Spatial mapping of acidity and vegetal multi-micronutrients in soils of the Meghalaya Plateau, northeastern Himalaya, India

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This study explores the high-precision mapping (1 : 50 K stratified random sampling) of spatial variability in soil acidity (pH), soluble aluminium (Al) and plant-available micronutrients (Fe, Mn, Cu and Zn extracted by DTPA) for the acid soils of the Meghalaya Plateau northeastern Himalaya, India. Results revealed that soils in nearly 88% of the total geographical area (TGA: 22,429 sq. km) fell below the pH limit of 5.5, of which significant areas (13.9% TGA) were strongly acidic in reaction (pH < 4.5). In close to 90% of the plateau soils, Al exceeded the critical toxicity threshold (>9.0 mg kg^{-1}). Over 93% of the soils were high in Fe concentration (>10.5–100.0 mg kg^{-1}). Mn, Cu, and Zn were found to be deficient in 12% (Mn < 5.0 mg kg^{-1}), 20% (Cu < 0.6 mg kg^{-1}), and 27% (Zn < 0.9 mg kg^{-1}) of TGA respectively. The multi-micronutrient composite maps of Fe, Mn, Cu and Zn displayed an intricate spatial dimension in the deficiency zones. The study concludes that there is a pressing need to manage site-specific micronutrients to improve crop productivity and the quality of the produce.

Keywords: Crop productivity, deficiency zone, micronutrients, soil acidity, soluble aluminium, spatial mapping.

Nearly 30% of the 2.24 m ha of the Meghalaya Plateau is degraded by soil acidity, water erosion and other forms of soil degradation[1]. Deforestation and cultivation (shifting and sedentary agriculture) in the sloping uplands of Meghalaya have accentuated serious water erosion, with the annual soil loss rising to 229-tonne ha^{-1} (ref. 2). The result is loss of fertile topsoil, soil acidification (per pH of 0.25–0.33 units) and decreases in soil fertility, including micronutrients from 17% to 79% (refs 3 and 4).

The absence of a high-precision, up-to-date map of the spatial variability of soil acidity and its interplay with micronutrients for the Meghalaya soil is a barrier to effective nutrient management on a priority basis. The region continues to rely on a coarse-resolution (made from 100 sites spanning 26.2 m ha) soil acidity map developed by Sharma *et al.*[5] in 2006. Shukla and Behera[6] conducted a national micronutrient mapping project at a crude resolution (at the district level). To represent the NEH region, they considered just 20 of the 93 districts (eight states, including Meghalaya). Similarly, from coarse resolution (1 : 250,000 K scale) mapping of acidic soils at the country level, Maji *et al.*[7] reported the absence of strongly acid soils (pH < 4.5) in Meghalaya, a contradiction to the presence of ultra-acidic to strongly acidic soils (pH 3.1 to