Investigating the Buffering Capacity of Mountain Communities to Socio-economic and Natural Shocks

Jorge Alberto Ramirez[1], Md Sarwar Hossain[1], Chinwe Ifejika Speranza[1], Olivia Martius[1], Tina Haisch[2], Heike Mayer[1], Margreth Keiler[1]

[1] University of Bern, Institute of Geography, Bern, Switzerland; *Email correspondence: jorge.ramirez@giub.unibe.ch; website: www.geomorphrisk.unibe.ch, www.risk-resilience.giub.unibe.ch

[2] University of Applied Sciences and Arts Northwestern Switzerland, School of Business, Institute for Nonprofit and Public Management, Basel, Switzerland

1. Background

Existing natural hazard research lacks interdisciplinary approaches that consider both natural and social shocks (Fig. 1).

Fig. 1 Mountain community shocks

Little is known about the resilience and recovery response of mountain communities to combined shocks (Fig. 2). Our study will address:

- What magnitude and frequency of shocks are buffered by mountain communities?
- Which shocks have a greater affect on mountain communities?

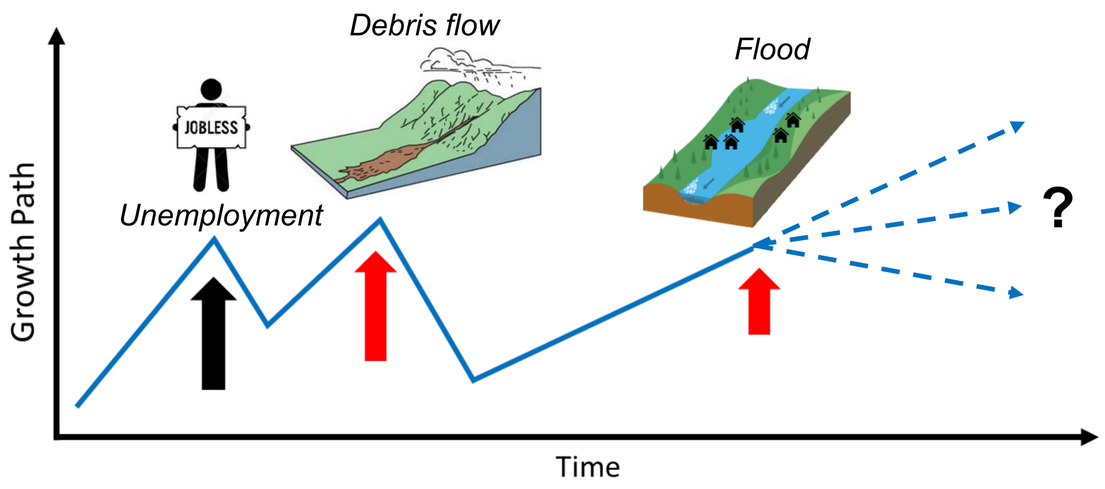

Fig. 2 Recovery trajectory of mountain communities exposed to shocks

2. Approach

The Risk and Resilience cluster brings together disciplines across the University of Bern Institute of Geography (Fig 3) to improve the understanding of risks and overcome the barriers to increasing resilience in mountain communities.

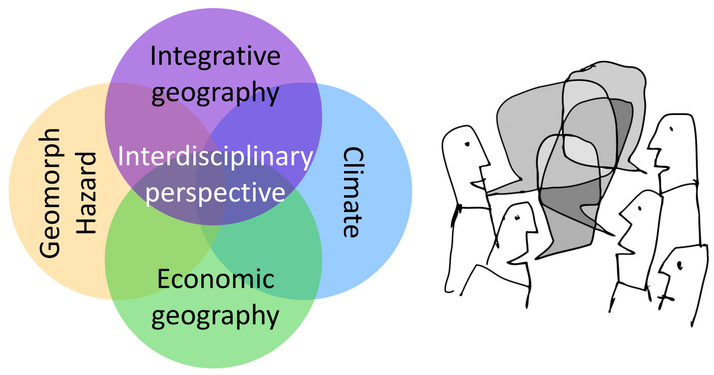

Fig. 3 Disciplines in the Risk and Resilience cluster

We adopted a modelling approach to develop a conceptual system model of a Mountain Community Coupled Human Landscape System (MC-CHLS). Our study focuses on the Swiss Alps where socio-economic dynamics occur at the community scale and natural hazards occur at the catchment scale and (Fig. 4).

