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“Solidarity in a competing world —
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Modelling Boran Cattle Populations under Climate Change and Varying Carrying Capacity in Borana Rangelands

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Abstract

Cattle populations in semi-arid rangelands are currently facing severe threats due to erratic rainfall and increasing drought frequencies, leading to poor vegetation quality and overgrazing. However, little is known how the particular sex and age cohorts respond to these threats and how population trajectories develop under these stochastic environmental conditions. In the Borana rangelands, southern Ethiopia, much detailed information is available on the Boran cattle (*Bos indicus*) population demographics, a special breed which is highly adapted to the prevailing environmental conditions. We generated stochastic models and assessed the future development of the cattle population under different drought scenarios. We analysed changes in age- and sex-cohorts of Boran cattle populations by introducing different drought frequencies (scenarios 1 to 4, i.e., one drought every 20-year and 5-year, respectively) and their effect on vital rates, carrying capacity and market demands. We calibrated the cattle model on the basis of 12-year data sets of the Borana zone. Model validation yielded R^2 values of 0.86, 0.94, 0.79 and 0.99 for scenarios 1, 2, 3 and 4 models, respectively. In our population model, sale of mature cows affected population trajectories most strongly (77%) under stochastic environmental conditions. Model outcomes were most sensitive to sale rates of mature cows, young cows, and juvenile females compared to vital rates and male sale rates of the population. Hence, through monitoring of demographic and environmental factors, we can improve predictions of cattle population development over time under different climate change scenarios. Further management should focus on lowering female sale rates through increasing sale of mature males that increases feed availability to females during drought years in the Borana Rangelands. This cows feeding strategy, through reserved grazing or supplemental feeding, further reduces calf mortality by increasing milk yield. Otherwise, the supplemental feeding during drought emergency will keep the population artificially high, which will negatively influence the carrying capacity that increases overgrazing and herd-crash in the following drought. Therefore, supplemental feeding should focus female animals than the whole herd to minimise herd-loss when drought happens.

Keywords: Drought frequency, modelling, stochasticity