Paper Number: 324

Hydrochemical characterisation and soil quality appraisal In Himalayan Foothills in parts of Uttarakhand, India

Sathikumar, R.[1] and Sharma, S.K.[2]

[1]*Marine & Coastal Survey Division, Geological Survey of India, Salt Lake, Kolkata - 700091, Email: georesmi07@gmail.com*

[2] *EG and Landslide Division, State Unit: Jammu and Kashmir, Geological Survey of India, Jammu*

The Indo Gangetic alluvial plain is a region of intensive agricultural and industrial activities. Over a few decades, industrialization associated with rapid growth in population made significant changes in the environment, which ultimately leads to pollution in the natural resources like water and soil. A study to assess the degree of contamination and to abbreviate the geochemical variation in soil and surface water chemistry in relation to geology, landuse-landcover and anthropogenic activities is conducted in parts of Nainital and Udhamsingh Nagar districts of Uttarakhand, where the primary occupation of the people is agriculture. Hydrochemical parameters and soil quality were assessed on the basis of soil, regolith and water samples each collected from area. Water is slightly alkaline in nature with specific electric conductance values ranging from 214µS/cm to 784µS/cm. Water chemistry suggests that alkaline earth exceeds alkalis; weak acids exceed strong acids suggesting the dominance of carbonate weathering followed by silicate weathering. No alkali hazard is anticipated to the crops as per the Sodium Adsorption Ratio (SAR), Percentage Sodium (%Na) and Residual Sodium Carbonate (RSC value less than 1.25) ratios. Ca +Mg and HCO_3+SO_4 relationship suggests that high values of sulphate are balanced by Ca+Mg and drawing contribution from chemical fertilizers, small/big sugar factories and anthropogenic activities. Dominance of Mg-HCO_3 hydrochemical facies of water indicates association of water with sandstone and indicates the process of partial ion exchange which is usually observed in the piedmont zones, alluvial plains and palaeochannel areas. According to U.S. Salinity Laboratory classification of irrigation water, about 70% of the samples fall under water type C_2-S_1, such water can be safely used if a moderate amount of leaching occurs and plants with moderate salt tolerance can also be grown whereas 10% under water type C_3-S_1, such water cannot be used on soils with restricted drainage. These are associated with area where industrial and agricultural activity is blooming, which clearly point towards the deterioration of water quality in this particular zone. Chemical Index of weathering determined for soil and regolith samples indicating a higher degree of chemical weathering and also shows a high proportion of clay minerals such as illite and muscovite. Major constituent of the soil is silica and higher percentage is noticed in the surface horizon compared to the sub-surface horizons. Illite rich Siwalik Sandstone attributed to high amount of Al_2O_3. Aanalytical results show enrichment of major and trace plant nutrients such as K, Cu, Fe, Mn, Mo and Zn. Conspicuous concentration of calcium (25729 ppm), tin(29.38 ppm) and strontium (66ppm) in regolith observed in the central part of the study area indicates a point source of contamination, which is associated with the industrial effluent and seawage. Visual estimation study of plant nutrients in sugarcane leaves (Fig.1) supports this observation.

The highly fertile Indo Gangetic alluvial plain is gradually and slowly affected by the intrusion of industrialisation and

wrong agricultural practises, which in turns upset the soil and water quality in the Himalayan foothills.
Figure 1: (a) High Na, sugarcane leaves have a pale-green to yellowish-green appearance ; (b)Magnesium deficient leaf (middle), Sulfur-deficient leaf (bottom), contrasted with a healthy leaf (top).