SHERPA = Soil Health Evaluation, Rating Protocol and Assessment

Supporting Information II
(Tables for data bases used and additional results)

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Table S2.1: Overview of degradation processes considered in Part 1 depending on land use (x = data included in evaluation, na = data not available, nr = process not relevant)

Soil degradation process	Arable	Grassland	Forest
Soil erosion			
water	x	x	x
wind	x	na	nr
tillage	x	nr	nr
harvesting	x	nr	nr
Land slides	x	x	x
Heavy metals	x	x	x
Nitrogen surplus	x	x	x
Phosphorus surplus	x	x	nr
Phosphorus mining	x	na	nr
Pesticide input	x	x	nr
salinization	x	x	nr
compaction	x	x	na
Loss of SOC	x	x	na

Table S2.2: Reference data sets used for the calculation of SHERPA scores part 1.

Part1_dataset	Spatial Resolution	Reference	Data_downloaded
Soil erosion by water (Forest and grassland)	100m	(Panagos et al., 2015)	Yes
Soil erosion all* (cropland)	100m	(Borrelli et al., 2023)	Yes
Land slide density	1 km	(Hollis et al., 2022)	Yes
Copper	500m	(Ballabio et al., 2018)	Yes
Mercury	250m	(Ballabio et al., 2021)	Yes
Zinc	250m	(Van Eynde et al., 2023)	Yes
Cadmium	250m	(Ballabio et al., 2024)	Yes
Nickle	1 km	(Tóth et al., 2016)	Yes
Lead	1km	(Tóth et al., 2016)	Yes
Antimony	1 km	(Tóth et al., 2016)	Yes
Arsenic	250m	(Fendrich et al., 2024)	Yes
Chromium	1 km	(Tóth et al., 2016)	Yes
Cobalt	1 km	(Tóth et al., 2016)	Yes
Nitrogen Surplus	10 km	(Batool et al., 2022)	Yes
Phosphorus excess and deficiency	1 km	(Muntwyler et al., 2024)	Yes
Pesticide	10 km	(Tang et al., 2021)	Yes
Salinization	Point scale	Lucas data (Orgiazzi et al., 2018)	Yes
SOC loss	500 m	(De Rosa et al., 2024)	Yes
Bulk density	100 m	(Panagos et al., 2024)	Yes
Soil texture	500 m	(Ballabio et al., 2016)	Yes

*all means water erosion, wind erosion, Tillage erosion, and Soil loss by harvesting root crops

Table S2.3: Data sets used for SHERPA Part2

Part2_dataset	Spatial Resolution	Reference
Climate classes	1km	(Beck et al., 2018)
Lithology data*	250m	(Isik et al., 2024)
Elevation	90m	(Neteler et al., 2022)
Land use maps (1992-2022)	300m	(Copernicus Climate Change Service, 2019)
Fraction Vegetation cover	300m	(Baret et al., 2016)
Fertilizer data	10 km	(Tian et al., 2022)

*Lithology data only used for those locations where the measured data was missing.

Table S2.4: Assignment of specific geological bedrock of the ICP Forest data to geological classes used in SHERPA Part 2, forests (table 2.1.1.1. to table 2.1.2.). The dataset includes a total of 280 sites, of which lithology data for 36 sites were missing. These missing values were supplemented using the lithology map from Isik et al. (2024). The * symbol indicates classes derived from the lithology map.

Calcareous bedrock or siliceous bedrock containing carbonates or siliceous base rich below 1400 m altitude	**Siliceous medium base content (e.g. Granite) below 1400 m altitude**	**Sand content to be expected > 85%, altitude above 1400 m**
Calcschist, skam	Granite	Eolian sands
Marl	Micaschist	Quartzite schist
Loamy loess	Granodiorite	Pre-quaternary sand
Siltstone	Clayey sandstone	Fluvial sands and gravels
Quaternary clay and silt	Glaciofluvial deposits	Sandstone
Limestone	Glacial till	(Meta-)Quartzite
Basalt	Quaternary clay and silt	Cover sand
Loess	Sandy loess	River terrace gravel
Calcareous rocks	Morainic deposits	Outwash sand, glacial sand
Marlstone	Gneiss	Quaternary sand
Hard limestone	Rhyolite	Quartzitic sandstone / orthoquartzite
Clayey and silty flysch	Phyllite	River terrace sand
River clay and silt	Eolian deposits	Floodplain sand
Residual clay	Pumice	Sandy flisch
Clayey loam	Acid regional metamorphic rocks	River terrace sand or gravel
Stony clay	Talus scree	Floodplain sand or gravel
Claystone / mudstone	Glacial debris	
Dolomite	Colluvial deposit	
Diabase	Molasse	
Gabbro	Andesite	
*Impure Carbonate Sedimentary Rock	Flysch	
*Marble	Glaciolacustrine deposits	
	Unconsolidated deposits (Alluvium, Weathering Residuum and Slope Dep osits)	
	Consolidated- Clastic- Sedimentary Rocks	
	Residual and redeposited loams from silicate rocks	
	Unconsolidated glacial deposits / Gla cial drift	
	Metamorphic rocks	
	Acid to intermediate volcanic rocks	
	*Gravel	
	*Migmatite	
	*Shale	
	*Granitoid	
	*Conglomerate	
	*Orthogneiss	
	*Clasticsedimentarymaterial	
	*Slate	
	*Clastic sediment	

