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Air Pollution Concentrations in Haryana Subregion, India

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The explosion of urban population, rapid growth of industries and increase of automobiles traffic in and around cities have resulted in severe air pollution and the threatening human health. Recently, air pollution problems in large cities in Asia was reported in 20 megacities report (WHO/UNEP, 1992). Central Pollution Control Board (CPCB, 2000) New Delhi, India have also established the National Air Quality Monitoring Programme (NAQMP) which comprised 204 sampling stations covering over 90 towns / cities distributed over 24 States and 4 Union Territories. Major air quality concern in India is suspended particulate matter (SPM) and respirable suspended particulate matter (RSPM). The SO_2 levels are well within the limit at many locations. The annual average NO_2 has been well within the limits with the exception of violations in some residential area of few cities. Global Environment Monitoring System (GEMS) in India is supported by 30 monitoring stations operated by National Environmental Engineering Research Institute (NEERI), Nagpur, India and data are reported to CPCB and UNEP/WHO. The NEERI's study found that ambient air pollution level includes PM-10, lead and NO_2 exceeding CPCB standards in major urban cities of India (NEERI, 2001). Another case study (NEERI,1998a) estimated human health damages due to air pollution in the National Capital Territory, Delhi, at Rs. 1168 millions per year. Recently, developing countries have been very much concern to human health and takes stringent action to restore air quality by affording the large investment in maintaining the cleaner surrounding air.

In Delhi, being the capital of India, besides population expansion of industries, increase in vehicle has led to air pollution problem. It is also experienced that the alarming level of air pollutants was found in ambient air of industrial growing centres to the periphery of Delhi. Delhi, the National Capital, has been unprecedented growth, causing serious ecological degradation and lowering living standards and also short falls in basic infrastructure. Cities around the Delhi are increasing rapidly in size and diversity. Increasing emissions from vehicular traffic, industries, domestic heating and refuse burning all pose potential risks for large air pollution exposures. The rapidity of economic development combined with the lack of emissions controls make those cities prone to more serious air pollution problems than the metropolitan cities. NEERI was therefore, undertaken a study to estimate carrying capacity of National

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Capital Region (NCR) covering an approximately 100 km area around Delhi (NEERI, 1998b). This study is to assist the industrial growing urban area in addressing rapidly growing environmental problems. The prime objective of the regional plan of NCR was to contain Delhi's population size within manageable limits. As strategy, after evaluating various alternating scenarios for development, it was recognized that growth needs to be moderate in the area around Delhi. Balance development in the NCR is to be planned through harmonized policies for landuse and development in infrastructure. Some region of Haryana State, which was belong to NCR is chosen for presenting the status of air pollution in this paper. Haryana sub region comprising of Faridabad, Gurgaon, Rohtak, Sonipat and Panipat districts and Rewari, and Bawal tehsils of Mahendragah district. The Haryana sub region which is second largest region of NCR comprises of 55 urban centres and 2413 villages covering an area of 13413 sq.kms. The Haryana sub region is growing rapidly with NCR which ultimately results in significant changes in environmental quality. For most of the year, the climate of Haryana is of a pronounced character, very hot in summer and markedly cold in winter. The study area has made rapid strides in the industrial sector. Gurgaon is fast growing industrial hub. Panipat has earned the reputation of being the weaver city of India for its exquisite-tuffled woolen carpets and colorful handloom products. The major industries are cement, sugar, paper, cotton, textiles, glassware, brassware, cycles, tractors etc. At the end of 1999-2000, there were 1023 large and medium industries and 79678 working small-scale industrial units in the state. Population decaded growth rate of Haryana sub region 1981-91 was 29%. This paper describes the existing ambient air quality around the Haryana sub region, which will give baseline scenario to assess the environmental impacts due to developments activities in the study region.

