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## **STUDY OF AMBIENT AIR QUALITY MONITORING ON HIMALAYAN REGIONS GARHWAL AND KUMAON, UTTARAKHAND, INDIA**

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### **ABSTRACT**

This paper presents data of the ambient air quality status of residential area of Himalayan region viz. Garhwal (NewTehri) and Kumaon (Muktheshwar) in state of Uttarakhand India. The Air quality was assessed based on New National Ambient Air quality Standard of Central Pollution Control Board of India measuring seven air pollutants. The outcome of the study has been presented in the form of Air Quality Index. The ambient air quality survey was carried out during the winter and summer for a period of 24 hrs. at four different locations with respect to, SO<sub>2</sub>, NO<sub>2</sub>, PM-10, benzo (a) pyrene, benzene, toluene, lead and nickel. During winter, the benzo (a) pyrene was found slightly higher (1.15 ng/m<sup>3</sup>) than the National Ambient Air quality Standard limit (1.0ng/m<sup>3</sup>). This may be due to Vehicle movement in the site selected at Muktheshwar. Rest of the other places benzo (a) pyrene levels were observed below 1 ng/m<sup>3</sup>. There are no industries in or along the roads in sampling area hence any source of atmospheric air pollution is not expected during the study period. Pollutants concentration (SO<sub>2</sub>, NO<sub>2</sub>, and PM-10) was used to calculate the air quality index which ranges from 7.91 to 14.93 thus categorizing the sites under the clean air and reported healthy.

**Key Words:** *Air pollutants, Air Quality Index, Clean Air, Himalaya, Uttarakhand*

### **INTRODUCTION**

Uttarakhand is strategically located at the foothills of the Himalayan ranges and has a Mountainous topography. The state of Uttarakhand is located in the Northern part of India. It is often referred as the land of gods due to many holy temples and pilgrimage centres. The state is divided into two divisions Garhwal and Kumaon. Himalaya is experiencing increase in the air pollution levels since last decade due to increase in transportation and industrial activities. Tourism is the largest retail industry in Uttarakhand state. Although tourism was once thought of as a “smokeless” industry with few, if any, environmental impacts, recognition of its potential for adverse impacts are growing (Davies and Cahill, 2000). Trends of tourist arrivals show that in Uttarakhand both foreign and domestic tourists have gradually increased. Most tourism-related air pollution comes from automobiles (Andereck, 1993). Automobiles emit by far the most carbon monoxide of all transportation modes. However, work on air quality in Uttarakhand has received little attention and no information exists on the air quality of sensitive area like tourist hill resorts. The present studies were therefore conducted at the Garhwal and Kumaon region in Himalaya which is located in the Uttarakhand states. It has famous tourist places and rich nature beauty.

The overall objective of the study was to assess the air water, soil trends in the upper Himalayan region so as to compare their level and determine trends in the plain area or urban areas. The air, water, soil are crucial factor in determining public health. The aim of the study is to generate the reliable data for the development of pristine environmental quality data in an identified stretches in Uttarakhand. To assess the ambient air quality with respect to SO<sub>2</sub>, NO<sub>2</sub>, PM-10, Benzo (a) Pyrene, Benzene, Toluene, Lead, Nickel by studying the trends of pollutants over a period of time in order to create a database for future use and to create public awareness about environmental pollution

## **Research Article**

### **MATERIALS AND METHODS**

#### **Study Area**

There were two manual station set up in each place. Accordingly at New Tehri two station and Muktheshwar two stations were identified. 24 hrs monitoring was carried out in the each station. Ambient air quality was monitored on December 2010 (winter, 13-16 December, 2010) and June 2011 (Pre-monsoon 20-25 June, 2011) at four sites in New Tehri (Garhwal) and Muktheshwar (Kumaon) in Himalayan region.

