Brief assessment of tools for measuring at field level, natural capital and ecosystem services provided by agricultural soils

Abstract
Agriculture produces most of the food and fibers and a large amount of the fuels that we eat, wear and burnt every day. In the coming decades, it is expected a global rising in the demand of those raw materials, while agricultural land area and water and chemicals supplies remain unchanged or even decrease. On the other hand, farming is responsible for important environmental impacts regarding soil loss and degradation, water pollution, loss of biodiversity or greenhouse gasses emissions, which are in turn, key efficiency indicators for farming processes. These are reasons why it is imperative a paradigm shift towards a new productive model, like sustainable intensification of agriculture.

New tools and indicators are being required by institutions and food and textile industries for measuring and monitoring sustainability of agriculture. These tools must be also useful for farmers, during their decision making processes. In this respect, there is a growing consensus that soil is a suitable indicator of the economic and the environmental pillars of sustainability at farm and field levels. Soil functions can be easily linked to the ecosystem services framework and to the natural capital approach, thus allowing the use of all the existing soil expertise in economic models and in inter- and transdisciplinary projects, for example.

Soil is a complex system resulting from the non-linear interactions among its wide range of components and affecting factors. From this point of view, observed spatio-temporal heterogeneity at field scale can be considered as an attractor of the system or as a set of metastable attractors. This approach allows tackling the overwhelming complexity from its effects or results, instead off from its causes.

To do that, it is possible to characterize and to monitor field variability using different ancillary variables obtained from remote sensing and other geospatial data. In addition, nonparametric and geographically weighted statistical tools allows for analytical tasks in the data, geographic and time domains. Thus, nonparametric measures of association, like Kendall’s tau and Kendall’s coefficient of concordance (W), show the temporal stability and variations of the variables’ spatial patterns and geographically weighted regression address spatial non-stationarity when sufficient data are available.

Other issues, like spatial autocorrelation, collinearity or small sample and population sizes, or sampling design for ground truthing data also need to be given attention.