Technical sheet

Policy
Europe: *SUSTAINABLE DEVELOPMENT GOAL 15; protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.*
EU Soil Strategy for 2030 COM(2021) 699 final

First draft

TOOL LAND DEGRADATION NEUTRALITY – *Scale: Europe, Italy*

The Sustainable Development Goal (SDG) 15.3 target is to achieve a land degradation-neutral (LDN) world. LDN has been defined by the United Nations as "a state whereby the amount and quality of land resources, necessary to support ecosystem functions and services and enhance food security, remains stable or increases within specified temporal and spatial scales and ecosystems".
In order to assess the degraded area as indicated by the guidelines for calculating SDG Indicator 15.3.1[i], ISPRA produced information from 3 sub-indicators is used: (i) Vegetation productivity, (ii) Land cover change, and (iii) Soil organic carbon. Each of these three sub-indicators is spatially explicit and generated on a raster map which is then integrated into a final SDG 15.3.1 indicator map that presents the information on the state of the soil, i.e. whether the latter is stable or exhibits increasing or decreasing degradation[ii].

WHY
To have an immediate reference about the state of the soil resource and corresponding trends.

FOR WHOM
This tool is dedicated to those Public Authorities (mainly at national and regional levels) who have to take action to combat land degradation.

TOOL LAND DEGRADATION NEUTRALITY

HOW
The tool works on the entire European Union and allows the free selection of a different scale areas by using any Administrative units; it is possible to select entire Nations, Regions and Municipalities.

Operational procedure
After clicking on the "Land Degradation" icon in the toolbox and selecting the "Land Degradation Neutrality" tool, a window appears in which users may select the territory for which they want information.
Once the Administrative limits have been selected, the system will automatically open the "Results" section; then by clicking on the last operation performed, the button with the name "PDF Land Degradation Neutrality – SDG 15.3" will appear in the "Elaboration detail" section at the bottom of the page. Clicking on this button will open, in a dedicated tab, the pdf file containing information about the region of interest, the LDN global SDG 15.3 indicator and its variations (in ha e %), as well as an insight into the Land Degraded areas, i.e. the main land cover classes affected (Corine CLC level 1).

What for
The information obtained provides support for Public Authorities as they endeavour to satisfy European and national regulations by quantifying the state of land degradation.

LIMITATIONS

This tool addresses the calculation of LDN UNCCD indicator SDG 15.3. This tool should be considered a demo version since we believe that the above indicator requires further testing in many countries. In this first prototype, the tool employs a more simplified analysis than that one offered by the Trends.Earth approach.

FUTURE DEVELOPMENT

In a second version, we seek to enable the user (e.g. a specific country) to upload its own data (maybe with better data quality and quantity), so that the system will perform the calculation on those new data.

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[ii] Sub-indicators calculation is performed in Trend's Earth (http://trends.earth/docs/en/), a free and open-source Qgis plugin produced as part of the project funded by the Global Environment Facility.

Productivity: Land productivity is the biological productive capacity of the soil, the source of all the food, fuel and fiber that sustains humans (United Nations Statistical Commission 2016). To assess land productivity the information derived from the Normalized Difference Vegetation Index (NDVI) was used. This index, computed using MODIS satellite imagery, exploits the information of red and infrared wavelengths through the calculation of annual integrals of NDVI. The resolution of the output raster cell is 250x250.Land productivity is then assessed in using three measures of change derived from NDVI time series data: trajectory, performance and state Trajectory measures the rate of change in productivity over time, Trend's.Earth computes a linear regression to identify areas experiencing changes in productivity from 2012 to 2018. Factors that can influence productivity are temperature and availability of water, nutrients and sunlight. Within a given ecosystem, primary productivity is affected by several factors, such as temperature, and the availability of light, nutrients and water. In the elaboration over Europe changes in water, availability strongly influenced annual integrals of NDVI identifying areas of soil degradation even in forest areas where climatic phenomena of this type have occurred; in a detailed analysis, it could be useful to use information layers to perform climate corrections. For the European level, given the non-availability of updated information on rainfall and water availability, it was decided not to use climatic corrections. The Productivity State indicator allows for the detection of recent changes (2016-2018) in primary productivity as compared to a baseline period (2012-2018) while the Productivity Performance indicator measures local productivity. The Productivity Performance indicator measures local productivity considers the correlation with the types of vegetation of similar bioclimatic regions within the country boundaries in which the information falls using land cover information. The three productivity sub-indicators are then combined as indicated in the tables below (source: Trends.Earth 0.67Documentation).

