

**Major Research Project
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**Impact of Anthropogenic Activity on Chemistry of Precipitation in A
Region and Cumulative Effect on Living Organisms**

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Summary of the Major Research Project

Impact of anthropogenic activity on chemistry of precipitation in a region and cumulative effect on living organisms.

Hisar is located approximately between latitude 29°09 N and 75°42E of the India. It has an average elevation 215 m (705 ft) above mean sea level and located 164 Km to the west of New Delhi India's capital region to develop as an alternative centre of growth. The continental climate with very hot summer and relatively cool winter, which affects the quality and quantity of the water resources results from the influence of two main wind systems the moist, relatively cool monsoon wind which blows from the south-west across the Indian Ocean towards the country and brings rainfall, and the hot, dry, dust-laden harm wind which blows from the north-west across the Thar desert with its accompanying dry weather and dust laden air. The mean temperature is generally between 37°C and 42 °C although because of the moderating influence of the sea the mean daily and annual maximum temperatures increase from the coast towards the interior. Rainwater is an important source of fresh water especially for those who live in rural areas, where water use is limited due to scarcity or where surface and underground water quality is poor. In many areas, rainwater is still considered as a safe and suitable source of potable water. But today, due to increase in population, urbanization and industrialization many substances are regarded as pollutants mixed with environment and toxic to man, animals or plants. These include emissions and effluent outflow from factories, refineries, waste treatment plant, oil or gases of varying quality and quantity directly into the atmosphere. These chemicals are mostly odourless, colourless and tasteless and most importantly, are health hazards. The massive increase in chemical utilization due to recent development in science and technology has greatly increased different contaminant present in water generally, regardless of its source. In an industrial area, there is possibility of acidic rain. Researchers suggested that if the source is influenced by anthropogenic activities, the nature of rainwater becomes acidic because anthropogenic activities contribute acidic gases like SO₂ and NO_x and a basic gas like

NH_3 . When these acidic gases are dissolved in clouds, sulphuric and nitric acids are formed, respectively. In this research, study area fall under residential area and has narrow roads on which vehicular traffic activity takes place. A national highway lies about 0.7 km from the sampling site. There is thermal power plant and small scales industries which is 10 km surrounding from it. The air pollutants encountered in the region are of both particulate and gaseous in nature, which is coming out as vehicular emission, thermal power plant and small scale industries. The thermal power plant emitted particulate matters and various gaseous pollutants in to the atmosphere, causing the deterioration of air quality. An attempt has been made to investigate the chemical composition of major ions, understand rainwater chemistry and generate data on rainwater composition at an urban environment. The most important pollutants that contribute to the formation of acid rain are nitrogen oxide and sulphur-dioxide, which react with moisture in the atmosphere, to form nitric and sulphuric acid. The sulphur and nitrogen compounds that contribute to acid rain primarily come from manmade source, such as industries, utilities, automobiles and other form of transportation and industrial process, such as melting. Acid rain has recently become a serious environmental problem in many industrialized countries including Japan, in Europe and in the northeast areas of the United States and Canada. These acid pollutants can be deposited in a dry form through dust. Pollutant that contributes to acid rain may be carried hundreds of miles before being deposited on the earth. Because of this, it is sometimes difficult to determine the specific sources of these acid rain pollutants. Hisar is a steel industrialized city of Haryana. Many of the factories in Hisar freely release their effluents and emissions to the environment. In the neighborhoods of these industrial centers, some forms of farming activities take place. The farmers and horticulturists in the areas depend on rainfall and the water harvested by the usual methods of rainwater harvesting (RWH). Beside farming and horticultural activities, the quality of rainwater has the potential to affect aquaculture. There is a need therefore, to investigate the effects of these pollutants on the rainfall occurring in the vicinity of these industries. Such study may form the basis for the recommendation of remedial actions.

During this research we found out that due to continental climate of Hisar city, it is very hot summer and relatively cool winter, which affects the quality and quantity of the water resources results from the influence of two main wind systems the moist, relatively cool monsoon wind which blows from the south-west across the Indian ocean towards the country and brings rainfall, and the hot, dry, dust-laden wind which blows from the north-west across the Thar desert with its accompanying dry weather and dust laden air. The rainwater samples were collected during June–July–August and analyzed for pH, major anions (Cl, NO₃, SO₄) and cations (Ca, Mg, Na, K, NH₄). The pH value varied from 6.6 to 7.1 indicating slightly acidic nature of rainwater during the monsoon season. The average and standard deviation of ionic composition was found to be 92.4 ± 4.40 eq l⁻¹. The total anions contribute 57 % and cations 43 %, respectively to rainwater. Neutralization factors (NF) followed a sequence of NFCaNF Mg (NFNH)₄ with factors of 1.0, 0.46 and 0.26 indicating the crustal components are responsible for neutralization of anions. The average ratio of (NO₃ + Cl)/ SO₄ observed as 1.5 indicates that nitric and hydrochloric acid influences the acidity of rainwater. The ratio of NH₄/ NO₃ and NH₄/SO₄ was observed as 0.58 and 0.46 indicate that the possible compounds which may predominate in the atmosphere are NH₄NO₃ and (NH₄)₂SO₄. Ionic correlation was established to identify sources of origin. A good correlation was seen between Ca and Mg (r = 0.88); suggesting the common occurrence of these ions from crustal origin. Similarly, the acidic ions SO₄ and NO₃ correlated well (r = 78) indicating their origin from similar sources. Other relatively significant correlations were observed between Ca and SO₄ (r = 0.94), Mg and SO₄ (r = 0.78), Ca and NO₃ (r = 0.08), Ca and Cl (r = 0.38) and Mg and Cl (r = 0.38), and Mg and NO₃ (r = 0.79). The observed rainwater ratio of Cl/Na (1.2) is closer to that of seawater ratio (1.18) indicates fractionation of sea-salt and modifications by non-marine constituents as the site is 2040 km away from the sea coast. The nss-Ca contribution was observed as 97.6% suggesting their crustal origin whereas nss-Mg and nss-K shows their contribution as 89.8% and 85.9% indicating influence of soil sources. The nss-SO₄ contributed as 88.7% shows anthropogenic origin.

