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“Development on the margin”

## Causes of Variability in Climbing Bean Farming Systems Across Different Farm Types in Northern Rwanda

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### Abstract

N2AFRICA is a development and research project focused on putting nitrogen fixation to work for smallholder farmers growing legume crops in Africa. Within this project, farming systems in northern Rwanda were characterised with focus on the role of climbing beans (*Phaseolus vulgaris* L.). Data was collected on resource flows, soil properties, crop productivity, field management and biological nitrogen fixation (BNF) and on farmers assessment of production constraints. Farmers were classified according to regional specific resource endowment indicators, following the governmental household typology ‘Ubudehe’. Large variations in soil fertility, productivity and BNF were observed within and between farms. While landscape had a clear effect on soil organic C, total N and sand content, individual management factors were not correlated to soil fertility. Fields were all managed intensively due to land scarcity and high population density (524 people km<sup>-2</sup>), and there were no clear effects of management or field distance from the homesteads on soil fertility. However, the density and height of stakes used as support for climbing beans correlated well with yield. Resource-poor farmers had less access to quality stakes and achieved smaller mean grain yields of 1.45 Mg ha<sup>-1</sup> than wealthier farmers who harvested 2.22 Mg ha<sup>-1</sup>. BNF measured with the natural abundance method was relatively low with on average 50% N derived from the atmosphere and 93 kg N ha<sup>-1</sup> fixed in all above- and below-ground plant parts. Depending on farmers’ bean residue management, N-budgets per field ranged from -80 to 45 kg N ha<sup>-1</sup> neglecting N returned to fields in animal manure after feeding bean residues. Resource-poor farmers, who all fed bean residues to animals, had an average negative N-budget of -43 kg N ha<sup>-1</sup>. Wealthier farmers, who retained part of the residues on fields, had an average N budget of -3 kg N ha<sup>-1</sup>. The study highlights the complexity of smallholder farming systems in East/Central Africa. Further, it shows that the ‘Ubudehe’ farm typology is useful to explain variations in resource use and productivity and is a potential tool for tailoring extension and technology services to the needs of farmers.

**Keywords:** Biological nitrogen fixation (BNF), climbing beans, farm typology, farming systems, N-budgets, N2AFRICA, *Phaseolus vulgaris*, Rwanda, Ubudehe