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Temporal relationships between heavy-metal concentrations in water and food crops at a Zambian urban agriculture site.

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In this paper, for a suite of 17 elements, we examine the temporal relationships between heavy-metal concentrations in water and food crops, and between different elements, at Chunga, Zambia, August 2004 to July 2005. In many locations in the developing world, the water source used for urban agriculture is often wastewater from industrial sources, and is potentially contaminated with heavy metals. In Zambia, the location of this study, the wastewater source for irrigation use in some urban areas has been called "a sink for sewage, mining and industrial effluents" all of which potentially contain heavy metals. We present field research results examining relationships between heavy-metal concentrations in both the water and the foodcrops from an urban agriculture location in northwest Lusaka (Chunga), the capital of Zambia. Monthly monitoring of water and food crops irrigated by the water was carried out at the study site, August 2004 to July 2005, for n = 39 water samples and n = 17 food crop samples. Heavy-metal concentrations were examined for Al, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Cd, Ba, Hg, Tl, Pb, U (17 elements) using ICP-MS. We find that both water and food-crop samples have peak concentrations for many elements in the wet season (October to February). When examining temporal relationships, we find some positive and negative statistically significant correlations between elements for both [water]:[food crop] and [food crop]:[food crop]. For the concentrations of [water]:[food crop] we find particularly strong positive correlations for V:Se and (V, Cr, Co, Zn, Cd, Hg, Pb, U):Tl; strong negative correlations are observed for V:Zn, Ni:Cu, Cd:Cu. For [food crop]:[food crop] particularly strong positive relationships are observed for Al:V, Al:Cr, Cr:V, and Cd:U. Theoretically, concentrations of heavy–metals in plant samples normally should reflect the heavy–metal contamination in the water used to irrigate the plants throughout the growth cycle (typically six weeks). A time-lag correlation between [water] and [food crop] was found for individual elements (Al, V, Fe, Co, Ni, Cu, Hg).