European Commission

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Towards a better characterisation of land degradation and desertification in the European Union

An assessment

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Abstract

Land degradation refers to the long-term decline in the quality and productivity of land resources due to various factors, including human activities and natural. The United Nations Convention to Combat Desertification (UNCCD) defines desertification as land degradation that occurs in drylands. Land degradation is driven by a range of factors and is widespread across the EU.

Among the recommendations of the European Court of Auditors (ECA) Special Report 33/2018 was the need to establish a methodology and relevant indicators to assess the extent of desertification and land degradation in the European Union (EU). To achieve this goal, the ECA report recommended that the Commission should collate and analyse relevant data on land degradation while building on the existing UNCCD indicator framework for SDG 15.3.1 “proportion of land that is degraded over total land area” (this is also referred as the Strategic Objective 1 in the UNCCD Strategic Framework 2018-2030). The outcome of the methodology should be regularly presented in a clear and user-friendly way for public use in the form of interactive maps. The ECA report made no recommendation regarding formal reporting obligations.

The resulting methodology, described in detail in JRC140897 “A methodology to characterise land degradation and desertification in the European Union”, consists of an improvement of the baseline assessment provided by the UNCCD SDG 15.3.1 framework through:

- better characterisation of land cover change, through a more relevant nomenclature for the EU, increased spatial resolution and a revised transition matrix that assess the impact of change based on biophysical changes in vegetation cover;
- an optimised characterisation of land productivity for the EU;
- replacement of the changes in soil organic carbon stock indicator with a more comprehensive and representative soil degradation indicator;
- application of an aridity threshold to define desertification, as highlighted in the ECA report;
- identification of areas vulnerable to desertification based on future scenarios of the Aridity Index.

Importantly, the methodology foresees that the spatial extent of the soil degradation layer can be updated through periodic data collection and derived assessments through the Soil Monitoring and Resilience Directive (entry into force on 16/12/2025).

This document describes the application of the methodology to continental EU, using elements from the EU Soil Observatory Soil Degradation Dashboard as a proxy for soil degradation.

Applying the methodology results in **drylands currently covering 15% of the EU (611 000 km^2),** an area twice the size of Italy. As expected, southwestern, southern and southeastern Member States are most affected.

Consequently**, desertification affects 530 000 km^2 (86.56%)** of this area (equivalent to around 12% of the EU territory) with implications for around **42 million people**.

The highest percentage of land under desertification conditions was observed in Spain (53%), Cyprus (45%) and Greece (36%).

A further **1 004 608 km^2 of the EU is flagged as being at elevated risk of desertification** based on future scenarios for the Aridity Index (2021-2040). Many of these areas are **outside the region currently considered as drylands** (e.g. Germany, Czech Republic, Poland, etc.).

Among the Member States (MS) land with at least one aspect of degradation accounted for the largest share of area in all cases, ranging from 72.74% in Greece, 73.11% in Spain, 73.31 in Slovenia, 73.41 in Hungary to 74.62% in Ireland, while sealed area ranged from 3.06% in Spain, 3.73% in Greece, 4.23% in Ireland, 5.96% in Slovenia to 6.16% in Hungary.

The updated methodology yielded two-to-three-fold higher share of degraded land in most MS compared with the standard SDG 15.3.1 approach (e.g. Sweden and Finland). This increase reflects a **more comprehensive definition of soil degradation** than described in the global UNCCD assessment framework.

As requested by the ECA report, a **user-friendly dashboard** is being made available through the EU Soil Observatory to provide public access to statistics and interactive maps depicting desertification and land degradation.

1 Introduction

One of the recommendations of the 2018 Special Report by the European Court of Auditors (ECA) on land degradation and desertification[1] was that the Commission, in cooperation with the Member States, should:

(a) establish a methodology and relevant indicators starting with the UNCCD's three indicators to assess the extent of desertification and land degradation in the European Union (EU);

(b) based on the agreed methodology, collate and analyse relevant data on desertification and land degradation, much of which is already being collected, and regularly present it in a clear, user friendly way for public use, preferably in the form of interactive maps for use in the EU.

Such a methodology is described in JRC140897 "A methodology to characterise land degradation and desertification in the European Union".

The scope of this document is to describe the application of the updated methodology for the land surface of continental EU. Soil degradation has been assessed with data from the EU Soil Observatory Soil Degradation Dashboard, as a proxy for data that will eventually be reported under the Soil Monitoring Law (expected 2031/2032).

In order to ensure a common understanding of key concepts, the following definitions are carried over from the methodological report:

Land degradation is defined as a persistent reduction in the capacity of the land to support humans and other forms of life on Earth. As reflected by the Sustainable Development Goal (SDG) 15, 'Life on Land', land degradation processes jeopardise the provision of ecosystem services such as productivity and habitats for biodiversity (Schillaci et al., 2022).

Desertification is considered as "land degradation in drylands, as the result of a range of factors, including climatic variations and human activities The term desertification does not describe conditions in areas traditionally described as deserts.

Drylands are areas with arid, semi-arid and dry sub-humid conditions.

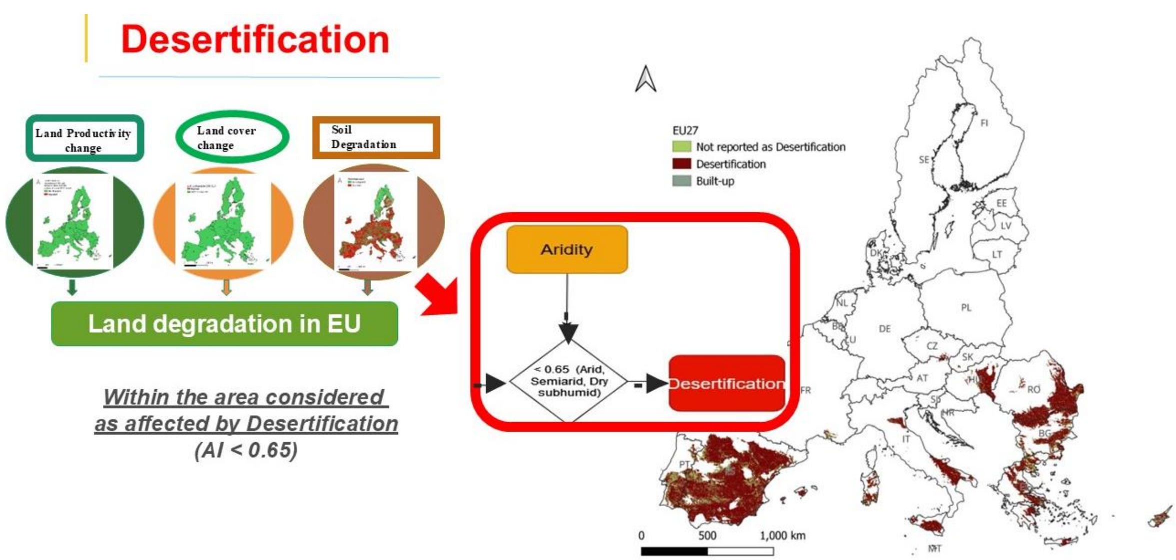
Land degradation **can occur anywhere** and is <u>not limited</u> to dryland regions.

[1] https://www.eca.europa.eu/en/publications?did=48393

2 Applying the new methodological approach

The proposed methodology to assess land degradation and desertification in the EU builds on the three sub-indicator logic of the UNCCD by addressing identified weaknesses and using European-centric datasets (Figure 1). In particular, the new approach adapts the UNCCD SDG15.3.1 methodology through a more accurate definition of the baseline for soil degradation by incorporating more pertinent data for the EU. Furthermore, land productivity is based on the trajectory of NDVI trends from 2000-2018 recently published by (Prăvălie *et al.*, 2024). Finally, degradation due to land cover changes is based on CORINE land cover data from 2000-2018, which incorporates a new biophysical based matrix based on NDVI changes within individual CORINE land cover classes (Schillaci et al. 2026). This latter approach allows the identification of degradation due to land cover change when primary land cover units do not change.

Figure 1. Updated framework to assess land degradation and desertification. Indicators on land cover change, land productivity dynamics and soil degradation are combined in a One-Out-All-Out (1OAO) approach with an aridity mask. See report JRC140897 "A methodology to characterise land degradation and desertification in the European Union" for more detailed explanations.



Source: Own elaboration

2.1 Data used

The following section describes the datasets (Table 1) used to define the SO1-1, SO1-2 and SO1-3 indicators. All data are scaled to 100 m and overlaid using the EPSG 3035 Lambert azimuthal equal area (LAEA) projection system.

Table 1. Data used in the application of the new methodology for the EU versus default global datasets.

Strategic Objective target	**Data used for the EU application (100-500 m)**	**Default in Performance Review and Assessment of Implementation System (PRAIS) Spatial resolution (300-1000 m)**
SO1-1 Trends in land cover	Copernicus CORINE (LAND COVER) (Schillaci et al. under review)	Land cover from the European Space Agency (ESA CCI), Trends.Earth
SO1-2 Trends in land productivity or functioning of the land	Land Productivity derived from MODIS NDVI time series (Prăvălie *et al.*, 2024)	A set of land productivity indicators derived from NDVI time series (source datasets: MODIS, AVHRR) Trends.Earth
SO1-3 Trends in carbon stocks above and below ground	EUSO Dashboard based on several LUCAS physical, chemical and biological soil properties, and modelled data (e.g. soil erosion, wildfire effect RCOVER).	ISRIC SoilGrids Soil Organic Carbon stock dataset, Trends.Earth
SO1-4 Proportion of land degraded over the total land area	Application of the One Out All Out (1OAO) methodology, in which the revised SO1-1, SO1-2, SO1-3 are combined.	Application of the One Out All Out (1OAO) methodology, in which SO1-1, SO1-2, SO1-3 are combined in Trends.Earth

Source: own elaboration

3 Land degradation

3.1 SO1-1 Land degradation due to land cover changes

As described in report JRC140897 “A methodology to characterise land degradation and desertification in the European Union” the new approach to assess land degradation due to changes in land cover are based on a higher spatial resolution and more nuanced nomenclature for European conditions that is provided by the Copernicus Land Monitoring Service CORINE Land cover dataset (Schillaci et al., 2026).

