

16 June, 2020

Land Use and Land Cover Statistics  
2018

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### **In 2018, 65% of Mainland Portugal was occupied by forest and cropland areas**

In 2018, almost two thirds (65%) of the area of Mainland Portugal was occupied by forest and cropland areas, with the Centro and Norte regions having, respectively, the highest proportions of forest and cropland areas. In 2018, the land use and land cover classes showed different territorial patterns of overrepresentation at local level, with a set of 16 municipalities, where the proportion of artificial territories was six times higher than in Mainland Portugal, standing out.

Between 2015 and 2018, the surface area of the classes relating to surface water bodies, artificial land and cropland areas were the fastest growing on Mainland Portugal, with the surface area of grassland scoring the largest relative decrease. In turn, cropland, forest, grassland and shrubland areas showed the most significant territorial changes, with forest, grassland and shrubland areas scoring negative balances in land use land cover transitions, and cropland areas a positive balance. At regional level, cropland areas showed a positive balance in all NUTS 2 regions on the mainland and in the Centro, Alentejo and Algarve regions, contrary to what was observed for Mainland Portugal, there were also gains in forest area.

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Statistics Portugal publishes the Land Use and Land Cover Statistics (LCLUStats) based on the Land Use and Land Cover Map (COS) produced by the Directorate-General of Territory (DGT).

The Land Use and Land Cover Statistics provide information for Mainland Portugal that allows characterizing the regional and local differentiation of land use and land cover and the dynamics of change over time based on a harmonized nomenclature of 9 classes of land use and land cover: 1 – Artificial map, 2 – Cropland area; 3 – Grassland area, 4 – Agro-forestry areas, 5 - Forest area; 6 – Shrubland area, 7 - Open spaces or sparse vegetated areas, 8 - Wetlands and 9 - Surface water bodies.

The nomenclature of Land Use and Land Cover Statistics is based on the revision carried out for the production of COS 2018 under the scope of a working group of the National Territorial Commission (CNT) coordinated by DGT, which brought together relevant entities in the fields of land use and land cover, including Statistics Portugal. The classification of COS 2018 is a hierarchical structure with four levels, which include 83 classes that can be grouped into 9 first level classes. Based on the nomenclature of COS 2018, new versions of previous editions of COS have been produced, benefiting from new information and thus ensuring greater thematic consistency and temporal comparability between COS series maps.

The results of the Land Use and Land Cover Statistics now released for 2010, 2015 and 2018 are based on COS 2018 and are therefore not directly comparable with the information previously released by Statistics Portugal. The published indicators and methodological options are available at [www.ine.pt](http://www.ine.pt), as indicated in the technical note of this press release.

In parallel to this dissemination, DGT, within the framework of the Observatory for Spatial Planning and Urbanism (OOTU), will make available the [thematic analysis on land use and land cover in 2018 and the evolution for the period 1995 - 2018, in Mainland Portugal](#).

***In 2018, almost two thirds of Mainland Portugal was occupied by forest and cropland areas, with the Centro and Norte regions having the largest proportions of forest and cropland area, respectively***

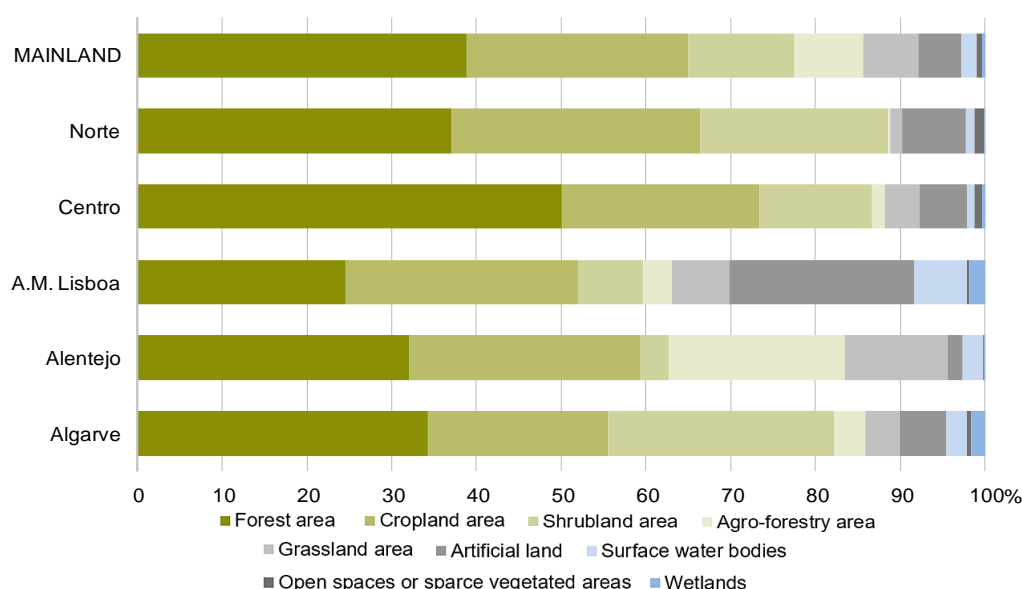
In 2018, around 38.8% of the area of Mainland Portugal corresponded to forest areas, 26.2% to cropland areas and 12.4% to shrubland areas. Still with a surface area of more than 5%, in Mainland Portugal, agro-forestry areas (8.2%), grassland areas (6.4%) and artificial land (5.2%) stood out, with the remaining three land use and land cover classes - surface water bodies, open spaces or sparse vegetated areas - representing together around 2.7% of the surface area.

