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"Development on the margin"

Gaseous Emissions from High and Low Input Homegardens of the Nuba Mountains, Central Sudan

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Abstract

Positive horizontal nutrient balances for homegardens in the Nuba Mountains, Central Sudan, may lead to substantial nitrogen (N) and carbon (C) losses through leaching and gaseous emissions. This study therefore aimed to assess soil gaseous emissions of NH_3, N_2O, CH_4 and CO_2 using a mobile closed chamber system consisting of a Teflon®-film coated custom-made cuvette connected with a photo-acoustic infrared multi-gas monitor (INNOVA 1312–5). To capture variation in gas fluxes across different management systems and times of the year, temperature and different soil moisture levels, measurements were conducted in four case-study gardens, two low and two high nutrient input ones, over a period of seven months, including the rainy season. An agriculturally un-used area served as a control. Within each of these locations, twice a month six replicate measurements were collected in a vegetable and a cereal plot during the coolest (6–8 am) and the hottest (3–5 pm) hours of a day. Compared to the morning emissions, afternoon fluxes of all gases tended to be higher during the whole year, with the daily temporal variation being more pronounced after heavy rainfall events at the end of rainy season. Across the four gardens gaseous emissions reached their peaks at the onset (2748 g CO_2-C ha^{-1} h^{-1}) or during the rainy season (528 g CH_4-C ha^{-1} h^{-1}, 28 g NH_3-N ha^{-1} h^{-1}, and 13.7 g N_2O-N ha^{-1} h^{-1}). Cumulative N and C fluxes were substantially higher for the four gardens (49 to 57 kg N ha^{-1} yr^{-1} and 5.1 to 7.7 Mg C ha^{-1} yr^{-1}) than for the uncultivated control (44 kg N ha^{-1} yr^{-1} and 2.9 Mg C ha^{-1} yr^{-1}). The prevailing form of the N emissions was NH_3 (65 to 73 %), while CH_4 contributed only 7–16 % to total C losses. Effects of input intensity were not significant for C emissions from vegetable and cereal plots, but gaseous N losses from vegetable plots in gardens were with 58 to 68 kg N ha^{-1} yr^{-1} higher than from cereal fields (40 to 47 kg N ha^{-1} yr^{-1}).

Keywords: Carbon, closed chamber system, INNOVA, nitrogen, nutrient fluxes, photo-acoustic gas monitor

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