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STUDY OF PH AND CONDUCTIVITY AT THREE DIFFERENT ENVIRONMENTS (RURAL, URBAN AND HIMALAYAN) IN THE NORTHERN PART OF INDIA

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1 Introduction

Removal of gaseous and aerosols from the atmosphere has an important role in inter-reservoir transfer mechanisms. Air-borne particulate matter, emitted from natural and anthropogenic sources is transported, diluted and scavenged by wet removal cycles or deposited by complex bio-geochemical mechanisms, primarily sedimentation. The impact of wet deposition is plays significant role due to cleansing of the atmosphere on one hand and on the other, has direct impact on ecosystem and human artifacts (Jain et al., 2000; Satsangi et al., 1998, Momin et al., 2005). The composition of wet deposition actually reflects the composition of the atmosphere through which it falls. Analysis of precipitation quality helps to evaluate the relative importance of the different sources for gases and particulate matter. Despite exhaustive research having been carried out already, on precipitation chemistry and acid deposition mechanisms (Kulshrestha et al., 2003), yet, no single protocol or reaction cycle can be proposed for the event. This is because the quality gradient of rainwater is a highly sensitive process, dependent on land topology, microclimate and anthropogenic conditions, thus becoming highly susceptible varying considerably from site to site and region to region. The chemical profile of precipitation is dependent greatly on phenomena like source apportion. On one hand fossil fuels causes acidic depositions while on the other dust particulates, especially in the Indian subcontinent, contribute base cations. Therefore, both anionic and cationic indexes are necessary to evaluate the overall characteristics of rainwater. Considering the above-mentioned importance of precipitation, the chemistry of rainwater study has been carried out at three different environments in the northern part of India during the southwest monsoon season of 2006 and 2007.

2 Experimental

2.1 Site description

Samples of rainwater were collected on event basis during the southwest monsoon season of 2006 and 2007 using wet only collectors at three different sampling sites as located in figure 1. These are Ballia (rural) in Uttar Pradesh (UP), Delhi (Urban) and Kullu (Himalayan) in Himachal Pradesh. The details of the sampling site are given below:

1. Ballia (25.8° N 84.2° E, 64 amsl, U.P): Ballia is a small town covering an area of 2961.02 sq km and located in east Uttar Pradesh. The district is bounded on north by Ghaghara River and in South Ganga River. The average rainfall of the district is 983 mm with 41.5^{0}c highest and 5.4^{0}c minimum average normal temperature. Agriculture, horticulture, sugar industry and a variety of small scale industries share the economic map of Ballia. The sampling site was Munjahi, Ballia which is a rural area, 35 km away in the northwest direction from Ballia.
2. Kullu (31° 88’N, 77° 18’E, 2050amsl Himachal Pradesh): The sampling location was Kothi in Kullu district and 6km away from Manali on the way of

Rohtangpass. These charming area cradled in a valley, are a short distance from each other. Both are surrounded by looming mountain and pictures scenery. The kullu district covers an area of 5,503 sq km having population 301,729. It is 606km away from Ambala, 550 kms from chandigarh and 798 kms from Delhi.

3. Delhi (28° 37’N, 77° 12’E, 217 amsl): Delhi is an urban city, is situated about 1100km away from the nearest coast of Arabian Sea. The city covers an area of approximately 1500 km^2 situated on the banks of Yamuna River. It is the fourth most polluted city in the world with respect to suspended particulate matter with 16 million inhabitants (Goyal and Sidhartha, 2002). The main pollution sources are Thermal Power Plants, vehicles, small-scale industries including brick kilns and domestic. Delhi is located in the border zone lying between the heavy rain fed Gangetic plains on the east and semi arid tracts of Rajasthan to the southwest.

2.2 **Sample collection and analysis**

Rain water samples were collected by wet-only collectors which were designed by MISU (Department of Meteorology, Stockholm University, Sweden), consisting of a cylindrical part with the funnel and bottle inside and a lid in polypropylene making a tight seal against the collector. The first raindrop that hits the rain sensor will activate the opening of the lid. Opening is quite rapid, takes less than 15 seconds. Both funnels have screw caps moulded to the spouts to give a watertight connection to the collecting bottle. Rainfall amount was obtained from measuring by collected rain; an estimate of daily average rainfall rate was obtained from the recording of open and closing time. Collected samples were then stored in small polythene bottles, which were cleaned by triple distilled water. Thymol (< 50mg) was added for preventing biological degradation of the samples. All samples were refrigerated at 4^{o}c in the laboratory till all ionic components were analyzed. Subsequently to the collection of samples their pH and conductivity were measured as immediately as possible. The pH was measured with the help of Elico make (model LI-120) digital pH meter using reference and glass electrodes standardized at pH 4.0 and 9.2 buffer. Conductivity was measured with a digital EC-TDS analyzer (Elico, model CM-183) calibrated against a reference KCL solution.

