

Climate Change and Livelihood Security in the High Atlas: A Model Based Threshold Analysis

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BACKGROUND & SCOPE

Pastoralism is the most **dominating land-use in semi-arid areas**. It takes place on 25 % of the world's land surface, most of it in developing countries and provides a major source of income (Fig. 1).

The socio-economic effects of climate change in these areas are not well investigated. For the Drâa catchment in southern Morocco/High Atlas, we investigate future **impacts of climate change on livelihood security**. Thresholds of reduced precipitation are assessed, at which profound changes in the socio-economic system might occur.

Fig. 1: Livestock market in Ait'Toumert (Southern Morocco): Selling sheep and goats provides an important share of income.

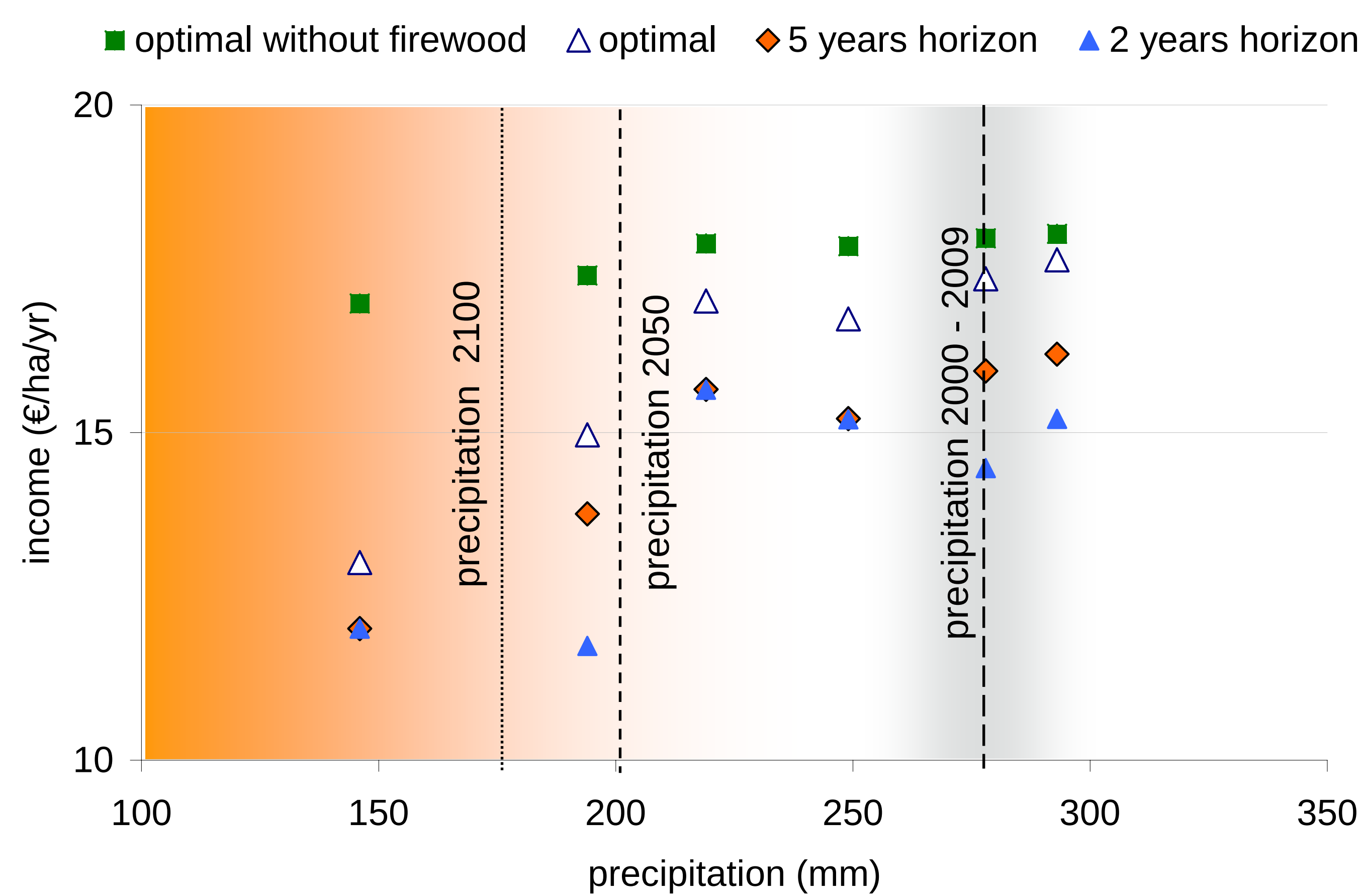


Fig.2: Threshold analysis with the bio-economic model. Different management options (optimizing horizons) and boundary conditions (with and without firewood-demand) are investigated.

