

**Policy documents**

Europe: Directive 2000/60/EC of 23 October 2000 framework for Community action in the field of water policy, Dir.91/676/EEC (Nitrates Directive)
EU Soil Strategy for 2030 COM(2021) 699 final

First draft

TOOL ECOSYSTEM SERVICES – Scale: Regional

WHY

Ecosystem services (ES) in the last years have been a topic in the spotlight of scientific community and policy, being a global challenge in the agenda of European environmental policies (e.g. European Green Deal). The research community aims to classify and quantify these services but to date there are no standardized approaches. Rather, different approaches are used that are expert-based or empirical, qualitative rather than quantitative, applied depending on the spatial scale and output required.

Here we present our approach to the quantitative evaluation of provision and regulating ESs, in which the soil is considered a key factor in regulating the functioning of agricultural ecosystems. Specifically, above ground biomass for provisioning ESs and filtering capacity, water storage, groundwater recharge, heat containment and runoff triggering for regulating ESs will be estimated. The approach involves the use of physically based models of the crop growth, the water flow and the solute transport in the soil-plant-atmosphere system.

FOR WHOM

The Ecosystem Services tool is designed to assist multiscale land management Public Authorities in designing plans and in evaluation of impacts of the measures in order to ensure environmental sustainability and optimum soil management and conservation.

HOW – if you want to *select your Region Of Interest (ROI)*

The tool works over the Campania Region, Marchfeld, Zala County and Valle Telesina, and allows the free selection of any region of interest (ROI), administrative unit (e.g. Municipality) by following this simple procedure:

Operational procedure for ROI (draw, save, plot)

- By clicking on the "Draw (Polygon)" button on the top bar, drawing the desired area (ROI) and assign it a nameⁱⁱ;
- Using the "Save" button, the ROI is stored in the system memory and can be retrieved whenever necessary.

Operational procedure for Administrative Unite (select, plot)

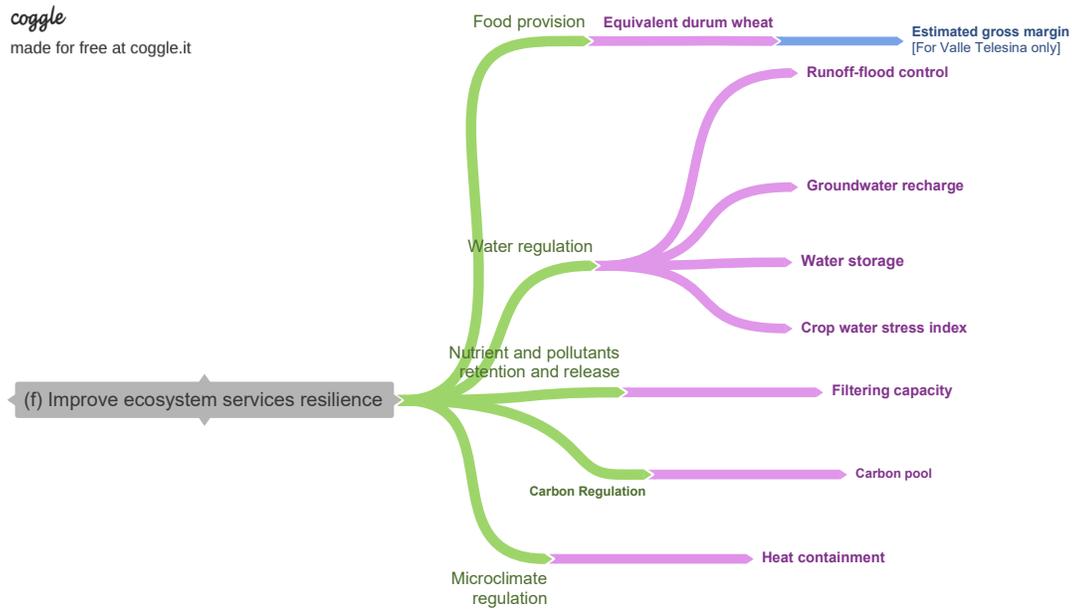
- By clicking on the "Select Administrative Unit" button on the top bar is possible to select the AU of interest (e.g. municipality).
- Using the "Run" button, the AU is clipped within the database and results are shown (see Results section).

HOW

Operational procedure

The **Ecosystem Services** tools can be selected from the Toolbox of the Graphic User Interface: (f) Improve ecosystem services resilience > Ecosystem services for Marchfeld, Zala County and Campania Region; f) Improve ecosystem services resilience > Biomass potential productivity > Equivalent wheat production for the Valle Telesina. The model requester is very easy to be filled in: the ROI or the Administrative limits and the type of ES to be provided.

The tree of the Ecosystem Services tools is depicted in the following figure:



In our approach, we used a deterministic model, namely the ARMOSA crop model (already used for other tools), for calculating the *equivalent durum wheat yield*. Therefore, we consider one crop (wheat) within a soil spatial variability and a climate space-time variability. This procedure allows to obtain a map representing the patterns of yearly average durum wheat yield in which the variability can be attributable to different production potentials due to soils and climatic differences.

Once the *equivalent durum wheat yield* has been calculated it was expressed in monetary value through Gross Margin. *Equivalent wheat yield* has been multiplied by wheat price, and then Variable Costs are subtracted. Wheat price and Variable Costs were computed as median value of the distribution of farms located in the inland hill and mountain areas of Campania Region available in the Italian Farm Accountancy Data Network (FADN).

