



# Interdisciplinary research in Critical Zone studies: Integrating socio-economic and natural data to assess the effect of LUC in the Italian Alps

Lisa Sella<sup>1</sup>, Francesca Silvia Rota<sup>1,6</sup>, Elena Ragazzi<sup>1</sup>, Andrea Scartazza<sup>2</sup>, Maria Adamo<sup>3</sup>, Ilaria Baneschi<sup>4</sup>, Olga Gavrichkova<sup>2</sup>, Michael Maerker<sup>5</sup>, Chiara Richiardi<sup>3</sup>, Valentina Rossi<sup>4</sup>, Matteo Salvadori<sup>4</sup>, Saverio Vicario<sup>3</sup>, Maddalena Pennisi<sup>4</sup>

<sup>1</sup>Research Institute on Sustainable Economic Growth (IRCRES-CNR); <sup>2</sup>Research Institute on Terrestrial Ecosystems (CNR-IRET); <sup>3</sup>Institute of Atmospheric Pollution Research (IIA-CNR); <sup>4</sup>Institute of Geosciences and Earth Resources (IGG-CNR); <sup>5</sup>Department of Earth and Environmental Sciences, University of Pavia; <sup>6</sup>Department of Economics and Statistics, University of Torino

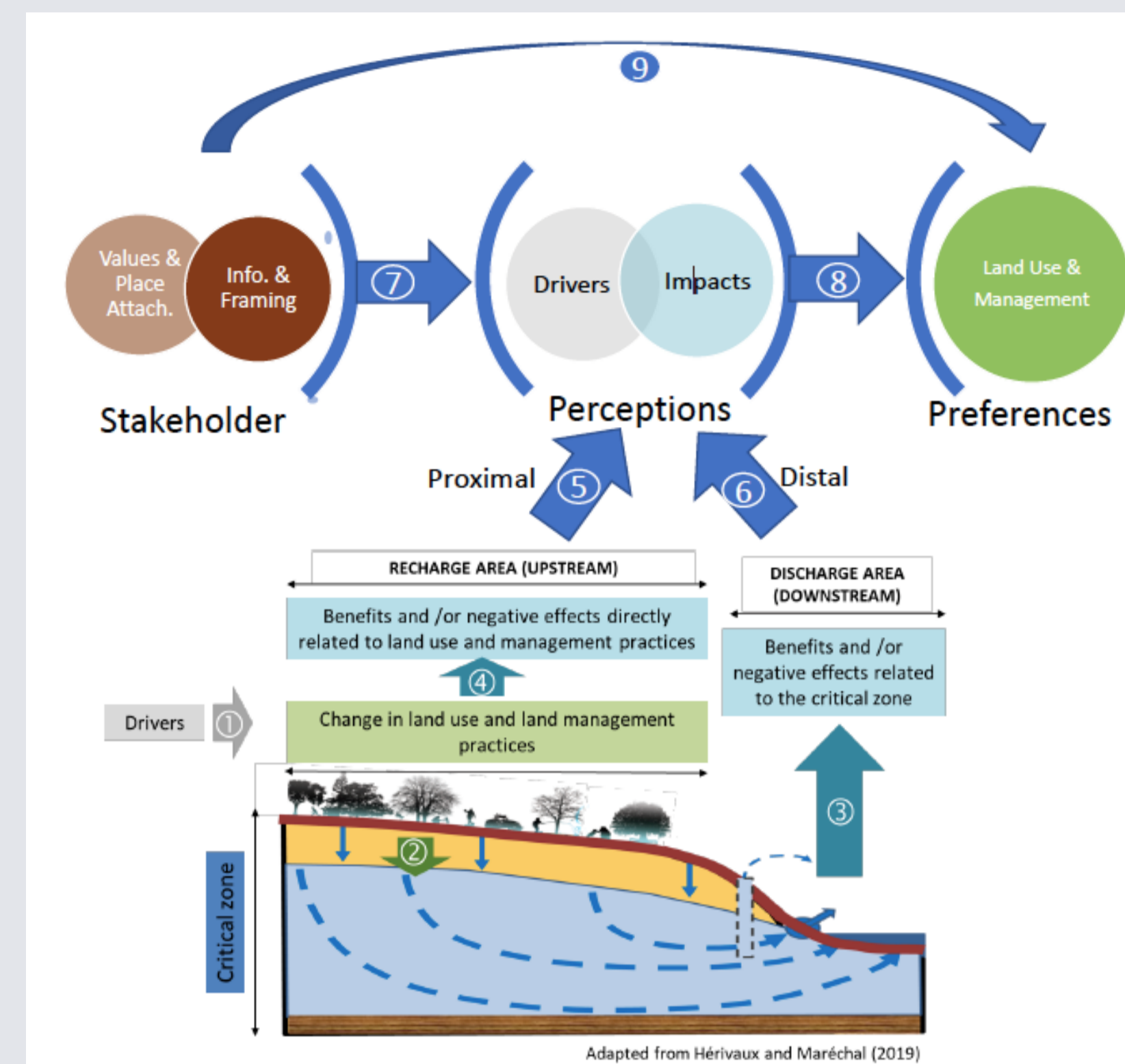


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Image credit: After Chorover et al., 2007. Catalina-Jemez CZO (artwork by R. Kindlmann).

