# ETH zürich **SCIAT**

## **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-andburn 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 ecoefficiency 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 hypnotised 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**

**Methods** 

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.

#### Field Work Farm Nutrient Use Efficiency and Nutrient Budgets NUE N from total balance N total input and output Farm Selection Literature Research 1 RHoMIS, pGIS Data Diversity, Market Orientation Index Input 🔗 al. 1991<sup>b</sup> Di Itis gen m IDIM1 IDIM2 IDIM2 IDIM1 IDIM3 IDIM3 IDIM3 IDIM3 IDIM3 IDIM3 IDIM3 IDIM3 IDIM2 IDM1 IDM1 IDM2 IDM3 IDM3 hDIM2 hDM2 hDM3 hDM3 hDM3 hDM3 3 Villages, 10 Farms DIM P total input and output NUE P from total balance Quantitative N and P Balances 3 (a) 2 (a) Soil Characterisation At farm level (total, partial) P [kg/ha/year] -40 -50 -60 -70 -80 -90 -100 -110 -120 Samples Profiles (total, partial) Input S : NUE Calculations 3 (b) At farm level (total, partial) At cassava field level IDhM2 IDhM3 hDIM1 hDIM2 hDIM2 hDIM3 hDM1 hDM2 IDIM1 IDIM2 IDIM2 IDhM1 IDhM3 hDIM3 hDIM1 hDIM2 hDIM3 hDIM3 hDM2 hDM2 1 MIDIM2 (total, partial) 3 (c) FarmDESIGN Model IMPACTIite Survey 2 (b) **Soil Properties** Soil-crop compartment Household characterization NUE calculations (farm 4 14 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 level) 1.48 1 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 Participatory Mapping 4 Qualitative 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 0.13 ទ្រួ Assess farmer's own perspective of their farming systems Discuss possible new farming implementations 1 trends for a specific crop. 1.0 1

Results

#### References

a 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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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

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.