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Regional assessment of agricultural soil ecosystem services and bundles definition through spatial analysis. A regional approach in Navarre (Spain).

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Soils play a crucial role in the sustainable delivery of a wide range of ecosystem services (ES), linking soil functions of ecosystems to human well-being and socio-economic activities. When such linkages are well recognized, in a medium to long-term trajectories in the delivery of soil-based ecosystem services (SES) in relation to climate and land use or soil management are poorly known, particularly when it is not question of individual services but to bundles of services and their relationships. The identification and assessment of bundles of ES, and the definition of reference thresholds represents a key point in the assessment of soil multifunctionality and in the monitoring of soil health.

The region of Navarre (10,391 km²) is characterized by a high climatic variability, with a rainfall gradient ranging from >2500 mm in the north to <350 mm in the southeast, as the most significant natural division in the territory. This translates into a variability in terms of agricultural use, which represents 39% of the total area with 90.7% cropland and 9.3% grassland, and where more than 30% is irrigated. This agricultural use was characterized in the context of the LIFE NADAPTA project, which aims to improve the adaptive management of agriculture soils to climate change in the region. In the framework of this project, twelve zones with homogeneous conditions for plant growth were defined by combining biogeographical and vegetation series information. In a second step a network of more than 150 agricultural plots within the region were defined, where a set of soil indicators were measured, including topsoil organic carbon, available water holding capacity and bulk density.

Going a step further, this work proposes the assessment of the SES provided by the agricultural soils in the region according to different stratification options of the territory, with the aim of identifying patterns in the support of SES within these stratifications. The hypothesis of the work is that a correct stratification of the territory can allow the clustering of the territory in homogeneous service providing areas and, therefore, identify bundles of SES and define reference thresholds. To this end, a first phase involved the identification and selection of the main SES provided by the soils in the region and the definition of a set of indicators for their evaluation. The SES considered are i) biomass production, ii) erosion control, iii) climate regulation and iv) hydrological control. The definition of SES indicators has been done using the cascade as a general indicator

framework. The set of indicators are going to be evaluated in a second phase of the work at the regional scale according to different stratification options within the region: no stratification, NADAPTA zoning, land use and climatic stratification.