Study of Rainwater during the monsoon period (2009) at Kurukshetra, Haryana

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Introduction:

1. Precipitation, which is a product of the condensation of atmospheric water vapor that is deposited on the Earth's surface especially rain, has a dramatic effect on agriculture. It occurs when the atmosphere, a large gaseous solution, becomes saturated with water vapor and the water condenses, falling out of solution.

2. Plants need varying amounts of rainfall to survive, therefore rain is important to agriculture while a regular rain pattern is usually vital to healthy plants, too much or too little rainfall can be harmful, even devastating to crops.
3. Agriculture of all nations at least to some extent is dependent on rain. Indian agriculture, (which accounts for 25 percent of the GDP and employs 70 percent of the nation's population) is heavily dependent on the rains, especially crops like cotton, rice oilseeds, coarse grains etc.
4. A delay of a few days in the arrival of the monsoon can, and does, badly affect the economy, as evidenced in the numerous droughts in India in the 90s.

5. In view of the above, the chemistry of rainwater is important. We have selected, Kurukshetra in our study.

Importance of precipitation study

• Precipitation is one of the most effective mechanisms for removal of air pollutants from the atmosphere. It also helps us to understand the relative contribution of different sources of atmospheric pollutants.

• Chemistry of rainwater varies from site to site and region to region due to influence of various sources.

•Dust particles, which is available in plenty in the atmosphere in the northern part of India, are also an important part of the atmosphere, which contains significant base cations (alkaline aerosols). These base cations neutralize the acidity of rainwater before being deposited on the ground surface.

Collection

- Rainwater samples were collected at **Kurukshetra** by using rain collector during monsoon season of 2009.
- All bottles were cleaned by triple distilled water three times.
- Thymal was used for preservation of samples in order to prevent biological degradation in rainwater.
- Samples were filtered through Whatman 41 filter paper and then stored in the refrigerator at 4 degrees centigrade for chemical analysis.