Additional Results:

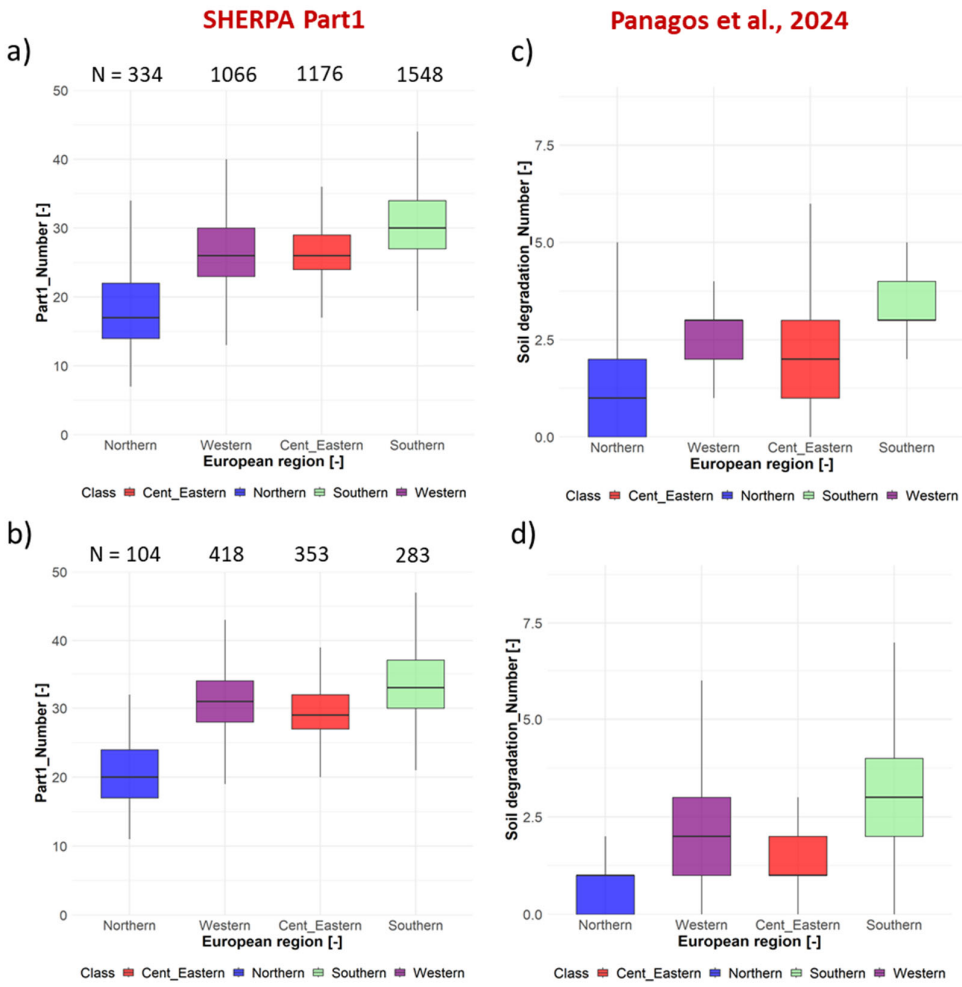

Figure S2.1: Comparison of the SHERPA Part 1 score with soil degradation values from Panagos et al. (2024) for (a) and (c) cropland, and (b) and (d) grassland. The Part 1 score exhibits a similar pattern to the results of Panagos et al. (2024). Note that the soil degradation number in Panagos et al. (2024) represents only the number of degradation processes occurring at each site, but no quantitative assessment. Additionally, the number of samples in Part 1 is higher than the final count presented in the manuscript, as the final count includes only those sites where data from both parts are available for calculating the final SHERPA score.

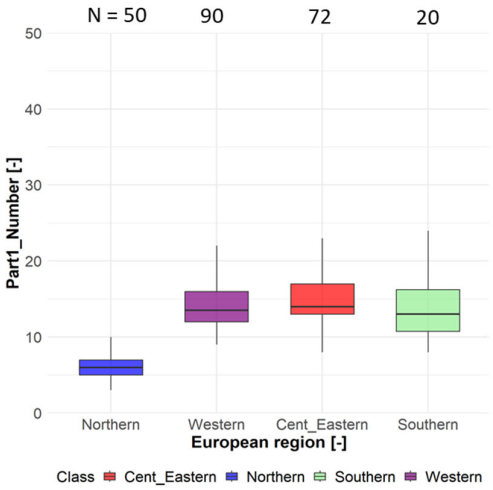

Figure S2.2: Comparison of the SHERPA Part 1 score for LULC forest.

Figure S2.3. Grassland disturbance in spite of 100% vegetation cover due to overexploitation and overfertilization. Dense cover of Rumex spec. and Epilobium spec. around Alp Piora in the Ticino.

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