## Context

The stable presence of humans in the Alps dates back to the Bronze Age and peaked in the mid-19th century, deeply shaping the landscape and allowing the co-evolution of numerous plant and animal species. Since the 1950s, socio-economic changes have led to the gradual depopulation of mountain areas, and the consequent abandonment of traditional agro-pastoral activities (Deskalova and Kamp, 2023). The rupture of the long-established balance between man and nature has triggered a process of transition, further exacerbated and accelerated by climate change (ABRESO Team, 2022). The land use and land cover change occurring due to land abandonment can have profound implications in the CZ, modifying bio-geo-chemical processes such as soil formation, carbon sequestration, storage of fresh groundwater, and stream flow generation that support the local ecosystems and provide a variety of products and services to humans.



## Overview

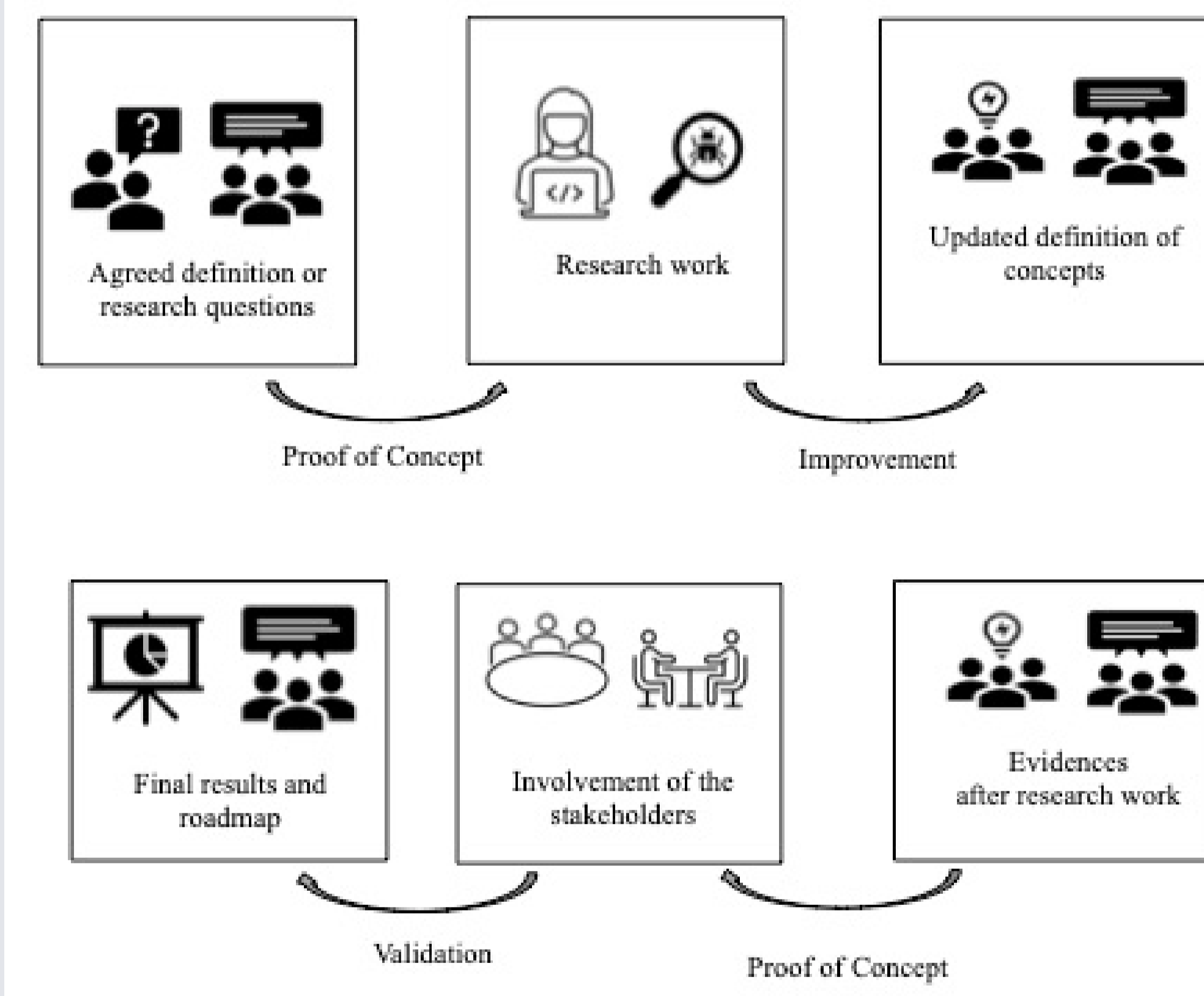
The Belmont Forum project ABRESO (*Abandonment and rebound: Societal views on landscape and land-use change and their impacts on water and soils*) aims at integrating the social sciences and the natural sciences and perspectives, co-constructing an inter-disciplinary approach (Stock & Burton, 2011).



