (RSPM) PM₁₀

All values in $\mu\text{g}/\text{m}^3$

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	180	23	136	220	151	164	180	201	218
A2	Survey Area	272	27	230	327	242	249	269	291	322
A3	ONGC/FRI	177	14	161	207	170	175	185	190	206
A4	ISBT	160	13	144	202	153	158	162	171	202
A5	Rajpur Road	174	18	148	209	151	162	170	193	207
A6	Raipur	176	19	145	205	150	157	178	194	204
A7	Wildlife Institute of India	143	15	122	178	126	132	140	156	175

Table: 6.9
Average, Cumulative Percentile, Maxima & Minima
Particulate Matter PM_{2.5} (PM_{2.5})

All values in µg/m³

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	126	16	95	154	106	115	126	140	153
A2	Survey Area	185	18	157	222	165	170	183	198	219
A3	ONGC/FRI	115	9	105	135	111	113	120	124	134
A4	ISBT	114	9	102	144	108	112	115	121	143
A5	Rajpur Road	110	11	93	132	95	102	107	122	130
A6	Raipur	121	13	100	142	104	108	123	134	141
A7	Wildlife Institute of India	91	10	78	114	81	84	90	101	112



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**Table : 6.10
Average, Cumulative Percentile, Maxima & Minima
Sulphur-Dioxide (SO₂)**

All values in µg/m³

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	BDL	0	BDL	BDL	1	1	1	3	4
A2	Survey Area	BDL	0	BDL	BDL	1	1	1	1	BDL
A3	ONGC/FRI	BDL	0	BDL	BDL	1	1	1	1	BDL
A4	ISBT	3	0	BDL	6	1	1	3	3	6
A5	Rajpur Road	BDL	0	BDL	BDL	1	1	1	1	BDL
A6	Raipur	BDL	0	BDL	BDL	1	1	1	1	BDL
A7	Wildlife Institute of India	BDL	0	BDL	BDL	1	1	1	1	BDL

BDL : Below Detectable Limit

Table: 6.11
Average, Cumulative Percentile, Maxima & Minima
Oxide of Nitrogen (NO_x)

All values in µg/m³

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	6	0	5	6	5	5	6	6	6
A2	Survey Area	4	0	4	5	4	4	4	5	5
A3	ONGC/FRI	4	0	4	5	4	4	4	5	5
A4	ISBT	6	0	5	6	5	5	6	6	6
A5	Rajpur Road	4	0	4	5	4	4	4	5	5
A6	Raipur	4	0	4	5	4	4	4	5	5
A7	Wildlife Institute of India	4	0	4	5	4	4	4	4	5

Table: 6.12
Average, Cumulative Percentile, Maxima & Minima
Ozone (O₃)

All values in µg/m³

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	19	1	16	22	18	18	20	20	22
A2	Survey Area	18	1	16	21	17	17	18	19	21
A3	ONGC/FRI	18	1	16	20	16	17	18	19	20
A4	ISBT	17	1	16	20	16	16	17	18	20
A5	Rajpur Road	18	1	16	21	17	18	18	19	21
A6	Raipur	17	1	15	20	16	16	17	18	19
A7	Wildlife Institute of India	18	1	16	20	16	17	18	19	20

Table: 6.13

Average, Cumulative Percentile, Maxima & Minima
Carbon Monoxide (CO)

All values in mg/m³

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	0.2	0.0	0.0	0.3	0.2	0.2	0.2	0.3	0.3
A2	Survey Area	0.2	0.0	0.0	0.2	0.1	0.2	0.2	0.2	0.2
A3	ONGC/FRI	0.2	0.0	0.0	0.2	0.1	0.2	0.2	0.2	0.2
A4	ISBT	0.3	0.1	0.0	0.3	0.2	0.2	0.3	0.3	0.3
A5	Rajpur Road	0.1	0.0	0.0	0.2	0.1	0.1	0.1	0.1	0.2
A6	Raipur	0.2	0.0	0.0	0.2	0.1	0.2	0.2	0.2	0.2
A7	Wildlife Institute of India	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.1



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**Table : 6.15
Average, Cumulative Percentile, Maxima & Minima
Respirable Suspended Particulate Matter (RSPM) PM₁₀**

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	198	25	150	242	166	180	198	221	240
A2	Survey Area	285	29	242	343	254	262	282	306	338
A3	ONGC/FRI	197	16	179	230	189	194	205	211	228
A4	ISBT	173	14	155	219	165	171	175	185	218
A5	Rajpur Road	189	20	161	228	165	177	185	210	225
A6	Raipur	186	20	154	218	159	166	189	206	216
A7	Wildlife Institute of India	156	16	133	194	137	144	153	170	191

Table: 6.16
Average, Cumulative Percentile, Maxima & Minima
Respirable Suspended Particulate Matter (RSPM) PM_{2.5}

All values in $\mu\text{g}/\text{m}^3$

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	135	17	102	165	113	122	135	150	163
A2	Survey Area	188	19	160	226	168	173	186	202	223
A3	ONGC/FRI	126	10	114	147	121	124	131	135	146
A4	ISBT	120	9	107	151	114	118	121	127	150
A5	Rajpur Road	133	14	113	160	115	124	130	147	158
A6	Raipur	126	14	104	147	108	112	128	139	146
A7	Wildlife Institute of India	95	10	81	118	84	88	93	103	116



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**Table : 6.17
Average, Cumulative Percentile, Maxima & Minima
Sulphur-Dioxide (SO₂)**

All values in µg/m³

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	2	0	1	3	2	2	2	2	3
A2	Survey Area	BDL	0	1	BDL	1	1	2	2	2
A3	ONGC/FRI	2	0	1	BDL	1	2	2	2	2
A4	ISBT	BDL	0	1	3	2	2	2	2	3
A5	Rajpur Road	BDL	0	1	BDL	2	2	2	2	2
A6	Raipur	BDL	0	1	BDL	2	2	2	2	2
A7	Wildlife Institute of India	BDL	0	1	BDL	1	1	2	2	2

BDL : Below Detectable Limit

Table: 6.18
Average, Cumulative Percentile, Maxima & Minima
Oxide of Nitrogen (NO_x)

All values in $\mu\text{g}/\text{m}^3$

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	8	1	7	10	8	8	8	9	9
A2	Survey Area	6	0	6	7	6	6	6	7	7
A3	ONGC/FRI	7	0	6	8	6	6	6	7	8
A4	ISBT	8	1	7	10	8	8	8	9	10
A5	Rajpur Road	7	0	6	8	6	6	7	7	8
A6	Raipur	7	0	6	8	6	6	7	7	8
A7	Wildlife Institute of India	6	0	6	8	6	6	6	7	8



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**Table-6.19
Average, Cumulative Percentile, Maxima & Minima
Ozone (O₃)**

All values in µg/m³

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	15	1	12	16	13	14	15	15	16
A2	Survey Area	14	1	12	16	13	13	14	15	16
A3	ONGC/FRI	14	1	12	15	12	13	14	14	15
A4	ISBT	13	1	12	15	12	12	13	14	15
A5	Rajpur Road	14	1	12	16	13	14	14	15	16
A6	Raipur	13	1	11	15	12	12	13	14	15
A7	Wildlife Institute of India	13	1	12	15	12	13	14	14	15

Table: 6.20
Average, Cumulative Percentile, Maxima & Minima
Carbon Monoxide (CO)