MATERIALS AND METHODS

For evolving temporal and spatial distribution pattern of present Ambient Air Quality (AAQ) status of the region, a short-term extensive cross-sectional air quality monitoring network was designed, considering to represent the all major urban activities as well as meteorological features of the region and greater emphasis on the criteria pollutants associated with major emissions and health impacts on population. A network spread over Haryana sub region consisting of 26 sites was operated activity zone wise to set entire coverage of ambient SPM, SO_2 and NO_2 concentration. For each city, three sampling sites representing residential, commercial and industrial activity were selected. Total 260 samples for each pollutant, ten at each site, at sampling frequency of twice in week were collected during the study period. SPM were collected from locations using sampler operated at the rate of 1.5 m^3/min for 24 hrs on pre-weighed glass fibre filter of 20 cm x 25 cm size and re-weighed after sampling in order to determine the mass concentration of the particles collected. The concentration of particulate matter in ambient air was then computed on the net mass collected divided by the volume sampled. SO_2 and NO_2 were collected from locations using sampler and bubbling the air through respective absorbing media at the rate of 0.5 ltr/min. for 24 hrs. Collected samples then analysed by standard methods for computation of concentration of SO_2 and NO_2. The details of analytical procedures are given elsewhere (Katz, 1977). The daily averaged of each pollutant concentration was averaged over all the three stations at each city during the study period in winter 1993 and presented in this study.

RESULTS AND DISCUSSION

Air quality monitoring was carried out at industrial, commercial and residential sites during the study period in various towns : 1. Panipat, 2. Sonipat, 3. Rohtak, 4. Bahadurgarh, 5. Gurgaon, 6. Faridabad, 7. Ballabhgarh, 8. Rewari/Dharuheda in Haryana sub region of NCR. The study revealed that daily average SPM concentration exceeded the limit set for industrial zone at all the monitoring location. The profile of daily average of SPM level ranged from 605 to 1415 $\mu g/m^3$ (SD $\pm$ 360) in Panipat, 454 to 555 $\mu g/m^3$ (SD $\pm$ 71) at Sonipat, 482 to 858 $\mu g/m^3$ (SD $\pm$ 105) at Rohtak, 299 to 523 $\mu g/m^3$ (SD $\pm$ 92) at Bahadurgarh, 268 to 721 $\mu g/m^3$ (SD $\pm$ 170) at Gurgaon , 435 to 799 $\mu g/m^3$ (SD $\pm$ 188) at Faridabad, , 228 to 1301 $\mu g/m^3$ (SD $\pm$ 234) at Ballabhgarh and 414 to 455 $\mu g/m^3$ (SD $\pm$ 29) at Rewari/Dharuheda. Daily average concentration averaged over all the three stations in various cities of Haryana sub region is presented in Figure 1. The road traffic, resuspension of road dust, domestic refuse burning and furnace oil used in industries are largest sources of SPM emissions. These sources at low height therefore contribute significantly to population exposure. The daily average concentration of SO_2 and NO_2 averaged over all the three station in various cities is delineated in Figure 2. The profile of daily-average of SO_2 level ranged from 6 to 34 $\mu g/m^3$ (SD $\pm$ 11)in Panipat, 28 to 62 $\mu g/m^3$ (SD $\pm$ 17) at Sonipat, 7 to 59 $\mu g/m^3$ (SD $\pm$ 13) at Rohtak, 10 to 53 $\mu g/m^3$ (SD $\pm$ 17) at Bahadurgarh, 18 to 35 $\mu g/m^3$ (SD $\pm$ 7) at Gurgaon, 12 to 91 $\mu g/m^3$ (SD $\pm$ 27) at Faridabad, 21 to 41 $\mu g/m^3$ (SD $\pm$ 23) at Ballabhgarh and 16 to 28 $\mu g/m^3$ (SD $\pm$ 6) at Rewari/Dharuheda respectively. The level of SO_2 was high at most of places and exceeded CPCB standards at some of sampling locations. Daily average of NO_2 level ranged from 28 to 62 $\mu g/m^3$ (SD $\pm$ 14), 27 to 32 $\mu g/m^3$ (SD $\pm$ 4), 15 to 45 $\mu g/m^3$ (SD $\pm$ 13), 11 to 19 $\mu g/m^3$ (SD $\pm$ 4), 11 to 15 $\mu g/m^3$ (SD $\pm$ 2), 9 to 51 $\mu g/m^3$ (SD $\pm$ 13), 21 to 37 $\mu g/m^3$ (SD $\pm$ 7), and 8 to 21 $\mu g/m^3$ (SD $\pm$ 6) at Panipat, Sonipat, Rohtak, Bahadurgarh, Gurgaon, Faridabad, Ballabhgarh and Rewari / Dharuheda respectively.

