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Humans as a soil-forming factor in mountain ecosystems – effects of land use legacies on functional properties of mountain soils

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Herders with their cattle utilize mountain ecosystems for millenia

Geomorphology 13 (1995) 233–253

The cow as a geomorphic agent — A critical review

Stanley W. Trimble, Alexandra C. Mendel
Department of Geography, University of California, Los Angeles, USA

Received 13 January 1995; revised 30 March 1995; accepted 6 April 1995

Herders are frequently using fire as a tool

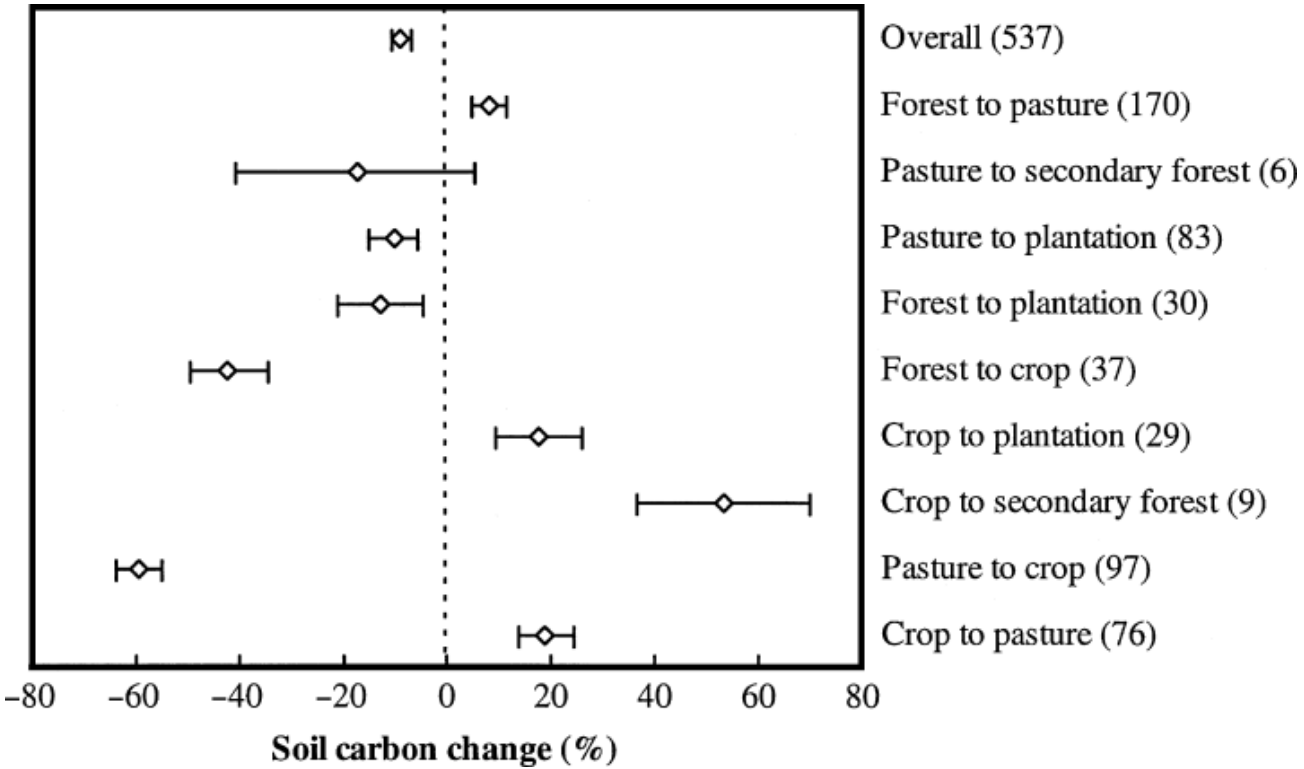
Mountain farmers ‘shape’ mountain ecosystems