All values in mg/m³

Site Code	Location	Mean	S.D	Min	Max	Percentile				
						10 th	25 th	50 th	80 th	98 th
A1	Ghanta Ghar	0.4	0.0	0.3	0.4	0.3	0.3	0.4	0.4	0.4
A2	Survey Area	0.3	0.0	0.2	0.4	0.2	0.2	0.3	0.3	0.4
A3	ONGC/FRI	0.2	0.1	0.2	0.4	0.2	0.2	0.2	0.3	0.4
A4	ISBT	0.4	0.1	0.3	0.5	0.3	0.4	0.4	0.4	0.5
A5	Rajpur Road	0.2	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
A6	Raipur	0.3	0.0	0.2	0.3	0.2	0.2	0.3	0.3	0.3
A7	Wildlife Institute of India	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.1

The average, minimum & maximum concentration of SPM,RSPM,SO₂, NO_x and CO for above data is as given in Table below:-



Chapter - 7 **Observation, Recommendation and Action Plan**

7.1 District Health Action Plan District Dehradun

The commitment to bridge the gaps in the public health care delivery system, has led to the formulation of District Health Action Plans. The collaboration of different departments that are directly or indirectly related to determinants of health, such as water, hygiene and sanitation, will lead to betterment of health care delivery, and to make this collaboration possible actions are to be outlined in the District Health Action Plan. Thus this assignment is a shared effort between the departments of Health and Family Welfare, ICDS, PRI, Water and Sanitation, Education and NGOs/CBOs to draw up a concerted plan of action. District Action Plan for Dehradun district of Uttarakhand entailed a series of Consultative Meetings with stakeholders at various levels (District/Block/Village), collection of primary/secondary data from various departments and analyzed at District level.

The present acknowledgement would be incomplete without mentioning the participation of representatives and officials from department of Integrated Child Development Services, Panchayati Raj Institution, Education, Water and Sanitation and various NGOs who actively participated in consultations with great enthusiasm. Without their inputs it would not have been possible to formulate the strategic health action plan for the district. The formulation of this plan being a participatory process, with inputs from the bottom up, the participation of community members at village level proved very helpful. These consultations at grassroots level supplemented the deliberations at block and district levels, adding value to the planning process. Finally, we would like to appreciate the efforts of all those who were associated with the team for accomplishment of this task and brought the effort to execution.



7.2 Urban Development Directorate Plan in Dehradun

DRAFT URBAN MUNICIPAL WASTE MANAGEMENT ACTION PLAN FOR STATE OF UTTARAKHAND.

The State of Uttarakhand, also referred as “Dev Bhumi” was formed on 9th November 2000 as the 27th state of the India. It was also the year when Municipal Solid Waste Management and Handling) Rules, 2000 was too formed. However it was only after the commencement of the JnNURM in year 2005-06, there was a conscious effort State of Uttarakhand initiated to scientifically manage its municipal solid waste. Dedicated solid waste management (SWM) projects were initiated in four towns of Uttarakhand i.e. Dehradun, Haridwar, Haldwani and Nainital and currently these projects are in various stage of completion.

However, the needs of integrated SWM plan for the other ULBs have been long felt by the Policy Planner of the State of Uttarakhand. Moreover the experience faced in setting up of the above four projects have also forced the Policy Planners to have a relook at the ways MSW is to be managed in the hilly state.

Government of India too has launched an ambitious “Swatch Bharat Mission” which undertakes to make India a clean country by 02nd October 2019 when the country shall be celebrating the 150th birth anniversary of Father of Nation – Shri. Mahatma Gandhi Ji. The main objective of this mission too is to ensure personal and community hygiene focusing on the scientific management and disposal of municipal solid waste.

The National Green Tribunal (NGT), Principal Bench of Hon’ble Supreme Court of India, New Delhi too also been proactive in this regard and have passed direction to the State Government under the Petition No. 199 of 2014 Almitra H. Patel & Anr. Vs. Union of India & Others to come forward with complete time bound action plan.

7.3 Plan in the works for green transport in polluted Dehradun

1. The transport department is required to launch eco-friendly vehicles to reduce pollution level in Dehradun, which was ranked 31st among the most-polluted cities in the world according to a recent WHO report.



Figure - 7.1 : E-Rickshaw for Dehradun

2. The authorities are required to check vehicular pollution in the city of buses and autos which run on diesel. Monitoring of diesel-run vehicles for public transport which are used should be monitored periodically.
3. The officials at the regional transport office (RTO) claimed that they took action against the vehicles not going for annual pollution checkup. The actions are required to be more stringent.

4. According to RTO records, out of 22% of 7, 629 vehicles penalised each year for violating pollution norms, 15% are commercial and private, while 7% are for public transport. However, the department has given permits only few e-rickshaws. The number of challans are given below made in 2015 and 2016 from Dehradun transport department. The data on these are given below:

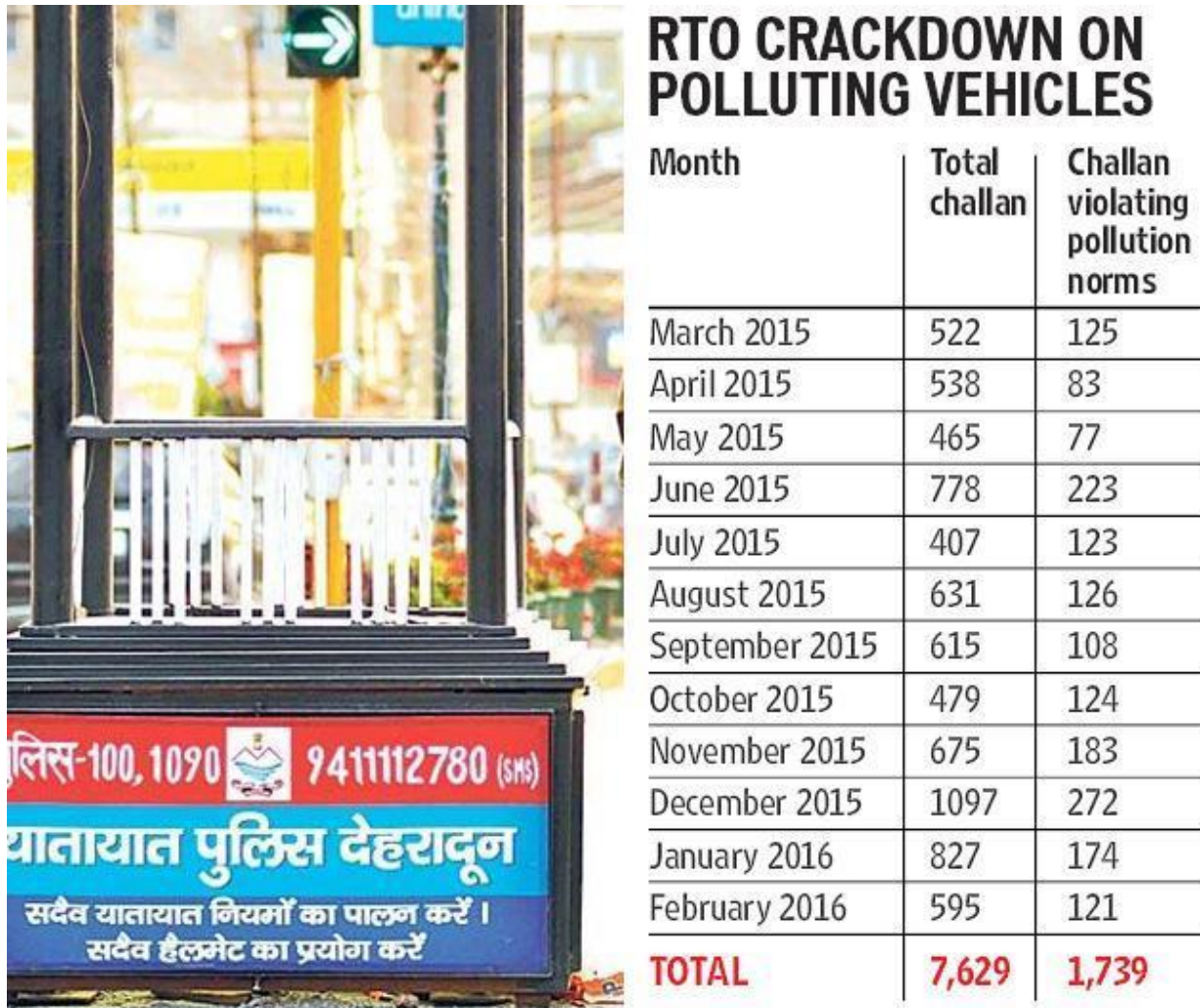


Figure- 7.2 Number of Polluting Vehicles



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5. More efforts are needed to launch an eco-friendly public transport system.
6. Rising population has also contributed to the city’s increasing pollution level. According to the Central Pollution Control Board (CPCB) norms, the respirable-suspended particulate matter (RSPM) level shall be 60. But, the data collected at three places – Clock Tower, Raipur Road and ISBT – shows it’s a three-fold increase. The Continuous Ambient Air Quality Monitoring System (CAAQMS) should be carried out.
7. Road Dust
Action taken: – repair and pavements and procure vacuum cleaning machines.
Procure vacuum cleaners in phase manner
 - Implement night-time sweeping and use of dust abatement techniques
 - Redesign streets with horticultural barriers
 - Reduce total vehicular trip by promoting walking/cycling through a network of infrastructure, Responsibility: Uttarakhand government
8. Waste burning /Construction dust - no waste burning and penalty for non-compliance should be enforced. Construction sites to follow guidelines for dust management strictly.
9. Strict enforcement •Improve waste management and ensure strict enforcement of ban on municipal solid waste burning.
10. Proper location of CAAQMS should be selected to monitor PM₁₀, PM_{2.5}, SO₂, NO_x and Carbon Monoxide. The LED display system should also be installed at these location displaying Ambient Air quality concentration at least one location i.e. Clock Tower (Ghanta Ghar). The detailed specifications of CAAQMS are given below:



7.4 Ambient Air Quality Monitoring System:

An online Ambient Air Quality Monitoring system (AAQMS) should be installed at one location i.e. at Ghanta Ghar (Clock Tower) to monitor the ambient air for SO₂, NO_x, CO, PM_{2.5}, PM₁₀. The details of analysers are given below:

Analysers

All the Analysers should be microprocessor based with automatic calibration facility, local LCD display and output OPC, Ethernet RS 232/485, TCP/IP, 4-20mA, relays, wireless connectivities. All Analysers shall be mounted in 19 inch analyser rack.

Other basic requirements shall be as follows,

- (a) SO₂ – UV fluorescence type,
- (b) NO_x - Chemiluminescence type,
- (c) CO - NDIR type,
- (d) PM_{2.5} and PM₁₀ - Beta attenuation measurement,

Analyser racks.

- All Analysers shall be mounted in 19 inch analyser rack. The cabinet shall be fully wired with pneumatic connections.
- Gas sampling system shall be provided with SS gas sampling hood, moisture trap, air compressor, air dryer etc.
- To cross check the built-in-calibration facility of the analysers/monitors a standard microprocessor based rack mounted multi gas calibration system for each AAQMS station with fast response time.



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- Automatic calibration unit shall be complete with solenoid valves and zero & span gas cylinders. Calibration cylinders shall be suitable for at least six months of operation.
- Flow measurement accuracy shall be +/- 2% or better , 4- 20 m A output Ethernet connectivity for remote access shall also be provided.

Data Acquisition System (DAS)

PC based DAS shall be provided in a local AAQMS station.

- Automatic alarm messages through GSM SMS and email transfer.
- Calculate vector mean of wind direction and wind speed.
- Graphic & tabular display of the current air quality monitoring data.
- Generation of wind roses, pollution roses, histogram, event analysis etc.
- Data reports, calibration reports and status reports for user selectable time period (instantaneous or averaged over a period of 1/2hr, 1hr ,4hr, 8hr, 24hrs, weekly, monthly, yearly, more than ten years).
- Control panel windows for controls of each analyser, including calibration.
- Alarm for all parameters.
- Real time multi- curves/graphs, tables, curves over user selectable time period and generation of reports.
- Historic multi-curves/graphs, Tables, curves over user selectable time period and generation of reports.
- Real time monitoring of all the analyzers and sensors with diagnostics.



DAS at local station

The minimum requirements shall be one set of PC with core i5 processor or better with 24 inch TFT monitor, laser jet printer, redundant Ethernet switch, cables, furniture, spares, consumables etc. for local station.

- In addition of the functional requirements as described above the DAS shall also perform a few activities such as data management, analysis and reporting over user defined periods of all data from AAQMS station and display of the same, should have the remote control facilities for calibration (zero & span) and measuring range, data backup facilities should be available. Minimum median, percentile, maximum, standard deviation frequency analysis and cumulative frequency analysis should be possible, should have the facilities of the following chart types like line & column chart, simple 3D, line & column chart, polar diagram and 3D perspective column chart.

AAQMS Station

AAQMS should be a completely assembled stand along shelter with analyser rack with analysers, sensors, compressors, DAS, gas sample and dust sample hoods, calibration gas cylinder, all internal piping, tubing, conduiting, junction boxes , earthing system , lighting electrode, antenna, windows air conditioner, power supply system, lumination, fire/ smoke detectors, fire extinguisher, tag plates etc.

Power Supply

Suitable UPS shall be provided for the AAQMS. Each of the main system shall have an individual isolation will consist of:

- e. 2x100% capacity UPS system battery (Lead Acid Plante Type) with back up time of 1 hour.
- f. One step down transformer; (415 V three phase to 240 V single phase) for bypass

- g. One static voltage regulator
- h. Two AC distribution boards

Ethernet Switch:

Data highway shall be of high speed Ethernet and full duplex configuration. Network shall be built on the Managed Ethernet switches for better control of data traffic & performance and future expansion. Switch configuration shall be redundant with seamless changeover without any upset in the process or equipment. All Ethernet switches to be used in the plant shall be of same type and shall conform the specification requirements.



Figure - 7.3 : A View of Shelter for Ambient Air Quality Monitoring (AAQMS) recommended to be Installed at Ghanta Ghar

The continuous data collected for PM10, PM2.5, SO2, NOx, & CO in AAQMS should be sent to UEPPCB via wireless networking using GSM or RF communication.

LED display Boards:

One LED display board with AAQMS shelter of size 6ft X 3ft and one LED board should be located at Ghanta Ghar.

LED display board shall be of multiline with red, yellow/orange and green colour.



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11. The diesel-run autos do not follow the CPCB norms. The people depend on such vehicles, as they do not have any other means of transport. The idea of mono rail can also be thought of. At present, the Govt. has no plans to launch an eco-friendly public system.

7.5 The Multi Story Car Parkings can help to solve traffic congestion.

The Uttarakhand government thinks car parks will ease traffic congestion in urban areas but Dehradun presents a sorry picture despite having several such facilities.

12. The tourist and commercial places are to be identified where car parks can come up in such areas. There are six municipal corporations, and 43 municipal council and an equal number of nagar panchayats in the state.

13. One of the reasons for the traffic mess is the ever growing population of vehicles. Uttarakhand with a population of just over 1 crore has 22.93 lakh registered vehicles. Dehradun (7.77 lakh), Haridwar (4.38 lakh), Udham Singh Nagar (3.79 lakh) and Haldwani (2.73 lakh) are where the vehicle population is mostly concentrated. The Car parkings at such type of places should be thought of.