3. **Results and discussion:**

Volume weighted mean (VWM), minimum and maximum pH of rainwater collected at Kothi, Delhi and Ballia along with conductivity (µS/Cm) are given in Table 1. Average volume weighted mean pH was 5.81, 6.27 and 6.08 of rainwater at Kothi, Delhi and Ballia respectively which shows alkaline in range considering 5.60 as the neutral pH of cloud water at equilibrium with atmospheric CO_2 (355ppb). Ten out of 49, four out of 38 and 3 out of 39 samples were found acidic at Kothi, Ballia and Delhi respectively. The acidity was more at Kothi as compared to other locations may be low alkaline particles. The observed alkalinity of rainwater is due to the high loading of particulate matter in the atmosphere commonly abundant in Indian conditions. The suspended particulate matter that is rich in carbonate and bicarbonate of calcium buffers the acidity of rainwater (Kulshrestha et al., 2003). The mean pH of rain water at Delhi was higher as compared to other location due to natural dust particles which carried by winds from the nearby arid zones and the Thar Desert in Rajasthan (Jain et al., 2000).

The average specific conductivity was 10.17µScm^{-1}, 41.17µScm^{-1} and 16.15µScm^{-1} in rainwater at Kothi, Delhi and Ballia which is also shown in Table 1. The conductivity was higher at Delhi as compared to other locations as pH. Naik et al., (1998) had indicated that soil oriented elements which are potentially basic in nature, are the main cause for high conductivity in rainwater. Horvath and Meszaros (1984) found the high conductivity in rainwater samples due to dissolution of coarse soil particles in the rainwater. However, the average specific conductivity values in the rainwater reported for 10 background stations in India range from 7 to 57 µS cm^{-1} (IMD, 1982). The high conductivity in rainwater at Delhi is may be influenced by the dissolution of wind blown soil dust. Chemical analysis is to be required for the above clarification. The analysis of those samples is in progress.

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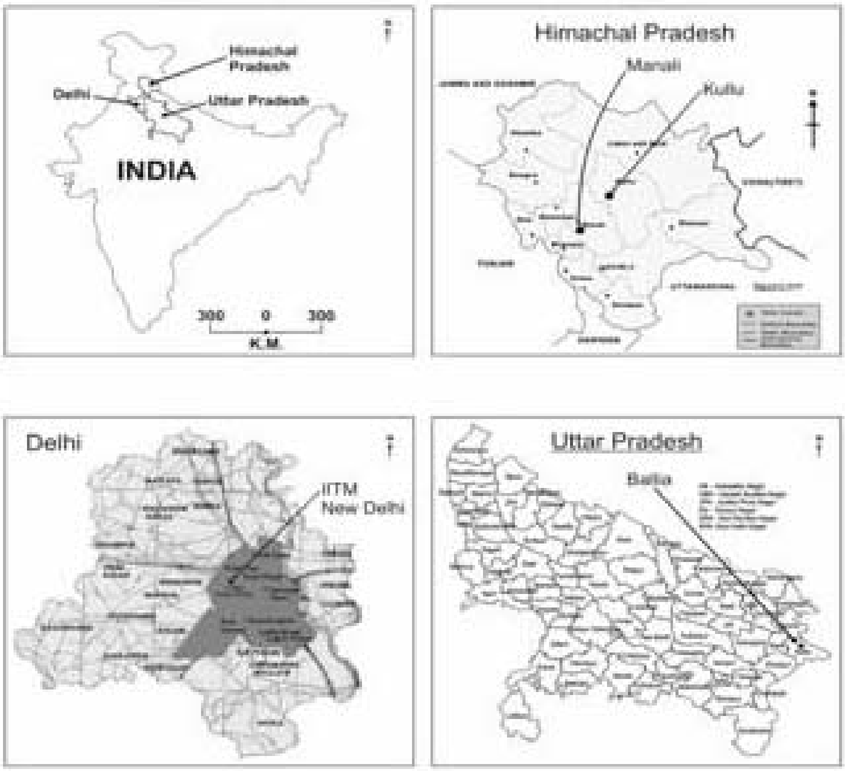

Figure.1: Maps of India, Delhi, Himachal Pradesh, Uttar Pradesh showing sampling locations

Table 1: Volume weighted mean (VWM), minimum and maximum pH of rainwater collected at Kothi, Delhi and Ballia along with conductivity (µS/Cm).

		pH			
Stations	Number of samples	Conductivity	Min	Max	VWM
Kothi (HP)	49	10.17	5.05	8.04	5.81
Delhi (Delhi)	39	41.17	5.08	8.27	6.27
Ballia (UP)	38	16.15	4.99	7.42	6.08