In addition, a biophysical approach, based on long-term trends in a vegetation index, was used to assess land degradation as a result of changes where the higher-level classes remained unchanged, which would have been defined as stable in the standard approach (Table 2).

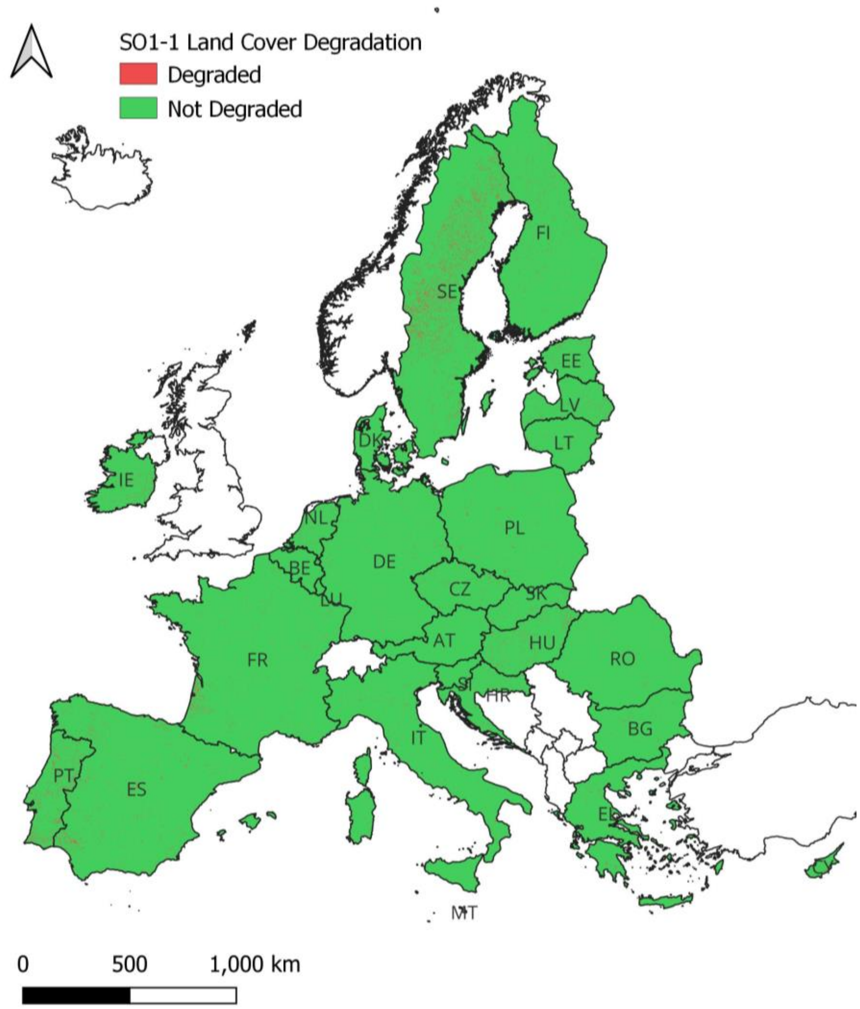
Table 2. Additional changes in CORINE level 1 land cover classes 2000-2018 due to the introduction of within class changes.

	Changed within CLC%	Improved	Degraded	Stable	Changed between CLC %	Improved	Degraded	Stable
CLC level-one Artificial surfaces	1.06%	0.67	0.10	99.24	0.60%	100.00	*	*
CLC level-one Agriculture	0.96%	0.49	0.35	99.16	0.82%	29.48	70.52	*
CLC level-one Forests and semi-natural areas	7.32%	3.60	2.49	93.91	0.34%	*	100.00	*
CLC level-one Wetlands	0.03%	0.02	0.00	99.97	1.05%	54.37	45.63	*
CLC level-one Water bodies	0.03%	0.00	0.02	99.98	0.09%	71.86	28.14	*

Source: Schillaci et al., 2026.

Changes in land cover were assessed for the period 2000-2018. The assessment of degradation due to land cover change is presented in Figure 2 and Table 3.

Figure 2. SO1-1. Red areas denote degradation as a result of land cover change.



Source: own elaboration,

Table 3. Land degradation due to land cover change by Member States.

Member	Not	Degraded	Tot area	% Land cover
SE	42617011	2356701	44973712	5.24
PT	8427875	457918	8885793	5.15
CY	895919	31860	927779	3.43
HU	9034556	268662	9303218	2.89
EE	4428193	109875	4538068	2.42
LV	6304228	155744	6459972	2.41
IE	6824432	167370	6991802	2.39
NL	3663302	74137	3737439	1.98
HR	5539361	104382	5643743	1.85
ES	49041721	824716	49866437	1.65
FI	33273485	493424	33766909	1.46
LT	6400074	92990	6493064	1.43
CZ	7779453	107922	7887375	1.37
SK	4837601	63338	4900939	1.29
FR	54346946	556118	54903064	1.01
EL	13058794	121327	13180121	0.92
BG	11001593	100939	11102532	0.91
DK	4327801	37536	4365337	0.86
PL	30937185	256670	31193855	0.82
LU	257524	2094	259618	0.81
IT	29849039	237272	30086311	0.79
DE	35502402	273815	35776217	0.77
BE	3047857	19096	3066953	0.62
RO	23703392	132642	23836034	0.56
AT	8366894	27947	8394841	0.33
MT	31286	95	31381	0.30
SI	2021856	4943	2026799	0.24

Source: own elaboration

3.2 SO1-2 Land degradation from the land productivity

In the UNCCD 15.3.1 approach, net primary productivity (NPP) is used to compute three productivity sub-indicators (i.e. trajectory, performance and state). The updated methodology has adopted the vegetation degradation raster used in (Prăvălie et al., 2024), which is based on annual NDVI data derived from MODIS data from Terra MOD13A1.

The NDVI trends remain one of the most widely used and robust approaches for evaluating vegetation health and long-term land productivity dynamics, due to their strong relationship with NPP and their capacity to provide temporally consistent observations across large spatial extents (Zhao et al., 2005). Furthermore, NDVI-based indicators are particularly suitable for continental-scale applications because they allow harmonized comparisons among regions and support operational land degradation assessments under the UNCCD framework (Ivits et al., 2013). Applying this methodology results in approximately 4.1% of the EU being classified as degraded land due to land productivity dynamics (Figure 3, Table 4).

Nevertheless, recent research highlights that multiple complementary approaches can be used to assess LP trends, each capturing different ecological processes and environmental constraints. Beyond NDVI-based productivity assessments, Water Use Efficiency (WUE) indicators derived from MODIS16A2 evapotranspiration products have gained increasing relevance for evaluating how efficiently ecosystems utilize water resources to sustain biomass production, particularly in water-limited environments (Hatfield & Dold, 2019). WUE-based approaches often provide more conservative and ecologically realistic estimates of degradation and improvement patterns, especially in regions affected by drought stress or irrigation pressures. Similarly, Rain Use Efficiency (RUE) approaches derived from CHIRPS precipitation datasets enable the evaluation of the relationship between rainfall availability and vegetation productivity, offering valuable insights into ecosystem resilience under variable climatic conditions (Funk et al., 2015). Such approaches are particularly relevant in regions characterized by strong rainfall variability and increasing climate pressures. Collectively, these methodologies demonstrate that LP assessment can be supported by multiple EO-derived indicators, each emphasizing different aspects of ecosystem functioning, resource limitation, and vegetation response. The integration of complementary LP products therefore represents an important opportunity to improve the robustness, environmental sensitivity, and policy relevance of SDG 15.3.1 land degradation assessments across diverse European landscapes.

Applying the methodology results in 4.1 % of the EU being defined as degraded land due to land productivity dynamics (Figure 3, Table 4).

Figure 3. SO1-2. Red areas denote degradation as a result a decrease in land productivity based on the Mann-Kendall (MK) test and Sen's slope estimator in the analysis of annual NDVI trends.

Source: own elaboration

Table 4. Land degradation due to land productivity change by Member States.

Member State	Not degraded	Degraded	Tot area	% Land
CY	816432	111347	927779	12.00
LT	5835706	657365	6493071	10.12
LV	6028324	431648	6459972	6.68
PT	8330620	555173	8885793	6.25
IE	6562277	429525	6991802	6.14
BE	2892902	174051	3066953	5.68
FR	52023533	2879531	54903064	5.24
ES	47276317	2590120	49866437	5.19
SK	4656526	244413	4900939	4.99
DK	4155419	209918	4365337	4.81
SE	42820460	2153252	44973712	4.79
NL	3567566	169873	3737439	4.55
LU	247936	11682	259618	4.50
HR	5436341	207402	5643743	3.67
RO	22963988	872171	23836159	3.66
EE	4379047	159021	4538068	3.50
PL	30144538	1049317	31193855	3.36
DE	34590600	1185617	35776217	3.31
HU	9001575	301643	9303218	3.24
AT	8153628	241213	8394841	2.87
BG	10795826	306706	11102532	2.76
FI	32888714	878195	33766909	2.60
SI	1977902	48897	2026799	2.41
IT	29388242	698069	30086311	2.32
EL	12918910	261386	13180296	1.98
CZ	7768151	119224	7887375	1.51
MT	30992	389	31381	1.24

Source: own elaboration

3.3 SO1-3 Land degradation from the soil component

In lieu of the availability of data flows from the Soil Monitoring Law (SML), soil condition has been based on a set of indicators described by the EUSO Soil Degradation Dashboard (Panagos *et al.*, 2024a). The selected indicators (Table 5) reflect several of the descriptors from the SML and use a ‘convergence of evidence’ approach to define areas experiencing multiple soil degradation processes (Figure 4). Future actions should lead to an enhanced indicator that includes, for example, a better representation of diffuse soil pollution, salinization and compaction.

With respect to the ‘default’ parameter of changes in soil organic carbon stocks, the new methodology delivers a more realistic baseline of soil degradation for 2015 rather than changes in degradation status (as per the UNCCD framework).

For each indicator, thresholds are set to represent an understanding of the point beyond which most soils can reasonably be considered degraded or vulnerable to a certain process. If any indicator exceeds the threshold, the location is classified as degraded (i.e. following the UNCCD ‘one out all out’ principle). Most thresholds are set at EU-level on the basis of published scientific criteria.

