

## Abstract

Woodland resources provide livelihoods for millions of people in Africa. Concerns about the impact of human utilization of woodlands have led to vigorous debates on woodland degradation. Ecological and socio-economic empirical data and understanding of the socio-ecological system have been synthesized in an agent-based model (ABM) to explore different woodland management options for a dynamic, semi-arid region in Kenya. In our simulations we accounted for the impacts of drought frequency, charcoal price changes, improved management practices and taxation of charcoal for a 20-year period to assess woodland changes in a spatially explicit way and evaluate the numbers of actors that can benefit from charcoal harvesting as a livelihood option.

The model is based on an agent typology derived from 150 household interviews that focused on livelihood strategies and decision-making processes. Furthermore, the model integrates knowledge from vegetation plots and focus group meetings. From the model simulations we learn that favorable prices, improved management and taxation do not directly have the anticipated impact on woodland resources, as the improved conditions lead to fewer constraints on involvement in charcoal making. This reduces the positive impacts of these measures on the woodland quality but, at the same time, allows a larger number of actors to benefit from charcoal harvesting. Results show a very strong decrease in woodland area under the base scenario thereby reducing possibilities for households to supplement their incomes with charcoal making. Increased droughts and low prices for charcoal lead to early depletion of woodlands and reduction in livelihood options. Taxation stabilizes the number of charcoal producers but does not stop the depletion of woodland area. Woodland loss can only be prevented by controlling the number of charcoal makers and the amount of charcoal harvesting.