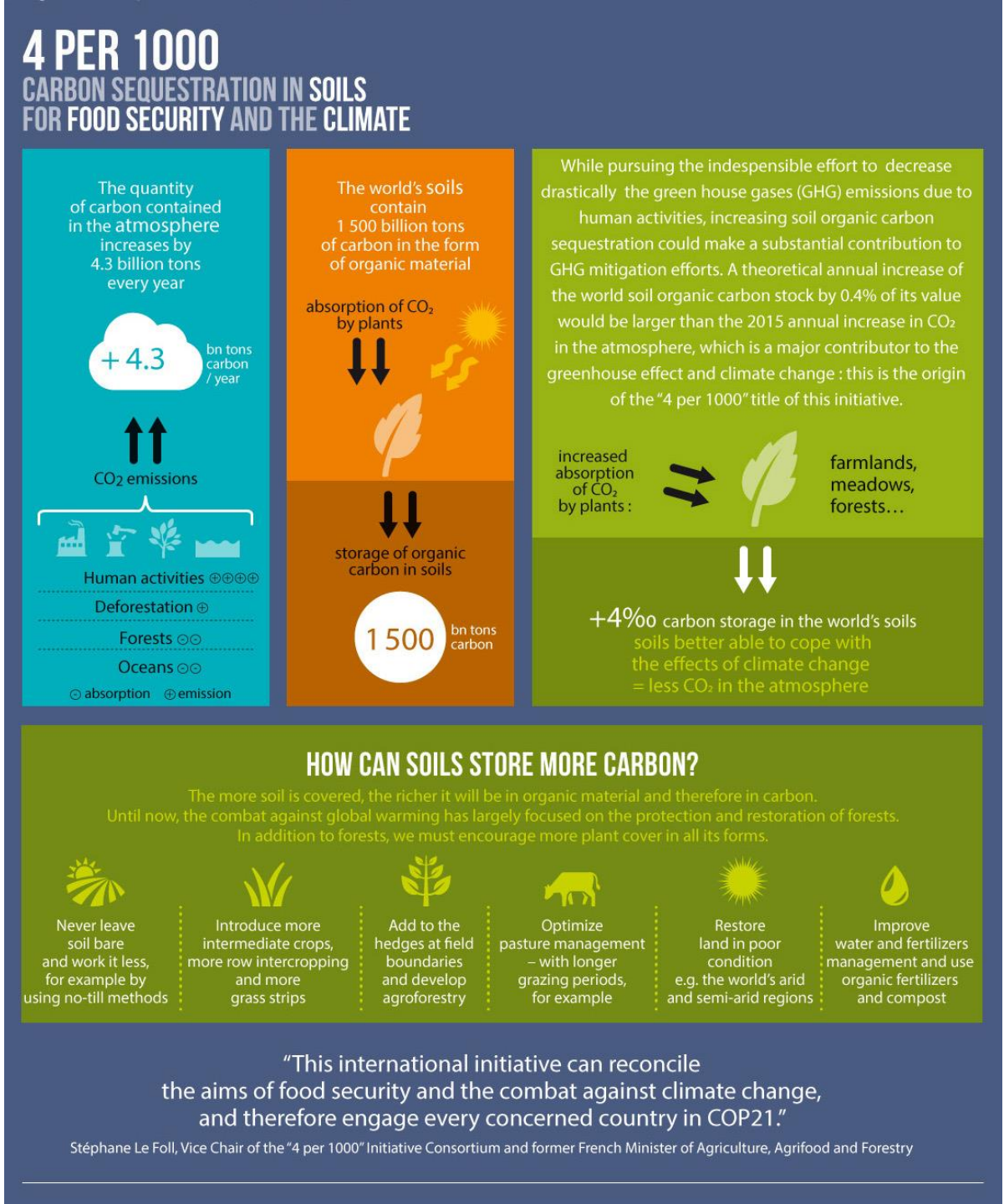
To what extent does that affect properties and functions of mountain soils, e.g carbon sequestration potential?

