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Transition from monoculture to agroforestry: Improving soil conditions and phytodiversity for sustainable land use and livelihood security in the mid-hills of Nepal

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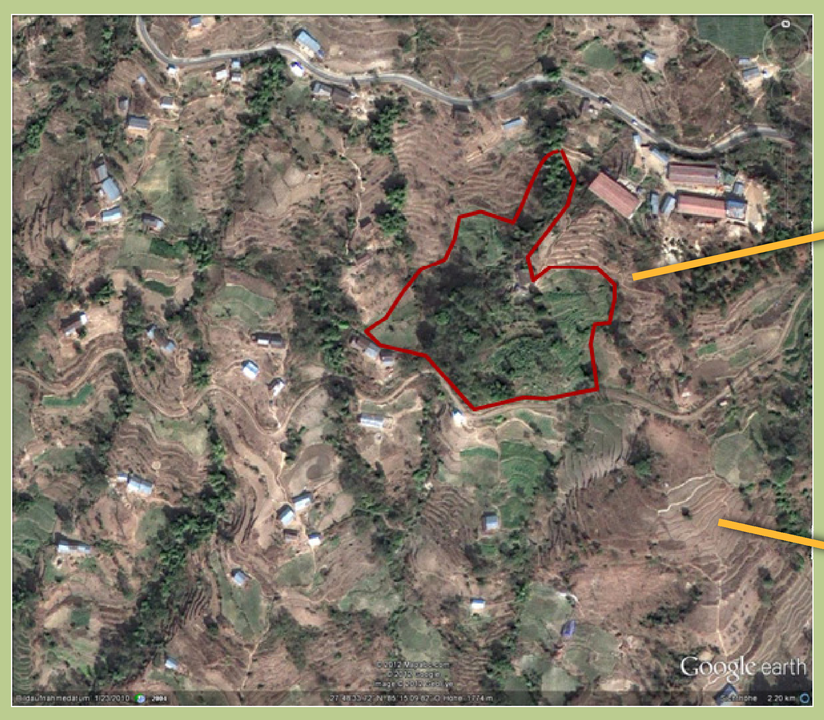
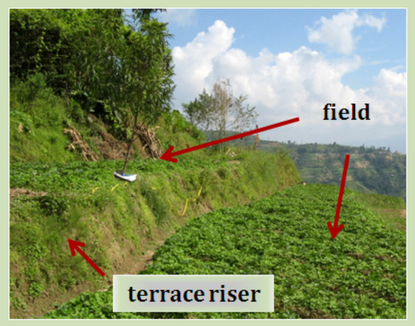


Agroforestry (AF) land (red line) surrounded by conventional crop rotating system. AF land has been established by one farmer for 15 years.

Material

- Study area: Mid-Hills of Nepal, village 'Kaule', 15km NW of Kathmandu, 1850m a.s.l.
- Soil and vegetation sampling
- 3 agroecosystems:
  1) Agroforestry-System (AF), mature, 15 years established
  2) System in transition to AF, conversion for 2 years
  3) Conventional (crop rotation) system

- Soil sampling: separate sampling of fields and terrace risers



Questions:

Agroforestry system *vs.* Conventional crop rotation system

1) Differences in **soil properties**?

2) Differences in **phytodiversity**?

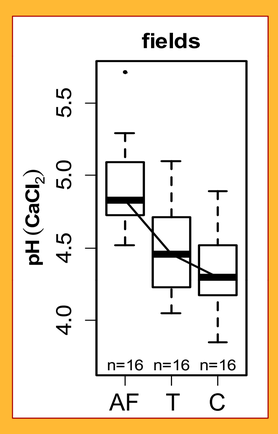
Methods - Soil

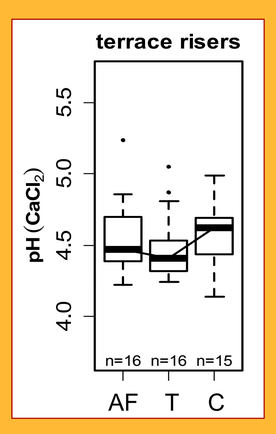
Soil sampling: - Field samples and terrace riser samples, 32 samples each system (n=96)
- At the lab: analyses for soil samples' main parameters
→ Comparison: ANOVA, Kruskal-Wallis test