The profile of daily average of SPM concentration was 560 (SD $\pm$ 320) $\mu g/m^3$ in Haryana sub-region. Daily average SO_2 and NO_2 concentrations in Haryana-sub region were 33 $\mu g/m^3$ (SD $\pm$ 21) and 25 $\mu g/m^3$ (SD $\pm$ 12) respectively. To know the air quality status of Delhi, air quality monitoring was also carried out in Delhi at 32 sites representing residential, commercial and industrial sites during the same period in 1993. Total 320 samples for each pollutant, ten at each site, at sampling frequency of twice in week were collected during the study period. The profile of daily average of SPM concentration was 617 $\mu g/m^3$ (SD $\pm$ 131) in Delhi. Daily average SO_2 and NO_2 concentrations in Delhi were 48 $\mu g/m^3$ (SD $\pm$ 19) and 35 $\mu g/m^3$ (SD $\pm$ 15) respectively. Air quality status of Haryana sub region is compared with air quality status of Delhi and presented in Figure 3 and 4. It

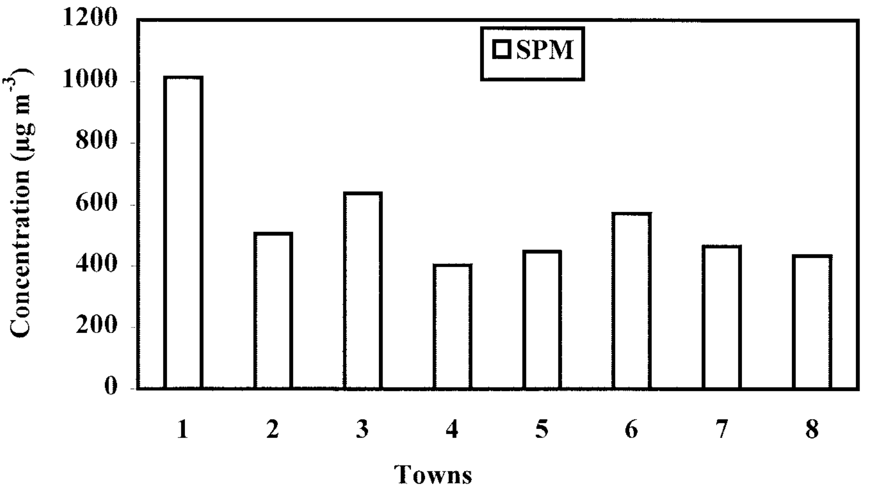

Figure 1. Status of SPM level in Haryana Sub-region

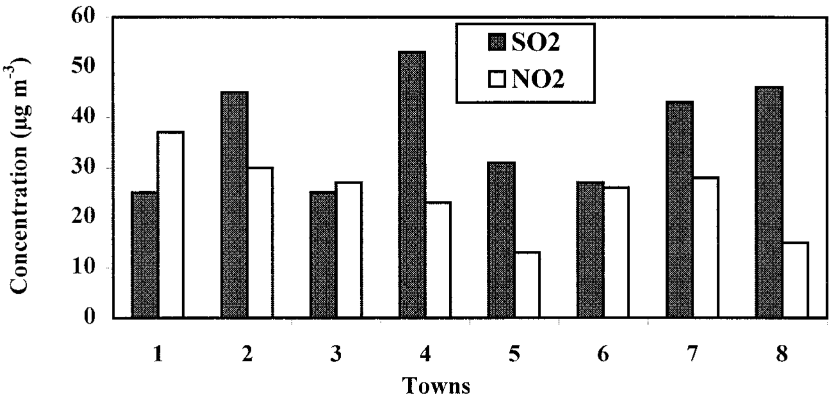

Figure 2. Status of SO_2 and NO_2 levels in Haryana Sub-region

indicates that there is no much significant difference in SPM level at Delhi and Haryana sub region. It was also observed from Figure 1 and 3 that the level of SPM at Panipat and Rohtak are high as compare to Delhi. Similarly as regard to SO_2 and NO_2 levels in Haryana sub region are almost similar to levels in Delhi except few towns.