A ‘0’ value indicates that none of the soil degradation indicators exceeds the thresholds set (Table 5). It should be noted that the zero-level can also highlight knowledge or data gaps (e.g. on diffuse pollution). This map is updated as new data are made available. Each dataset is subject to a degree of uncertainty (e.g. scale, resolution, method of assessment, date) and underlying assumptions, which need to be considered when reading the map.

Applying this methodology results in soil degradation occurring over 56.4% of the study area (Figure 5, Table 6).

Table 5. Soil degradation indicators included in the EUSO Soil Degradation Dashboard, and their respective thresholds and data sources.

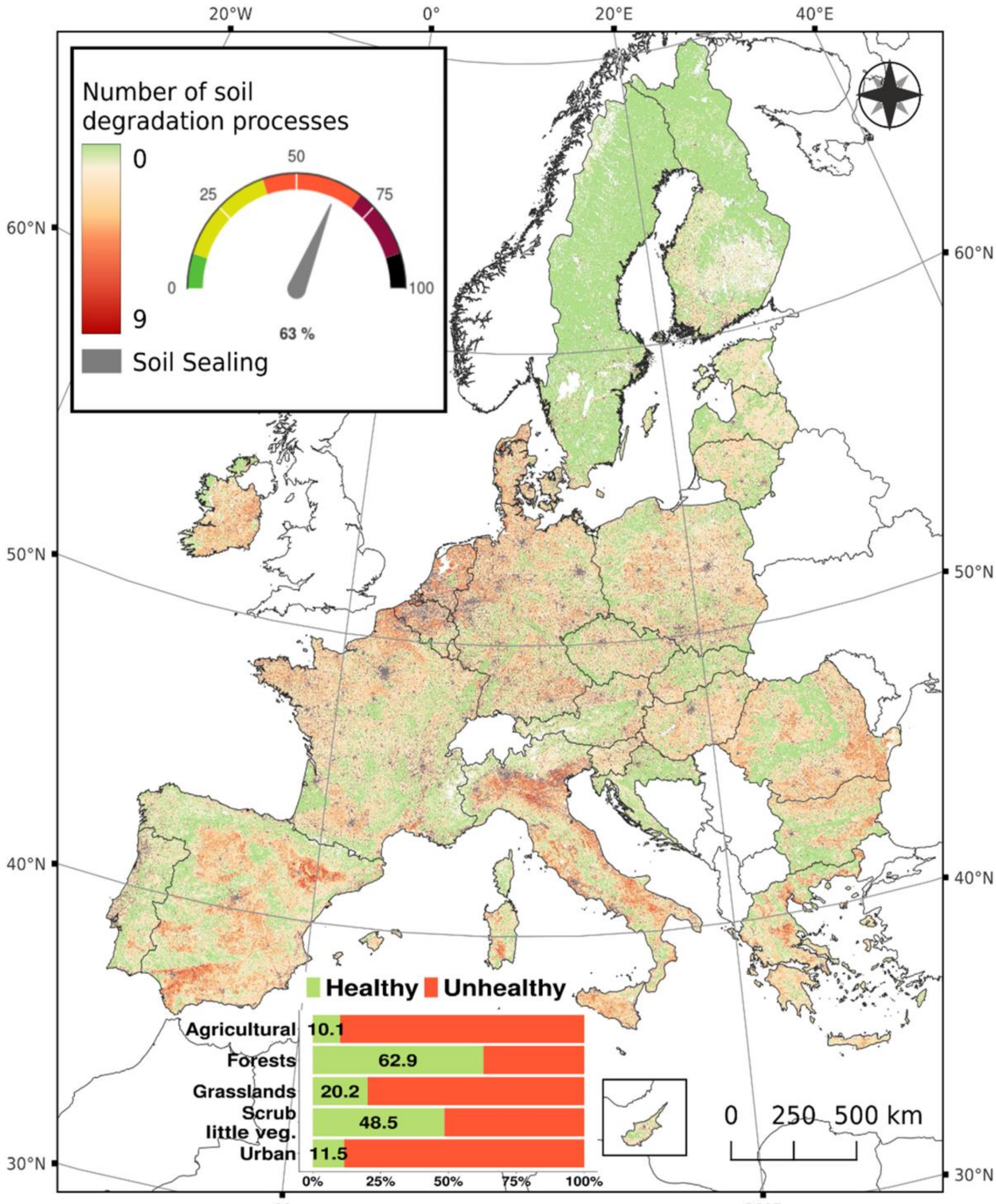
Groups of soil degradation processes	**Indicator**	**Threshold**	**Reference**
Erosion	Water erosion	Erosion rate > 2 tonnes ha^{-1} yr^{-1}	Panagos et al., 2020
	Wind erosion	Erosion rate > 2 tonnes ha^{-1} yr^{-1}	Borrelli et al., 2017
	Tillage erosion	Erosion rate > 2 tonnes ha^{-1} yr^{-1}	Borrelli et al., 2023
	Harvest erosion	Erosion rate > 2 tonnes ha^{-1} yr^{-1}	Panagos et al., 2019
	Post fire recovery	Recovery rate < 1	Vieira et al., 2023

Pollution	Copper excess	Cu concentration > 100 mg kg^{-1}	Ballabio et al., 2018
	Mercury excess	Hg concentration > 0.5 mg kg^{-1}	Ballabio et al., 2021
	Zinc excess	Zn concentration > 100 mg kg^{-1}	Van Eynde et al., 2023
	Cadmium excess	Cd concentration > 1 mg kg^{-1}	Ballabio et al., 2024
	Arsenic excess	P Exceedance probabilities for limit of action in Europe 45 mg kg^{-1}) > 5%	Fendrich et al:, 2024
Nutrients	Nitrogen surplus	Agricultural areas where N surplus > 50 kg ha^{-1} yr^{-1}	Grizzetti et al., 2022; Lugato et al., 2018
	Phosphorus deficiency	P deficiency < 20 mg kg^{-1}	Ballabio et al., 2019
	Phosphorus excess	P excess > 50 mg kg^{-1}	Ballabio et al., 2019
Loss of soil organic carbon	Distance to max SOC level	Distance to max SOC level > 60%	De Rosa et al., 2024
Loss of soil biodiversity	Potential threat to biological functions	≥ Moderately-high level of risk	Orgiazzi et al., 2016
Compaction	Packing density	Packing density ≥ 1.75 g cm^{-3}	Panagos et al., 2024
Salinization	Secondary salinization risk	Areas in Mediterranean region where >30% is equipped for irrigation	Siebert et al., 2013
Loss of organic soils	Peatland degradation risk	Peatlands under hotspots of cropland	United Nations Environment Programme (UNEP), 2022

Soil sealing	Built-up areas	No threshold (all built-up areas)	Copernicus, 2018

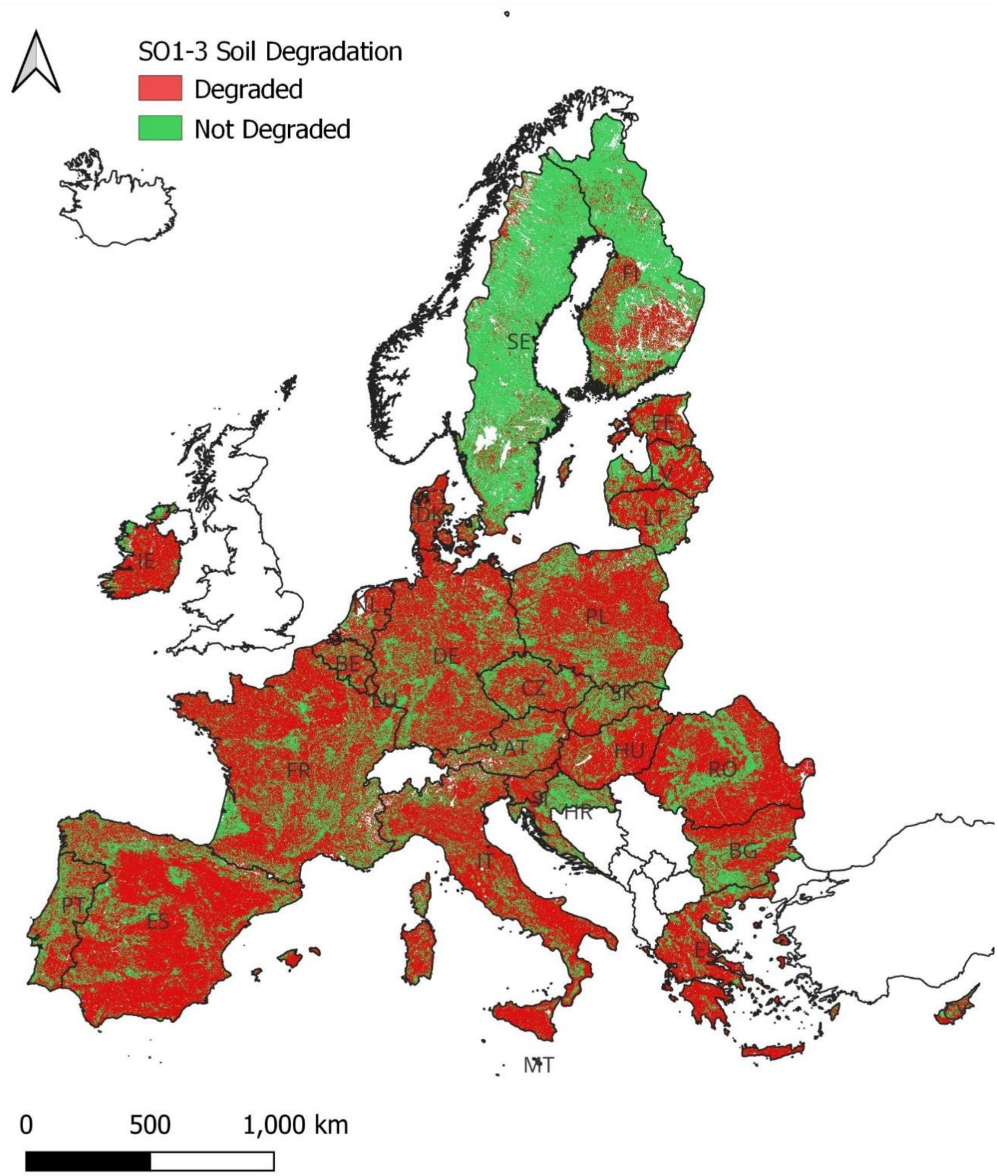
Source: own elaboration

Figure 4. Convergence of evidence of soil degradation in the EU according to the EUSO Soil Degradation Dashboard.