Water regulation ESs were calculated by using the FLOWS-HAGES model simulating water flow and solute transport in the groundwater-soil-plant-atmosphere system. The outputs are the average of runs for 4-years of consecutive different climates. For all the simulation the wheat was the reference crop.

The groundwater recharge is calculated as the average water fluxes arriving at bottom boundary (mm/y); the crop water stress index was calculated as $1 - T_{act}/T_{pot}$ (%); the runoff-flood control was the number of days of runoff triggering for rainfall > soil infiltration and/or for upper soil horizon oversaturated (d/y).

The water storage was calculated as the integral in the 0-100 cm soil depth of the available water capacity expressed as the difference between field capacity and wilting point.

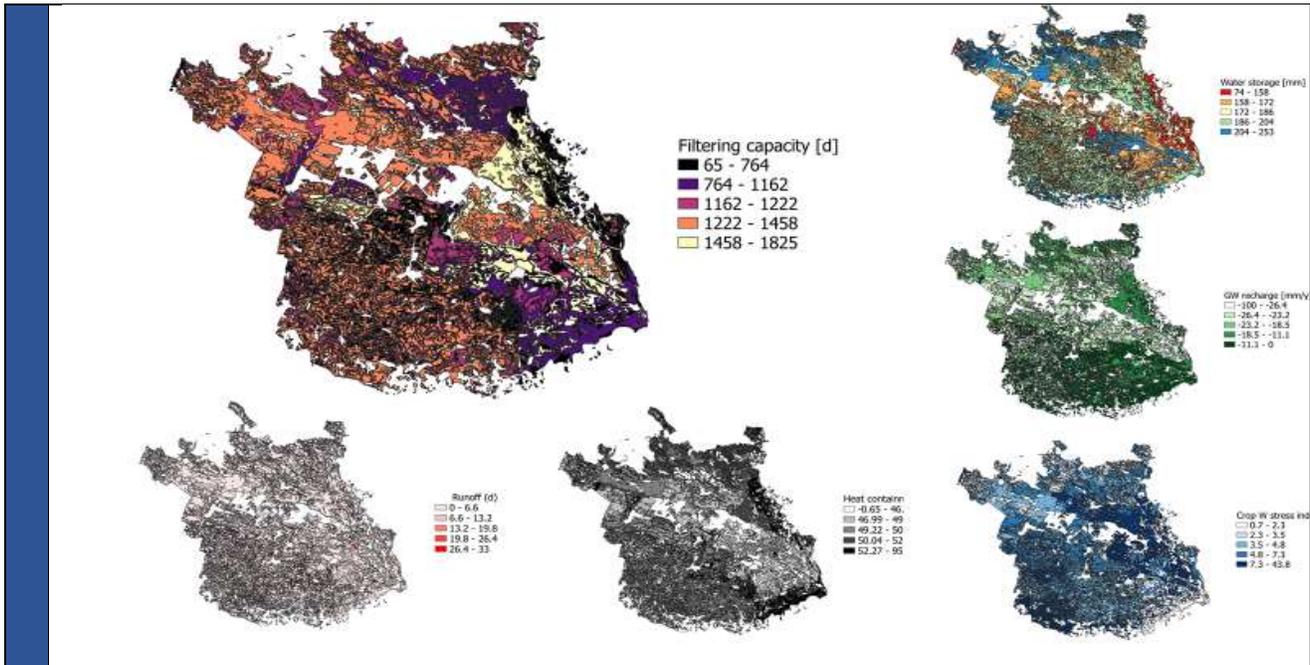
The nutrient and pollutants retention and release ES was calculated by using the FLOWS-HAGES model.

Specifically, we calculated the filtering capacity as the days for solute peak arrival at groundwater table (d).

Finally, the heat containment was expressed as the average ET_{act} (mm/y).

What for

The results depict high spatial resolution of the mapped soil ES for each region (see example below for the entire Marchfeld). Furthermore, using a physically-based modelling approach allows to get an internal coherence between the different results.



LIMITATIONS

The user should be aware that the following limits exist. Spatial variability of climate data is not actually considered. The soil maps, just like all the other thematic layers, have inherited the limits (scale, n. observation, etc.) of the original maps (see metadata on the platform). Currently, the model cannot work with user-customizable data.

FUTURE DEVELOPMENT

The ecosystem services tools are the basis of the soil health (SE) tools, being the SE defined as “the continued capacity of soils to contribute to ecosystem services in line with the SDGs and the Green Deal”.

ⁱ Special care is required when user draws/select the Region of Interest. In fact, LANDSUPPORT is a multi-scale decision support system. Each of the 15 available tools is designed for a specific application and for a specific scale. Furthermore, the databases using specific standards required for that specific scale. The users of LANDSUPPORT web platform must therefore be well aware of the limitation embedded in the different maps that they require for their specific application. The users must be expert on their specific problem and must understand if the input data offered by the platform are suitable for their problem. In light of the above, the system provides very reliable results only if used appropriately.

ⁱⁱ It is also possible to draw a ROI with numerous polygons. In this case, it is possible to assign different values (eg numbers) to each of the drawn polygons.