Global Change Biology

Soil carbon stocks and land use change: a meta analysis

L. B. Guo, R. M. Gifford



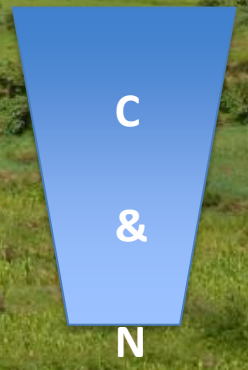


Land use by hill farming communities in the Ethiopian highlands
Conversion of forest to cropland and grazing land may lead to severe soil degradation

Topsoil (0-15 cm) carbon and nitrogen pools reflect the disturbance gradient

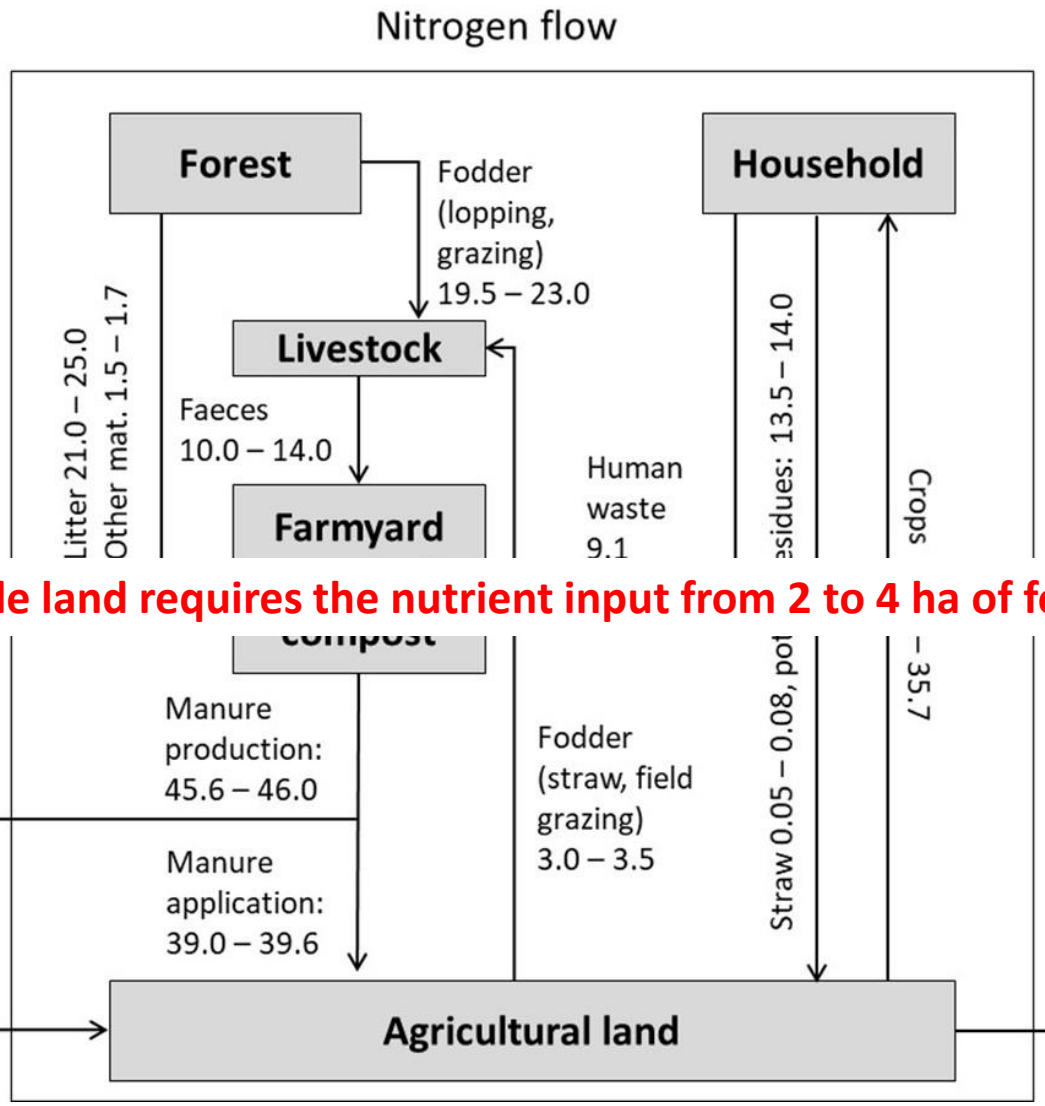
(example from two case study areas, Feyisa Beyene 2012)

	C [Mg ha^{-1}]	N [Mg ha^{-1}]
Church forest (primary forest)	65	5.3
Community forest (reforested)	32 - 61	2.8 - 4.9
Grazing land	33 - 45	3.1 - 4.0
Agriculture	24 - 38	2.2 - 3.3