Uttaranchal became 27th state of the Republic of India in the year 2000. This hilly state comprises 17.3% of India's total land area with 51,125 sq km. According to the 2011 census of India, Uttarakhand has a population of 10,116,752. Tehri district lies between the parallels of 30.3' and 30.53' north latitude and 77.56' and 79.04' east longitude. Uttarkashi from the north, Rudraprayag from the east, Puri Garhwal from the south and DehraDun from the west are bounding the districts. It is situated at an elevation between 1550 to 1950 mts. above sea level Muktheshwar is located at 29.4722°N 79.6479°E. It has an average elevation of 2,171 metres (7,123 feet). Muktheshwar is a town and tourist destination in the Nainital district of Uttarakhand, India. It sits high in the Kumaon Hills at an altitude of 2286 meters (7500 feet).

The manual air quality monitoring stations were set up at two sites each at both the places as follows;

#### **Station 1:**

Southy Coat, Hillock Opposite to Hemvati Nandan Bahuguna University campus, Badshahithol, New Tehri)

#### **Station 2:**

Behind Guest House, THDC (New Tehri)

#### **Station 3:**

Behind Krishna Resort (Muktheshwar)

#### **Station 4:**

IVRI Main Gate (Indian Veterinary Research Institute), Muktheshwar

#### **Sampling Procedure**

Respirable Dust Samplers (APM-460NL)/High Volume Sampler are used for Ambient Air quality. Suspended particulate matter in ambient air is collected on EPM 2000 filter paper for 8 hr and gaseous sampling is conducted for 4 hr in respective absorbing media. The monitoring stations were established at the selected sites with keeping in the mind following requirements: The heights of the inlet pipe were kept 3-10 mt. above the ground level, the sampler were placed more than 20 m from the trees, the distance of the sampler were kept to any air flow obstacle i.e. building, must be more than two times the height of the obstacle above the sampler and with confirmation that there must be unrestricted air flow in three of four quadrants.

