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SHORT CONTRIBUTION

Chemistry of rainwater and its contribution to nutrient input in forests of central India

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The quality of the environment has a great bearing on the qualitative changes in rainwater. Therefore, for the assessment of the environmental quality, the variations in all of the environmental inputs must be considered and evaluated in the biogeochemical cycles of natural systems. The chemistry of rainwater has been studied by a number of workers in various regions of the world, e.g. Ångström and Högberg (1952a, b), Emanuelsson et al. (1954), Larson and Hettick (1956), Herman and Gorham (1957), Wilson (1959), Allen et al. (1968) and Gore (1968), but information on rainwater and its chemistry for the Indian subcontinent is not available so far.

The present study was carried out in a forest catchment of Gopalpura (Madhya Pradesh) India, situated a few kilometres north of the Tropic of Cancer at 23° 50′ N and 78° 40′ E. The rainwater was collected from a series of standard rain gauges kept in open within the study area during the rainy season (July to October) of 1976. Total annual rainfall during this year was only 789 mm which is considerably low in comparison to the average annual rainfall of 1250 mm for this place.

Acid rains have been reported from various parts of north-eastern U.S.A. (Likens et al., 1972) and Europe due to mounting levels of certain gaseous pollutants such as sulphur and nitrogen oxides. During the present study the average pH value was 7.31 ± 0.11, which indicates alkaline nature of rainwater. pH may be considered an overall indicator for determining general ecological conditions of the environment, hence it appears that the environment of the study area is unacidified. Moreover, higher pH may be correlated with a higher nutrient content of water, as earlier suggested by Odum (1971). It is also evident from positive correlations obtained between pH and Ca, Na contents of rainwater. The values of correlation coefficients (r) were 0.78 and 0.80 for Ca and Na, respectively, significant at 0.01 probability level.

Average values of nutrient concentration in rainwater and its annual inputs to the ground are given in Table 1.

Variations in nitrogen concentration were more pronounced during different showers. Concentration was greater in early thunder showers of high intensity, which is a direct indication towards the electrical fixation of nitrogen (Visser, 1964). Phosphorus concentrations were relatively lower than those of other nutrient elements studied. It

Table 1. *Nutrient concentration of rainwater and its contribution to annual input*

Nutrient	Concentration (mg/l ± S.E.)	Annual input (kg/ha)
Total N	1.01 ± 0.09	7.96
P	0.05 ± 0.004	0.394
K	0.56 ± 0.07	4.42
Ca	0.62 ± 0.08	4.89
Na	3.40 ± 0.58	26.83

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may be due to lesser amount of its oxides in air-borne dust particles present in the atmosphere.

Standard errors calculated for mean K, Ca and Na content of rainwater (Table 1) were found to be 13, 13 and 17% of their respective means. This reveals great variability of these cations during different showers. It was experienced that big rain showers were usually associated with lower status of nutrients than those of small showers after a period of drought. The average Na concentration was higher, though the study site was quite far off from the coast, therefore, it may be stated that this element may have some sources other than salt spraying near the coastal areas.

Table 1 reveals that significant quantities of nutrient elements were added to the ground through rainfall annually. There appears a great diversity in respect to the nutrients contributed by rains in various parts of the world. The maximum quantity of inorganic nitrogen added annually to the ground by rainfall was recorded by Jones (1960) and Thornton (1965) in north Nigeria and two different places of Gambia, respectively, whereas such minimum quantity was reported by Wetselaar and Hutton (1963) from Australia. The quantities of phosphorus were more or less comparable except for Jones (1960) who has reported higher values of annual incorporation of this element (2.50 kg/ha) by rainfall. The greater variations in the quantities of cations addition by rainfall may be mainly due to the variability in location and climatic conditions of the study site.

The annual incorporation of nutrients by rainfall to the natural forest ecosystems of tropical regions probably has greater significance to microbes, groundflora and other young and sprouting seedlings by making available a nutrient reservoir for instantaneous requirements of plants in their vigorous growth during this period; this is their role in the whole biogeochemical cycles of these systems (Stenlid, 1958; Yadav, 1978).

REFERENCES

Allen, S. E., Carlisle, A., White, E. J. and Evans, C. C. 1968. The plant nutrient content of rainwater. *J. Ecol. 56*, 497–504.

Ångström, A. and Högberg, L. 1952a. On the content of nitrogen (NH_4-N and NO_3-N) in atmospheric precipitation. *Tellus 4*, 31–42.

Ångström, A. and Högberg, L. 1952b. On the content of nitrogen in atmospheric precipitation in Sweden. *Tellus 4*, 271–279.

Emanuelsson, A., Eriksson, E. and Enger, H. 1954. Composition of atmospheric precipitation in Sweden. *Tellus 6*, 261–267.

Gore, A. J. P. 1968. Supply of six elements by rain to an upland peat area. *J. Ecol. 56*, 483–495.

Herman, F. A. and Gorham, E. 1957. Total mineral material, acidity, sulphur and nitrogen in rain and snow at Kentville, Nova Scotia. *Tellus 9*, 180–183.

Jones, E. 1960. Contribution of rainwater to the nutrient economy of soil in Northern Nigeria. *Nature 188*, 432p.

Larson, T. E. and Hettick, I. 1956. Mineral composition of rainwater. *Tellus 8*, 191–201.

Likens, G. E., Bormann, F. H. and Johnson, N. M. 1972. Acid rain. *Environment 14*, 33–40.

Odum, E. P. 1971. *Fundamentals of Ecology.* 3rd ed., Philadelphia, Saunders.

Stenlid, G. 1958. Salt losses and redistribution of salts in higher plants. *Encyclopedia of Plant Physiology 4*, 615–637.

Thornton, I. 1965. Nutrient content of rainwater in the Gambia. *Nature 205*, 1025p.

Visser, S. A. 1964. Origin of nitrates in tropical rainwater. *Nature 201*, 35p.

Wetselaar, R. and Hutton J. T. 1963. The ionic composition of rainwater at Katherine, N. T. and its part in the cycling of plant nutrients. *Aust. J. Agric. Res. 14*, 319–329.

Wilson, A. T. 1959. Surface of the ocean as a source of air-borne nitrogenous material and other plant nutrients. *Nature 184*, 99p.

Yadav, A. K. 1978. A study of mineral circulation in some forests of Sagar with special reference to stemflow and throughfall. Ph.D. Thesis, approved by Saugar University, Sagar (India).