

Balance designs revisit indices commonly used in agricultural science and eco-engineering

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Abstract

Most agronomists and eco-engineers diagnose the interrelated soil, plant and feed compositions in agro-ecosystems in terms of total concentrations, proportions and dual ratios. However, the pre-compositional tools developed in the 20th century to diagnose compositions do not account for the special properties of strictly positive and intrinsically multivariate compositional data, i.e. data bounded to measurement scale or unit. Balance designs can provide a coherent understanding of the relationships between the components of complex soil-plant-animal systems and sub-systems. Balances are illustrated by a mobile design, where isometric log ratios (*ilr*) are computed at fulcrums from concentrations located in buckets. Power parameters are useful to normalize the distribution of *ilr* data and to regulate component accessibility in biological, physical and chemical systems. Our objective is to revisit common diagnostic indices in agricultural science and engineering using compositional balances and power parameters. Revisited soil indices are the ternary diagram, mean weight diameter, sufficiency level of available nutrients, basic cation saturation ratios, and nutrient intensity and balance concept. Revisited plant indices are the critical concentration ranges, dual ratios, stoichiometric ratios, the Kenworthy index, and the Diagnosis and Recommendation Integrated System. Revisited feed quality indices are the dietary cation-anion difference and the K/(Ca+Mg) ratio. Rather than consider compositions in terms of their isolated parts, agronomists and eco-engineers are urged to think in terms of interactive balance systems. As is the case for other disciplines, research in agronomy can benefit from compositional tools.