Source: Panagos et al., 2024.

Figure 5. SO1-3. Red areas denote soil degradation based on new baseline from the EUSO Dashboard.



Source: own elaboration

Table 6. Land degradation due to soil change by Member States.

Member	Not degraded	Degraded	Tot area	% Soil
SI	487415	1539384	2026799	75.95
IE	1760141	5231661	6991802	74.83
HU	2452981	6850237	9303218	73.63
EL	3478212	9702084	13180296	73.61
ES	13696801	36169636	49866437	72.53
IT	8642837	21443474	30086311	71.27
RO	7222406	16613753	23836159	69.70
DK	1351406	3013931	4365337	69.04
EE	1538718	2999350	4538068	66.09
PL	10997574	20196281	31193855	64.74
LU	92060	167558	259618	64.54
FR	19865406	35037658	54903064	63.82
BE	1127016	1939937	3066953	63.25
DE	13226742	22549475	35776217	63.03
NL	1388551	2348888	3737439	62.85
MT	11754	19627	31381	62.54
BG	4297154	6805378	11102532	61.30
LT	2540340	3952731	6493071	60.88
LV	2618353	3841619	6459972	59.47
CY	384332	543447	927779	58.58
CZ	3289673	4597702	7887375	58.29
PT	4101050	4784743	8885793	53.85
AT	3924650	4470191	8394841	53.25
SK	2365248	2535691	4900939	51.74
HR	3516977	2126766	5643743	37.68
FI	25252622	8514287	33766909	25.21
SE	40310350	4663362	44973712	10.37

Source: own elaboration

3.4 SO1-4 Extent of degraded land in the European Union

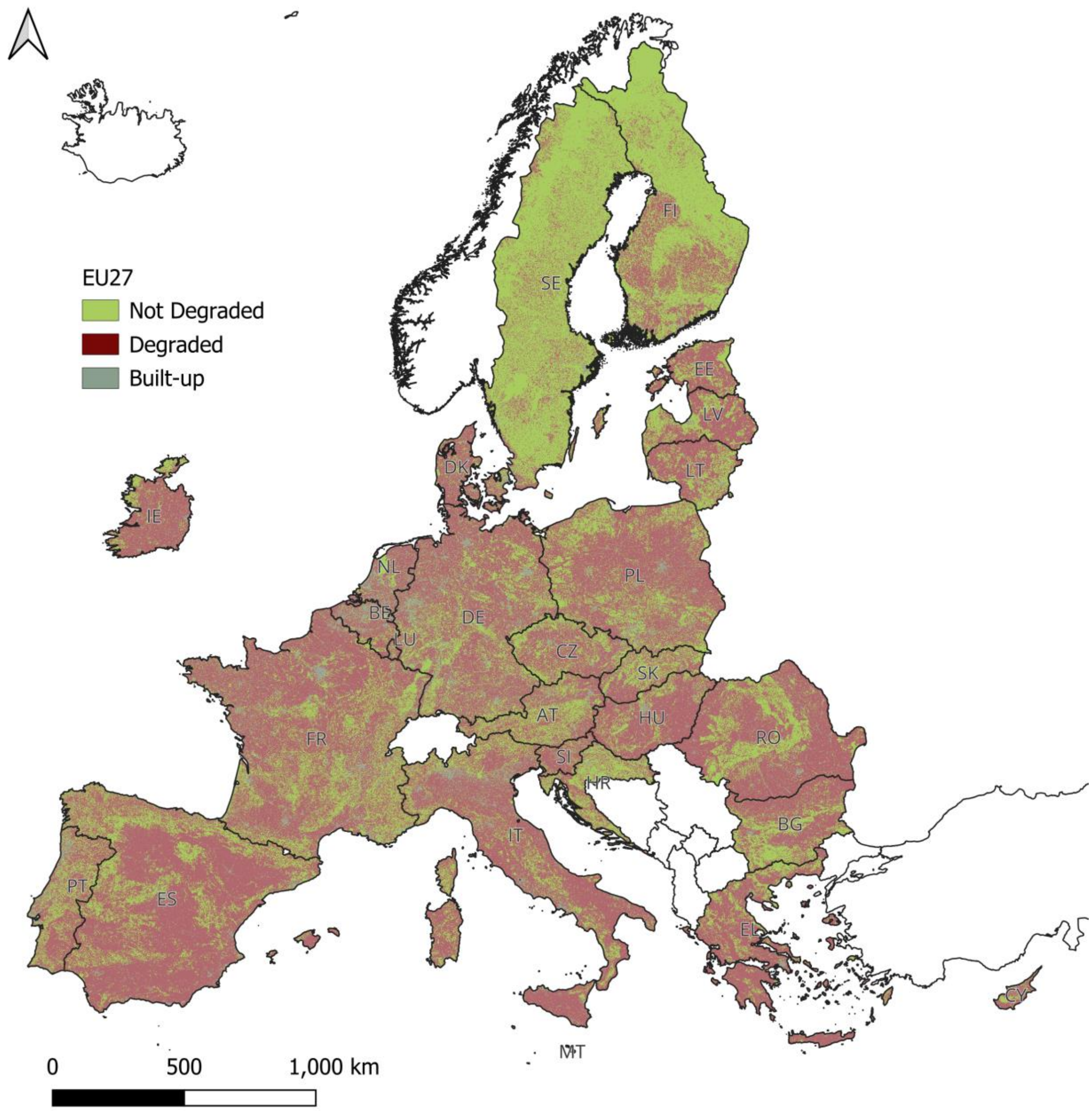
Combining the three SO1 indicators allows us to generate SO1-4, the proportion of land degraded over the total land area (Figure 6, Table 7), with statistics at MS level presented in (Figure 7 & 8).

Table 7. Land degradation by Member States.

Member States	Non degraded %	Degraded %	Built up %
IE	20.63	75.33	4.04
SI	20.71	73.34	5.96
DK	21.67	68.02	10.31
EE	30.98	67.52	1.50
PL	30.52	63.37	6.11
LT	33.71	63.00	3.29
FR	29.40	62.64	7.41
LV	35.91	62.35	1.74
LU	27.41	61.76	10.83
DE	28.94	60.24	10.81
NL	23.98	58.54	17.48
BE	23.35	58.08	18.57
CZ	35.62	55.21	7.08
IT	21.84	55.19	6.55
HU	18.59	54.14	4.68
MT	15.90	54.10	30.00
SK	41.43	52.04	5.81
AT	41.52	51.32	6.27
EL	16.93	43.44	1.40
RO	23.78	42.34	2.62
HR	55.35	40.26	4.39
PT	23.03	30.15	5.64
BG	27.63	28.31	1.50
FI	70.92	27.37	1.71
ES	14.14	20.29	1.00
SE	79.27	19.30	1.43
CY	9.94	16.59	1.56

