

# Exploring nutrient flows of smallholder farms in Ratanakiri

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## Context

The Cambodian Province of Ratanakiri underwent a significant shift in land use over the past decade. Diverse subsistence slash-and-burn farm systems were successively replaced by market oriented monocultures with dramatic ecological repercussions. The International Center for Tropical Agriculture (CIAT) aimed to characterise existing crop-livestock systems in terms of their eco-efficiency and resilience under the Hands and Minds<sup>a</sup> project.

- This work contributes to the project by describing nitrogen (N) and phosphorus (P) nutrient flows, balances, and nutrient use efficiencies (NUE) of small-scale crop-livestock farms in Ratanakiri.
- We initially hypothesised that NUE differ among farm systems, where more diverse farms have lower NUE and less diverse farms have higher NUE. Diversity refers here to the on-farm number of crop and animal varieties.

## Conclusions

We rejected our hypothesis as:

- Farm and cassava field N and P budgets indicated nutrient mining for all studied farms with one exception.
- These N and P budgets influence the NUE to be high independently of the farm diversity.

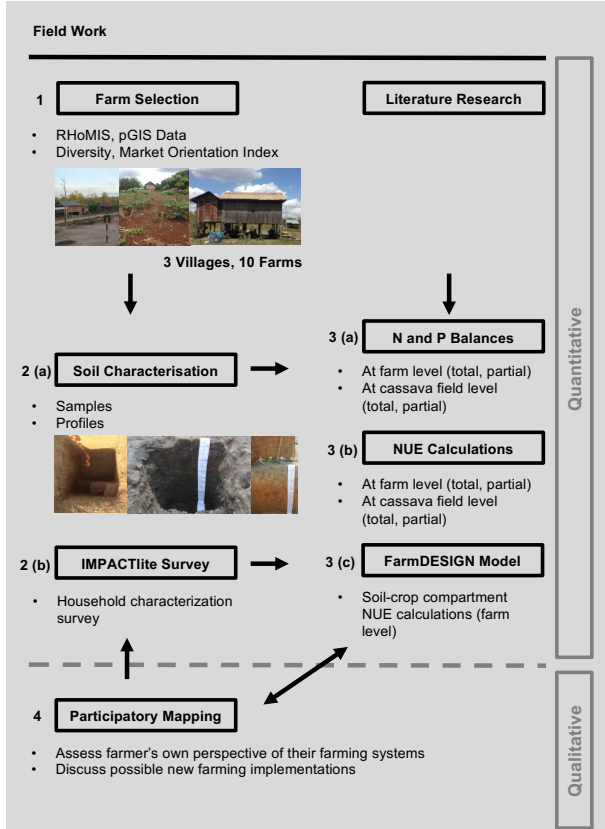
However, following conclusions were established:

- Symbiotically fixed legume N was the main N source, whereas there was no farmer driven P input.
- Crop sales and crop residue incineration accounted for the main N and P output.

- Erosion results in high N and P losses depending on plot location.
- Farm management plays a major role in farm NUE, which could also be confirmed by calculations specifically to the cassava field level.

- The major challenge resides in adjusting the P inputs to produce a favourable P budget.
- Socio-economic and cultural concerns play an important role in the farmer's daily business.

## Methods



## Results

### Farm Nutrient Use Efficiency and Nutrient Budgets

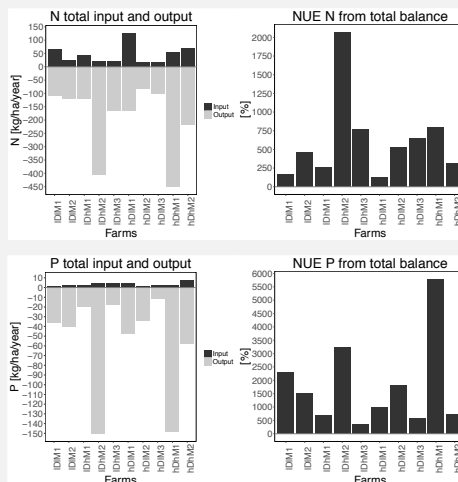


Figure 1: N and P NUE and budget calculated at farm system level. "Total Balance" hereby refers to the considered in- and output in the calculations referring to the method proposed by Stoorvogel et al. 1991<sup>b</sup>.

Farms are divided in four typologies IDIM, IDhM, hDIM and hDhM where I stands for Low, h for High, whereas D for Diversity, and M for market orientation. NUE is defined as the output divided by the input expressed in percentage.

Very high N and P NUE were mainly due to high erosion output assumptions. NUE range differences between N and P NUE were caused by higher P output proportions: there were no farmer driven P inputs whereas legume crop cultivation influenced N balances positively.

### Soil Properties

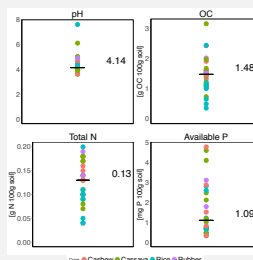


Figure 2: Available P (Bray II), total N (Kjeldahl), Organic C (Walkley Black) and pH under cashew (n=7), cassava (n=10), rice (n=8) and rubber (n=2). All data points are shown except the outliers for available P=9.98 and 19.95, and pH= 0.76. Median values are shown. The soil study point to low to very low available phosphorus, and low total nitrogen, low pH and medium organic carbon values. Soil characteristics were in the same range under all planted crops and values typically spread over the entire range for a given crop. There were no significant trends for a specific crop.

## References

<sup>a</sup> Hands and Minds connected to boost Eco-efficiency on Smallholder Livestock-Crop Systems: Participatory approaches towards eco-efficient livestock-crop systems for smallholder farmers in Laos, Cambodia, and Vietnam b Stoorvogel, J. and Smaling, E. (1990). Assessment of soil nutrient depletion in Sub-Saharan Africa: 1983-2000. Technical report, The Winand Staring Centre. Report 28, 4 Volume; Volume 1, Wageningen (The Netherlands).

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