

Title: Investigating soil physicochemical factors influencing trace element contamination at the semi-urban-rural home gardening interfaces on the Fiji Islands

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Abstract: Due to its ecological and public health implications, home gardening soil pollution is challenging. However, the physicochemical factors of trace element pollution in semi-urban-rural home gardening soil interfaces in Fiji are unclear. Self-organizing map (SOM), chemometrics, compositional data analysis (CDA), and soil quality indices were used to evaluate spatial patterns, contamination characteristics, sources, and factors affecting trace element contamination in 55 soil samples from semi-urban and rural Fiji. The average contents of diethylenetriaminepentaacetic acid (DTPA)-extractable forms of trace element levels (mg/kg) increased in rural areas as Fe (55.7) > Mn (40.4) > Zn (9.4) > Cu (5.9) and semi-urban areas as Fe (55.2) > Zn (35.9) > Mn (37.1) > Cu (16.1). Rural soils have less ecological risks to home gardening than semi-urban soils. SOM and CDA analysis showed four spatial clusters: clusters 1 and 3 are natural geogenic in rural regions while clusters 2 and 4 are human-induced non-point sources in semi-urban areas. Principal component analysis (PCA) and hierarchical cluster analysis showed that semi-urban Cu-Zn was more affected by manufacturing emissions or fertilization, whereas rural Fe-Mn was more likely to be lithogenic. The research found that pH and organic matter significantly affect Cu and Zn pollution in semi-urban soils ($p < 0.05$). For rural and semi-urban soils, trace element subsets explained 44 %–87 % of soil contamination changes using the stepwise regression model. These findings aid to establishing a primary database of eco-environmental risks and facilitate comprehensive strategies for assessing soil contamination and potential threats to food safety.

Keywords: Food safety, Organic matter, Eco-environmental risk, Soil pollution, Principal component analysis (PCA)

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