



## CASE STUDY Farm-scale trade-offs between legume use as forage versus green manure

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This case-study addresses the farm-scale trade-offs between using multipurpose legume canavalia as feed or as green manure. The use of canavalia as forage increased cattle milk yields in traditional maize-bean-cattle traditional farming system in Nicaragua, while the use as green manure increased nutrient cycling efficiency. Short term net annual income increased when used as a forage but the study stresses that long-term effects are highly site dependent.

### Important Details

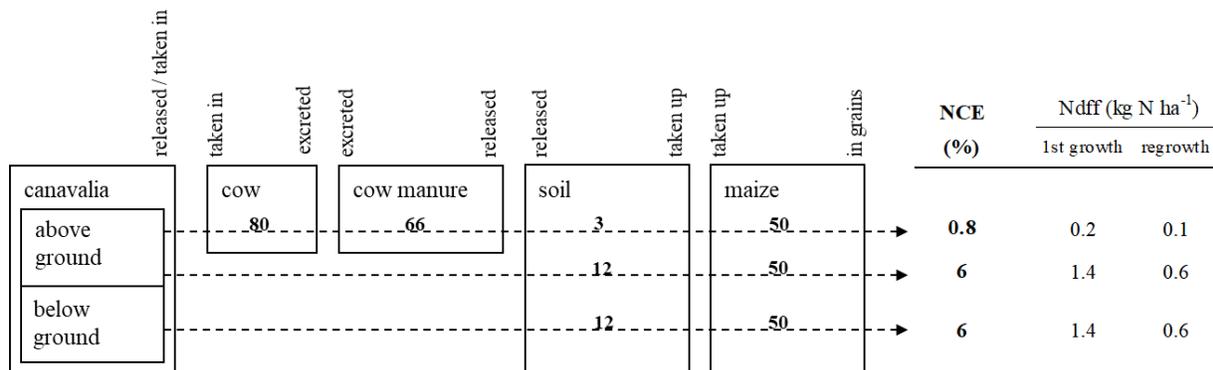
time (or time period)	2007-2008
country & region	Nicaragua, Central America
context & agro-eco landscape type	hillsides in rural areas
key actors, stakeholders & beneficiaries	Smallholder mixed crop-livestock farmers
model and/or tools used	Field trials with traditional farming system: maize-bean-cattle ; Integrated legume: <i>Canavalia brasiliensis</i> Mart. Ex. Benth (Brazilian jack bean) and a Structural Mental Model Approach was employed

### Overview

To support a sustainable increase in agricultural productivity, the multipurpose legume *Canavalia brasiliensis* (canavalia) was integrated as forage and green manure into the smallholder crop-livestock system of the Nicaraguan hillsides. When using canavalia, farmers face two alternatives: (a) a short-term alternative, where canavalia is grazed together with maize residues to increase milk production and earn an extra income during the dry season when milk prices are highest; or (b) a medium-to-long-term alternative, where canavalia is left in the field to enhance soil fertility in order to improve crop yields in subsequent years. One major drawback is that one usage limits the other. To balance these biophysical and socio-economic trade-offs in resource allocation and use, a good understanding of the effects of the legume on the individual components of the farming system was needed. This was investigated through on-farm trials, surveys, and on-station experiments, including farmers' perception. The different options for use of canavalia above ground biomass were not equivalent in terms of nitrogen (N) cycling efficiency (NCE), which was reflected in the N availability for the subsequent maize crop.



**Figure 1.** Cows grazing canavalia in farmers' fields (photo credit: Rein van der Hoek, CIAT)



**Figure 2.** Nitrogen (N) pathways in maize-canavalia rotation for different uses of canavalia biomass. Dashed arrows indicate the N pathways through various compartments according to the various management options for canavalia. NCE = Nutrient cycling efficiency, ratio of effective or useful output to input in the system component.

The NCE approach showed that the use of canavalia as green manure provided a more substantial N input to the subsequent maize than the use of animal manure, although both amounts were small compared to maize total N needs. Use as forage increased milk yields while use as green manure increased nutrient cycling efficiency. Short term net annual income decreased when used as green manure and increased when used as forage.

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## Lessons Learned & Recommendations

There is a need to define the longer-term economic threshold of productivity at the whole farm level for farmers to adopt canavalia as a legume option, as on more degraded soils, canavalia needs to be combined with mineral fertilizer and other soil fertility management practices during the early part of its integration.

Long-term effects and complex spatial arrangements must be further tested and will be highly site dependent. Risks associated with continuous use of new technologies over years (e.g. nutrient mining for legume used as forage or pest/development as invasive weed if used as green manure) are still poorly defined, and long-term testing is necessary. Complex rotations combining different legumes with different purposes on the same farm could be promising.

Management options to handle trade-offs and maximize legume benefits must be evaluated by multi-stakeholders groups, particularly when there are short- and long-term effects to balance. Farmers' perception and implementation of new technologies must be monitored to make adjustments when needed and ensure that the introduced technology is both economically and ecologically sustainable.

### Key references

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