At the regional level, the Centro region had the highest proportion of forest area (50.1%) and the Norte region the highest proportion of cropland area (29.3%), and the presence of this latter class, cropland area, was also significant in the Metropolitan Area of Lisboa (27.4%) and in the Alentejo (27.3%).

The Metropolitan Area of Lisboa also stood out for its greater proportion of artificial land (21.7%) and surface water bodies (6.2%).

The Alentejo region had the highest proportion of agro-forestry areas (20.8%) and grassland areas (12.1%), while the Algarve had the largest area of shrubland areas (26.6%).

**Figure 1 - Surface distribution of territorial units by land use/cover classes, Mainland Portugal and NUTS 2, 2018**



**Source:** Statistics Portugal/DGT, Land use land cover statistics.

***In 2018, land use and land cover classes showed different territorial patterns of overrepresentation with a set of 16 municipalities, where the proportion of artificial territories was six times higher than in Mainland Portugal, standing out***

The following figure presents estimated location quotients<sup>1</sup> at municipality level and shows that in 2018 there was a greater expression of artificial land in a number of municipalities closer to the coast and in the Algarve, as well as in the municipality of Sines, highlighting a set of 16 municipalities mostly located in metropolitan areas, but also Paços de Ferreira and Entroncamento, where the proportion of artificial land was six times higher than in Mainland Portugal.

Forest areas assumed greater expression in municipalities of the Centro region, extending in a territorial continuum, to municipalities in the North - Arouca, Vale de Cambra, Castelo de Paiva - and in the South, to municipalities of Lezíria do Tejo and Alto Alentejo. Despite the relative over-representation of cropland areas in several dispersed municipalities on the mainland, it is possible to identify three areas of greater concentration of this class: in municipalities of the sub-regions of Alentejo Central and Baixo Alentejo, of Lezíria do Tejo and Oeste, and of Terras de Trás-os-Montes.