Hill farming in Nepal: Mountain farmers have developed **sophisticated nutrient management methods**

…including ‚tapping‘ resources from neighboring (forest) systems



1 ha of arable land requires the nutrient input from 2 to 4 ha of forest land

Litter is used as a bedding for cattle and the compost is applied to fields

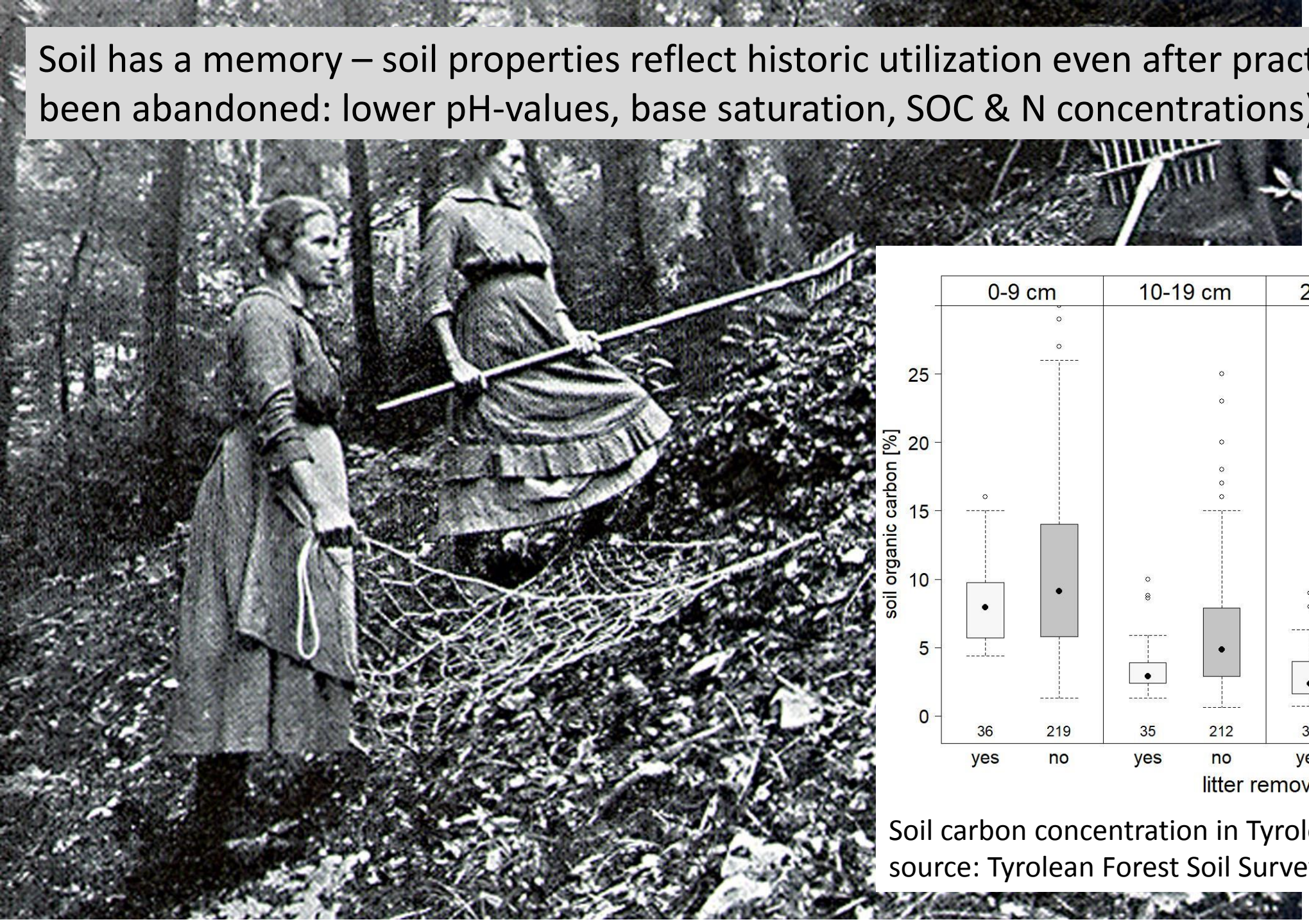
Nutrient flows in two communities in the buffer zone of Sagarmatha National Park, Nepal (Giri & Katzensteiner, 2013)