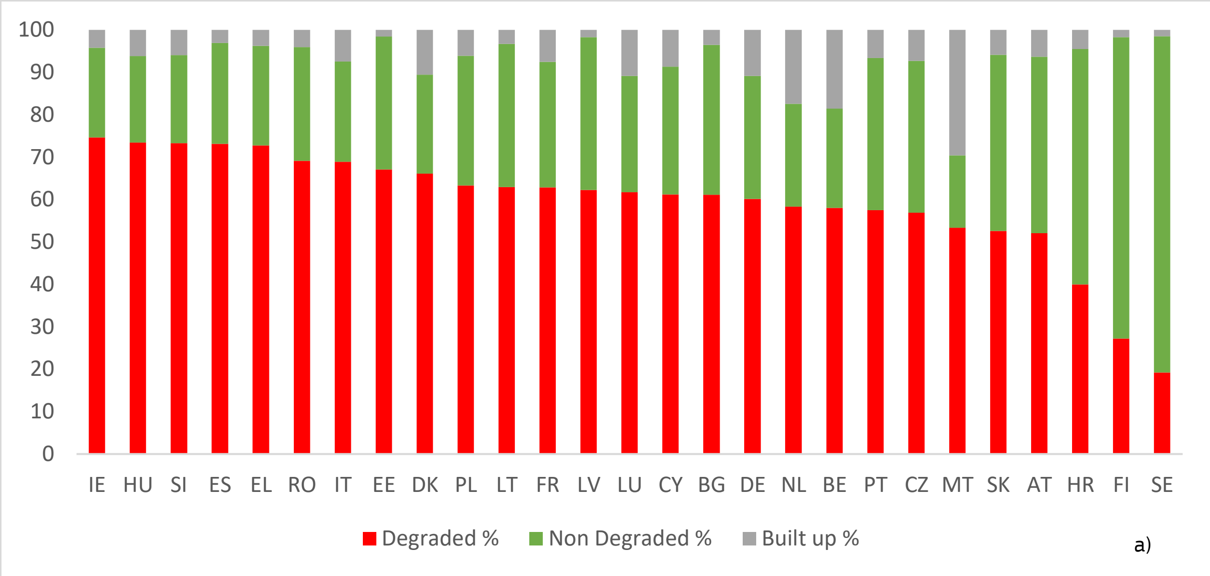
Source: own elaboration

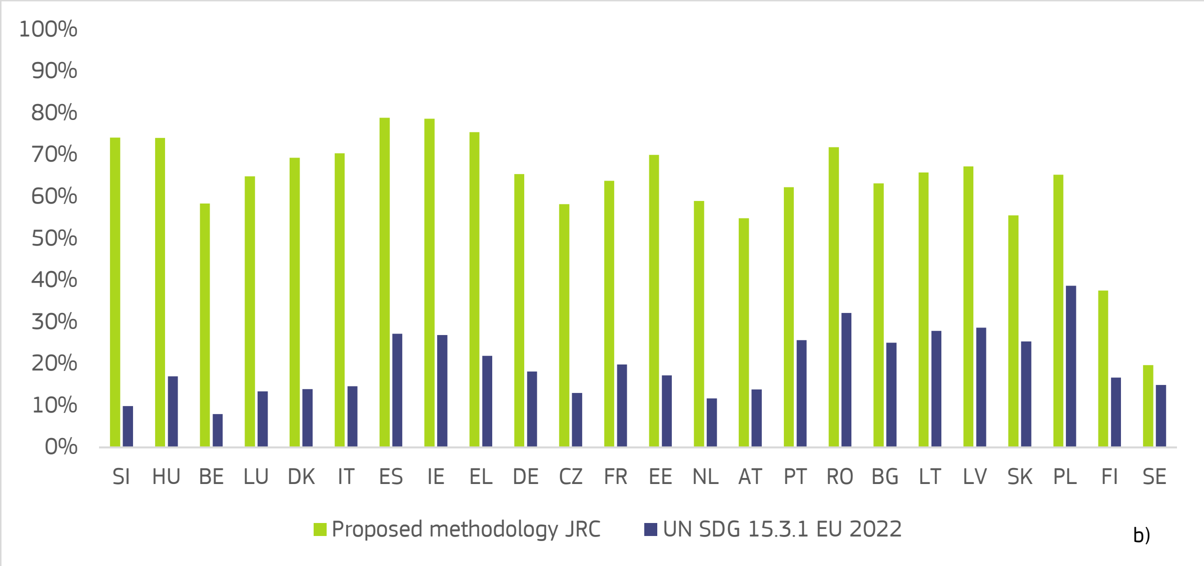
Figure 6. Map showing areas with multiple land degradation processes reflecting the three sub-indicators: land cover degradation (SO1-1), land productivity degradation (SO1-2) and soil degradation (SO1-3), combined with the 1OAO approach.



Source: own elaboration

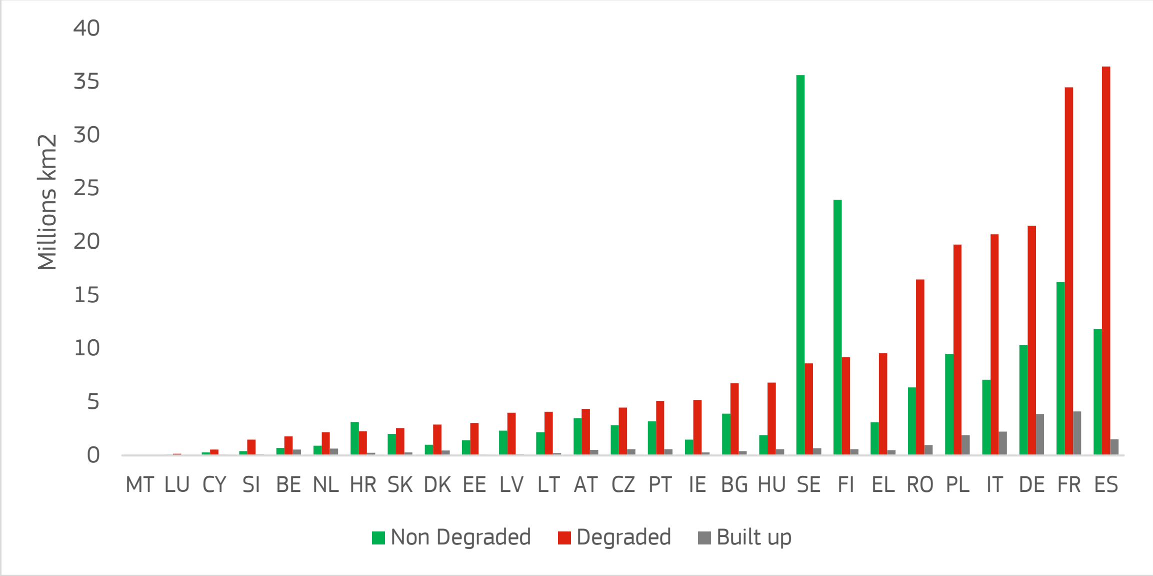
Figure 7a. Distribution of degraded land, non-degraded and built up in % of the country area (SO1-4). 7b. Difference between the proposed methodology and the previously published assessment of the SDG 15.3.1 at EU level Schillaci et al.,2022.





Source: own elaboration

Figure 8. Distribution of degraded land, non-degraded and built-up in million km².



Source: own elaboration

3.5 Results

Applying the updated methodology to the EU shows land degradation is evident in all Member States (Figures 6, Table 7).

More than 50% of Ireland, Hungary, Slovenia, Spain, Greece, Romania, Malta and Italy are classified as degraded with Estonia and Denmark close behind.

With the exception of Sweden and Finland, the methodology yielded a two- to three-fold increase in the share of degraded land per Member State, compared to the standard SDG 15.3.1 approach. This reflects a more realistic, evidence-based, characterisation of soil degradation processes compared to the global 15.3.1 framework.

The data on land degradation for the PRAIS 2022 reporting period reveals significant variations in the proportion of degraded land across different countries. A total of 14 countries have made their reporting available. The countries with the largest areas of degraded land are Spain (55 631 km²), Italy (36 990 km²), and Hungary (13 229 km²). Finland reports the lowest area with (1 327) km² (Figures 12a,12b).

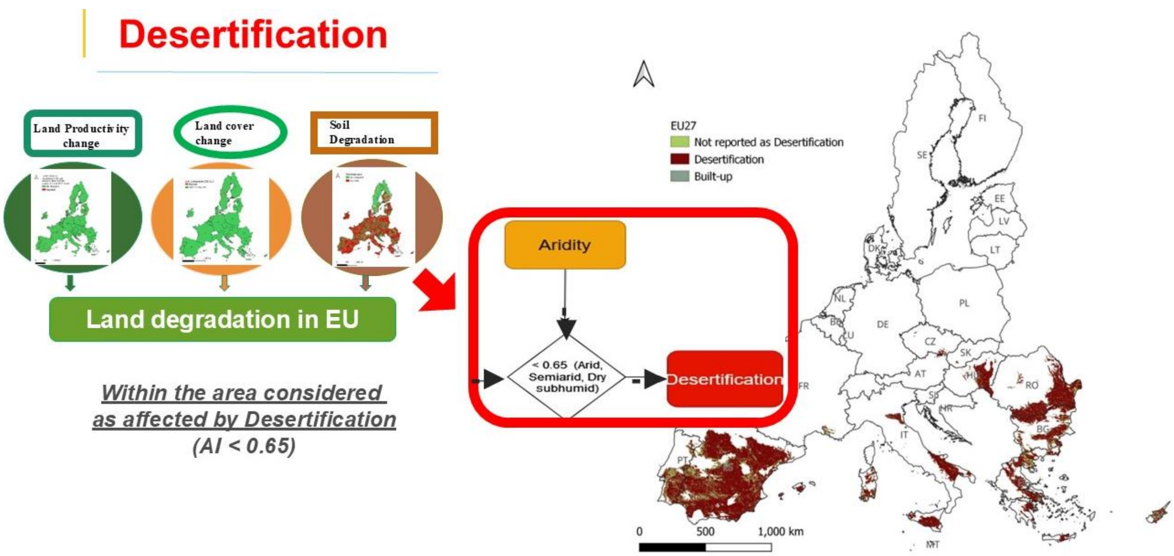
Other countries with notable areas of degraded land for their size include Lithuania (9 106 km²), Slovakia (5 585 km²) and Portugal (5 368 km²).

It is worth noting that the data in the PRAIS reports only provides information on the proportion of degraded land over the total land area for each country, without specifying the causes or consequences of land degradation. Further analysis would be necessary to understand the underlying factors driving land degradation in these countries and to identify potential strategies for mitigation and restoration.

4 Defining the extent of desertification

Building on the ECA report, desertification is defined as land degradation in arid areas. Consequently, the methodology applies United Nations Environment Programme (UNEP) thresholds for the Aridity Index (Table 8) to define the extent of dry lands (Figure 9,10), which when masked with the land degradation layer defines desertification (see Figure 9).

Figure 9. Definition of the extent of desertification through the application of aridity thresholds.