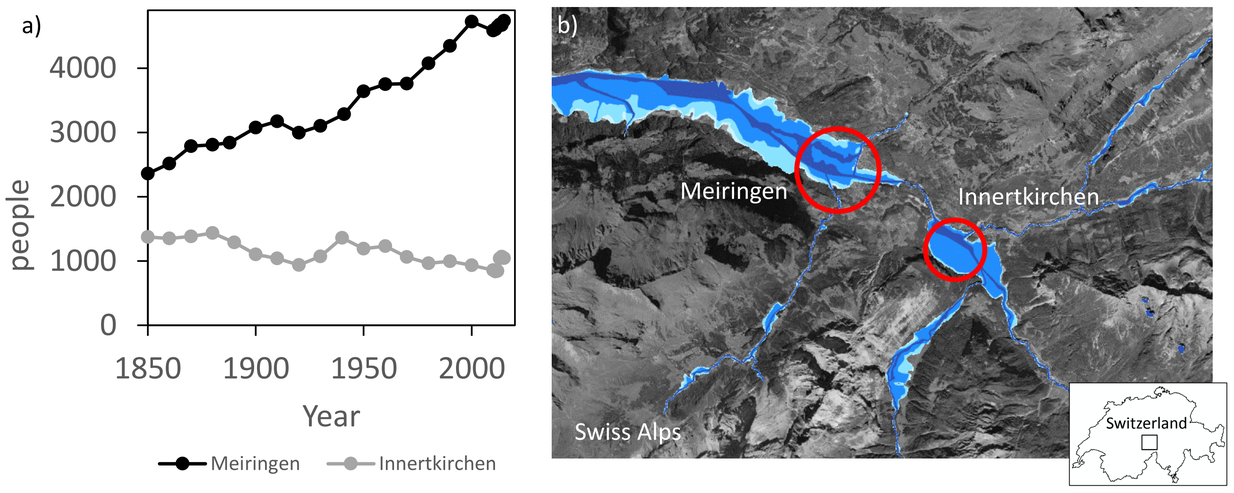

Fig 4. Swiss mountain community (a) population and (b) potential flood levels

3. Conceptual System Model

MC-CHLS consists of both physical and human components (Fig. 5) where:

- Employment, tax base, and political pressure is core to the human component
- Natural hazards (shocks) refer here to debris flows and floods
- Natural hazard mitigation includes land use and land cover change, protective measures and river restoration
- Feedbacks occur between human and landscape system (e.g. flood mitigation)