The ABRESO project started in 2021, involving an international partnership that includes five countries: the United States, France, Italy, Japan and Taiwan. Italy participates with three case study sites: Noaschetta, in the Gran Paradiso National Park; Val Grande, in the homonymous national park; and Pieve Tesino site. These sites are characterized by different environmental and demographic features and are affected by different processes of abandonment (and rebound) of traditional agro-sylvo-pastoral activities.

## The interdisciplinary approach

Inter-disciplinarity is pursued via a co-creation process to define common research questions and methodologies. Time series of environmental essential variables from Earth Observation (EO) data, such as Snow Cover Duration (SCD), Land Cover Change (LCC) and Gross Primary Productivity (GPP) maps will be provided for each study area of the project. The EO data will upscale and will be validated against *in situ* measurements, including plant biodiversity and carbon and nitrogen isotopes in soil and plants. The observed environmental processes will be compared with the perceptions of the stakeholders, who determine the local land management practices and policies. Their preferences for land use will be assessed.



## Goal

The combination of information derived from the natural and the social sciences will help policy makers identify the best spatial management strategies and policies within the different Alpine scenarios. Moreover, the active involvement of the stakeholders will be the basis for future trans-disciplinary research (Chien *et al.*, 2021). Consistent with the literature, in fact, to address a process that exerts crucial impacts on the sustainable development of human communities, livestock and wildlife, there is the need to involve stakeholders in the research processes and implement the results as part of the process itself.

## References

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Chien, H., Phan, L. T., Joo, S. (2021). *Social Science Approaches to Critical Zone Studies: A Review*. Paper presented at the 3rd ESP Asia Conference, Online/Nagasaki, Japan, 14-17 Dec. 2021.  
Daskalova, G. N., Kamp, J. (2023). Abandoning land transforms biodiversity. *Science*, 380(6645), 581-583.  
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**OBSERVED**

- Essential variables extracted from remotely sensed time series
- Land Cover Change (2016, 2021)
- Snow Cover Duration (SCD 2020/2021 (Days): 365 to 0)
- Grazing pressure and chlorophyll (N-CAR2 / MSA02 (chlorophyll / total pigments) vs Snow free period)
- Forest ↔ Pasture Transition (Majla Telvagola)
- Plant functional biodiversity (Leaf N concentration, Leaf δ<sup>15</sup>N, Leaf δ<sup>13</sup>C)
- Soil Carbon & Nitrogen concentration (C (%), N (%), Soil depth 10-20 cm)

**PERCEIVED**

- Field surveys to collect ground truth data
- Do citizens and stakeholders acknowledge the real changes in land cover? What are their perceptions?
- Are stakeholders and shepherds aware of the effects of grazing on biodiversity and pasture productivity?
- Are shepherds aware of land cover effects on the grazing season? On forage quality? On water availability?
- How are vegetation dynamics and territorial forest management plans related?
- Do stakeholders acknowledge the real dynamics of Forest-Pasture transition?
- Past and expected LU change (Wild Forest, Productive Forest, Farm, Built)
- LU change preferences (A GREAT DEAL, A LOT, A MODERATE AMOUNT, SLIGHTLY, DO NOT PREFER)
- LU impact on CZ components (Air, Organisms, Soil, Water, Rock)

**TERRITORIAL AND LOCAL POLICIES**

- Surveys and cooperation with stakeholders
- Partners: PNGP, P. ValGrande, Club Alpino Italiano, UNCEM, Noasca, Castello Tesino, Pieve T., Cinte T., Cossogno