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AMBIENT AIR QUALITY NEAR KAZIRANGA NATIONAL PARK, ASSAM

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Abstract**:** The work investigates the concentration of the pollutants PM 10, PM 2.5, SOx, and NOx from various sources like automobiles, oil refinery etc in and around the Kaziranga National park. 3 sampling sites were selected including 1 industrial(InT), 1 residential(TS) within the refinery & 1 roadside(BP) within the kaziranga national park area. At each site all 4 pollutants were monitored twice a week and eight times in a month using PM 2.5/10 sampler for particulates and High volume Sampler with gaseous attachment for SO_2 and NO_2 during the year June 2013 to May 2014. The values of all these pollutants (particulates and gaseous) are observed to be very much below according to National Ambient Air Quality Standards. However the area is mostly covered with forest reserve.

Keywords: ambient air quality: SOx; Nox; PM10; PM2.5

1. Introduction:

Increased urbanization and industrialization, the rapid growth of population and transport services have altered the air quality. Air pollution has now become a global problem. Most of the developing nations are affected by atmospheric pollution not only in terms of human health[1] but also in terms of several other aspects like climate change[2] and loss of bio-diversity[3]. Air-pollution is a major challenge to be addressed in 21st century. Developing effective pollution mitigation strategies require a lot of information in terms of sources as well as nature of pollutants. Such information can be obtained by continuous air pollution monitoring. Environment impacts include intensification of the greenhouse effect, acid rain, poorer water quality, ground water contamination, among others. The oil and gas industry may also contribute to biodiversity loss as well as to the destruction of ecosystem that in some cases may be unique. Most potential environment impact related to oil and gas industry activities, that they are major polluters, consuming large amount of energy and water, producing large quantities of waste waters, releasing hazardous gases into the atmosphere and generating solid waste that are difficult both to treat and to dispose of[4]**.** Among the harmful chemical compounds, coming from burning fossil fuel in oil and gas industry puts into the atmosphere, are carbon dioxide (CO_2), carbon monoxide (CO), nitrogen dioxides (NO_2), sulphur dioxide (SO_2), and tiny solid particles-including lead from gasoline additives-called particulates[5]**.** Around the globe level of air pollution is being estimated by active and or passive monitoring. Active monitoring methods include sampling on the filter papers using high volume sampler[6]. However, continuous air quality monitoring is a challenge in terms of technical difficulties related to instrumentation and economic burden, particularly in the developing countries. To overcome such limitations, passive monitoring is being considered as an alternative to active pollution monitoring.

Air pollution in India has increased rapidly because of intensive population growth, increase in the numbers of vehicles, use of fuels with poor environmental performance, badly mentioned transportation systems, poor land use pattern, industrialization, and above all, ineffective environmental regulations. In most of the Indian cities with a million-plus population, air pollution levels exceed World Health Organization"s (WHO) recommended health standards[7]. In every city, the levels are getting worse because of rapid industrialization, growing number of vehicles, energy consumption, and burning of wastes. Several cities face severe air pollution problems, with annual average levels of total suspended particulates (TSP) at least three times as high as the WHO standards. A study conducted by the World Bank indicates premature deaths of people in Delhi owing to high levels of air pollution(*CPCB,2003*). Following is the table for National ambient air quality standard

Table 1: Table for National ambient air quality standard.

Pollutant	Time average	Conc in industrial, residential area microgm/m3	Conc in ecologically sensitive area microgm/m3	Methods of measurement
SOx	24 hour	80	80	West and Gaeke
NOx	24 hour	80	80	Jacob &Hochheiser
PM2.5	24 hour	60	60	Gravimetric
PM10	24 hour	100	100	Gravimetric

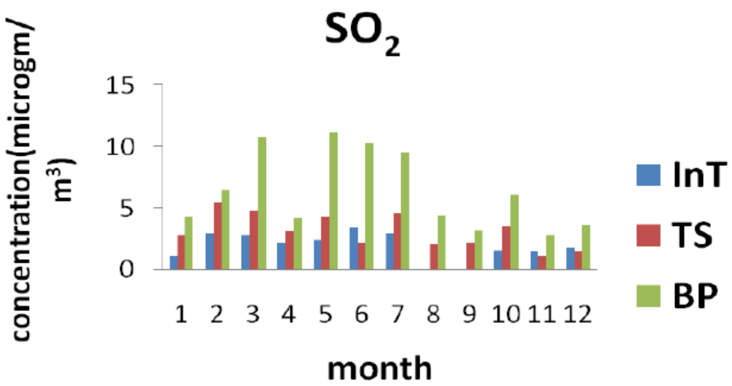

Figure 1: SO_2 concentration in three statio.