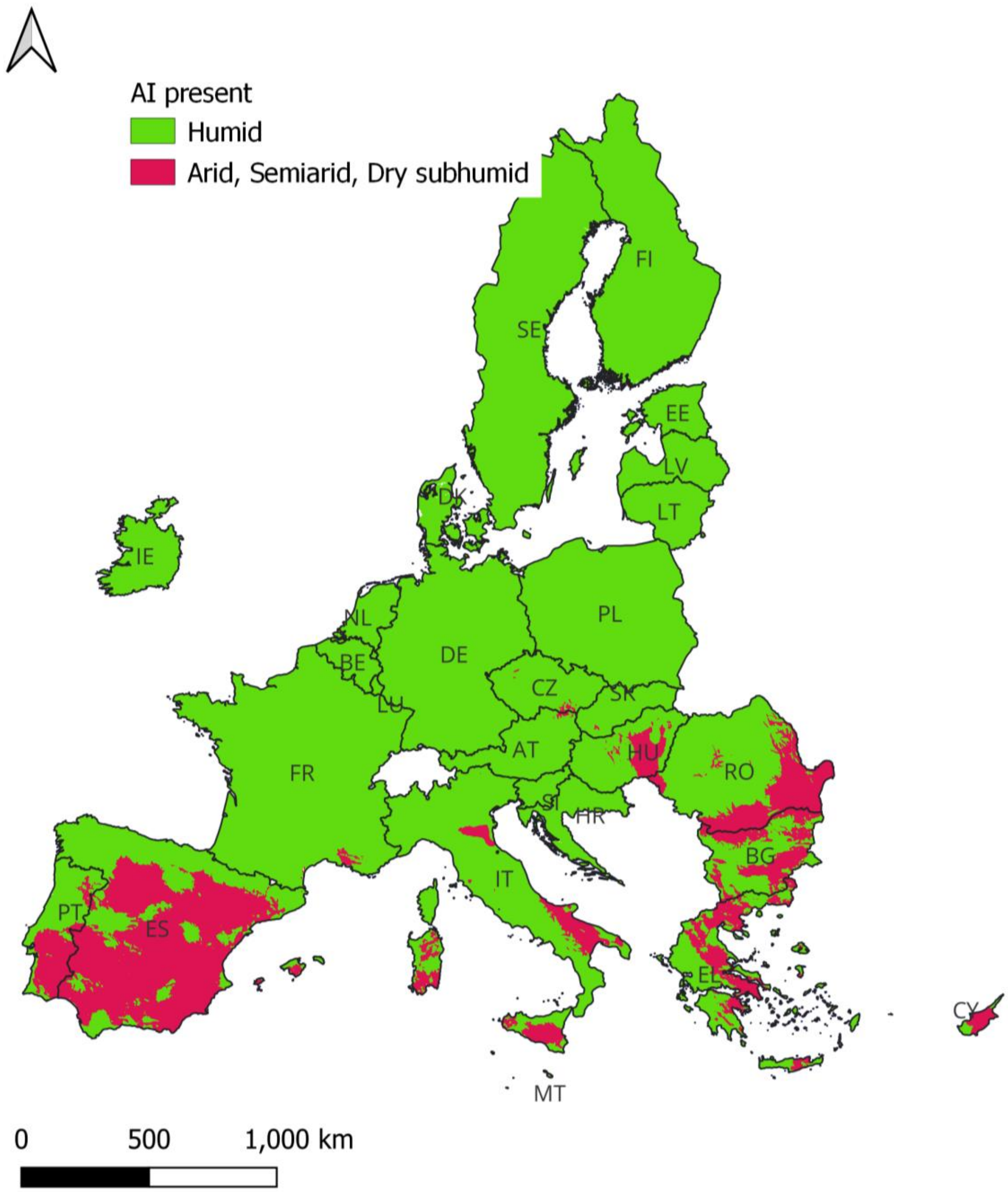
Source: own elaboration

Table 8. Aridity Index classes**.**

Aridity Index Value	Climate Class
<0.03	Hyperarid
0.03–0.2	Arid
0.2–0.5	Semi-arid
0.5–0.65	Dry subhumid
>0.65	Humid

Source: UNEP

Figure 10. Map of the extent of drylands reflecting the reclassification of Aridity Index of arid, semi-arid and dry subhumid (AI 0.03-0.65).

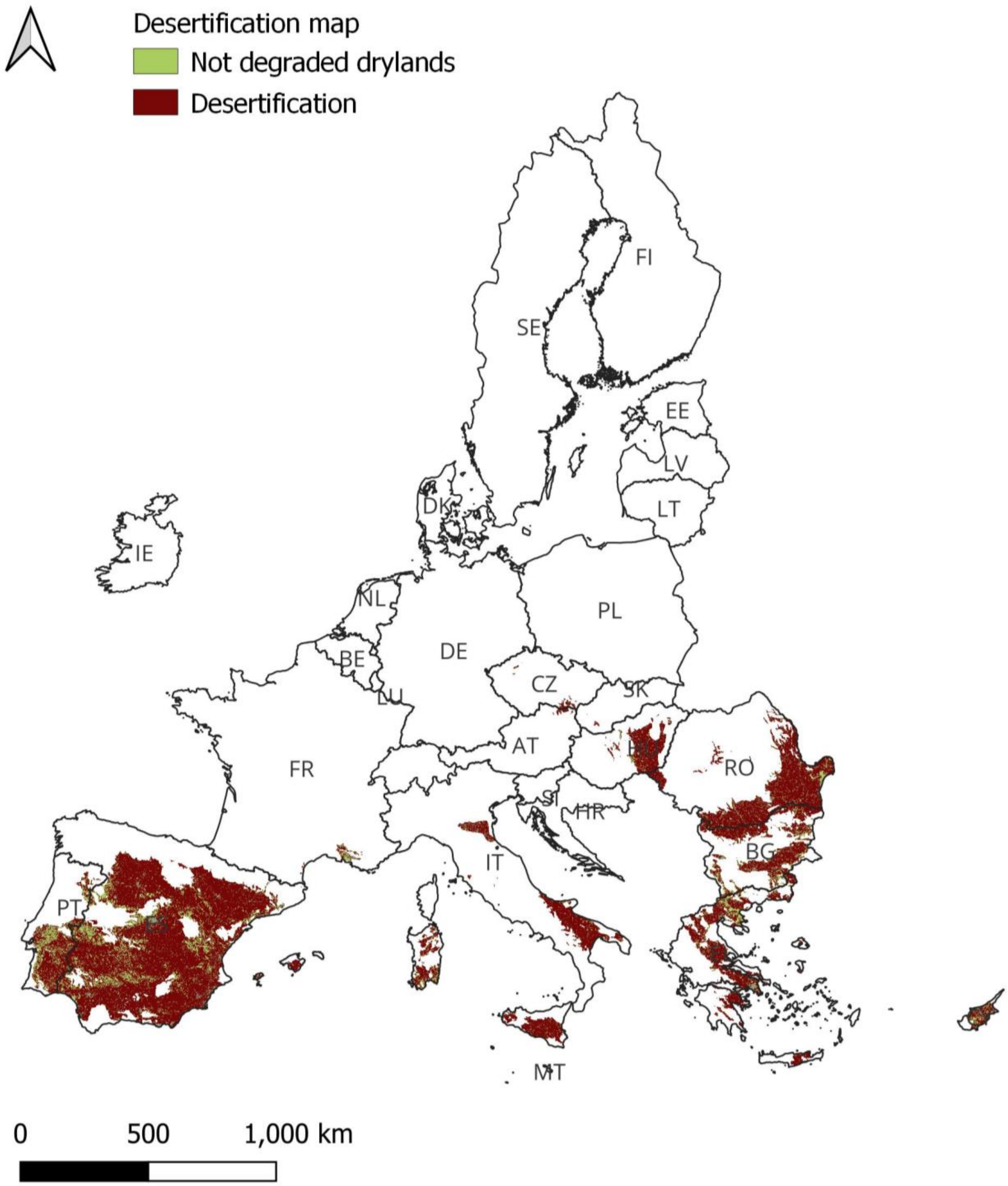


Source: own elaboration

Applying the proposed methodology results in a designation that approximately 15% of the EU's land area is affected by desertification (Figure 10, Table 10).

The most affected regions include Spain, Italy, and Greece, Romania and Bulgaria. Spain and Portugal have a considerable proportion of land classified as degraded and a higher share of desertification (50% and 25% respectively).

Figure 11. Map of the extent desertification based on the proposed methodology.



Source: own elaboration

Table 9. Summary of desertification for EU Member States.

Member States	Desertification %	Built up %
AT	0.77	0.06
BE	-	-
BG	32.85	2.05
CY	45.15	6.82
CZ	1.65	0.20
DE	-	-
DK	-	-
EE	-	-
EL	30.02	2.04
ES	52.92	2.01
FI	-	-
FR	0.28	0.10
HR	-	-
HU	19.28	1.48
IE	-	-
IT	13.97	0.85
LT	-	-
LU	-	-
LV	-	-
MT	-	-
NL	-	-
PL	-	-
PT	27.47	1.00
RO	26.83	1.48
SE	-	-
SI	-	-
SK	0.59	0.07

Source: own elaboration

5 Areas at risk of future desertification

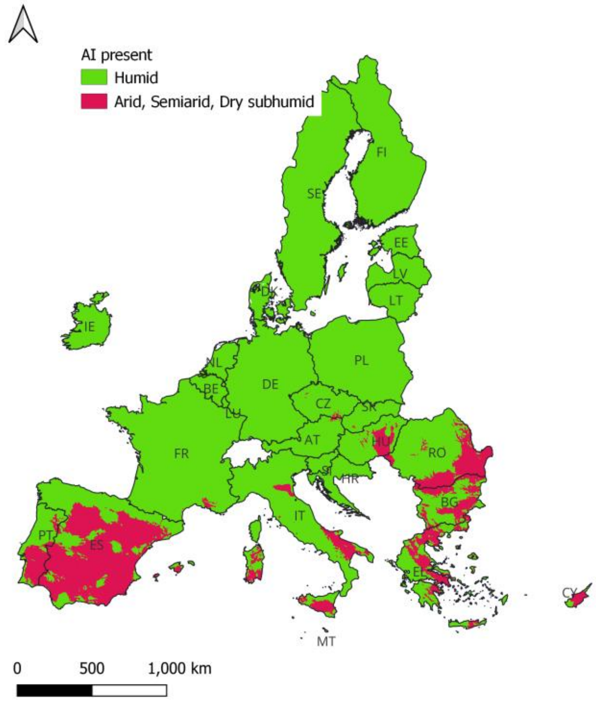
The ECA report notes that projections on climate change in the EU indicate that the risk of desertification is increasing. Precipitation is projected to become scarcer in some parts as droughts occur more frequently. In parallel, temperatures are projected to increase by more than 2°C in certain regions by the end of the century. Over the same time period, summer precipitation is projected to decrease by 50% or more in southern Europe.

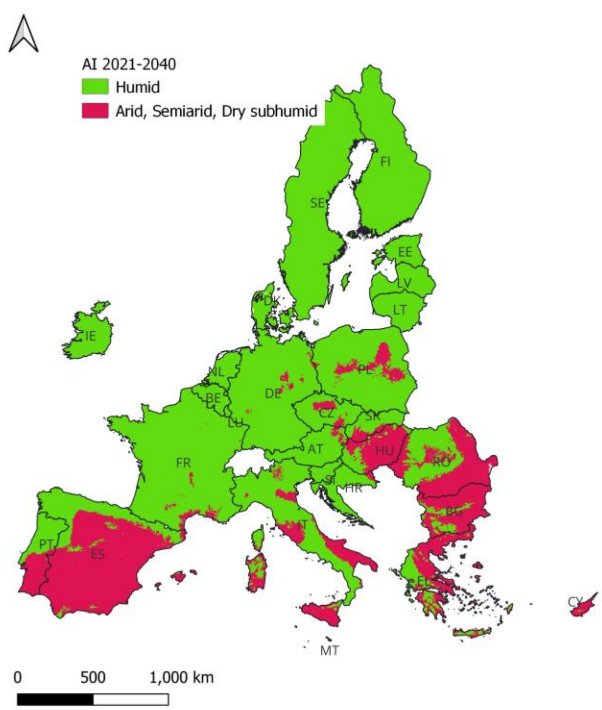
To assess areas at future risk of desertification, the methodology uses the Future Projections Global Aridity Index and Potential Evapotranspiration Database (Future_Global_AI_PET Version 1 Zomer & Trabucco, 2024).