Methods - Vegetation

Vegetation sampling: - Crop, tree & shrub layer, 8 plots each system (=24 plots), abundance & cover
- Comparison of species richness (Kruskal-Wallis test)
- Alpha-diversity: ${}^{q}D_{\alpha}$ –diversity measure, weighting for abundance and for dominant species (Jost 2007)

Results - Soil





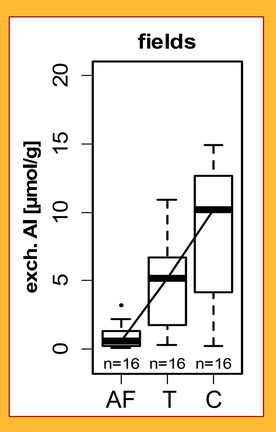
pH and exch. aluminum content:

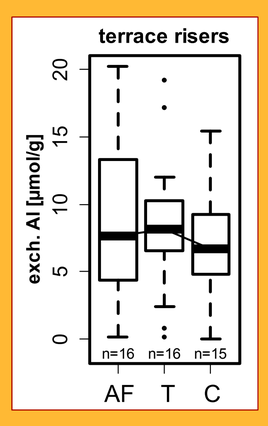
terrace fields
contrasting management practices

→ significant differences:
AF ↔ conventional system

terrace risers
not intentionally managed

→ no significant differences between both ecosystems

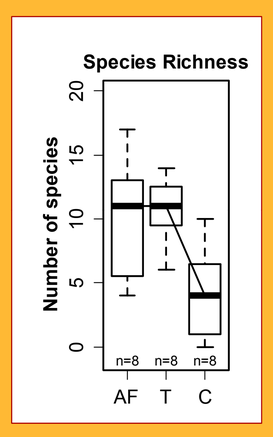




AF: **a**groforestry **s**ystem
T: **t**ransition to AF system
C: **c**onventional crop rotation

Likewise significant differences in:
total C, total N, SOM, electric conductivity, base saturation, exchangeable cations

Results - Vegetation



AF: **a**groforestry **s**ystem
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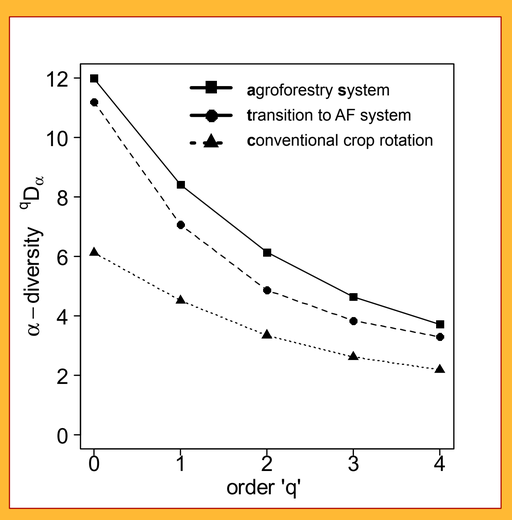
species richness:

- Significant higher number of species in both agroforestry and transition land compared to conventional land use system
- 3 most common species:
Ficus neriifolia, *Buddleja asiatica*, *Alnus nepalensis*

alpha- (α-) diversity:

- Order 0: ≙ species richness
- Order 1: abundance weighted
- Order > 1: dominance weighted



Discussion – Soil:

- Although the transition process to agroforestry has been in progress for only 2 years in 'T' (transition land), soil parameters already reflect the shift to restoring farm soil fertility.
- Terrace risers' soil parameters are not correlated with management → validation of management's influence on the fields' soil conditions.

Discussion – Vegetation:

- Species richness of agroforestry lands' tree and shrub layers is higher compared to conventional lands'.
  → AF: highest alpha-diversity
  → Transition land: alpha-diversity resembles AF-system
  → Dominance-weighting reduces differences between the three agrosystems.

Conclusion: Population growth results in intensified land use in developing countries' mountain areas, which is the case for the Mid-Hills of Nepal. Poor nutrient conditions and susceptibility to erosion characterize the region's prevalent soils. These are influenced highly by management as the results show. Agroforestry systems offer farmers and their families an alternative to traditional farming that can be advantageous in terms of productivity, biodiversity, and ecosystem based services provided.

Reference: Jost, L. (2007): Partitioning diversity into independent alpha and beta components. Ecology 88, 10: 2427–2439; Acknowledgements: Nirmala Joshi (MSc., plant identification), Dr. Elke Fischer (lab management, soil analyses support).

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