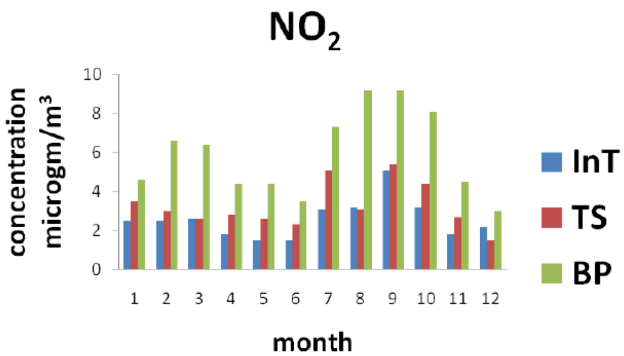

Figure 2: NO_2 concentration in three stations.

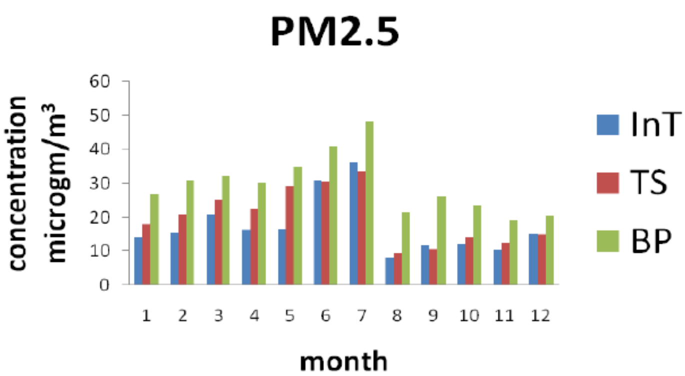

Figure 3: PM2.5 concentration in three station.

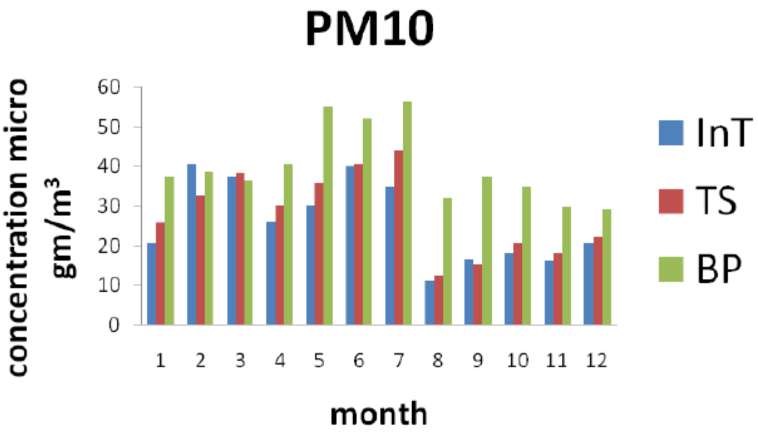

Figure 4: PM 10 concentration in three station.

2. Materials and methods:

Monitoring stations were set up to evaluate air quality. Starting from the set of potential sites in which a monitoring station can be located, the basic idea is to formulate an optimization strategy based on different sitting objectives and to take into account the coverage area and the detection ability of legal violations of each allocated station. TSP (total suspended particulate), SO_2, and NO_2 emissions from point, area, and line sources in the study area were computed and compiled for each month during the study period. Selection of SO_2, NO_2, and TSP as criteria pollutants is based on the rationale that: a) these are the significant pollutants emitted from refineries, b) they are the only air pollutants which are subject to current Indian standards and WBEG (world bank emission guidelines), c) they are measurable/continuously monitored by regulatory authorities, d) changes in parameters can be predicted by the modelling process.

Air pollution measurements were taken for twice weekly, eight times in a month over one year in three stations.. One is along the road side where national highway(BP) passes located in aerial distance nearly 25 km from refinery and another two is intake(InT) and township(TS) stations are located nearby the refinery. Pollutants and meteorological parameters were measured for 24 hours a day. The pollutants were included SO_2, NO_2, PM10 and PM2.5. The recorded meteorological conditions are relative humidity, wind speed, wind direction, ambient temperature and solar intensity.

Total suspended particulate (TSP)matter, repairable particulate matter (PM10 mm aerodynamic diameter), sulphur dioxide (SO_2) and oxides of nitrogen (NOx) were sampled by high volume samplers (HVS) with an average flow rate greater than 1.1 m^3 and having PM10 and gaseous sample collection attachments. The HVS having PM10 and gaseous attachment were kept on the houses roof-top, approximately 3 m height above ground, at all the monitoring stations. The height of sampling for a particular monitoring station was same throughout the study period. The exhaust gas was used after having passed the TSP/PM10 hivol for collection of gaseous samples. The HVS were regularly calibrated for the proper measurement of air pollutants. Samples were collected at regular interval. Particulate monitoring instruments generally use particle concentration measurement techniques: gravimetric. Gravimetric or filter-based instruments collect particulates on ventilated filters. The filters are later weighed at special laboratory facilities to determine the mass concentration of particulate collected. Gravimetric monitoring techniques have been used for years to quantify mass concentration levels of airborne particulate matter. Filter-based sampling is labor intensive. Filters must be conditioned, weighed before sampling, installed and removed from the instrument, and reconditioned and weighed again at a special facility. Results may not be available for days or weeks. Also, airflow rates and elapsed sampling time must be carefully monitored and recorded to ensure accurate results. Filter-based techniques integrate samples over a long period of time, usually 24- hours, to obtain the required minimum mass for analysis. Gravimetric monitoring is best for projects where high-accuracy is needed and the time delay in receiving the data is not a problem. State monitoring networks designed to detect violations of air quality standards rely largely on gravimetric monitors[8].

