

Assessing the sensitivity of a Mediterranean commercial rangeland to droughts under climate change scenarios by means of a multidisciplinary integrated model

Martínez-Valderrama, J.

Ibáñez, J.

Ibáñez, M.A.

Alcalá, F.J.

Sanjuán, M.E.

Ruiz, A.

del Barrio, G.

Abstract

Rangeland productivity is strongly conditioned by the amount and temporal distribution of precipitation. Thus, the worsening of droughts with climate change could be a serious threat to their existence. This paper presents a modelling study aimed at evaluating the sensitivity of a valuable type of commercial rangelands, namely Spanish dehesas, to increases in the frequency and intensity of droughts driven by climate change. The assessment consisted in a multi-way ANOVA carried out on the basis of 5400 simulations of a multidisciplinary integrated model. It included two blocking factors linked to climate change scenarios, namely Representative Concentration Pathway and downscaling method, and two treatment factors, namely return period and severity of droughts. The levels of all factors were included as part of the simulation scenarios. The response variables constituted a summary of model's behaviour throughout one simulation. They were average profits per farmer and average stocking rate, both calculated over the entire simulation period, and remaining soil depth at the end of the simulation. The effects of the treatment factors on the response variables were small for all blocks, thereby suggesting that the sensitivity, and thus the vulnerability, of Spanish dehesas to the worsening of droughts would be low under climate change. Farmers were defined as conservative in all model simulations, that is, they minimized changes in the size of their herds and bought supplementary feed to meet shortfalls in livestock feed unless it was excessively expensive. Thus, we conclude that this group strategy could explain the adaptive capacity of Spanish dehesas to droughts. This paper shows that multidisciplinary integrated models are valuable learning tools to acquire insights into the relationships between climate, ecologic and socio-economic factors. Although there is a recurrent call for holistic studies, they are still rare in the rangeland literature. Hopefully, this paper will motivate some researchers to consider this approach.

Author keywords
Climate change
Conservative farmers
Drought-enduring strategies
Rangeland
Supplementary feed
System dynamics
Vulnerability