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Nutrient Deposition During the Harmattan Dry Season Across the Northern Region of Ghana

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Abstract

The harmattan dry season (November to February) across West Africa is associated with dry nutrient deposits that are attributed to external dust sources and the redistribution of nutrients from local soils. Quantities of dry nutrient deposits are mostly estimated at single sites or in a single (North to south) direction; limiting data and knowledge on the two dimensional spatial nutrient deposits. In this study, the geospatial distribution of dry nutrient deposits across 15 (5 latitudinal zones and 3 longitudinal zones) sites of the entire northern region of Ghana is investigated through a modified stratified contiguous unit based spatial technique in order to ascertain the spatial variations and the mean dry nutrient inputs. Deposited nitrate-N showed no apparent trend in spatial distribution. However, quantity of deposited P, K, Ca, and Mg positively correlates with latitude ($p < 0.05$) and with longitude ($p > 0.05$), with latitude being the greater predictor of dry nutrient deposits. Negative correlations between Ca and Mg concentrations on one hand with Na and K concentrations on the other hand for all sites suggest that substantial amounts of deposited Na and K may not have come from same sources as Ca and Mg. Variation in mean nutrient concentration (mg kg^{-1}) with month ($\text{NO}_3^{-1}\text{-N}$: 24-640; P: 23-56; K: 2720-4150; Ca: 1680-2010; Mg: 740-930) and not space is attributed to temporal differences in nutrient sources. High nutrient concentrations of dry deposits compared to the concentrations of soils of harmattan dust sources and to concentrations of local soil nutrients (total N: 710; P: 12; K: 25; Ca: 610; Mg: 200) given similar chemical treatments as the dry deposition, suggest the return of burned vegetation debris to be a major contributor to dry nutrient deposits besides dust transport and redistribution from local soils. Given the relatively low amount of total annual dry deposits per unit area (95 % confidence interval: 53–122 Mg km^{-2}), the total supply of plant nutrients (kg km^{-2}) by dry deposition ($\text{NO}_3^{-1}\text{-N}$: 3-40; P: 1-6; K: 100-620; Ca: 70-200; Mg: 40-90) is however minimal to the soils available nutrient pool.

Keywords: Burned ash, food security, geospatial distribution, harmattan, nutrient source