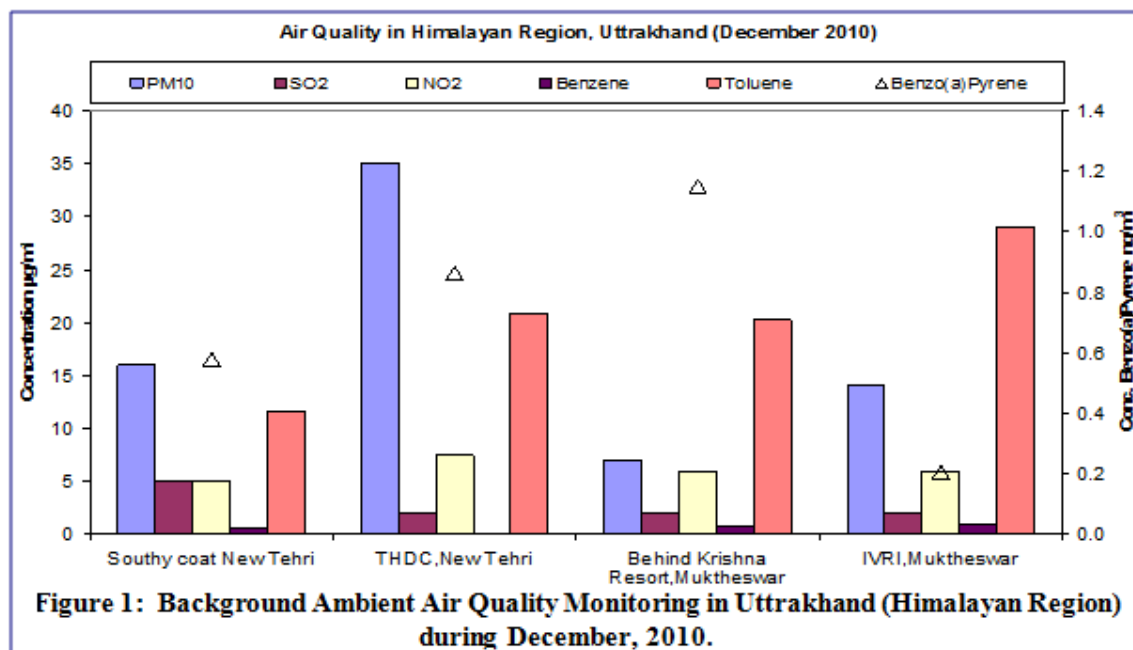


### **RESULTS AND DISCUSSION**

The 24 hourly mean concentration profiles of the various pollutants like as PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>x</sub>, BaP, Benzene and Toluene are given in table 1. From the Table 1 and Figure 1, it seems that all pollutants are within the National Ambient Air Quality standard. The PM-10 levels range between 7 and 35 µg/m<sup>3</sup>, SO<sub>2</sub> and NO<sub>x</sub> range below MDL. The Benzene ranges below 1 µg/m<sup>3</sup>, whereas the Toluene ranges between 12 to 29 µg/m<sup>3</sup> of ambient air. The Benzo (a) pyrene at Krishna Resort was found slightly higher (1.15

## Research Article

ng/m<sup>3</sup>) than the NAAQS limit (1.0ng/m<sup>3</sup>). This may be due to Vehicle movement in the premises of Hotel Krishna Resort. Rest of the other places its levels were observed below 1 ng/m<sup>3</sup>.



**Table 1: Parameters of Ambient Air Quality at different location (Phase I)**

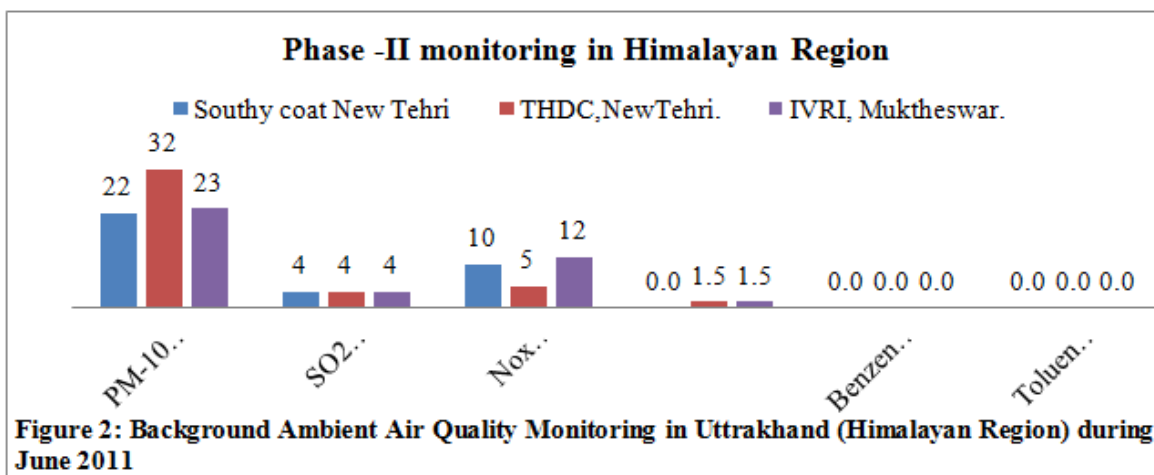
Parameters Locations	PM-10 µg/m <sup>3</sup>	SO <sub>2</sub> µg/m <sup>3</sup>	No <sub>x</sub> µg/m <sup>3</sup>	Benzo(a)Pyrene ng/m <sup>3</sup>	Benzene ug/m <sup>3</sup>	Toluene ug/m <sup>3</sup>	Lead ng/m <sup>3</sup>	Nickel ng/m <sup>3</sup>
Southy coat New Tehri	15	6.5	6	0.5	BDL	BDL	BDL	BDL
THDC, New Tehri.	27	8	6.25	0.6	BDL	BDL	BDL	BDL
Hotel Krishana Resort	10	4	7	1.15				
IVRI, Muktheswar.	23	4	6.5	0.2	BDL	BDL	BDL	BDL

The 24 hourly mean concentration profiles of the various pollutants like as PM10, SO<sub>2</sub>, NO<sub>x</sub>, BaP, Benzene and Toluene are given in Table 2 and Figure 2. The II-phase monitoring was carried out during 20-25, June 2011 only in 3 places instead of 4 places. It is found that almost all parameters are well within the limit of Ambient Air quality standards. It is important to note that the VOCs are below detectable limit in all the locations.