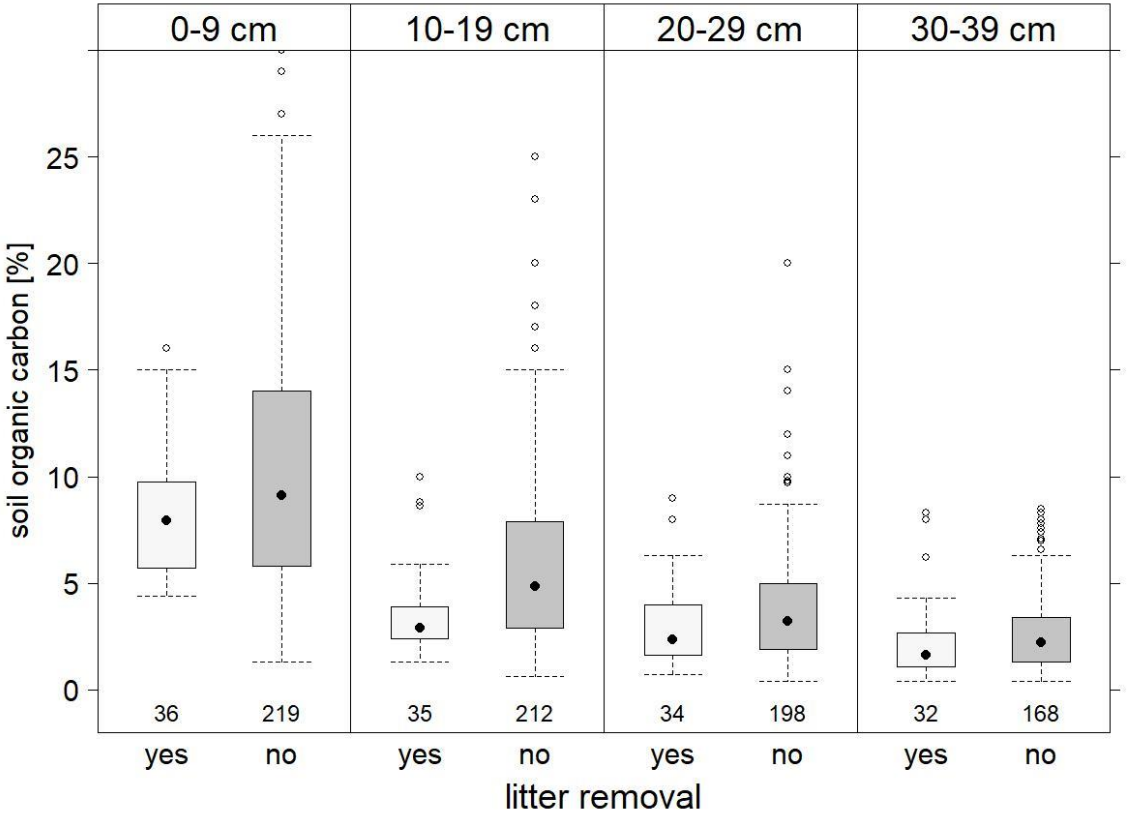
Soil carbon and nutrient pools (0-70 cm) in arable soils are equal or higher than those in degraded forests *(examples from Giri A. 2011)*

	C [Mg ha^{-1}]	N [Mg ha^{-1}]
Less disturbed forest (only grazing)	135 - 149	8.0 - 9.1
Disturbed forest (litter raking & grazing & lopping)	114 -127	6.6 - 7.6
Arable land	123 - 133	9.4 - 10.3