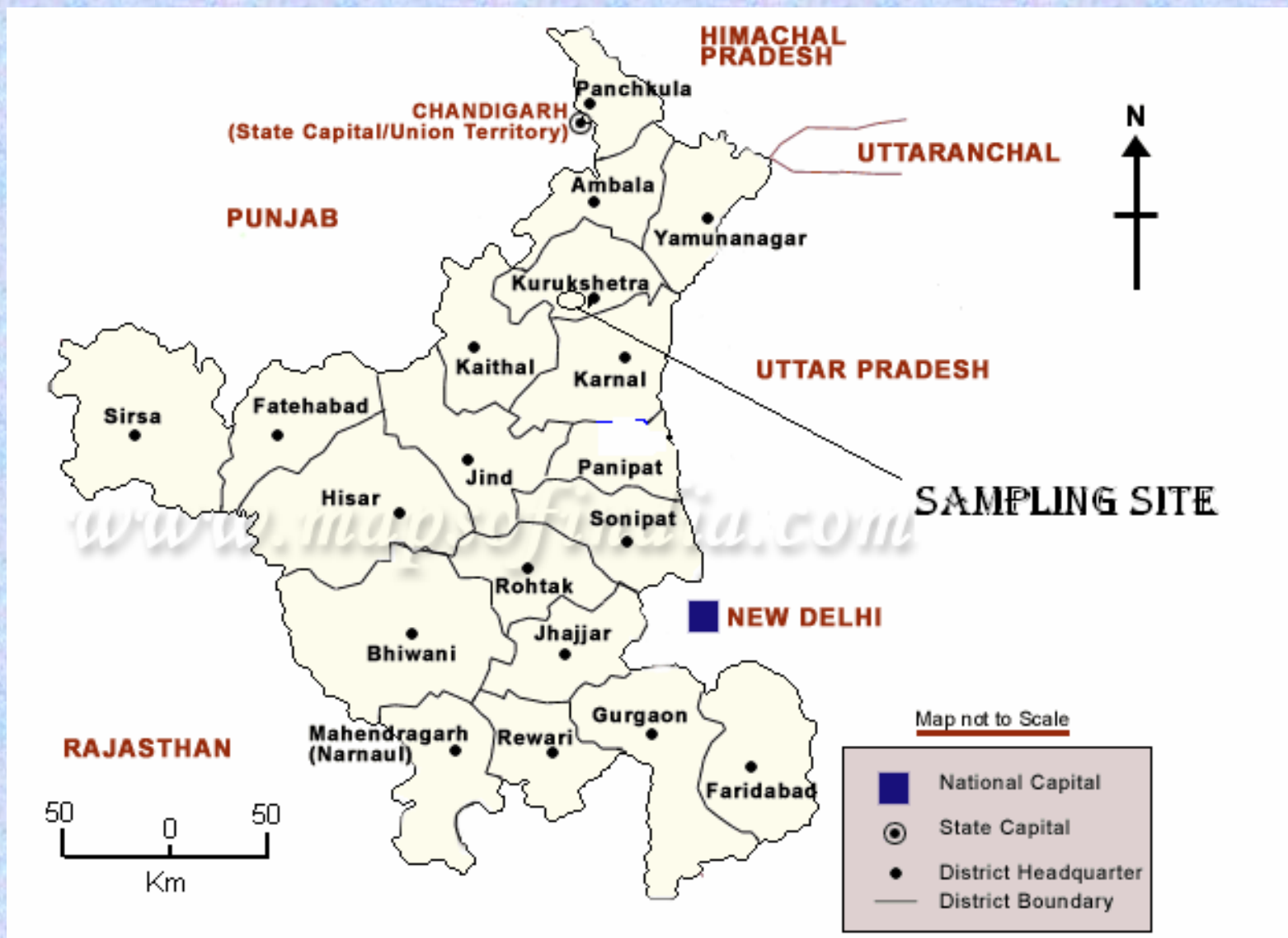


Fig- Map of Haryana, sampling location at Kurukshetra

Chemical analysis:-

Anions- F^-, Cl^-, NO_3^- and SO_4^{2-} and

Cations-Na^+, K^+, Ca^{2+}, Mg^{2+} and NH_4^+ → Ion chromatograph (model Dionex-2000).

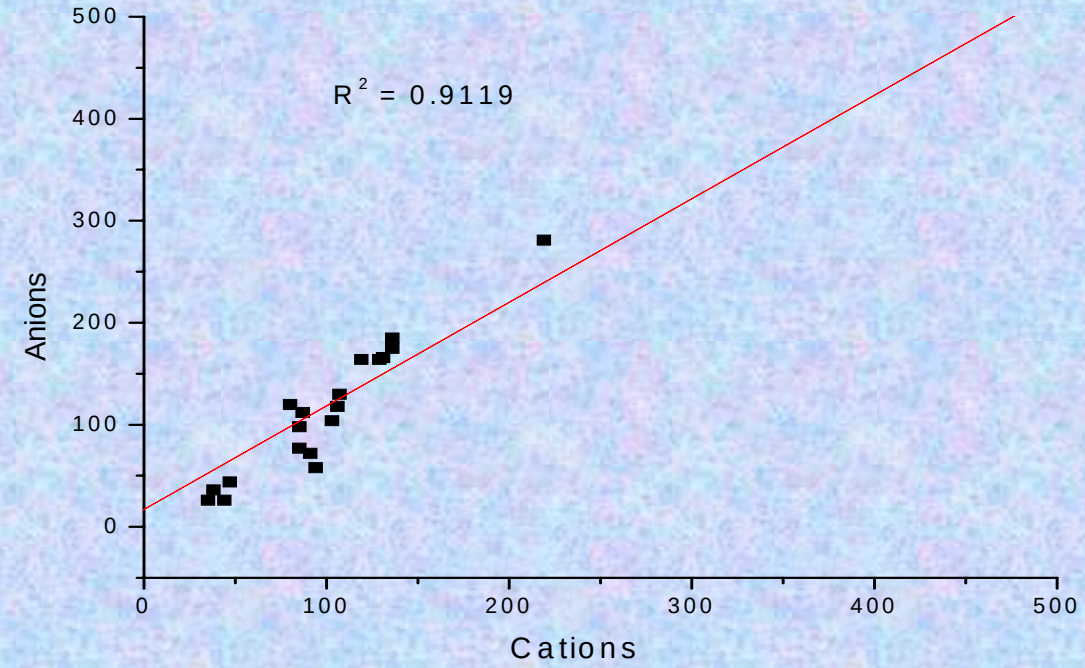
pH → Standard digital pH meter (Elico Pvt. Ltd.) Using KCL as reference.

Conductivity → digital EC-TDS analyzer (Elico, model CM-183)

HCO_3^- → Estimated from the theoretical relationship between pH and HCO_3^-

Ion chromatograph (model Dionex-2000).

Quality Control



Sum of the cations and sum of the anions (µeq/l)

