



## **Soil organic carbon stocks in rangelands of SW Iberian Peninsula as influenced by land degradation**

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Rangelands in SW Iberian Peninsula occupy approximately 95,000 km<sup>2</sup> of land grazed by millions of domestic animals. They are characterised by grasslands with varying tree density, interspersed in some areas with shrubs. The herbaceous layer is dominated by annual species and the tree layer is mainly formed of evergreen oak. Most rangelands are exploited in large farms (>100 ha), held mainly on private ownership and dedicated to extensive livestock breeding. Soil organic carbon (SOC) is an essential component of the fertility and productivity in both, natural and human-induced ecosystems. Previous research evidenced SOC is concentrated mainly in the top 5 cm soil layer, displaying large spatial variability, with higher values beneath tree canopies as compared to the open spaces. Traditional practices such as cereal cultivation, as well as an increasing number of domestic animals in the last decades, have been remarked as some of the main causes of SOC depletion in rangelands. However, a better understanding of how livestock grazing affects soil organic carbon stock is still needed.

The main objective of this study is to investigate the possible relationships between land degradation and SOC stock in rangelands of SW Iberian Peninsula. Previous studies have shown that sheet erosion is one of the main soil degradation processes. In this study, we have compared SOC stock values from reference soils belonging to a farm where no livestock exists for more than 100 years, with those from 10 farms grazed by domestic animals in the Spanish region of Extremadura. The reference farm is an example of an undisturbed natural area composed of Mediterranean forest and dense scrub. In each farm at least 2 areas were selected, constituting in the case of the grazed farms fenced areas, where the stocking rates could be determined. These units are representative of different rangeland types: wooded rangelands (dehesas), treeless grasslands and scrublands of *Retama sphaerocarpa* with stocking rates ranging from 0.19 to 15.76 LU ha<sup>-1</sup>. SOC stock was estimated from 48 soil profiles. The study included measurement of a large number of soil properties and degradation indicators, including the assessment of erosion features.

The reference soils showed SOC stocks of 71.5 T ha<sup>-1</sup>, as compared to the 22 grazed units which had an average of 31.1 T ha<sup>-1</sup>, ranging from 9.7 to 63.6 T ha<sup>-1</sup>. The units more strongly affected by soil erosion presented lower SOC stocks (26.5 T ha<sup>-1</sup>) as compared to those presenting few or absence of erosion features (35.1 T ha<sup>-1</sup>). Remarkable are also the relationships found between SOC stock and other variables such as tree density, soil depth, Ah-horizon thickness and livestock density. Results suggest that soils from dehesas with high tree density store considerable amounts of organic carbon. However excessive stocking rates may lead to land degradation processes, such as water erosion, provoking topsoil losses, where most of SOC is concentrated. Furthermore, the results indicate a complex relationship between SOC and livestock, existing presumably a positive feedback with low to moderate livestock densities and a negative one with high animal density. Further research is necessary to be able to draw definitive conclusions about the influence of domestic animals on carbon stock.