

Multivariate Statistical Analysis of Heavy Metals Pollution of Dietary Vegetables in Swabi, Khyber Pakhtunkhwa, Pakistan

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Abstract : Toxic heavy metal contamination has a negative impact on soil quality which ultimately pollutes the agriculture system. In the current work, we analyzed uptake of various heavy metals by dietary vegetables grown in wastewater irrigated areas of Swabi city. The samples of soil and vegetables were analyzed for heavy metals viz Cd, Cr, Mn, Fe, Ni, Cu, Zn and Pb using Atomic Absorption Spectrophotometer. High levels of metals were found in wastewater irrigated soil and vegetables in the study area. Especially the concentrations of Pb and Cd in the dietary vegetable crossed the permissible level of World Health Organization. Substantial positive correlation was found among the soil and vegetable contamination. Transfer factor for some metals including Cr, Zn, Mn, Ni, Cd and Cu was greater than 0.5 which shows enhanced accumulation of these metals due to contamination by domestic discharges and industrial effluents. Linear regression analysis indicated significant correlation of heavy metals viz Pb, Cr, Cd, Ni, Zn, Cu, Fe and Mn in vegetables with concentration in soil of 0.964 at $P \leq 0.001$. *Abelmoschus esculentus* indicated Health Risk Index (HRI) of Pb >1 in adults and children. The source identification analysis carried out by Principal Component Analysis (PCA) and Cluster Analysis (CA) showed that ground water and soil were being polluted by the trace metals coming out from industries and domestic wastes. Hierarchical cluster analysis (HCA) divided metals into two clusters for wastewater and soil but into five clusters for soil of control area. PCA extracted two factors for wastewater, each contributing 61.086 % and 16.229 % of the total 77.315 % variance. PCA extracted two factors, for soil samples, having total variance of 79.912 % factor 1 and factor 2 contributed 63.889 % and 16.023 % of the total variance. PCA for sub soil extracted two factors with a total variance of 76.136 % factor 1 being 61.768 % and factor 2 being 14.368 % of the total variance. High pollution load index for vegetables in the study area due to metal polluted soil has opened a study area for proper legislation to protect further contamination of vegetables. This work would further reveal serious health risks to human population of the study area.

Keywords : health risk, vegetables, wastewater, atomic absorption spectrophotometer

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