14. The car parkings should be so developed that it eases out traffic congestion. The Mussoorie Dehradun Development Authority had built the Rajiv Gandhi Multipurpose Complex at Dispensary Road and the MDDA commercial complex near the Clock Tower. Each of these facilities can accommodate 50 to 80 two- and four-wheelers.

15. Though the twin-level Dispensary Road car parking was built for the commuters visiting Paltan Market and adjoining markets, the people nevertheless park their vehicles on the busy Market Road. “The problem is that there are many offices in the complex because of which the parking gets full in the morning. Even local shopkeepers park vehicles there. This leaves no space in the afternoon for the people who park outside”.

16. The three-storey MDDA commercial complex is confronted with a unique problem. Many vehicles are parked there for months together. The complex also has offices of Urban Housing Development Authority (UHDA), metro rail and tehsil. Even as the police and the MDDA officials initiated a drive few months ago, it has not changed the scenario.

17. Traffic situation has only worsened in most of the roads in Dehradun. Arterial roads such as Rajpur Road, Subhash Road, EC Road, Saharanpur Road, Clock Tower, Chakrata Road, Nemi Road and Court Road and others are wilting under the pressure of vehicles during the peak day and evening hours. The action plan should be developed to manage the ambient air pollution.
18. Places where there is a major traffic rush, the people are left with no choice other than to park vehicles on main road. The parking system infrastructure should be made strong to accommodate the maximum number of vehicles where the roads are narrow. Water sprinkling on the roads should be done to arrest the dust fly off on the major roads, like Rajpur road, Raipur road, Clock tower to FRI road and secretariat road.



Figure- 7.4 : A View of Vikrams in Dehradun

19. It has been seen that every winter, thick blue smoke envelops this town, casting a shadow on one of the most picturesque valleys in Asia. Doon is a broad valley. This sometimes gives rise to a lateral inversion that does not allow hot air to rise from the valley. As a result the smoke settles over the valley.
20. A resident of Dehradun, has reported that the first rains of the monsoon, leave scars on car and doubted about the rains may be acidic although no studies have been conducted.
21. Air pollution in Dehradun has been in the headlines for some time now. More than a decade ago it was limestone mining, but this was banned in 1986 by the Supreme Court in



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response to a public interest petition. Although the SPM levels have shown a downward trend over the years, they are still above the prescribed limits at all the monitoring sites in Dehradun. The city's annual average RSPM level was more than twice the permissible limit and the maximum RSPM level was more than thrice the standard. Moreover, RSPM levels were higher in residential areas compared to industrial areas. The Green Belt development should be done in the areas which are not in use.

22. Today, vehicular emissions are the main reason for air pollution. According to the road transport authority, only 10,000 vehicles were registered in Dehradun between 1937 and 1967. There are more than 126,452 vehicles plying on the roads at present, more than 100,000 of these are two-wheelers. However, the length and width of roads have increased only marginally. Result: traffic congestion. Air pollution is concentrated in the middle of the town. The Saharanpur road, Gandhi road and the Railway station areas are the most polluted areas.
23. A study by the Dehradun-based People's Science Institute (psi), a non-governmental organisation, says, "The abnormally high levels of RSPM in Dehradun are mainly due to natural dust and particulate-laden smoke from diesel-fuelled vehicles, especially Vikrams, trucks, buses and three-wheelers." The functionaries say the prevalence of respiratory diseases has risen alarmingly over the past decade and most cases are linked to air pollution. The institute conducted a study in which it selected a few plants and monitored the growth of their leaves at four sites in the town and one control site far away from the town.
24. Vikrams were petrol-driven, but the replacement rate of petrol engines by diesel engines is about 99 per cent," Kumar says. Officially, about 2,050 Vikrams are registered in the town. "But there are several Vikrams registered in nearby towns like Saharanpur plying in Dehradun", according to PSI.

Another cause for concern are two-wheelers. "In the absence of a public transport system - and Vikrams being the only alternative - most middle-class people prefer scooters," says

Gantzer. "There is also a class distinction attached with Vikrams. Most people prefer their own vehicles". A viable alternative is to be found for Vikrams, the sight that a tourist will behold from Mussourie, will not be a pleasant one.

7.6 Development of Dehradun as a Smart City

Dehradun Smart City: An opportunity for a new quality of life should be developed with good Environment, preserve green doon, smart city Dehradun.



Figure 7.5 : Dehradun as a Smart City

A dictionary definition of “smart” is something that has a “clean, tidy and stylish appearance”. “Smart Cities” are an effective response to today’s needs. In our view, the “smart city” is an urban model that needs to guarantee an elevated quality of life while preserving ecology and areas for sustainability.

The Dehradun smart city of tomorrow is a challenge to be faced today, an opportunity to “re-invent” Dehradun by retrieving a strong concept for the future, yet without forgetting the



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past. There is potential though, to improve Dehradun within the confines of the Central Government’s Smart City Mission without destroying its heritage and green areas like the

Arcadia Tea Estates. The competitive advantages emanating from an educational, agricultural and cultural heritage, must evolve to becoming a source of profit.

Citizens’ Action Group, which comprises 27 NGOs plus hundreds of other eminent citizens of the valley in their individual capacity, feels that the Smart City concept as it stands proposed by the Mussorie Dehradun Development Authority (MDDA) appears to be premature for Dehradun. The plan is to “retrofit” what it has called Zone 4 of Dehradun, a 3788 acre area that covers the Clock Tower or iconic Ghanta Ghar, Paltan Bazaar, Khurbura, Jhanda Sahib, Lakshman Chowk, Indirapuram, GMS Road, Mohitnagar, Indiranagar, Vasant Vihar, Rajendra Nagar, Vijay Park and Majra.

The Citizens’ Action Group agrees that the town or city centre of Dehradun needs refurbishment but it must keep in mind the fact that Dehradun exists in an eco-sensitive zone. As a seminal report on Doon’s development by NEERI points out, ““The Doon Valley is a distinct and unique ecosystem. The geological fragility and hydrological sensitivity of the Himalayan mountain system contribute to the ecological sensitivity of the Doon Valley ecosystem. The deterioration of this fragile ecosystem is aggravated by poverty driven ecological degradation, in which resident population as well as migrants overexploited the forest and natural resources to meet their short term needs at the cost of long term equilibrium between environmental and societal systems. Unplanned industrial development and inappropriate technological choices have destroyed the balance.”

Simply repeating in the future what was done in the past will not be enough. The city must be re-thought, starting from its basic premises and heritage structures.



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Smart cities represent an important step in the social and cultural change required. More intelligent and efficient urban systems are not an option – they are an absolute necessity. In fact, urban technologies, systems and infrastructure must be continuously adapted to needs as they arise. However, the challenge will be guaranteeing that technologies are truly able to provide an effective response to the problems of citizens and business: there must be a clear plan when adopting technologies. Smart cities cannot be only a technological challenge. Above all, they must be a social challenge.

Towards these goals we have formulated a brief proposal that constitute a basic plan of action. Key element of the proposal is a metric of the benefit to citizens while keeping in mind fragile environmental health of Dehradun valley.

Overall, the development of Dehradun as a smart city will go further to improve the air quality by all the means, conservation of resources, waste minimization and friendly ecological techniques as discussed above.

A SMART WAY TO MAKE DEHRADUN SMART

The Nodal Officer’s plan is to “retrofit” what it has called Zone 4 of Dehradun, a 3788 acre area that covers the Clock Tower or iconic Ghanta Ghar, Paltan Bazaar, Khurbura, Jhanda Sahib, Lakshman Chowk, Indirapuram, GMS Road, Mohitnagar, Indiranagar, Vasant Vihar, Rajendra Nagar, Vijay Park and Majra. This is not just a damning indictment of ill-planned development but also bears omens of how difficult the future can be without a course-correction.