The resulting changes of areas at future risk of increasing aridity is shown in Figures 12 and 13, this represent the result of the climatic modelling scenario (Zomer *et al.*, 2024).

Based on the aforementioned scenarios, the European Union is expected to undergo a measurable expansion of dryland conditions over the coming two decades. In particular, the areas classified as dry sub-humid or drier (AI < 0.65) are projected to increase by approximately 5–10% of the EU territory, corresponding to an expansion of about 200,000 to 400,000 km². Within this broader shift, zones characterized by semi-arid conditions (AI < 0.5) are also expected to expand, with an estimated increase of 2–5%, equivalent to roughly 80,000 to 200,000 km². The most pronounced changes are projected to occur in Southern Europe, notably in Spain, Italy, Greece, and the Balkan region, where drying trends are already evident, as well as across transitional zones including parts of France, Hungary, and Romania, which are likely to experience progressive shifts toward more arid climatic regimes (Zomer et al., 2024).

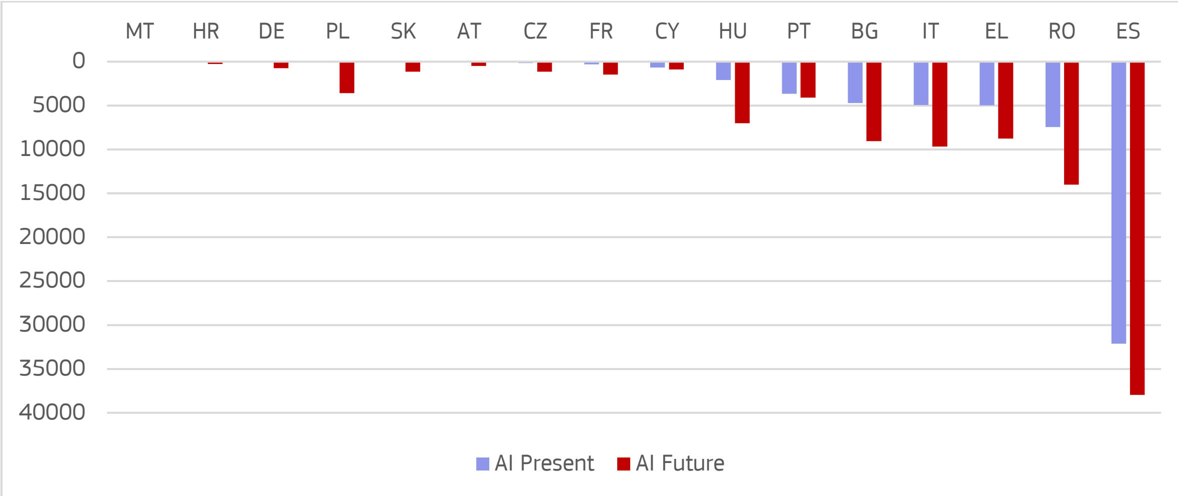
Figure 12. Future scenario of changes in the extent of drylands for 2040 (right) versus the present (left). The red areas on both maps denote Aridity Index values between 0.03-0.65. The map on the left indicates the current situation. The map on the right shows the predicted area of drylands for 2040 (Zoomer et al 2024).





Source: own elaboration

Figure 13. Present distribution of drylands (AI > 0.65) in km^2 and projected increase from the present to the 2040 (Sources: CHELSA, Zoomer et al 2024).



Source: own elaboration

6 Population affected by desertification in the EU

As a proxy for SO2.1 Trends in population living below the relative poverty line or income inequality in affected areas Eurostat regional data on people at risk of poverty or social exclusion[2] can be used to give an indication areas where additional support may be needed (Figure 14). It should be noted that this indicator is generally considered relevant to less developed countries, where extreme poverty and destitution are core development challenges.

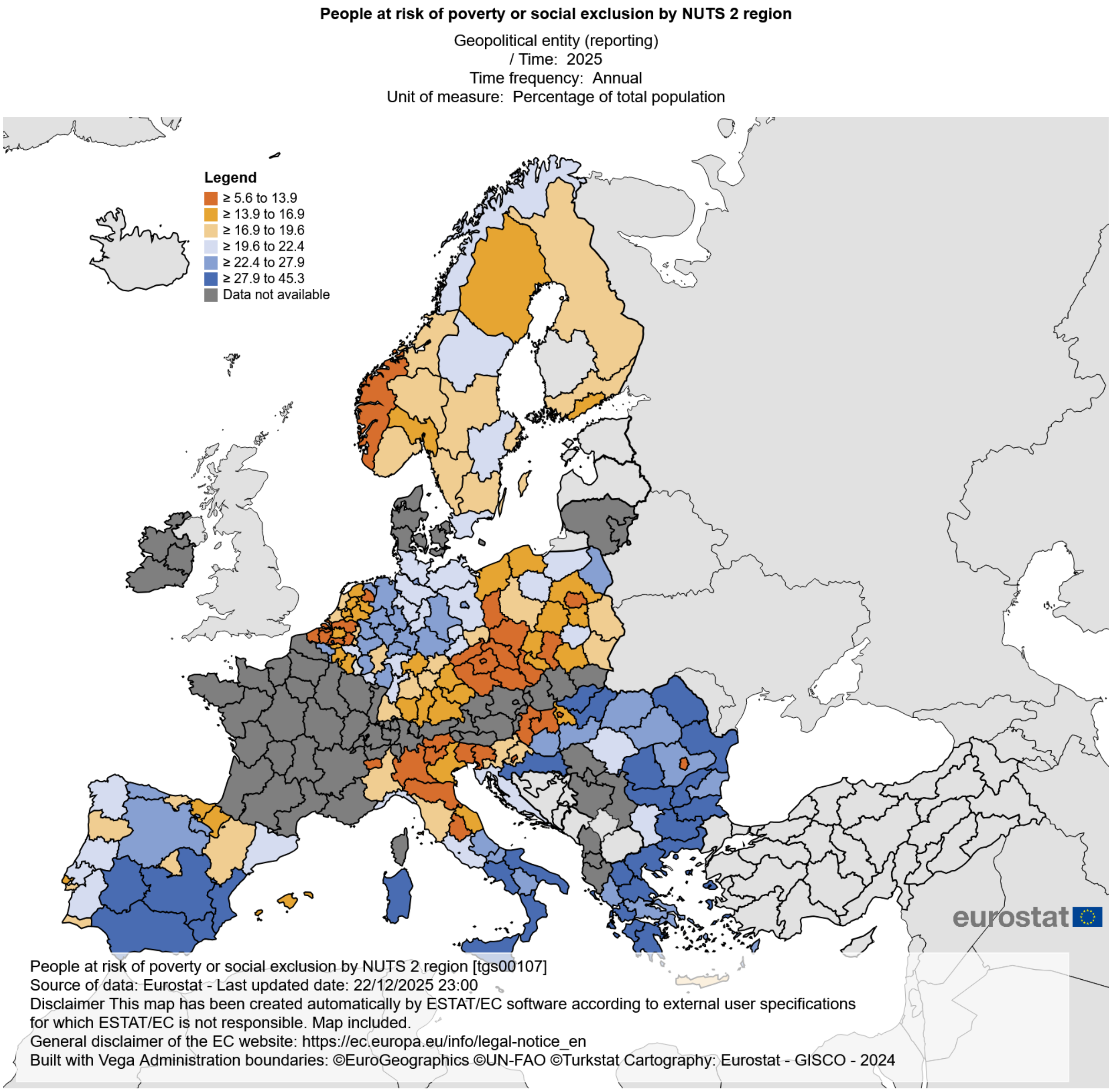
The indicator, derived from the EU Statistics on Income and Living Conditions (EU-SILC) framework, combines multiple dimensions of socio-economic vulnerability, including low disposable income, severe material and social deprivation, and very low work intensity at household level. As such, it provides a broader representation of social exclusion and economic fragility than purely income-based poverty metrics.

Within the European context, the regional distribution of people at risk of poverty or social exclusion reveals strong territorial disparities, with higher shares often concentrated in southern, rural, peripheral, or structurally disadvantaged regions. Eurostat regional statistics at NUTS2 level therefore provide a valuable basis for integrating socio-economic dimensions into land degradation and drought vulnerability assessments. However, it should be emphasized that this proxy remains conceptually far from the original intent of the UNCCD SO2.1 indicator. The SO2 framework was primarily designed for developing countries and dryland regions where extreme poverty, food insecurity, limited access to basic resources, and severe livelihood vulnerability represent core development challenges directly linked to land degradation and desertification processes. In contrast, despite the presence of important regional socio-economic inequalities within the European Union, overall living standards, welfare systems, institutional support, and social protection mechanisms are substantially different from the contexts for which SO2.1 was originally conceived. Consequently, the use of Eurostat poverty-related indicators within the EU should be interpreted primarily as a relative measure of socio-economic vulnerability and territorial inequality, rather than as an equivalent representation of severe poverty conditions typically addressed under the original UNCCD framework.

Nevertheless, integrating harmonised Eurostat social statistics with land degradation indicators can still support a more holistic assessment of territorial vulnerability across Europe, helping identify areas where environmental pressures may interact with socio-economic fragilities and where additional policy support targeting sustainable land management interventions may be required. Furthermore, the availability of regularly updated and harmonised Eurostat datasets enables consistent cross-country comparisons and long-term monitoring of socio-economic trends associated with environmental pressures related to land degradation dynamics across the EU.

[2] https://ec.europa.eu/eurostat/databrowser/view/tgs00107/default/map?lang=en

Figure 14. People at risk of poverty or social exclusion by NUTS 2 region for 2025 (ESTAT).



Source: Eurostat

Table 10. SO2.1 approximation based on EUROSTAT indicator "People at risk of poverty or social exclusion by NUTS 2 region" and share of region considered as affected by desertification.