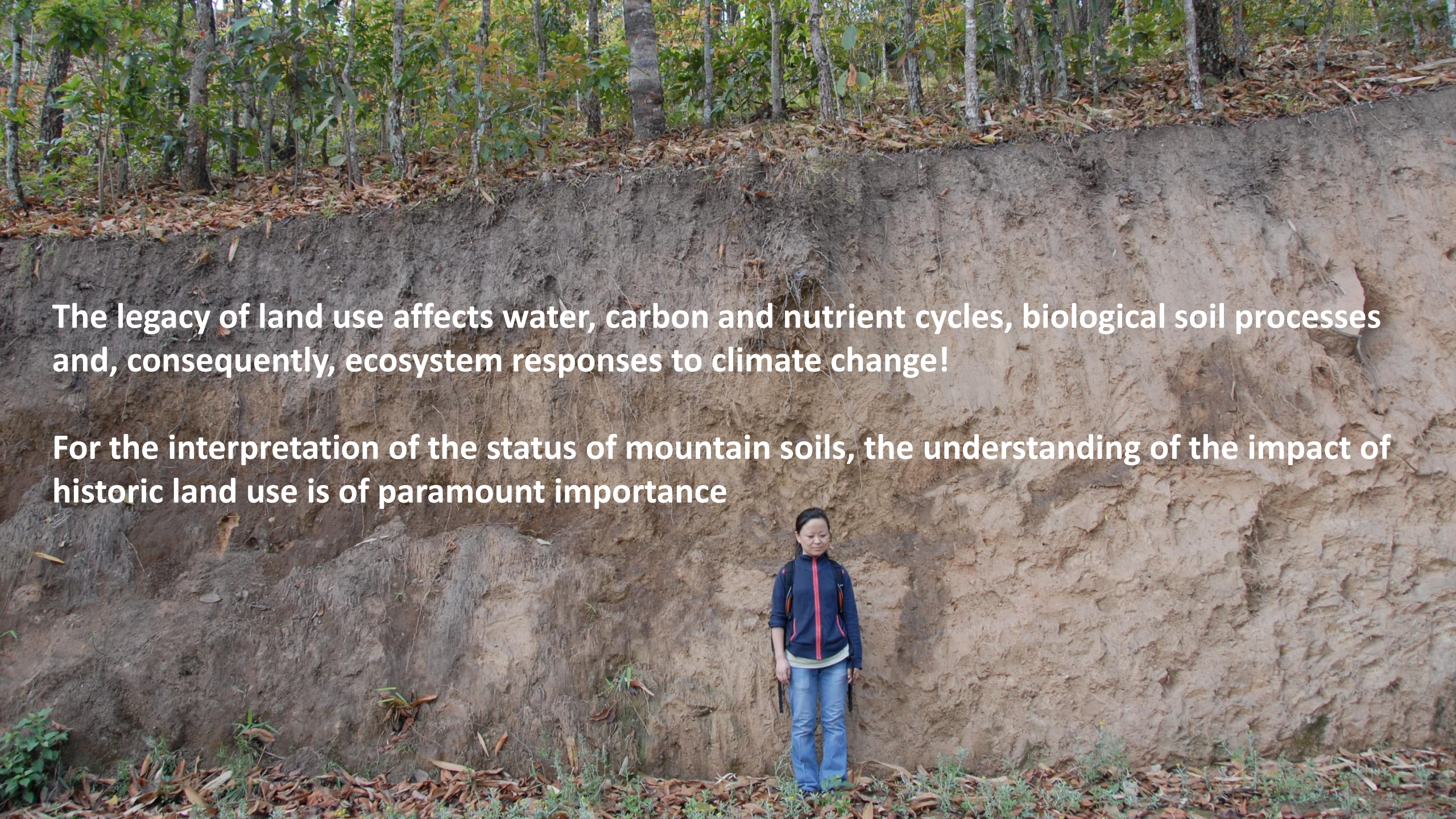
Soil has a memory
A 200yr old mixed coniferous forest in the Austrian Alps (site Purgstall)
subcutaneous karst indicating previous soil coverage
Where is the soil?
indicator species for nitrogen enrichment
remnants of a cowshed

Soil has a memory – soil properties reflect historic utilization even after practices have long been abandoned: lower pH-values, base saturation, SOC & N concentrations)





Soil carbon concentration in Tyrolean forest soils (data source: Tyrolean Forest Soil Survey 1988, prep. Simon A.)



The legacy of land use affects water, carbon and nutrient cycles, biological soil processes and, consequently, ecosystem responses to climate change!

For the interpretation of the status of mountain soils, the understanding of the impact of historic land use is of paramount importance

a **BOKU CO_2 offsetting system project**

If you feel flight shame … compensate

Carbon offsetting as an opportunity for sustainable rural development in Nepal 2016-2036