The area under “Zone 4” as described above therefore needs re-assessment. For one, it takes us back to the boundaries of the contentious tea gardens, which are vital as a green lung. Secondly, this demarcation does not consider Dehradun’s improvement in a holistic manner. Rather, it appears to be a line drawn on a map.



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It is suggested that Ghanta Ghar is made the hub of the smart city retrofitting plan, taking into consideration an arc that covers Paltan Bazaar, Jhanda Sahib, the river courses of the Rispana and Bindal and extends all the way to Dilaram Bazaar. The revival of these rivers is vital to Doon’s water-charging capabilities. Gandhi Park, Pavilion Ground and Parade Ground need to be brought under this Smart City plan, being the city’s only green and open areas.

This area is the heart of Dehradun in terms of heritage and history besides being its commercial centre. A maximum number of Doon residents and visitors regularly visit or pass through here. If this “smartification” is successful, the rest of Dehradun would undoubtedly benefit.

Public transportation system: UTC will need to phase out its older vehicles and replace them with latest Bharat Stage compliant vehicles; in addition, it is proposed to purchase 800 new buses to meet the increased demand for efficient public transportation and reduction in emission load.

Control of vehicular pollution with the following objectives: (a) To control pollution caused by motorized vehicles plying in the state; (b) to create awareness amongst the motoring public in particular and the public at large on the effects of vehicular pollution; (c) to provide pollution-checking facilities at petrol pumps and workshops; (d) to enforce the standards of various pollutants according to the relevant rules including the Motor Vehicles Act and (e) to facilitate enforcement of environmental pollution control in the

7.7 Alternative Fuels in Dehradun

Alternative fuels: The Transport Department will also proactively consider the promotion and use of alternative fuels such as CNG and bio-diesel in the state for not only the public transportation system but also private vehicles.



These are vital parameters, as mentioned in smart city guidelines, that the smart city plan must cover to improve the air quality and develop a better eco balance:

1. Tree Cover

Dehradun needs to go back to its tree-lined avenues. Roadside trees need to include local varieties like Peepal, Mango, Acacia, Silver Oak, Kachnar, Jamun and Tun as well as some ornamental trees as desired. While these trees will help with air pollution by absorbing CO₂, latex-bearing plants which can absorb NO₂ and SO₂ can be planted in road dividers. A return to Doon’s once iconic litchi orchards would be magnificent.

2. A Pedestrian Plaza from Ghanta Ghar to Paltan Bazaar

Paltan Bazaar can be a tourist attraction with its old-style shops with good bargains and a wide variety of products and all the atmosphere of a traditional Indian bazaar. The two-wheelers that are permitted however are a nuisance and a danger. The idea of making Paltan vehicle-free needs to be reintroduced. Vehicles can be allowed at some point in the afternoons (1 pm to 3 pm) to allow shopkeepers to bring in their stock and also between 10 pm and 8 am. However, no pedestrian plaza can work without adequate parking which has to be accommodated within walking distance. The vehicle-free strategy will free the air quality with the vehicular air pollution and improve the environment. The malls built for the rehabilitation of shopkeepers from Chakrata road are currently lying less occupied. Their use needs to be reconsidered and their underground parking facilities increased.

3. Green and open spaces

Of what use is Dehradun’s famed natural beauty and greenery when the truth, as we all know, is that our green cover is constantly being destroyed. Apart from Gandhi Park, we have no public park worth the name. From New York’s Central Park to Mumbai’s maidans, all cities need open green areas to improve air quality and allow citizens to appreciate and enjoy nature. The old bus stand near Hotel Drona can also be utilised in some other means in a



planned manner. The Smart City plan must earmark other smaller areas which can be transformed.

4. Heritage conservation

Dehradun is known for its grand institutions like the FRI and IMA. It is also home to some unique art and architectural features which can be seen the Guru Ram Rai Darbar at Jhanda Sahib. The Smart City plans needs to keep these precious resources in mind. Pritam Castle, Arhat Bazaar, Tagore Villa, Imanullah Building must be included to save our history and culture.

5. River Rejuvenation

The river courses of Rispana and Bindal are struggling under the burdens of encroachment, unchecked garbage and waste disposal and the blocking of their sources higher up in Rajpur and Jakhan. If we do not rejuvenate these, our future is in jeopardy given the twin threats of climate change and global warming. In addition, our canals are lost to mind and sight. The recharging of aquifers may be an additional blessing.

6. Wifi and IT

Being “smart” in 21st century terms means the use of technology. Therefore free wifi and internet access are paramount. Special services for tourists and citizens could include information about emergency healthcare, restaurants, shops and so on. Effective use of IT could also help government services assess the extent and use of facilities offered. IT can help improve public services like water supply by checking on bill defaulters but also check on leakages and pilfering. Disaster management protocols must also be included in the IT section of the Smart City Plan.



7. Tourist facilities

Any smart city needs well-marked road signs, which includes tourist attractions and roadside maps. Information kiosks which use technology and/or manpower are an additional much-needed feature.

8. Roads, pavements and transportation

Solar lighting, already in use on hill roads in the Guniyal Gaon and Bhagwantpur areas of Dehradun will be of ecological and economical use and serve as an example to all of Dehradun. Pavements need to allow walking space as well as some greenery as well as water runoff. Existing infrastructure projects like flyovers must be completed. There is also a need to reduce the dependence on diesel and encourage autos, vikrams, cars and buses to shift to CNG or battery options.

9. Allotments and water conservation

Many western cities now allow citizens to set up kitchen and/or regular gardens on public land. This not only encourages urban farming and increases greenery but also opens more city land for ground water recharging. Could this be considered in the smart city zone? It may well help the water department cut down its dependence on tubewells. Rooftop rainwater harvesting is another suggestion which accrues enormous benefit after a small initial investment.

10. Vocational Training

Dehradun is already known for its educational institutions. But India and this city also need people with substantial skill training. Part of a smart city would include encouraging the setting up of polytechnics and diploma colleges for professional training.



11. An informational/awareness campaign

It is urgently needed to reach a wide base in the short-term because smart-related issues are familiar to few and risk being perceived as “elitist”. The overwhelming majority of the population in Dehradun has no idea what exactly a smart city is. Given the major social implications of this area which will revolutionize our way of experiencing cities, launching any kind of process without the public being adequately informed, prepared and motivated in terms of the potential and benefits is absolutely necessary (social networks are the best way to do this). Communication must emphasize the concept of inclusion.

If these suggestions are kept in mind, Dehradun can become an example to the rest of India on how nature and development and the past and the present can coexist in harmony. We owe that much at least to the future.

12. Save the Tea Gardens

Although the destruction of part of Dehradun’s tea gardens are no longer part of the current “Smart City” Plan, Dehradun must work towards the conservation of this vital green space and heritage district of Dehradun. The tea garden area contains over 30,000 trees and also contains the upper catchment area of the Asan river. Then there are the tea gardens themselves, the first in India, which ought to be a matter of civic pride instead of the current indifference and ignorance.

It was suggested that the government works out how to preserve the Doon valley’s tea heritage as well as this essential green lung. The existing tea gardens can be made into a museum of India’s first teas. We could also showcase speciality teas with health benefits, as demonstrated by the committed and concerned tea workers.

Part of the land could become a biodiversity park, which allows nature to thrive and us to survive. A botanical garden, fruit orchards, herb gardens and floriculture are other possibilities.



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The National Forest Policy of 1988 mandates that a forest cover of 66 per cent is maintained in the hills and of 33 per cent in the plains. NEERI suggests that Doon needs “harmonious and environmentally compatible growth” with “judicious exploitation” of Doon’s natural resources.

Though the officials at the regional transport office (RTO) claimed that they took action against the vehicles not going for annual pollution checkup, this is not enough.