The 24-hr average samples were obtained following the NAAQS protocol of the Central Pollution Control Board, New Delhi[9]. TSP and PM10 were measured by difference in weight, SO_2 by the improved West and Gaeke method with ultra-violet fluorescence and NOx by the Jacob–Hochheiser modified method (Na-Arsenic) with gas phase chemiluminescence. During the study period there were no significant changes in the climate within a month, allied activities and sources of air pollution. All the samples were not accepted and when errors were observed, samplings were repeated for collection of representative samples for the respective monitoring station.

3. Result and discussion:

The results obtained from various stations are shown with the help of figures. SO_2 concentration in three stations are found with average value of 3.4μg/m^3 for intake, 5.5μg/m^3 and 11.2μg/m^3 for township and bypass station respectively as shown above figure 1. The values are within the range of permissible limit framed by Central Pollution Control Board India. In the entire three stations one thing we can observe that the concentration of SO_2 increases in dry season i.e. from January to May and suddenly decreases in the wet season. SO_2 concentration is relatively higher in bypass station then the township and intake respectively. This is due to the emissions from distant oil refinery which is driven by the wind flow. Also these receptor locations have a higher density of diesel vehicles on the roads, emitting a significant amount of SO_2 into the atmosphere. The WBEG (World Bank Emission Guidelines) for SO_2 are concentration based, whereas, Indian standards are based on the stack height. The Indian coal has low sulphur contents (0.2–0.3%) compared to imported coal, where the sulphur content is in the range of 0.6– 1.5% (NTPC, 1995). The adoption of WBEG for refineries may not affect ambient SO_2 concentrations significantly.

NO_2 concentration in three stations are found with average value of 5.1μg/m^3 for intake, 5.4μg/m^3 and 9.2μg/m^3 for township and bypass station respectively as shown in figure 2. In entire stations the NO_2 level shows slight high in concentration from July to November. Generally the rises in the values are due to vehicular trafficking. NO_2 average rates depend strongly on traffic. The values are lower than the minimum permissible limit framed by CPCB India. NO_2 concentration in bypass station is comparatively high then the township and intake station. At areal distance of ~ 20 km oil refinery is located from Bypass station. This number concentration of pollutants is due to long range transportation from wind flow. The concentration of NOx is found to be higher in the season i.e. August to November. During summer the wind speed is relatively higher therby increasing the concentration of NO_2. There is fall of concentration in month of June and July i.e. post monsoon compared to month of February to April i.e. pre monsoon. It was found that in comparison to pre monsoon there was a significant increase of clean and fairly clean area and decrease of moderately polluted area of the refinery during post monsoon.

The yearly average value for PM2.5 is 25.25 μg/m^3, 20.16 μg/m^3, 29.55 μg/m^3 in Intake, Township and Bypass station. However in the month of October to January there is a rise in concentration level this may due to the dry weather season. As shown in Fig. 3 the concentration of fine particles is highest in winter season compared to summer. The size distribution of particles is strongly effected by prevailing weather conditions. During summer season the wind speeds are relatively higher thereby increasing the resuspension of coarse fraction of particles. The observed high levels of particulate number concentration during winter season is due to inversion conditions and low mixing height resulting in low dispersion of particles.

PM10 also values are lies within the permissible limit in all the station as shown in the Fig 4. The yearly average is 26.10 μg/m^3, 28.09 μg/m^3, 40.02 μg/m^3 for intake, township and bypass stations. In all station the concentration is high in the month of October to February. Winter concentrations of ambient PM10 were observed to be higher irrespective of the monitoring sites and duration of sampling, suggesting longer residence times of these pollutants in the atmosphere during winter due to stagnant conditions and low mixing heights[10].

4. Conclusion:

Ambient air quality was assessed using three monitoring stations in and around Kaziranga national park, the studies have clearly revealed the levels of air pollutants for PM10, PM2.5, NO_2 and SO_2.The values of all these pollutants (particulates and gaseous) are observed to be very much below National Ambient Air Quality Standards except the particulate matters in all station in month of January to July. This increase in air quality index at this site is probably due to the increased transportation on the road and windy weather in the dry season. The air quality is giving the holistic view of air pollution levels. So from the result, it is evident that for the time being, the ambient air around Kaziranga National Park do not need any attention from the policy makers except the particulate matter, but may be in the future we need to formulate some ways to counteract the increase in air pollution at specific sites as we may never know when the growing urbanization and the traffic will increase the air pollution level around the National Park much more than the maximum permissible limits.

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