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Modelling agricultural suitability along soil transects under current conditions and improved scenario of soil factors

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Agricultural land suitability analysis and improvement of soils by addressing major limitations may be a strategy for climate change adaptation. This study aims to investigate the influence of topography and variability of soil factors on the suitability of 12 annual, semiannual and perennial Mediterranean crops in the province of Seville (southern Spain). In order to represent the variability in elevation, lithology and soil, two latitudinal and longitudinal (S-N and W-E) soil transects (TA and TB) were considered including 63 representative points at regular 4 km intervals. These points were represented by 41 soil profiles from the SDBm soil database -Seville. Almagra model, a component of the agro-ecological decision support system MicroLEIS, was used to assess soil suitability. Results were grouped into five soil suitability classes: S1-optimum, S2-high, S3-moderate, S4-marginal and S5-not suitable. Each class was divided in subclasses according to the main soil limiting factors: depth (p), texture (t), drainage (d), carbonate content (c), salinity (s), sodium saturation (a), and the degree of development of the soil profile (g).

This research also aimed to maximize soil potential by improving limiting factors d, c, s and a after soil restoration. Therefore, management techniques were also considered as possible scenarios in this study. The results of the evaluation showed that soil suitability ranged between S1 and S5p - S5s along of the transects. In the northern extreme of transect TA, high content of gravels and coarse texture are limiting factors (soils are classified as S4t) In contrast, the limiting factor in the eastern extreme of transect TB is the shallow useful depth (S5p subclass). The absence of calcium carbonate becomes a limiting factor in some parts of TA. In contrast, the excessive content of calcium carbonate appeared to be a limiting factor for crops in some intermediate points of TB transect. For both transects, soil salinity is the main limiting factor in lowlands.

The decrease in the severity of soil limiting factors in the improved scenario leads to an increase of soil suitability for the twelve crops along TA and TB transects, except in segments with shallow soils and very coarse texture. In the hypothetical scenario with no limiting factors, the highest improvement on suitability is observed under perennial crops in the TA transect. Land evaluation has proved to be a good way to distinguish the best soil suitability by addressing limitations and is an essential tool for land use and climate-change adaptation planning.

Keywords: Digital Elevation Model, Toposequence, MicroLEIS DSS, Almagra model, Soil quality.