Hot spots were identified based on primary data using air quality index to assess the combined impacts of SPM, SO_2 and NO_2 concentration on air environment.

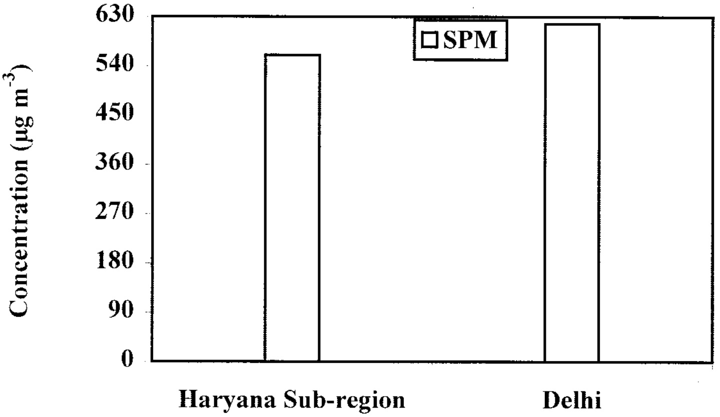

Figure 3. Comparison of average SPM level in Haryana Sub-region and Delhi

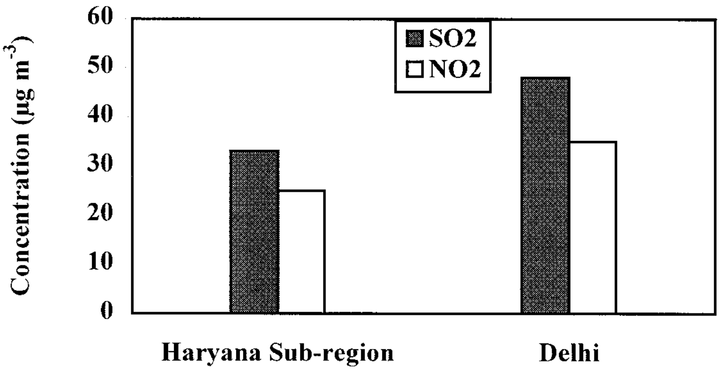

Figure 4. Comparison of average SO_2 and NO_2 levels in Haryana Sub-region and Delhi

This indicates that the Panipat, Faridabad area were more polluted in respect of ground level concentration of SPM, SO_2 and NO_2 and fall in the dangerous category. Air quality index was also been estimated for Delhi, which shows that Delhi is highly polluted and fall in dangerous category. Delhi has various industries comprising mainly of three power plants, besides metal based engineering industries, rubber, textile, chemical and chemical product. Contribution of these industries to the emission of SPM, SO_2, and NO_2 in Delhi were 366, 311, and 239 kg/hr respectively. In addition vehicular sources and domestic sources were also contributed the major pollutants like SO_2 and NO_2 and SPM with their significant levels in the air environment. As regards to

Haryana sub region, the cities are dominated by small scale industries. The cluster of small scale industries in an industrial area causes an adverse impact on environment. Further, due to indiscriminate siting of the small scale industries in study area next to residential areas, their effective impact may highly significant. Among the Haryana sub-region, industrial emission estimated for SPM was 217; 86; 83; 23; 49; 109; 36 kg/hr for Faridabad, Ballabhgarh, Panipat, Gurgaon, Rohtak ,Sonipat and Bahadurgarh respectively. Total emission for SPM from industrial, vehicular and domestic sector estimated in the region was 96, 130, 53, 37, 138, 293, 127 kg/hr to Panipat, Sonipat, Rohtak, Bahadurgarh, Gurgaon, Faridabad and Ballabhgarh respectively. These high level emissions of SPM were reflected the SPM levels in ambient air of the towns in Haryana.

In view of the potential air environmental consequences, the environment management strategy is to be formulated for implementation of end-of-pipe treatment measures to maintain standards prescribed by regulatory agencies for air environment. To evaluate the long term impact it is needed to carry out in depth studies of each alternative options, technological intervention for reduction of pollution level on air environment. Feasibility of various alternatives besides their cost benefits and their implementations for environment management need to be evaluated critically to facilitate the task. This study will assist the local development authority of these cities to develop action plan that would be an integral part of air quality management system for study region.

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