RESULTS

- The **bio-economic model** shows a steep decrease in income (15-23% less) at **25% reduction of precipitation**, which corresponds to a precipitation level projected around 2050 (Fig. 2).
- Satisfying the energy demand for cooking and heating by other sources than **fire-wood from rangelands** (e.g. solar power) shows huge potential for abating the impacts of climate change (Fig. 2, green squares)
- Given current socio-economic constraints, 38-50 % of pastoralists would opt for **sedentarity as major alternative strategy** under precipitation scarcity (Fig. 3, grey). This alternative would put further pressure on scarce resources such as arable lands and freshwater.
- In order to move away from sedentarity as preferred alternative livelihood options, our socio-ecological model suggests an **enhanced availability of capital and education** (Fig. 3, green). By this, commercial pastoralism becomes a dominant alternative. However, the system becomes less predictable.

METHODOLOGY

Our investigation is based on a combination of two approaches:

- **Bio-economic model:** It uses a recursive-dynamic optimization procedure (i.e. maximizing profit within a certain planning horizon). Included to the model is a Markov chain of the **soil-vegetation model EPIC**. Livestock numbers depend dynamically on management decisions and fodder availability. Spatial representation of the rangeland is done using homogeneous response units. Different projected precipitation scenarios are investigated (Hertig&Jacobeit 2008 Int. J. Climatol 28: 1025-1045).
- **Semi-quantitative socio-ecological model:** It is based on a survey done with pastoralists. The model uses a **multi-criteria approach** in order to reveal the preferences of the pastoralists concerning alternative land use options under limited resources. The key criteria investigated is decreasing precipitation to an extend, at which the current land use (transhumant pastoralism) becomes an unfavorable option.

CONCLUSION

- Given the projected climate scenarios for 2050 and beyond, the current mode of land use will be inappropriate in order to achieve a similar income level as today.
- The current trend towards sedentarisation will be aggravated by climate change especially in the second half of this century.

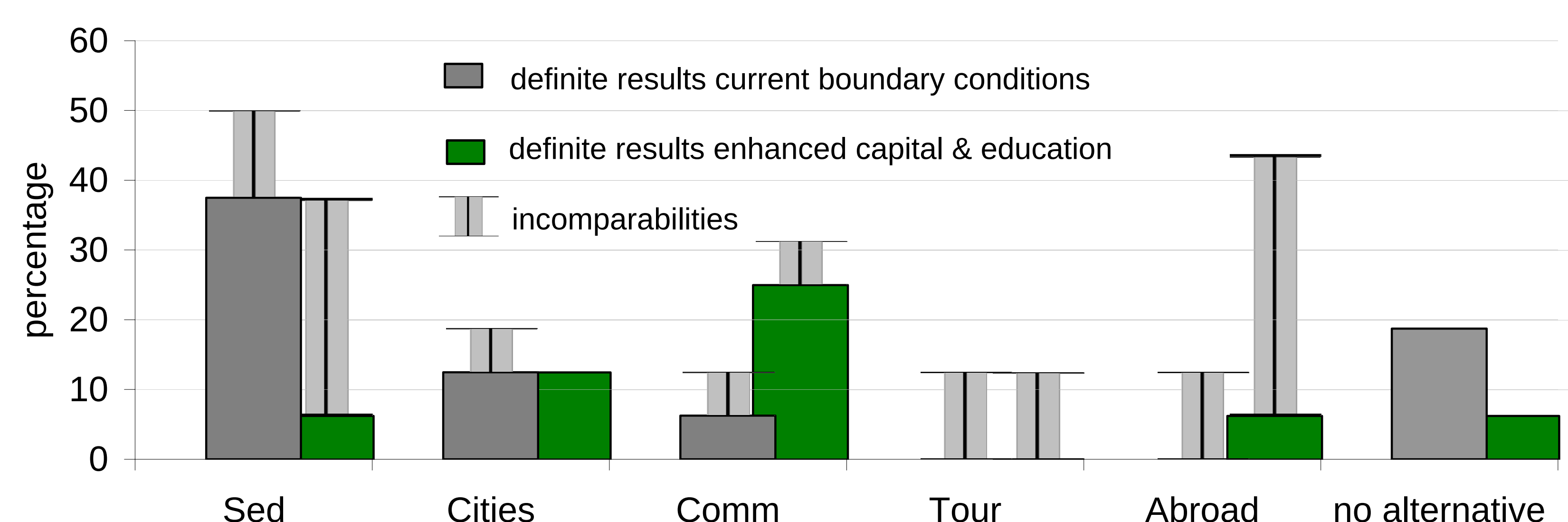


Fig. 3: Alternative land-use options mentioned by pastoralists in case of precipitation scarcity (n = 16). Sed: sedentarity; Cities: emigrating nationally; Comm: commercial pastoralism; Tour: Engaging in tourism; Abroad: emigrating internationally. Incomparable preferences are likely to cause deviations from definite results.

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