The pollution level is higher because there’s no monitoring of diesel-run vehicles for public transport.

According to RTO records, out of 22% of 7, 629 vehicles penalised each year for violating pollution norms, 15% are commercial and private, while 7% are for public transport. However, the department has given permits to only 50 e-rickshaws this year.

“Certainly, more efforts are needed to launch an eco-friendly public transport system.

Rising population has also contributed to the city’s increasing pollution level, as between 2001 and 2011 it has seen 32% surge in number of residents.

According to the Central Pollution Control Board (CPCB) norms, the respirable-suspended particulate matter (RSPM) level shall be 60. But, the data collected by Uttarakhand Environment Protection and Pollution Control Board (UEPPCB) at three places – Clock Tower, Raipur Road and ISBT – shows its three-fold increase. The RSPM recorded in the capital is 187-388, and the level of sulphur dioxide has gone up from 24 to 29 against its permissible limit of 20.

However, the diesel-run autos do not follow the CPCB norms. People depend on such vehicles, as they do not have any other means of transport. The plan should be made to introduce an eco-friendly public system.”



Figure -7.6 Covered in dust, cars remain parked inside the Commercial Complex in Dehradun for months.

Framework Prepared for State Climate action plan

DEHRADUN: The forest department has prepared the framework to implement state climate action plan. According to the plan, chief Secretary will head all the bodies and the sectors working under the plan.

A state Council for Climate Change shall be formed at the apex level.



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According to sources, these four sectors have been taken at priority level under the State Action Plan of Climate Change which will be implemented in two phases-first phase from 2016 to 2018 and second phase from 2019-2021. Integration of climate concerns into all aspects of developmental policies will be prime objective. Under the first phase, climate vulnerabilities and risks will be identified in these selected sectors. With this, a scientific data base document will be built which will help in improving scientific base for implementation in second phase.

7.8 Need for Climate Change Action Plan for Uttarakhand

On a geographical level, the sub-national entities, the state acts as the ‘ground zero’ of climate change battle. Preparation and implementation of State Action Plans on Climate Change (SAPCC) thus forms a crucial clog in the strategy to address climate change, as most of the interventions aimed at improving the climate resilience/ adaptation ability of the communities, public or private infrastructures and preserving the eco-systems are undertaken and implemented at the state level. Besides, technology improvements in production, consumption and other related sectors at the state level are also critical in enhancing the effectiveness of national policies for mitigation. The process of preparation of Climate Change Action Plan for Uttarakhand stems from these imperatives. The government has therefore identified the State Forest Department (SFD) as the Lead Agency to coordinate preparation and implementation of the UAPCC in consultation with various line departments and other relevant stakeholders. For the preparation of the plan, all the concerned Departments and Agencies were organized into 11 different sectors, each under the leadership of the concerned Principal Secretary/Secretary to the State Govt. Several rounds of debates and discussions were held within the sector and issues & solutions pertaining to the sector were identified and discussed at the state level in sessions chaired by the Chief Secretary. This resulted in the evolution of this Action Plan through various versions that were exposed to scrutiny through website, workshops, seminars etc. For a state like Uttarakhand, adaptation has more significance than mitigation, as the contribution of the



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State to the GHG pool is miniscule compared to the developed states in the country. State wide consultations were also held with NGO's, academia, people's representatives, civil society groups and village folks (including women) who have their own perceptions based on their experience and knowledge.

Uttarakhand is most vulnerable to climate mediated risks. Mountainous regions are vulnerable to climate change and have shown “above average warming” in the 20th century. Studies conducted by MoEF have shown an increase in annual temperature in the Himalayan region, a net increase in rainfall in the 2030s with respect to the simulated rainfall of the 1970s in the Himalayan region. Impacts are expected to range from reduced genetic diversity of species to erratic rainfall leading to flash floods to glacial melt in the Himalayas leading to increased flooding that will affect water resources within the next few decades.

The natural resources of the region provide life supporting, provisioning, regulating, and cultural ‘eco-system’ services to millions of locals as well as people living downstream. The economy of the state as a whole is characterized by low economic growth combined with high rates of population growth. The livelihoods are almost totally based on natural resources - water, forest, agriculture, etc. About three-fourth of state's population is rural and virtually all depend on agriculture. Tourism and Animal husbandry are other sources of income. With over 15 important rivers and over a dozen of major glaciers, Uttarakhand is a valuable freshwater reserve. Hydel power continues to be a prime resource base for state's economy (with more than 200 large and medium sized hydro-projects). A large portion of the state is under forests with several forest based industries. Climate change will have direct impacts on livelihoods as most of the economic and livelihood sectors are dependent on the biodiversity and natural resources of the state which are vulnerable to the impacts of climate change.



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Some of the reported climate change induced changes in the Uttarakhand Himalayas include: receding glaciers and upwardly moving snowline, depleting natural resources, erratic rainfall (leading to flash floods as seen in June 2013 disaster), irregular winter rains, advancing cropping seasons, fluctuations in the flowering behaviour of plants (e.g. *Renwertia* spp), shifting of cultivation zones of apple (the zone has moved by 1000 m to 2000 m), reduction in snow in winter, rise in temperature, increasing intensity and frequency of flash floods, drying up of perennial streams, etc.

Transforming Opportunities into Crisis

The climate response strategy of Uttarakhand has key elements such as accelerating inclusive economic growth, promoting sustainable development, securing and diversifying livelihoods, and safeguarding ecosystem services. Further, the strategy envisaged should not be viewed as a standalone action; instead it should be integrated into the regular developmental planning process. Similarly, while it is important to pursue both mitigation and adaptation measures, considering the overall socio-economic and ecological contexts and vulnerabilities, it would be of importance to give priority to adaptation options including Disaster Risk Reduction.

DEHRADUN: The Uttarakhand government thinks car parks will ease traffic congestion in urban areas but Dehradun presents a sorry picture despite having several such facilities.

Recently, urban development minister sought proposals from urban local bodies for identifying areas where car parks can come up in their areas. There are six municipal corporations, and 43 municipal council and an equal number of nagar panchayats in the state.

One of the reasons for the traffic mess is the ever growing population of vehicles. Uttarakhand with a population of just over 1 crore has 22.93 lakh registered vehicles.



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Dehradun (7.77 lakh), Haridwar (4.38 lakh), Udham Singh Nagar (3.79 lakh) and Haldwani (2.73 lakh) are where the vehicle population is mostly concentrated.

Like Dehradun, there's no guarantee whether car parks will ease out traffic congestion. The Mussoorie Dehradun Development Authority had built the Rajiv Gandhi Multipurpose Complex at Dispensary Road and the MDDA commercial complex near the Clock Tower. Each of these facilities can accommodate 50 to 80 two- and four-wheelers.

Though the twin-level Dispensary Road car parking was built for the commuters visiting Paltan Market and adjoining markets, the people nevertheless park their vehicles on the busy Market Road. “The problem is that there are many offices in the complex because of which the parking gets full in the morning. Even local shopkeepers park vehicles there. This leaves no space in the afternoon for the people who park outside.

The three-storey MDDA commercial complex is confronted with a unique problem. Many vehicles are parked there for months together. The complex also has offices of Urban Housing Development Authority (UHDA), metro rail and tehsil. Even as the police and the MDDA officials initiated a drive few months ago, it has not changed the scenario.

In the meanwhile, traffic situation has only worsened in most of the roads in Dehradun. Arterial roads such as Rajpur Road, Subhash Road, EC Road, Saharanpur Road, Clock Tower, Chakrata Road, Nemi Road and Court Road and others are wilting under the pressure of vehicles during the peak day and evening hours.