**Table 2: Parameters of Ambient Air Quality at different location (Phase II)**

Parameters Locations	PM-10 µg/m <sup>3</sup>	SO <sub>2</sub> µg/m <sup>3</sup>	No <sub>x</sub> µg/m <sup>3</sup>	Benzo(a)Pyrene ng/m <sup>3</sup>	Benzene µg/m <sup>3</sup>	Toluene µg/m <sup>3</sup>	Lead ng/m <sup>3</sup>	Nickel ng/m <sup>3</sup>
Southy coat New Tehri	22	4	10	BDL	BDL	BDL	BDL	BDL
THDC, New Tehri.	32	4	5	1.5	BDL	BDL	BDL	BDL
IVRI, Muktheswar.	23	4	12	1.5	BDL	BDL	BDL	BDL

## Research Article



### Air Quality Index

The air quality index (AQI) is a measure of the ratio of the pollutants concentration to the status of ambient air in places. Indices of air pollutant or air quality have been used for about 25 years (Zlauddin and Siddiqui, 2006; Joshi and Semwal, 2011). The following computation was used to drive the air quality index of the sites under Consideration:

$$AQI = \frac{1}{3} \left[ \frac{PM_{10}}{sPM_{10}} + \frac{SO_2}{sSOx} + \frac{NO_2}{sNOx} \right] \times 100 \dots \dots \dots \text{Equation 1}$$

Where sPM10, sSOx and sNOx represent the new ambient Air quality standards as prescribed by the Central Pollution Control Board of India (CPCB) and PM 10, SO<sub>2</sub>, NO<sub>2</sub> represent the actual values of pollutants obtained on sampling. After compiling the results, the concentration of each pollutant was converted into an AQI. The pollutant with the highest AQI number became the overall AQI for a particular location. The higher the AQI value, greater is the level of air pollution and greater the damage to health. The AQI scale was divided into five categories describes the range of air quality and its associated potential health effect (Table3). The air quality index have 5 levels using a scale from 0 (very low) to > 100 (very high), the index values between 0-25 regarded as clean air and between 26-50 regarded light air pollution were used for present study.

**Table 3: Rating scale of AQI values (Rao and Rao, 1989)**

S. No.	Index Value	Remarks
1	0-25	Clean air (CA)
2	26-50	Light air pollution (LAP)
3	51-75	Moderate air pollution (MAP)
4	76-100	Heavy air pollution (HAP)
5	>100	Severe air pollution (SAP)

**Table 4: Index values of air quality index calculation**

Winter Seasons Monitoring Air Quality Index values(1 <sup>st</sup> phase)			
Monitoring Locations	Measured AQI Values	Index Value	Remark
Southy coat New Tehri	10.20	0-25	Clean air
THDC, NewTehri.	14.93		
Hotel Krishana Resort	7.91		
IVRI, Muktheswar	12.04		
Summer Season Monitoring Air Quality Index Values (2 <sup>nd</sup> Phase)			
Southy coat New Tehri	13.16	0-25	Clean air
THDC, NewTehri	14.41		
IVRI, Muktheswar	14.33		

### **Research Article**

The Mean of AQI is calculated individually with respect of the Garhwal and Kumaon divisions to compare and indices of the Air quality (Table 4). The AQI of Garhwal division 13.18 and Kumaon Divisions AQI is 11.44. However, the Air quality status of the Kumaon is healthier than Garhwal Divisions. The possible reason of it may be the high human and vehicular activities. Air pollution from tourist transportation has impacts on the global level, and it can contribute to severe local air pollution. The study showed increase in concentration of air pollutants during peak tourist activity. Tourist inflow, vehicular density, roadside dust, and burning of coal and fuel wood on a large scale are main sources of air pollution in that area. there is no an urgent need to monitor but to be made a Remote hill Area environmental policy to protect their importance in respect of Bio-diversity, wildlife and many important Herbals get from that area which are used for made the medicine. Ambient air quality stations is established to monitor the climate change and other effect of environmental related viz. produce base line data made future new ambient air policy regarding that areas for the remote place and to see the watch the change in the air quality day by day Ambient air quality monitoring would be set up to monitor the. Data can be used to model and validate scenarios of pollutant behavior in response to changes in policy or pollution generation patterns

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