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## Integration of *Canavalia brasiliensis* into the Crop-livestock System of the Nicaraguan Hillsides: Environmental Adaptation and Nitrogen Dynamics

SABINE DOUXCHAMPS<sup>1</sup>, EMMANUEL FROSSARD<sup>2</sup>, REIN VAN DER HOEK<sup>3</sup>, AXEL SCHMIDT<sup>4</sup>,  
IDUPULAPATI RAO<sup>5</sup>, ASTRID OBERSON<sup>6</sup>

<sup>1</sup>ETH Zurich, Institute of Plant Sciences, Switzerland

<sup>2</sup>ETH Zurich, Institute of Plant, Animal and Agroecosystem Sciences, Switzerland

<sup>3</sup>International Centre for Tropical Agriculture (CIAT) Central-America / CIM, Nicaragua

<sup>4</sup>Independent Consultant, Peru

<sup>5</sup>International Centre for Tropical Agriculture (CIAT), Colombia

<sup>6</sup>ETH Zurich, Switzerland

### Abstract

Due to population growth in the rural poor areas of the Nicaraguan hillsides, land use has been intensified in a way that adversely affects soil fertility. Crop and livestock productivity have therefore declined, leading to decreased income and food insecurity. Nitrogen (N) is the nutrient most limiting crop production in the area. To sustain agricultural production, the drought-tolerant cover legume *Canavalia brasiliensis* (canavalia) has been introduced as green manure and forage into the traditional maize-bean-livestock system. Different aspects of this introduction were studied in order to check the sustainability of the proposed technology. On-farm, environmental adaptation and impact of canavalia on system N budgets were assessed. On-station, its benefits for the subsequent maize were determined using <sup>15</sup>N-labelling techniques.

Biomass production varied between 448 and 5357 kg ha<sup>-1</sup>, and was significantly affected by the carbon and N content of the soil surface horizon, the amount of clay and stones in the whole profile, and the soil depth. Canavalia derived in average 69% of its N from the atmosphere. Although it increased the N balance of the rotation when used as green manure, the system N budget remained negative without mineral fertiliser application. When used as forage, it bears the risk of soil N depletion unless N would be recycled to the plot by animal manure. Maize recovered 12% of N from canavalia residues, while most of it remained in the soil, building soil organic matter stocks.

In conclusion, it can be stated that the integration of canavalia in the Nicaraguan hillsides is on track, but there are still knowledge gaps to be filled in order to be able to make the most of canavalia attributes. Indeed, farmers will most likely use canavalia as forage but recycling of animal manure to the plot is not yet current practice and the fertiliser value of this manure has not been determined. The question of the biophysical trade-offs of using canavalia as forage or as green manure still need to be complemented with N budget studies for different rotational sequences over several years and with studies aiming at optimising N use efficiency at farm level.

**Keywords:** <sup>15</sup>N isotope techniques, *canavalia brasiliensis*, crop-livestock systems, N budget, on-farm