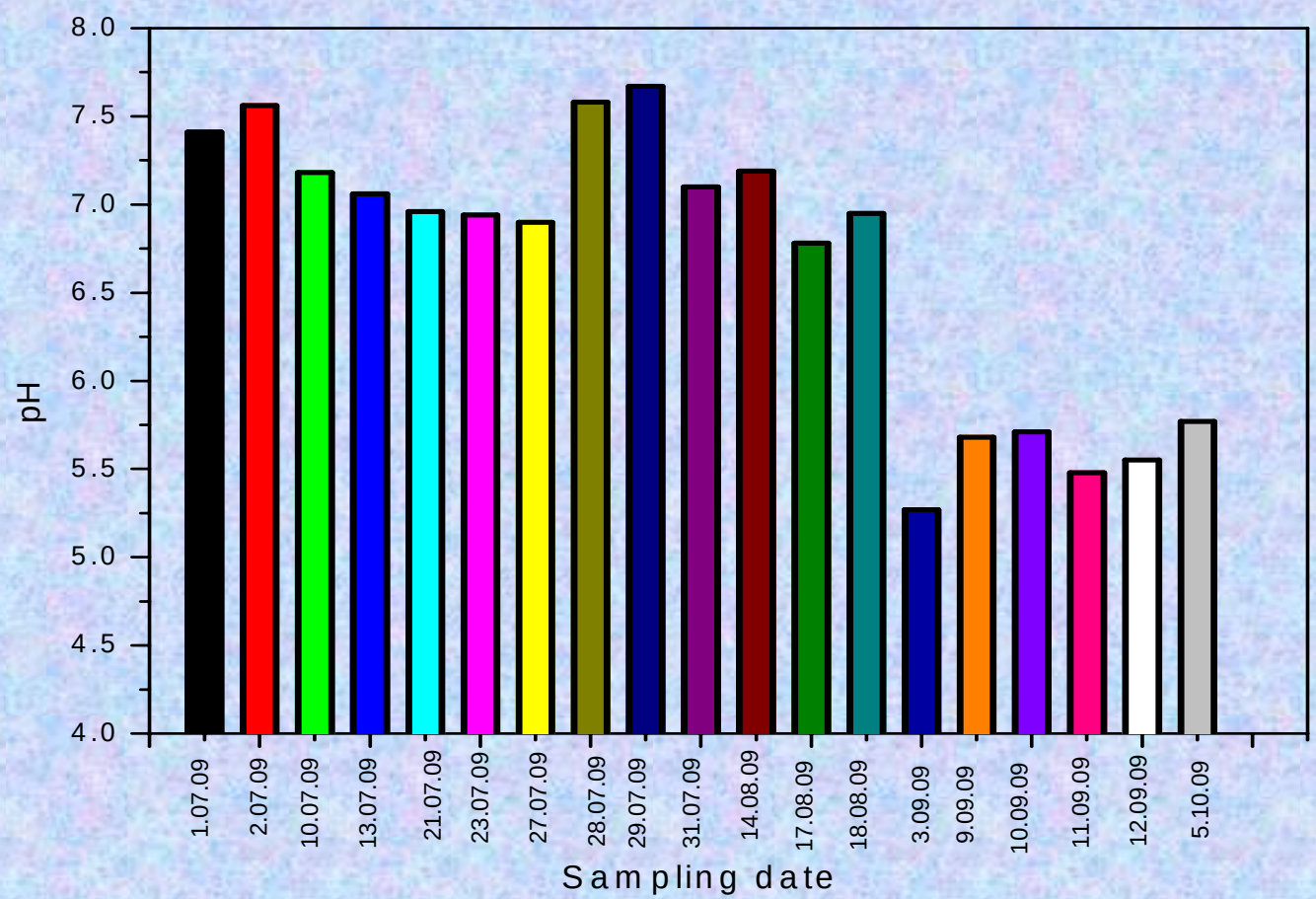


Fig: Daily pH variation of rainwater at Kurukshetra

Volume -weighted mean ionic composition (in micro eq / l) in precipitation at Kurukshetra , Ballia and Delhi

Parameters	Kurukshetra	**Ballia**	**Delhi**
pH	**6.67**	**6.17**	**6.84**
F^-	**5.10**	**2.16**	**4.29**
Cl^-	**26.13**	**33.55**	**89.96**
SO_4^{2-}	**64.63**	**33.06**	**191.78**
NO_3^-	**26.70**	**22.53**	**55.23**
Na^+	**21.27**	**49.33**	**109.36**
NH_4^+	**33.22**	**53.11**	**124.06**
K^+	**12.06**	**8.89**	**15.77**
Mg^{2+}	**19.57**	**13.15**	**73.35**
Ca^{2+}	**70.10**	**54.53**	**201.34**
H^+	**1.41**	**0.68**	**0.15**
HCO_3^-	**47.47**	**13.25**	**61.88**

Results

- The major ions in precipitation samples showed a trend as SO_4>HCO3>NO_3>Cl > F for anions and Ca>NH_4>Na>Mg>K>H for cations.
- The average pH was 6.67 and varied between 5.27in September and 7.67 in July. The contribution alkaline components was 52% , of the total ion mass of measured values whereas, the contribution of the acidic components was observed as 48%.
- The SO_4 concentration (64.6μeq/l) was found to be very high when compared with those in the literature for similar studies. High SO_4 concentrations are due to strong SO_2 emissions around Kurukshetra. The nitrate concentration (26.7μeq/l) was also found to be higher than the other sites in India.
- Principal Component Analysis (PCA) approach was performed which revealed that in general, the most dominating sources identified were suspended soil-dust and sea salts at all the sites which are natural sources. Sources like agriculture plus cattle, brick kilns and industries were reflected in third or fourth PC indicating moderate influence of anthropogenic activities.
- High concentration of Ca^{2+} (70μeq/l) has been found to play an important role in maintaining high alkalinity of rainwater. It is attributed mainly to the large influence of the Natural sources.
- Most of the SO_4^{2-} and NO_3^- were found well correlated with alkaline aerosols in rainwater in the form of $CaSO_4$, $MgSO_4$ or $(NH_4)_2SO_4$ and $Ca(NO_3^-)_2$ respectively.

Thank you