Heavy Metal Contamination in Soils: Detection and Assessment Using Machine Learning Algorithms Based on Hyperspectral Images

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Abstract : The levels of heavy metals in agricultural lands in Lebanon have been witnessing a noticeable increase in the past few years, due to increased anthropogenic pollution sources. Heavy metals pose a serious threat to the environment for being non-biodegradable and persistent, accumulating thus to dangerous levels in the soil. Besides the traditional laboratory and chemical analysis methods, Hyperspectral Imaging (HSI) has proven its efficiency in the rapid detection of HMs contamination. In Lebanon, a continuous environmental monitoring, including the monitoring of levels of HMs in agricultural soils, is lacking. This is due in part to the high cost of analysis. Hence, this proposed research aims at defining the current national status of HMs contamination in agricultural soil, and to evaluate the effectiveness of using HSI in the detection of HM in contaminated agricultural fields. To achieve the two main objectives of this study, soil samples were collected from different areas throughout the country and were analyzed for HMs using Atomic Absorption Spectrophotometry (AAS). The results were compared to those obtained from the HSI technique that was applied using Hyspex SWIR-384 camera. The results showed that the Lebanese agricultural soils contain high contamination levels of Zn, and that the more clayey the soil is, the lower reflectance it has.