NUTS_ID	Share of land affected	People at risk of
BG31	91.7	33.5
BG32	88.16	33.8
BG33	87.03	27.7
BG34	83.43	35.8
BG42	79.46	34.4
EL30	68.49	23.6
EL41	63.79	27.9
EL42	60.19	27.5
EL51	56.62	31.6
EL52	55.86	33
EL53	55.73	29.5
EL61	53.99	30.5
EL63	53.71	27.9
EL64	53.21	27.4
EL65	51.55	38.1
ES23	50.05	22.8
ES41	46.15	24.1
ES42	44.7	34
ES43	44.48	30.4
ES51	42.85	21.3
ES52	42.38	30.7
ES61	41.16	34.7
ES62	38.25	32.5
HU31	30.11	30.5
HU32	30	28.4

HU33	28.47	25.1
ITF1	24.82	24.7
ITF2	23.28	22.8
ITF3	19.92	41.2
ITF4	18.86	35
ITF5	17.12	25.1
ITF6	17.01	45.3
ITG1	16.2	44
ITG2	15.6	29.7
ITI4	9.4	20.7
PT1D	2.26	20.4
RO11	1.64	27.5
RO12	1.18	24.1
RO21	0.9	30.3
RO22	0.74	38
RO31	0.7	27.5
RO41	0.59	36
RO42	0.47	20.2

Source: own elaboration

Ancillary information allowed for a spatial statistic calculation of the people living under desertification conditions, Analysis of population data[3] for the area considered under desertification conditions (Table 12) results in almost 42 million inhabitants as affected. This equates to 9% of the EU population.

Cyprus (61%), Greece (47%), Spain (43%), Romania (39%) and Bulgaria (37%) exhibit the highest shares of population affected by desertification.

[3] https://hub.worldpop.org/project/categories?id=3

Table 11. Summary of population affected by desertification.

Member	Population total	Population	% population
AT	9.0	0.0	0%
BG	6.9	2.6	37%
CY	1.2	0.7	61%
CZ	10.7	0.2	2%
EL	10.2	4.8	47%
ES	44.0	18.8	43%
FR	65.0	0.6	1%
HU	9.7	1.4	14%
IT	59.2	4.4	7%
PT	9.3	0.6	7%
RO	19.2	7.5	39%
SK	5.4	0.0	1%
TOTAL	**249.8**	**41.7**	**17%**
TOT %	**56%**	**9%**	

Source: own elaboration

7 EU Desertification Dashboard

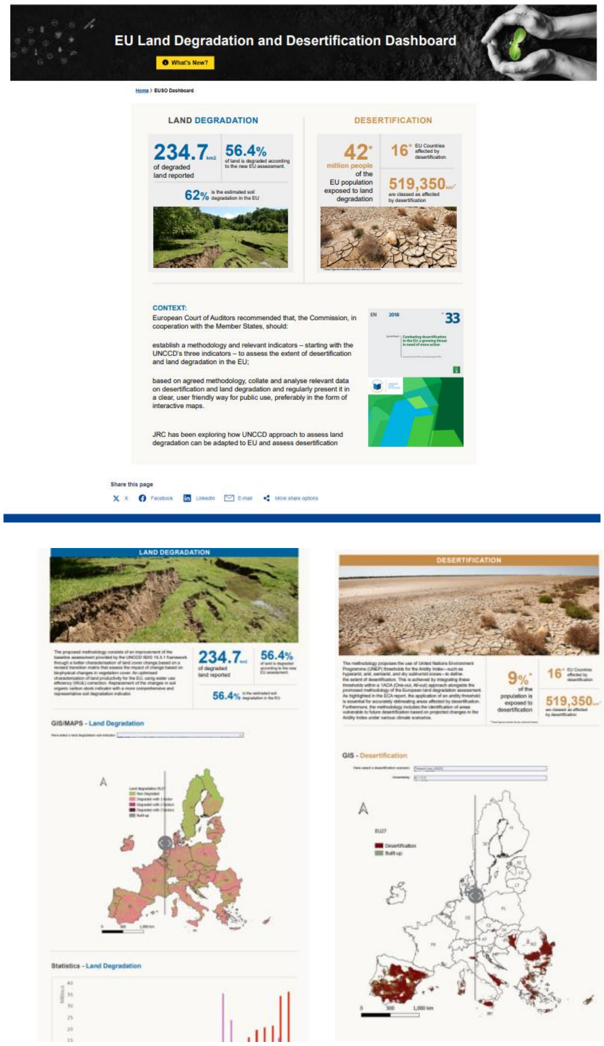
An important consideration of the recommendation from the ECA report was that the Commission should regularly present relevant data on desertification and land degradation in a clear, user friendly way for public use, preferably in the form of interactive maps.

Building on its Soil Degradation Dashboard[4], the EU Soil Observatory is establishing an EU Desertification Dashboard[5] that will provide access to up-to-date statistics and maps of the extent (and impact on population) of land degradation and desertification on the EU. The concept is being developed based on the currently available data, which is described in this report. Some initial screenshots are presented in Figure 15.

[4] https://esdac.jrc.ec.europa.eu/esdacviewer/euso-dashboard/

[5] https://knowledge4policy.ec.europa.eu/soil-observatory_en

Figure 15. Conceptual design of EUSO Desertification Dashboard.



Source: own elaboration

8 Conclusions and future perspectives

This document is a response to the recommendation of the European Court of Auditors (ECA) Special Report 33/2018 to establish a methodology and relevant indicators to assess the extent of desertification and land degradation in the EU.

Building on the existing UNCCD indicator framework for SDG 15.3.1, the Commission has developed a methodology to collate and analyse a range of data on land degradation in order to define areas subject to desertification.

The proposed methodology provides an improvement on the standard approach provided by the UNCCD SDG 15.3.1 framework through:

- a EU-centric characterisation of land cover change that reflects a more relevant, increased spatial resolution and a revised transition matrix that assess the impact of change based on biophysical changes in vegetation cover;

- an characterisation of land productivity that is optimised for the EU;

- the replacement of the changes in soil organic carbon stock indicator with a more comprehensive and representative soil degradation indicator in this evaluation, soil degradation is based on the EU Soil Observatory Soil Degradation Dashboard. However, in due course, indicator SO1-3 can be derived

- through periodic data collection from the Soil Monitoring and Resilience Directive;

- the application of an aridity threshold to define the present desertification extent.

- the identification of areas vulnerable to desertification based on future scenarios of the Aridity Index.

The application of the methodology on currently best available pan-European data results in the following conclusions:

- desertification affects 530 000 km^2 (around 12%) of the EU

- with implications for around 42 million people

- the highest percentage of desertification was observed in Spain (53%), Cyprus (45%) and Greece (36%), Portugal (28%).

- a further 1 004 608 km^2 of the EU is flagged as being at elevated risk of desertification based on future scenarios (2021-2040) of the Aridity Index. Many of these areas are outside the regions currently considered as drylands

- applying the methodology delivers two-to-three-times more degraded land per MS compared with the standard SDG 15.3.1 approach for much of continental EU. This reflects a more realistic definition of soil degradation than described in the UNCCD assessment framework that only looks at changes over time and not a starting baseline for land degradation.

The outcome of the methodology is presented in a clear and user-friendly way for public use in the form of interactive maps and indicators through the EUSO Desertification Dashboard.

Using this methodology is highly dependent on data availability at continental scale. Nevertheless, more detailed assessment can be carried out at country scale that can reveal the pattern of land degradation and desertification reflecting local and microclimatic conditions.

With regards to the UNCCD reporting framework, the methodology is fully compliant regarding the land cover and land productivity indicators, as the framework foresees the possibility to replace default global datasets with more relevant regional or national versions.

The Trends in Carbon Stocks indicator, currently represented by Soil Organic Carbon (SOC) stocks, which estimates land degradation through changes in carbon content using land cover change as a proxy to determine if stocks are increasing or decreasing.

However, as seen by the descriptors used in the Soil Monitoring and Resilience Directive, changes in SOC stocks alone do not fully capture the full spectrum of soil degradation. In which case, the methodology replaces the trends in carbon stocks indicator with trends in soil health, which can be fully provided by Member States through data flows and critical thresholds from the Soil Monitoring and Resilience Directive. This would also provide a synergy between the Soil Health Assessment foreseen under the Directive and the UNCCD reporting framework.

The methodology could be used by the EU and MS for the 2026 deadline for reporting SO1 based on existing European or national soil health datasets and current concepts (SMRD trigger/target values are not yet defined). However, the methodology can be used for the subsequent reporting phase in 2031, which is in line with the foreseen monitoring cycle of the Soil Monitoring and Resilience Directive, where both the EU and MS will have access to coherent soil health (viz degradation) data.

9. Data availability

Data can be downloaded (in a single geopackage, .gpkg format) at the ESDAC page; https://esdac.jrc.ec.europa.eu/content/land-degradation-and-desertification-assessment-eu

The related layer legends are provided below.

Table 12. ESDAC dataset page.

Land Degradation GPGK	**Layers names**	**Layers description**	**Data used**	**Legend**
Land degradation area SDG 15.3.1	SO1-1	SO1-1 Land degradation due to land cover changes	Copernicus CORINE (LAND COVER) (Schillaci et al. 2026)	1 (non degraded), 1(degraded)
	SO1-2	SO1-2 Land degradation from the land productivity	Land Productivity derived from MODIS NDVI time series (Prăvălie *et al.*, 2024)	0 (non degraded), 1(degraded)
	SO1-3	SO1-3 Land degradation from the soil component	EUSO Dashboard based on several LUCAS physical, chemical and biological soil properties, and modelled data (e.g. soil erosion, wildfire effect RCOVER).	1 (non degraded), 1(degraded)
	SO1-4	SO1-4 Proportion of land degraded over the total land area	Application of the One Out All Out (1OAO) methodology, in which the revised SO1-1, SO1-2, SO1-3 are combined.	0 (non degraded), 1-3 (degraded with 1 to 3 factors), 9 (areas with built up)
Desertification extent	AI_extent	AI present AI < 0.65	Zoomer et al., 2024.	1000 (non affected by desertification), 2000 (affected according to AI<0.65)
Desertification area	SO1-4_AI_extent	Land degradation area SDG 15.3.1 in the Desertification extent	own elaboration	2000 (Non Degraded land at desertification risk), 2001-2003 (Degraded with 1 to 3 factors at desertification risk), 2009 (Built up surface at desertification risk)

Sealing-Built up area	SBU	Soil Built Up (SBU)	High Resolution Layer Imperviousness (above average sealing % per non urban land covers affected by sealing)	0 (not built up), 1 (built-up according to threshold).

Source: own elaboration

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