“We don't have parking facilities at all. Places where there is a major traffic rush, the people are left with no choice other than to park vehicles on main road. We seriously lack infrastructure. Roads are narrow and there aren't any option,”



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Every winter, thick blue smoke envelops this town, casting a shadow on one of the most picturesque valleys in Asia. "Doon is a broad valley. This sometimes gives rise to a lateral inversion that does not allow hot air to rise from the valley. As a result the smoke settles over the valley," says a resident of Mussourie and a member of a monitoring committee set up by the Supreme Court to restore the "natural normalcy of the Doon Valley".

Air pollution in Dehradun has been in the headlines for some time now. More than a decade ago it was limestone mining, but this was banned in 1986 by the Supreme Court in response to a public interest petition. "Although the rspm levels have shown a downward trend over the years, they are still above the prescribed limits at all the monitoring sites in Dehradun.

7.9 Ambient Air Quality Monitoring & Management

Table : 7.1

Environmental Issues	Solution of Environmental Issues	Responsible Authorities
Ambient Air Quality Monitoring & Management	<p>It was found that there is no ambient air quality checking facilities/data available at Dehradun. At most of places the Suspended Particulate matter was more than the prescribed standard limits due to vehicular movement & their emissions of the existing and floating vehicles in Dehradun. This problem is due to existing & floating vehicle density at Dehradun. Therefore the following action has been proposed for ambient air quality management :</p> <ol style="list-style-type: none">1. There should be permanent Ambient Air Quality Stations installed for the monitoring of air pollutants like Suspended Particulate Matter, Respirable Suspended Particulate Matter, Sulfur Dioxide & Oxide of Nitrogen.2. To reduce the Suspended Particulate Matter & Emission of Vehicular Pollutant the Vehicles must be turned off while under idling condition at parking places.3. There is no existing mechanism to phase out old vehicles after prolonged use. Measures should be	<ol style="list-style-type: none">1. Collector2. State Pollution Control Board Administrator can organize Ambient Air Quality Monitoring work with SPCB.3. Road Transport Department can control & ensure for follow-up of traffic rules in the city.4. Fuel Supply Department like IOC, BPCL should ensure the quality of the fuel supply to Haridwar/ Rishikesh.5. Transport Manufacturers



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	<p>taken so the old vehicles should not be given the Fitness Certificate after the age period of vehicles from R.T.O. There should be restriction of old Model Vehicles on Road of Dehradun.</p> <p>4. The Quality of Fuel should also be monitored.</p> <p>5. The overloading in three wheelers need to be discouraged by traffic police.</p> <p>6. The number of Vehicles for parking in Town should be allowed as per the capacity of parking places and the time limits for stoppage at Parking places should also be given. This should be strictly followed. This would help the authorities to maintain emission level in ambient air within the standard due to traffic congestion.</p> <p>7. There should be permanent Ambient Air Quality Stations installed for the monitoring of air pollutants like Suspended Particulate Matter, Respirable Suspended Particulate Matter, Sulfur Dioxide & Oxide of Nitrogen.</p>	
Environmental Issues	Solution of Environmental Issues	Responsible Authorities
Ambient Air Quality Monitoring & Management	<p>8. To reduce the Suspended Particulate Matter & Emission of Vehicular Pollutant the Vehicles must be turned off while under idling condition at parking places.</p> <p>9. There is no existing mechanism to phase out old vehicles after prolonged use. Measures should be taken so the old vehicles should not be given the Fitness Certificate after the age period of vehicles from R.T.O. There should be restriction of old Model Vehicles on Road of Dehradun.</p> <p>10. The Quality of Fuel should also be monitored.</p> <p>11. The overloading in three wheelers need to be discouraged by traffic police.</p> <p>12. The number of Vehicles for parking in Town should be allowed as per the capacity of parking places and the time limits for stoppage at Parking places should also be given. This should be strictly followed. This would help the authorities to</p>	



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Ambient Air Quality Monitoring & Management	<p>maintain emission level in ambient air within the standard due to traffic congestion.</p> <ol style="list-style-type: none">13. The arrangement should be made by the authorities to replace environmentally friendly fuel (like CNG) for Vehicles in phased manner at various commercial places, so that these emissions be reduced in air during peak days of tourists.14. Vehicle manufacturers may also look into modification in engine of three wheelers for use with CNG/Propane instead of petrol/diesel.15. RTO may register only those new three wheelers in four-stroke engine category manufactured by reputed auto manufacturers.16. Strict implementation of standards should be enforced for vehicular emissions.17. The compliance of vehicular emission standards needs to be ensured by the vehicle manufacturers.18. The crowded market and residential areas should have the desired pedestrian areas.19. Regular exercise on public awareness and a social consciousness on the issue of vehicular pollution may be conducted.20. Signal lights & its timing system during peak hours needs to be introduced. This measure is expected to help in reducing the pollution load at various commercial places.21. Development of efficient traffic management is required with the emphasis on environmental pollution.22. Regular monitoring of ambient air quality for CO, HC, NO_x, and SO_x at congested traffic intersections should be studied and the impact of vehicular pollution on air quality should be carried out.	
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Guidelines For Action Plan

The guidelines for preparation of action plans for control of Air Pollution is as given below:





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1. An action plan should be presented to prioritize the list of abatement and other measures to improve air quality, and to maintain it within pre-described levels in the short and medium term. It outlines the steps required to implement a full air quality management system in any Haridwar city, consistent with that city's circumstances, capabilities and needs.
2. The aim of the action plan should be to identify and implement a least- cost package of measures to improve air quality, such that the marginal costs equals the marginal benefits.
3. Authorities responsible for preparing action plans regarding control of air pollution in their Dehradun city base their decisions on subjective assessment of economic and social costs, benefits, feasibility and other considerations.
4. While preparing action plan for control of air pollution the following components should be taken in to consideration:
 - Constitution of Working group for action plan preparation.
 - Development of a working strategy .
 - Air quality assessment.
 - Environment damage assessment
 - Evaluation of various control options
 - Cost benefit analysis or cost effective analysis
 - Selection of abatement measures, and
 - Development of an time bound optimum pollution control strategy
 - Traffic Plan

Action Plan should include the following:

- Assessment of air quality, environmental damage and abatement options are inputs into cost- benefit analysis or cost effective analysis.
- Cost- benefit analysis and cost effective analysis.



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- The final result of such analysis is an optimum control strategy in the form of action plan, with prioritized abatement measures.
- All these components required for preparing an effective action plan
- Besides above said components other things that are required to be incorporated in action plan is a background note on the Dehradun city for which action plan has to be prepared. Note on the Dehradun city should take in to consideration the topography, climatic conditions, land-use pattern, historical significance of the city (if any), prominent environmental problems, health status & steps taken so far for control of air pollution in the city.
- The background may also include the road network and infrastructure facilities available in the city/town. Any major environmental episode or any serious air pollution hazard being faced by the city/ town, if any, should also find special mention in the background note. There are three developmental phases in an action plan
- Phase-I: Immediate actions.
 - Strategy for immediate control of most urgent problems.
- Phase-II: Intermediate actions. Strategy for control in an intermediate time scale (about 5 yrs), based on current development trends.
- Phase- III: Long –term action. Strategy for control over a long- time scale (more than 10 yrs), based on long term projection. Guidelines for preparation of an effective action plan are described in details in the coming chapters which includes:
 - Assessment of air quality and environmental damage, evaluation of abatement option for the control of pollution and development of Optimum control strategy in the form of an action plan.

Constitution of working group A working group has to be constituted for preparation of action plan. Working group may include representatives from CPCB, SPCB, local agencies,



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Development authorities, city planners, state transport department, educationalist & researchers of concerned field, representatives from public forum, NGO’s etc.