In this research we also try to find out the effect of anthropogenic activities on the physico-chemical properties of rain water from five different industrial sites in Hisar. Rain water samples were collected from five locations (viz Jindal Chowk, Red Square

Market, Grain Market, Milgate and Gangwa) of Hisar, during the months of June, July and August and the rainwater samples were taken to the laboratory and analysed. The first four locations were industrial and market layouts while the last one was a rural, non-industrialised community on the outskirts of Hisar. The result of analyses on the rainwater samples indicated that at the five locations (*i.e* Jindal Chowk, Red Square Market, Grain Market, Milgate and Gangwa) the average values were: colour (6.6, 6.0, 6.2, 6.0 and 5.0 Hazen units); turbidity (0.18, 0.162, 0.161, 0.163 and 0.16 NTU); chloride (14,12.6, 13.3, 12.6 and 10.6 mg/l); total hardness (23.0, 21.3, 22.0, 15.1 and 14.3 mg/l) respectively. The pH values of the samples show that rain water from the four industrial locations showed slight acidity (*i.e.* pH< 6.6), particularly for the month of June 2013, which for the year under consideration marked the onset of the rainy season after a spell of dryness. This shows that it is possible to have acidic rain in these locations and thus suggestive of immediate corrective actions. This acid rain also has some cumulative effect on the living organisms and small plants *i.e* skin irritating in organisms and yellowish of leaves color & fall of leaves in plants.

Contribution to the Society

Rainwater is an important source of fresh water especially for those who live in rural areas, where water use is limited due to scarcity or where surface and underground water quality is poor. In many areas, rainwater is still considered as a safe and suitable source of potable water. But today, due to increase in population, urbanization and industrialization many substances are regarded as pollutants mixed with environment and toxic to man, animals or plants. These include emissions and effluent outflow from factories, refineries, waste treatment plant, oil or gases of varying quality and quantity directly into the atmosphere. These chemicals are mostly odourless, colourless and tasteless and most importantly, are health hazards. The massive increase in chemical utilization due to recent development in science and technology has greatly increased different contaminant present in water generally, regardless of its source. In an industrial area, there is

possibility of acidic rain. During study we found out that rainwater becomes acidic because anthropogenic activities contribute acidic gases like SO₂ and NO_x and a basic gas like NH₃. When these acidic gases are dissolved in clouds, sulphuric and nitric acids are formed, respectively. There are thermal power plant and small scales industries which is 10 km surrounding from research sites. The air pollutants encountered in the region are of both particulate and gaseous in nature, which is coming out as vehicular emission, thermal power plant and small scale industries. The thermal power plant emitted particulate matters and various gaseous pollutants in to the atmosphere, causing the deterioration of air quality. An attempt has been made to investigate the chemical composition of major ions, understand rainwater chemistry and generate data on rainwater composition at an urban environment. The most important pollutants that contribute to the formation of acid rain are nitrogen oxide and sulphur-dioxide, which react with moisture in the atmosphere, to form nitric and sulphuric acid. The sulphur and nitrogen compounds that contribute to acid rain primarily come from manmade source, such as industries, utilities, automobiles and other form of transportation and industrial process, such as melting. Acid rain has recently become a serious environmental problem in many industrialized countries including Japan, in Europe and in the northeast areas of the United States and Canada. These acid pollutants can be deposited in a dry form through dust. Pollutant that contributes to acid rain may be carried hundreds of miles before being deposited on the earth. Because of this, it is sometimes difficult to determine the specific sources of these acid rain pollutants. Hisar is a steel industrialized city of Haryana. Many of the factories in Hisar freely release their effluents and emissions to the environment. In the neighborhoods of these industrial centers, some forms of farming activities take place. The farmers and horticulturists in the areas depend on rainfall and the water harvested by the usual methods of rainwater harvesting (RWH). Beside farming and horticultural activities, the quality of rainwater has the potential to affect aquaculture. There is a need therefore, to investigate the effects of these pollutants on the rainfall occurring in the vicinity of these industries. Such study may form the basis for the recommendation of remedial actions.

No. of Publication out of the Project: (Plz. see Reprint Attached)

During the research work , published two research papers in International Journal

(1). **Suresh Kumar, K. Gopal and P.R. Salve** (2013): Characterisation of major inorganic ions in precipitation in area of Hisar, India. **J. Ecophysiol. Occup. Hlth. 3: 67-73.**

(2). **Suresh Kumar** (2016): Physico- Chemical Characterization of Rain Water Collected from Industrial Areas of Hisar. **J. Ecophysiol. Occup. Hlth. 16 (3&4) 72-77.**

(3). **Suresh Kumar and PR Salve** (2016) Impact of anthropogenic activities on physico-chemical composition of rainwater collected from urban area of Hisar, International Journal of Water, Air and Soil Pollution (Communicated).

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