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“Bridging the gap between increasing knowledge and decreasing resources”

Agent-Based Modelling of Transhumant Cattle Herd Movements in Southwestern Madagascar

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Abstract

Managing natural resources sustainably in grazing systems requires a sound understanding of the limiting factors and dynamics of the herbivore-influenced ecosystem. Due to the high spatial heterogeneity and the high stochasticity in precipitation and resource distribution, deterministic models have shown shortcomings in depicting this dynamics in semi-arid and arid environments.

Traditionally, seasonal water and forage shortage constrained animal husbandry of zebu (*Bos indicus*) herds by the pastoralists of the area surrounding the Tsimanampetsotsa National Park in southwest Madagascar to extensive levels, and transhumant herd movements between coastal and inland grazing grounds largely followed the seasonal availability of natural resources. In recent times, however, population increase and lack of security due to cattle rustling in certain areas of the region led to a change in spatial and temporal pasture use and thereby unsustainable demands for resources.

To assess the potentially degrading impact of domestic herbivores on the ecosystem within framework of change in land use, we developed a spatially explicit agent-based model on the herbivore-vegetation interactions within the agropastoral/transhumant grazing mode of herders of the Mahafaly plateau.

In a first step, the temporal variability in availability of natural resources and the foraging activities of the zebu herds have been simulated and parameterised on a daily resolution for one village incorporating GIS, high-resolution remote sensing and field-based validation data. Based on the animals' metabolic energy and protein needs and expenditures for maintenance, growth and movements, the agent-based model simulates the interacting effects between herd demography and resource availability in terms of quality and quantity. In a future version, the agent-based model will be applied to analyse the ecosystem response under different livestock management strategies as well as future climate and land use change scenarios.

Keywords: Herbivore-vegetation interactions, herd demography, resource availability, spatio-temporal modelling