



Tropentag, October 6-8, 2009, Hamburg

“Biophysical and Socio-economic Frame Conditions
for the Sustainable Management
of Natural Resources”

Spatial and Temporal Changes in Biomass Production of Rangelands on Al Jabal al Akhdar, Northern Oman

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Abstract

The semi-arid rangelands of Al Jabal al Akhdar mountains in the northern Hajar range of Oman are valuable wildlife and plant habitats and serve as extensive grazing grounds for livestock. However, the productivity of these rangelands is spatially and temporally highly variable, and the increasing grazing pressure as well as climatic changes threatens the vegetation resource. Numerous reports indicate a decrease in the vegetation cover and biomass production of rangelands during the last decades. But the extent of these degradation related changes as well as the spatial distribution of biomass production has not yet been quantified.

To quantify the productivity of the different plant communities on the central Jabal al Akhdar region (60 km²), a combination of destructive and non-destructive biomass measurements was conducted based on a systematic sampling design. Life-form specific allometric equations were used for grasses, herbs, subshrubs and weeds (unpalatable species) and combined with existing biomass data of phanerophytes. Additionally, remotely sensed vegetation indices (VI) were calculated from actual satellite images and their suitability for the cover and biomass estimation was evaluated. Following a geostatistical interpolation method, the spatial distribution of Annual Net Primary Production (ANPP) was modeled based on the biomass samples. Ordinary kriging and co-kriging with the VI values as covariates were used processed with the geostatistical extension of ArcMap 9.1. The predicted biomass map was tested by cross-validation. To determine the temporal changes in vegetation cover and biomass production from past to present, the VI was calculated for a series of Landsat satellite images from 1990 to 2009. Selected for this analysis were images captured at the peak vegetation growth as derived from corresponding rainfall data. The results of the time series in vegetation cover were related to climate data and additional socio-economic statistic.

Generally, the rangelands are characterised by a relatively low density of ground vegetation with a high fraction of bare soil patches. The ANPP differed significantly between the life forms and the different plant communities. A remarkable decrease in vegetation cover was detected during the last 20 years as a result of climate change combined with increasing livestock numbers.

Keywords: Annual Net Primary Production (ANPP), climate change, co-kriging, degradation, Ordinary kriging, Vegetation indices (VI)

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