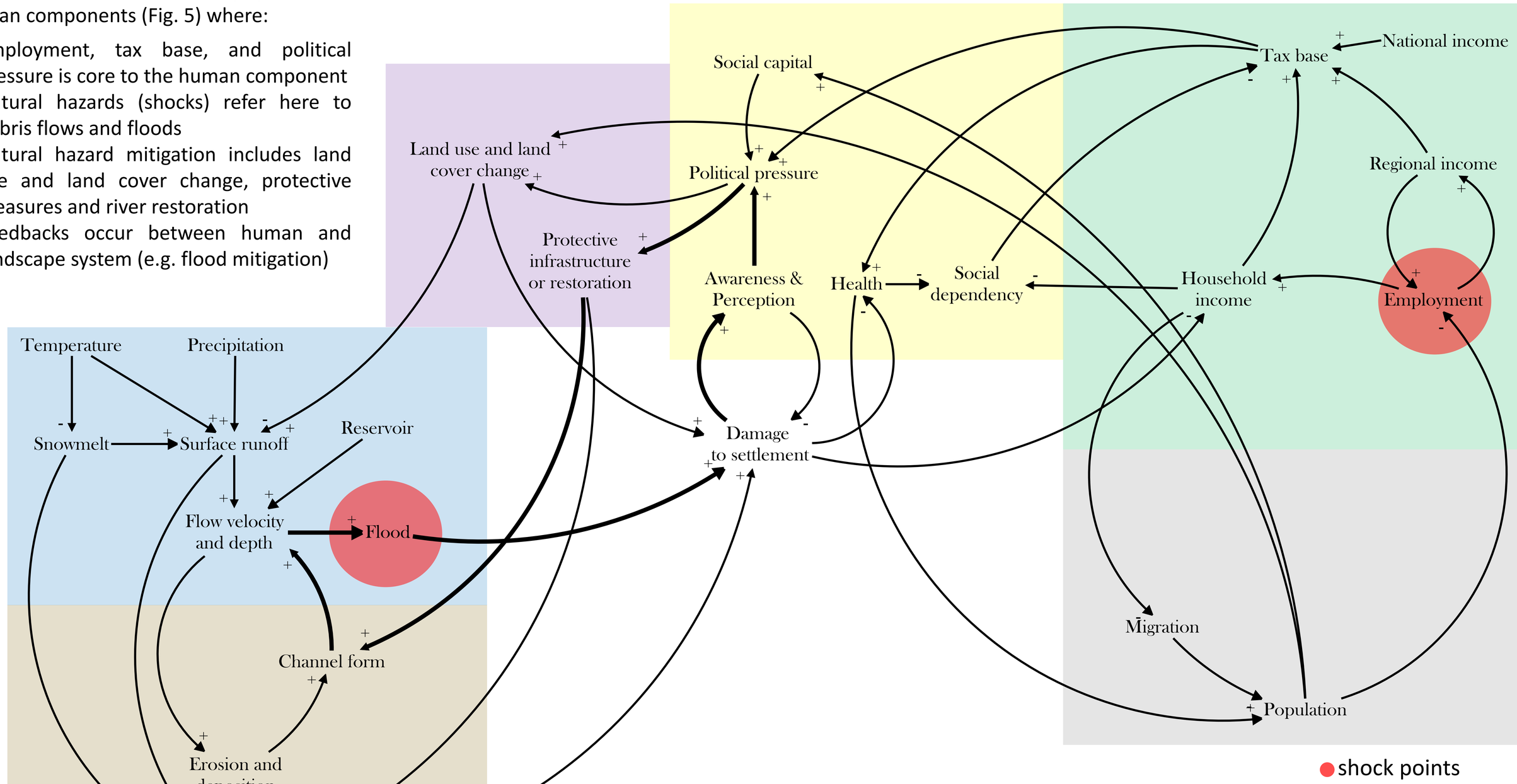

Figure 5. Schematic of MC-CHLS. Shading demarcates components that include geomorphology and hazard (brown), climate and hydrology (blue), land use land cover change (purple), social and institutions (yellow), economy (green), and demographics (grey). Flood mitigation feedback in bold. Positive polarity means two variables move in the same direction, while negative polarity implies movement in opposite directions

4. Discussion and next step

- Shock points are locations in MC-CHLS where the system can undergo a perturbation (e.g. unemployment or major flood)
- Variables from MC-CHLS can be combined to determine indicators of disaster resilience within communities (e.g. population, employment, and household income)
- MC-CHLS considers combined physical and socio-economic shocks and feedbacks between both physical and human systems
- MC-CHLS is generic and can be applied to most mountain communities
- Future work will focus on the realization of the MC-CHLS as a coupled computer model that includes a:
  - landscape evolution model to replicate floods, debris flows and landscape changes
  - system dynamics model replicating socio-economic interactions