Remote sensing, wetlands and agriculture

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Agricultural policies have shifted in recent decades from encouraging agricultural production to the agricultural sustainability. Worldwide, many wetlands have been lost and degraded by agricultural intensification, and loss might increase in the future. The continuous degradation of wetlands in agroecosystems is more intense in dry regions where modern agriculture involves strong landscape transformations due to farm consolidation and the development of large irrigation projects.

As an example, the Spanish Government launched a project to irrigate over 60,000 ha in southern Monegros, NE Spain, a territory containing Ramsar sites and whose uniqueness has been already recognized for birds and plants protection under EU Directives. The forthcoming irrigated lands will deal with two new circumstances, the modification of wetlands hydrology and soils characteristics, whose consequences for habitats preservation have not been evaluated. A major threat for Monegros saline wetlands is flooding by fresh and polluted water flowing from irrigated lands, which can destroy existing habitats and extinguish extremophiles and/or endemic organisms, and finally, lead to eutrophication. Meanwhile, smaller wetlands have been plowed and wetlands that have survived suffer extensive perimeter loss.

Scientific understanding of the roles that wetlands play in the ecosystem has increased the appreciation for wetlands in arid environments. One of the problems in monitoring and preserving arid wetlands is the scarcity of records. For this reason, remote sensing was applied early to wetlands monitoring to identify their hydrological cycles. However, soil management is key to preserve bio- and edaphodiversity in arid lands and to reconcile agriculture with habitats conservation in Monegros.

In Monegros, we used remote sensing for the delimitation of agricultural soils in dry-farmed lands with low or nil production due to their aridity and soil composition. Distinctly colored decametric patches with different soil properties and crop (winter cereal) development are dominant in the landscape. Gypsum- and carbonate-rich soils are spread in the dry-farm area in relation with the limestone and gyprock substrate; gypsum rich areas are known as very low production areas.

White color patches are discriminated with Landsat, Aster and Quickbird images. Post-harvest summer maps were produced from unsupervised classified images of the different sensors, with spectral signatures interpreted using field data. The summer maps showed the distribution of vegetation subclasses (stubble, fallow, and volunteer plants), bare soil subclasses based on different humidity, and white patches. The maps of low production areas derived from Quickbird data are suitable for agricultural management at the scale of agricultural plot.

Within white patches, gypsum rich areas were differentiated from carbonate rich areas using the spectral signatures and band ratios, and comparing them with mineral spectra and data composition from soil surface. NDVI maps from spring images together with yield data showed the decrease in crop production in withe areas, especially in years with a good development of winter cereal. Identifying low-production areas around wetlands and their fringes can avoid the current intensive plowing and the destruction of native vegetation, as well as decrease chemigation and water application.

Keywords: agricultural landscape, aridity, Common Agricultural Policy, gypseous soils, inland saline wetlands, soil heterogeneity.

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