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The quinoa boom of the southern Bolivian Altiplano - linking geomorphology, erosion and spatial production patterns

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Quinoa (Chenopodium quinoa Willd.) is a native Andean crop that gained worldwide popularity over the last few decades due to its outstanding nutritional properties. The plant is characterized by an exceptional adaptation and is able to produce decent yields despite harsh environmental conditions like drought, frost, or soil salinity. Quinoa is thus an exceptional income opportunity in the arid southern Bolivian Altiplano, an area endemically struck by rural poverty and malnutrition.

In the early 1970s, the Bolivian government introduced the first tractors to southern Bolivia's Salar region with the intention to push agricultural development – with obvious success. The cultivation of quinoa is today the most important land use, with a continued increase in production volume and areal extent.

We here trace back land-use changes from 1972 to 2013 in one of the most important areas of quinoa production. Using Landsat images, SRTM elevations and field survey data, we investigate the relationship of field areas to erosion patterns and large-scale geomorphology.

The soils of the southern Bolivian Altiplano are highly susceptible to particle entrainment due to a loose and sandy substrate, strong winds, and rapid drainage during precipitation and snow melt events. It appears that many of the first quinoa fields were established on flood plain deposits, where good yields could be anticipated despite the apparent risk of erosion. The subsequent expansion of production areas was paralleled by an increase in field density. Locally, this implied a reduction of fallowing length and the incorporation of marginal lands. The almost complete removal of natural (i.e. protecting) vegetation over large and continuous areas, results in increased wind erosion and partial crop failure.

While production extended by approx. 1,6 % per year between 1985 and 2003, an average annual increase of 8,4 % could be observed for the last decade, when many new fields were established at lower elevations. While agricultural exploitation prior to 2003 was mainly restricted to quaternary alluvial deposit, the post-2003 expansion entered the flat shoreface topography of late Pleistocene Lake Tauca (18-14 ka BP; Placzek et al 2006) and hence a domain of increased soil salinity.

These recent developments pretty well illustrate southern Bolivia's "quinoa boom": an escalating, land-intensive production on marginal soils, characterized by high erosion rates and a dissipative resource use. Given the arid conditions and the resulting low resilience of the landscape, the current trends are likely to trigger widespread land degradation, jeopardizing future livelihood opportunities.

References

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