

Submitted Abstract

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Abstract

Mountain regions provide multiple ecosystem services to human societies, such as water supply or landscape quality. At the same time, they are experiencing environmental and socioeconomic changes, which are impacting ecosystems, natural resources and local livelihoods.

This study applies a Social-Ecological System (SES) approach to the analysis of the upper Segre basin in the Southeastern Pyrenees, with the objective of obtaining an integrated view on its current functioning and interpreting the emerging patterns in terms of sustainability of the system. A total of 17 hydrological, biodiversity, climatic, land-use and remote sensing-derived environmental variables, and of 16 socio-economic variables from the study area, spanning from 2000 to 2020 were first analysed via the construction of 23 complementary path models using subsets of variables. The obtained models were then combined into an integrated social-ecological network depicting the relationships among all 33 variables.

Results indicate that the upper Segre basin SES greatly depends on the services sector # particularly tourism# as a factor of economic growth, at the expense of agriculture. Subsidies to the agricultural sector have a mild but positive effect on both farmer's salaries and productive cultivated land, but the lack of effect on occupation in this sector indicates subsidies alone have not been enough to promote employment in agriculture in the region. Snow and vegetation greenness are both factors of attraction for visitors, but the former seems to still have more importance for the economy, which may be problematic in the context of climate change. Therefore, diversifying the economy and opting for a less seasonal touristic model should improve the resilience of the system to future changes. Regarding biodiversity, both butterfly diversity and bird richness are negatively affected by roads and cultivated land, linked to habitat loss and fragmentation. Water resources are influenced both by precipitation and snow cover, as well as variables related to domestic consumption and irrigation. In the perspective of an increasingly water-consuming society and decreasing mountain water supplies, avoiding a mismatch between water demand and water availability will be crucial. Our study highlights the importance of having a holistic perspective when studying complex socio-ecological systems, as most socio-economic, environmental and biodiversity variables of our system are connected directly or indirectly to one another. In this context, quantitative analysis like ours become useful tools to better assess the direct and indirect effects among elements.