Development of Work Strategy for air quality Management Working group requires to develop working strategy for air quality management at local level by referring into successful air quality management strategies & practices at international and national levels.

Assessment of air quality and environmental damage /Inventory Involves emission inventory of both mobile and stationary sources, ambient air quality monitoring, identification of non- attainment areas, and ultimately identification of most important damage categories and priority pollutants.

Evaluation of control options: This involves subjective verification and selection of all technical measures available for controlling pollution , air quality management strategies practiced in India, feasibility of implementation by considering social, environmental, health and finally financial issues.

Optimal control strategy Ultimately optimal control strategy i.e. action plan is formulated along with time frame required for its implementation.

Constitution of air quality management &surveillance committees Requires constitution of several committees for management & maintenance of good air quality and reviewing of various actions initiated.

7.10 Traffic Management Problems

Table: 7.2

Environmental Issues	Solution of Environmental Issues	Responsible Authorities
Traffic Problem	All relevant traffic data should be recorded and processed by an integrated system. The information should cover all type of vehicles on traffic junctions and the control programs of traffic light systems to current traffic flows of a town will forms a perfect basis for town and traffic planning. 1. To reduce the Respirable Suspended Particulate Matter & Emissions of Vehicular Pollutants the Vehicles Engine must be turned off while stand still at Parking places in Dehradun.	1. Collector 2. State Road Transport Department. 3. Traffic Police Superintendent



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	<ol style="list-style-type: none">2. Arrangement of Water Spray should be made thrice in a day so that SPM level could be maintained at low level in the Air.3. There is no existing mechanism, which forces the users to phase out old vehicles after prolonged use. Measures are taken so that old vehicles do not get fitness certificates year after year from R.T.O. There should be restriction of Old Model Vehicles on Roads of Dehradun.4. The Quality of Fuel at Dehradun should also be monitored.5. The overloading in three wheelers need to be discouraged by traffic police.6. The number of Vehicles for parking in Town should be allowed as per the capacity of parking places and the time limits for stoppage at Parking places should also be given. It should be strictly followed. This would help the authorities to maintain low emission level in ambient air due to traffic at Dehradun.7. Arrangement should be made by the authorities to replace petrol/diesel with environmentally friendly fuel (like CNG) for Vehicles in phased manner at Dehradun, so that these emissions could be reduced in air during peak days of tourists visiting to Dehradun.8. Rigorous efforts should be made by vehicle manufacturers to reduce emissions from engines. For this purpose alternative engine design with 4 stroke engines should be seriously considered and adopted. This is likely to provide twin benefits of fuel economy improvements by 25 to 40% and also 80 to 90% reduction in HC emission.9. Vehicle manufacturers may also look into modification in engine of three wheelers for use with CNG/Propane instead of petrol/diesel.10. RTO may register in future only three wheelers in four-stroke engine category introduced by the auto manufacturers.	
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7.11 Actions for Vehicular Emission Reduction at Dehradun

The following are the assessment & observation on Vehicular Emissions :

- To reduce the Suspended Particulate Matter & Emission of Vehicular Pollutant the Vehicles must be kept off while standing at Parking places in Dehradun.
- Arrangement of Water Spray should be made thrice in a day so that low RSPM level could be maintained in the Air.
- There is no existing mechanism, which forces the users to phase out old vehicles after prolonged use. Measures should be taken so that old vehicles do not get fitness certificates year after year from R.T.O. There should be restriction of Old Model Vehicles on Roads of Dehradun.
- The Quality of Fuel at Dehradun should also be monitored.
- The overloading in three wheelers need to be discouraged by traffic police.
- The number of Vehicles for parking in Town should be allowed as per the capacity of parking places and the time limits for stoppage at Parking places should also be given. It should be strictly followed. This would help to authorities to maintain emission level in ambient air due to traffic at Dehradun.
- The arrangement should be made by the authorities to replace environmentally friendly fuel (like CNG) for Vehicles in phased manner at Dehradun, so that these emissions could be reduced in air during peak days of tourists visiting to Dehradun.
- Rigorous efforts should be made by vehicle manufacturers to reduce emissions from engines. For this purpose alternative engine design with 4 stroke engines should be seriously considered and adopted. This is likely to provide twin benefits of fuel economy improvements by 25 to 40% and also 80 to 90% reduction in HC emission.
- Vehicle manufacturers may also look into modification in engine of three wheelers for use with CNG/Propane instead of petrol/diesel.
- RTO may register in future only three wheelers in four-stroke engine category introduced by the auto manufacturers.
- Strict implementation of standards enforced for vehicular emissions need to be ensured.

- The compliance of vehicular emission standards needs to be ensured by the vehicle manufacturers.
- The congested market and residential areas should be declared as pedestrian areas.
- Regular exercise on public awareness and a social consciousness on the issue of vehicular pollution may be conducted.
- Signal timing system during peak hours need to be worked out. This measure is expected to help in reducing the pollution load at Dehradun.
- Development of efficient traffic management is required with emphasis on environmental pollution.
- **Introduction of Electric Buses (Battery Operated)**



Bangalore, Karnataka



Delhi



Manali, Himachal Pradesh

Environmental benefits of the use of electric vehicles:

- Electric vehicles produce no GHG emissions, at the tailpipe. So they are considered 'green' because they have no emissions in the place where they are used.
- However, battery electric vehicles can be considered Zero emission engines only locally, because they produce GHG in the power plants where electricity is generated.
- The two factors driving these GHG emissions of Battery Electric Vehicles are:
 - The Carbon intensity of the electricity used to recharge the Electric Vehicle (commonly expressed in grams of CO₂ per kWh)
 - The consumption of the specific vehicle (in kilometers/kWh)

TABLE: 7.4
National Ambient Air Quality Standards
Central Pollution Control Board
NOTIFICATION
New Delhi, 18th November, 2009

NATIONAL AMBIENT AIR QUALITY STANDARDS

S.No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Area	Ecologically Sensitive Area (Notified by Central Government)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide (SO ₂), ug/m ³	Annual* 24 hours**	50 80	20 80	-Improved West and Gaeke - Ultraviolet fluorescence
2	Nitrogen Dioxide (NO ₂), ug/m ³	Annual* 24 hours**	40 80	30 80	- Modified Jacob & Hochheiser (Na-Arsenite) - Chemiluminescence
3	Particulate Matter (size less than 10um) or PM ₁₀ ug/m ³	Annual* 24 hours**	60 100	60 100	- Gravimetric - TOEM - Beta attenuation
4	Particulate Matter (size less than 2.5um) or PM _{2.5} ug/m ³	Annual* 24 hours**	40 60	40 60	- Gravimetric - TOEM - Beta attenuation



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5	Ozone (O ₃) ug/m ³	8 hours**	100	100	- UV photometric - Chemiluminescence
		1 hours**	180	180	-Chemical Method
6	Lead (Pb) ug/m ³	Annual*	0.05	0.05	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper
		24 hours**	1.0	1.0	- ED-XRF using Teflon filter
7	Carbon Monoxide (CO) mg/m ³	8 hours**	02	02	- Non Dispersive Infra Red (NDIR) spectroscopy
		1 hours**	04	04	
8	Ammonia (NH ₃)um/m ³	Annual*	100	100	- Chemiluminescence - Indophenol blue method
		24 hours**	400	400	
9	Benzene (C ₆ H ₆) ug/m ³	Annual*	05	05	- Gas chromatography based continuous analyzer - Adsorption and Desorption followed by GC analysis
10	Benzo(a)Pyrene (BaP)- particulate phase only, ng/m ³	Annual*	01	01	- Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As), ng/m ³	Annual*	06	06	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni), ng/m ³	Annual*	20	20	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper



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* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

**24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive day of monitoring.

Note.-Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.