ABSTRACT

Peri-urban landfill adjacent agricultural soils are common worldwide and pose risks to human health via heavy metals common in such systems. This research employed a combination of portable X-ray fluorescence (PXRF) spectrometry and geostatistical methods to identify pollution hotspots in peri-urban landfill adjacent agricultural soils of Kolkata, India. Among all tested heavy metals, Zn, Mn, Cu, and Pb exceeded their threshold limits at all sites. Indicator and ordinary kriging were employed to show the heavy metal spatial variability. Eight different pollution indices were calculated and spatially compared. Moreover, two XRF beams from PXRF were extracted, preprocessed, and subsequently used in different combinations to predict soil Cu, Mn, Zn, Cr, and Pb via random forest regression. Beam1 and beam 1+2 produced similar prediction results and outperformed beam 2. The attenuation impacts of organic matter (OM) and moisture on PXRF performance were measured following the addition of three OM surrogates at different levels of moisture. Empirical correction factors were calculated for OM at a fixed level of moisture as well as for moisture at a fixed level of OM. Correction factors were applied to 11 randomly selected soil samples for correcting the attenuation impacts of OM and moisture on PXRF. The correction factors successfully generated heavy metal values close to the geochemical values of the soil samples. Additionally, soil colour data from an inexpensive Nix Pro colour sensor was used with visible near infrared diffuse reflectance spectroscopy (VisNIR DRS) (590-2490 nm) to predict soil organic carbon (OC) content. Generalized additive model and partial least squares regression were applied to model VisNIR DRS spectra and Nix Pro data, respectively, both independently and by combining model predictions using a bilinear regression. Results showed that the combined model outperformed either sensor independently where the 30% external test set achieved a validation R^2 of 0.95 relative to laboratory-measured OC data. Future studies should evaluate the effectiveness of such an approach on a wider variety of soil orders, its effectiveness *in-situ* under variable moisture conditions, and in possible combination with other proximal sensing platforms.

Keywords: PXRF; Nix Pro; VisNIR DRS; heavy metal; organic matter; moisture