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"Filling gaps and removing traps
for sustainable resource management"

Eating the Soil – Environmental Effects on Nutrient Concentrations in Food Produced on Soils of Different Fertilities

Sahrah Fischer[1], Thomas Hilger[1], Irmgard Jordan[2], Jeninah Karungi[3], Georg Cadisch[1]

[1] *University of Hohenheim, Inst. of Agric. Sci. in the Tropics (Hans-Ruthenberg-Institute), Germany*
[2] *Justus-Liebig University Giessen, Center for International Development and Environmental Research, Germany*
[3] *Makerere University, Department of Agricultural Production, Uganda*

Abstract

Very little is known about the connection between food nutrient composition and environmental factors. The main aim of this study is therefore to elucidate the importance of environmental factors on the variance of food nutrient concentration in different types of food crops; specifically (i) whether soils of different fertilities produce foods with significantly different nutrient concentrations; (ii) do environmental or anthropogenic factors have a significant influence on the nutrient concentration of different food crops and different soil types?

Maize grain (*Zea mays*, n=31) and cassava tuber (*Manihot esculenta*, n=27) samples were collected in Teso South, Kenya (low fertility) and maize grain (n=30) and matooke fruit (*Musa acuminate*, n=54) samples collected in Kapchorwa, Uganda (higher fertility) paired with soil samples. All samples were measured using a portable X-Ray Fluorescence Spectrometer for the total concentration of macro (Mg, P, S, K, Ca) and micronutrients (Fe, Zn, Mn, Cu). Soils were evaluated for eCEC, N and C content, pH and texture. Yields per field as well as anthropogenic factors (fertilisation, distance to household, crop species richness and diversity) were collected. Canonical Correspondence Analysis (CCA) coupled with permutation ranking tests per crop and region were done.

Soil of higher fertility produced foods with significantly higher food nutrient concentrations and yields. Although the largest food nutrient difference between the two areas was micronutrients, the largest deficiencies in both areas were macronutrients. Variance in food nutrient concentration was described best by full CCA models (Maize >80%; Cassava 76%; Matooke 39 %). Surprisingly, pH was not a significant factor affecting nutrient concentration in the acidic low fertility region. Agrobiodiversity had no effect in the low fertility area and a significant positive effect in the higher fertility region. A natural dilution effect observed in the higher fertility region becomes important when planning fertiliser strategies, as a higher nutrient input could exacerbate this effect. Generative storage organs (grain) of annual plants were affected most by environmental effects compared to storage organs (tuber) of perennial crops, or generative organs of perennial crops (fruits). Soil fertility as well as cultivation practices can affect the quantity and quality of produced foods.

Keywords: Agriculture, canonical correspondence analysis, environment, nutrients, plant nutrition

Contact Address: Sahrah Fischer, University of Hohenheim, Inst. of Agric. Sci. in the Tropics (Hans-Ruthenberg-Institute), Garbenstr. 13, 70599 Stuttgart, Germany, e-mail: sahrah.fischer@uni-hohenheim.de