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Gaseous Carbon and Nitrogen Losses in Urban Gardening of Niamey, Niger

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Abstract

Calculations of horizontal input and output balances in urban agriculture (UA) of Africa and Asia have indicated large nutrient surpluses whose fate, however, remains unclear. An INNOVA photo-acoustic infrared multi-gas monitor was used over 12 months to quantify gaseous emissions of CO_2, CH_4, NH_3 and N_2O in UA systems of Niamey, Niger. Measurements with the closed chamber system were taken in triplicate once every month for 10 min during the coldest (6–7:30 am) and hottest (13–14:30 pm) part of the day.

Morning ambient temperatures were 10–15° C in December and reached 30° C during the hot dry season (April-May). Afternoon temperatures peaked during the hot dry season at 48° C and dropped to 29–33° C in December. In the morning soil moisture at 6 cm depth varied from 0.2–14.6 vol% during the hot dry season and from 19.3–47.3 vol% in the rainy season. In the afternoons soil moisture reached 21 vol% in the hot dry season and 54 vol% in the rainy season.

Emissions of NH_3-N and N_2O-N and CO_2-C and CH_4-C were highest at the end of May and in August 2006. During these days the respective afternoon maxima reached 48 and 25 g N ha^{-1} h^{-1} and 6815 and 734 g C ha^{-1} h^{-1}. The high flux rates at the onset of the rainy season were likely due to higher soil moisture and a man-made high nutrient concentration in the topsoil during these measurements, which preceded the next cropping season.

Extrapolated average morning emission rates of 21 kg N ha^{-1} a^{-1} and 20 490 kg C ha^{-1} a^{-1} and afternoon rates of 85 kg N ha^{-1} a^{-1} and 29 800 kg C ha^{-1} a^{-1} were up to two-fold higher than reported from irrigated oasis soils in Oman. These losses may be partly due to excessive fertilizer inputs and partly to ineffective nutrient management. In addition to the high volatilisation rates, on the sandy garden soils nutrient losses from leaching during the rainy season are also expected to be high but have not yet been quantified.

Keywords: Carbon, gaseous emissions, Niger, nitrogen, urban agriculture

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