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"Resilience of agricultural systems against crises"

Partial Horizontal Carbon and Nutrient Balances in Homegardens of the Nuba Mountains, Sudan

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Abstract

The transformation of traditional homegardens in the Nuba Mountains, Sudan, towards more intensified production systems raises concerns with respect to the sustainability of these systems, particularly regarding carbon and nutrient management. To assess these different horticultural systems, a nutrient budget approach was used to quantify the management related partial horizontal fluxes of carbon (C), nitrogen (N), phosphorus (P) and potassium (K). To this end, six representative homegardens, comprising three traditional (low input) and three intensified (high input) sites, were selected. In each garden, four to five observation plots with site-specific crops were monitored daily to quantify management-related carbon and nutrient inputs and outputs.

Horizontal C balances were positive for all homegardens (1,922 kg ha^{-1} a^{-1} for low and 3,706 kg ha^{-1} a^{-1} for high input systems). In low input homegardens nutrient balances amounted to -84 kg N ha^{-1} a^{-1}, -10 kg P ha^{-1} a^{-1} and -117 kg K ha^{-1} a^{-1} *versus* 15 kg N ha^{-1} a^{-1}, 7 kg P ha^{-1} a^{-1} and -168 kg K ha^{-1} a^{-1} in high input gardens. Manure amendments provided most nutrients in both types of homegardens (low input: 29 kg N ha^{-1} a^{-1}, 9 kg P ha^{-1} a^{-1}, 19 kg K ha^{-1} a^{-1}; high input: 112 kg N ha^{-1} a^{-1}, 27 kg P ha^{-1} a^{-1}, 70 kg K ha^{-1} a^{-1}). A significant N input by biological N fixation was only observed in low input systems (17 kg N ha^{-1} a^{-1}) indicating a possible change of plant species composition through intensification. The main C source estimated at 3,900 to 5,000 kg ha^{-1} a^{-1} for low and high homegarden types, respectively, was photosynthetically captured C stored in the rooting zone.

The horizontal balances approach indicated nutrient deficits which might result in long-term declines of crop yields, in particular for traditional homegardens. Adapted management strategies to improve soil fertility through increased organic fertilisation and higher nutrient use efficiency are recommended.

Keywords: Carbon fluxes, East Africa, nutrient fluxes, nutrient use efficiency, soil surface nutrient budget approach

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