Aggregating the productivity sub-indicators

Trajectory	State	Performance
Improvement	Improvement	Stable
Improvement	Improvement	Degradation
Improvement	Stable	Stable
Improvement	Stable	Degradation
Improvement	Degradation	Stable
Improvement	Degradation	Degradation
Stable	Improvement	Stable
Stable	Improvement	Degradation
Stable	Stable	Stable
Stable	Stable	Degradation
Stable	Degradation	Stable
Stable	Degradation	Degradation
Degradation	Improvement	Stable
Degradation	Improvement	Degradation
Degradation	Stable	Stable
Degradation	Stable	Degradation
Degradation	Degradation	Stable
Degradation	Degradation	Degradation

3 Classes	5 Classes
Improvement	Improving
Improvement	Improving
Improvement	Improving
Improvement	Improving
Improvement	Improving
Degradation	Stable
Stable	Stable
Stable	Stable
Stable	Stable
Degradation	Stable but stressed
Degradation	Early signs of decline
Degradation	Declining
Degradation	Declining
Degradation	Declining
Degradation	Declining
Degradation	Declining
Degradation	Declining
Degradation	Declining

Land cover: To assess changes in land cover users need land cover maps covering the study area for the baseline and target years. Corine Land Cover maps for 2012 and 2018 were used, aggregating the land cover classes to a first level including Forest, Grassland, Cropland, Wetland, Artificial Area, Bare Land, and Water Body. Land cover transitions that cause degradation are highlighted in green in the matrix below (source: Trends.Earth 0.67 documentation), on the contrary improvements in the condition of the soil are those highlighted in green whilst Stable areas in the rest of the cases

Land cover in baseline year \ Land cover in target year	Forest	Grassland*	Cropland	Wetland	Artificial area	Bare land	Water body
Forest	0	-	-	-	-	-	0
Grassland*	+	0	+	-	-	-	0
Cropland	+	-	0	-	-	-	0
Wetland	-	-	-	0	-	-	0
Artificial area	+	+	+	+	0	+	0
Bare land	+	+	+	+	-	0	0
Water body	0	0	0	0	0	0	0

Legend

Degradation	Stable	Improvement
-	0	+

*The "Grassland" class consists of grassland, shrub, and sparsely vegetated areas (if the default aggregation is used).

Soil organic carbon: The third sub-indicator for monitoring land degradation as part of the SDG process quantifies changes in soil organic carbon (SOC) over the same reporting period. The changes in the SOC are particularly difficult to evaluate for several reasons: the high spatial variability of the soil properties, the different frequency of monitoring, as well as the different survey methods make SOC estimates difficult to achieve for most of the countries. To simulate the changes of organic carbon in the soil (in the first 30 cm), a combined land cover/SOC method is used in to estimate changes in SOC and identify potentially degraded areas. SoilGrids250m produced by International Soil Reference and Information Centre (ISRIC) was used as a reference estimate for the content in tons per hectare of organic carbon in the first 30 cm of the soil. The same land cover layer mentioned above was also used for this sub indicator. Changes in SOC in land cover transitions involving agriculture, are calculate with different coefficients for each of the main global climatic regions as suggested by the methodology proposed by Conservation International. Negative changes in the carbon content are considered soil degradation while the increases are considered as improving soil conditions.

Final Map of the Land Degradation in Europe: The three sub indicator following the one-out all-out rule are then combined, meaning that if an area was identified as potentially degraded by any of the sub-indicators, then that area will be considered potentially degraded in the European Land Degradation Map. In the same way, for the remaining cases, each single pixel is assigned the value of improvement or stable For detailed information on trends.earth models, the user can visit the website http://trends.earth/docs/en/.