IMPETUS Morocco

Assessing future herbivore – biomass dynamics in a changing climate with the ecosystem model SAVANNA for the Drâa catchment in south-eastern Morocco

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Introduction

Southern Morocco is a semiarid, heavily grassed region with a long tradition of transhumance activity. The spatial ecosystem model SAVANNA is being used to model ecosystem dynamics and to gain knowledge about the thresholds of sustainable use in this region.

Some of the aims of this study are the determination of regional influences of herd populations on vegetation cover, species composition, distribution and regional water use. The simulated data will help to understand vegetation dynamics under conditions of herd dynamics, climate change and human decision making.

Model basics

Within SAVANNA, three different plant functional groups herbaceous, shrub and tree are defined to simulate plant growth and competition for nutrients and water. In addition, biomass intake by animals, withdrawal by humans and spatial variability of herds are simulated (see fig. 1).

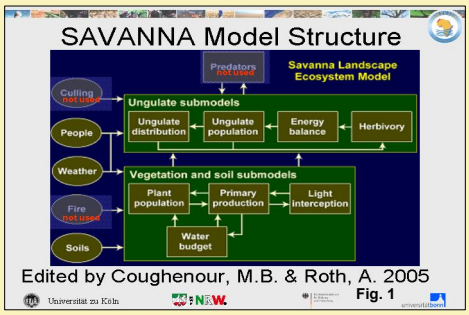

Fig. 1

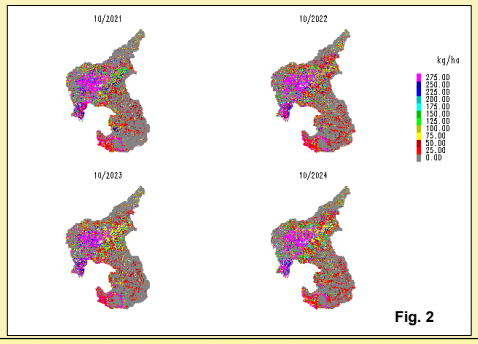

Fig. 2

Results

Fig. 2, 3: 50 years (2001-2050) of simulation of aboveground net primary production (ANPP in kg ha^{-1}) for herbaceous (Fig. 2) and shrub (Fig. 3) plant functional types for IPCC A1B scenario of the Drâa catchment. Herbaceous PFT results under moderate grazing intensities (600.000 heads) predict for the autumn of 2021-24 that most of the area is covered by small patches of 35-50 kg ha^{-1} ANPP or lower and a loose distribution. The western part of the basin of Ouarzazate is the most productive area with amounts of >275 kg ha^{-1} . The model shows for shrub PFT productivity a more homogenous picture with amounts between 250-350 kg ha^{-1} in 2033-34. Higher shrub productivity for the entire area is calculated for 2035-36 with amounts of up to >550 kg ha^{-1} mainly due to climate conditions. The circle hot spots of productivity in the south indicates the surroundings of water wells for herds.

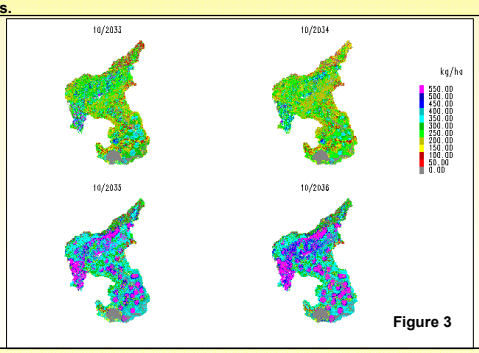

Figure 3

Conclusions:

The SAVANNA ecosystem model is well suited to appropiately simulate the complex herbivore-biomass system. Results depict that under predicted climate conditions shrub PFT is more adapted to grazing pressure and climate scenarios than herbaceous PFT. The shown results are related to detailed subcatchment studies for the aim of a local decision support tool for pastoralists and forestry organisations.

No Grazing Conditions | **Grazing Conditions**

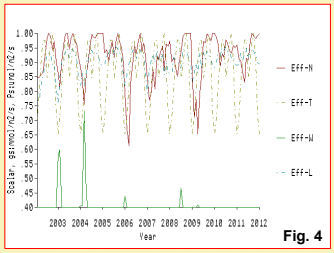

Fig. 4

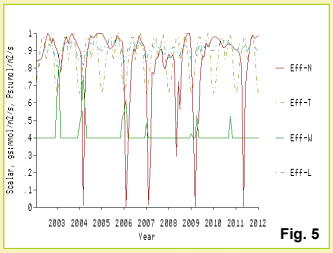

Fig. 5

Fig. 4, 5: Sensitivity analysis towards effects of water, light, nitrogen and temperature for vegetation for a 10 years run for calibration purposes at the site TAUJGALT. Value 1 indicates low sensitivity for effects, value 0 high sensitivity. The 'No grazing' run shows especially for water and temperature a high sensitivity. Whereas in the 'grazing' run water sensitivity has been reduced, but nitrogen sensitivity occurs. Temperature gains higher sensitivity in the 'no grazing' run but stays moderately important.

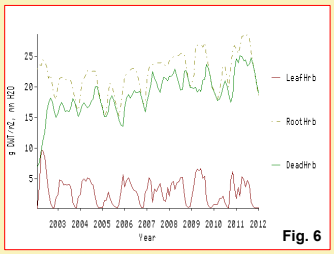

Fig. 6

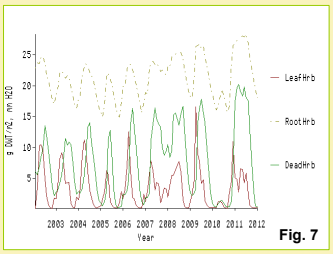

Fig. 7

Fig. 6, 7: Simulated plant growth and death rates (g m^{-2} DWT) of herbaceous PFT at TAUJGALT. Results indicate higher values for herbaceous leafs under 'Grazing' compared to 'No grazing' model runs. Increasing animal grazing induces higher growth rates at certain time steps and reduces the amount of dead biomass due to diet preferences of animals during the dry season.

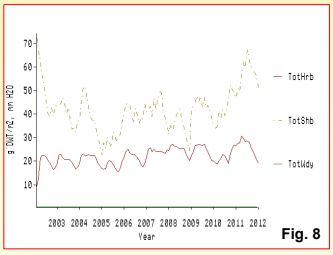

Fig. 8

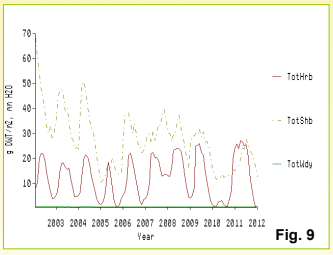

Fig. 9

Fig. 8, 9: Total herbaceous-, shrub- and woody biomass at TAOUJGALT in g m^{-2}. Herbaceous biomass rests stable, even in drought years in the 'no grazing' run. Whereas the 'grazing' run shows larger inter-annual fluxes. 'No grazing' run: shrub biomass declines between 2005/09, due to drought years but recovers. 'Grazing' run: shrub biomass declines to low level and rests stable there. This shows the high potential of recovering mechanisms of herbaceous plants to grazing even under drought conditions.

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