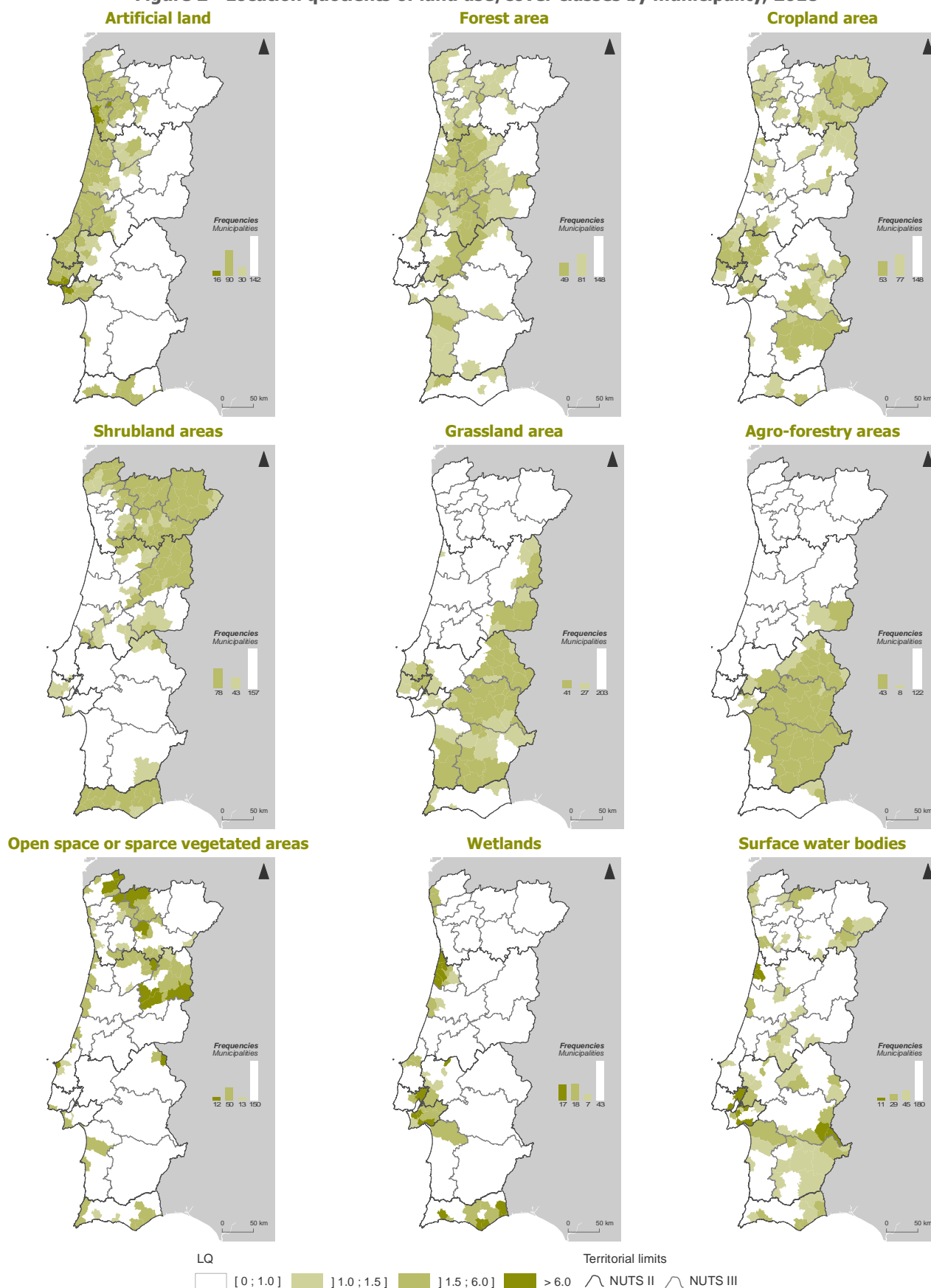
Shrubland areas assumed greater expression in municipalities of the Northeast of Mainland Portugal and in the Algarve, and grassland areas, which showed no relative expression in the municipalities of the Norte region, were present in the remaining regions of the mainland, with this class being over-represented in municipalities of Alentejo. Agro-forestry areas had a greater expression in Alentejo municipalities, and also in Alcochete, Castro Marim and Idanha-a-Nova.

With regard to open spaces or sparse vegetated areas, a group of 12 municipalities stands out, mostly located in the Norte and Centro regions, where the proportion of this land use/cover class was six times higher than in the mainland. Wetlands were more prevalent in municipalities located on the coast of Mainland Portugal, with an over-representation of this class standing out in a group of 17 municipalities, mainly located in the Centro, the Metropolitan Area of Lisboa and in the Algarve.

Finally, surface water bodies assumed greater expression in several dispersed municipalities of the mainland, with this class being over-represented in the municipalities of Alcochete, Moita, Setúbal, Vila Franca de Xira, Lisbon and Barreiro, in the Metropolitan Area of Lisboa, in the municipalities of Murtosa, Aveiro and Ílhavo, in the Centro region, and in the municipalities of Mourão and Reguengos de Monsaraz, in Alentejo.

<sup>1</sup> Location Quotients (QL) correspond to the ratio between the proportion of each land use and land cover class in municipalities and the respective proportion on Mainland Portugal. Thus, QLs above 1 indicate an over-representation of the class in relation to the territorial reference context.

**Figure 2 - Location quotients of land use/cover classes by municipality, 2018**



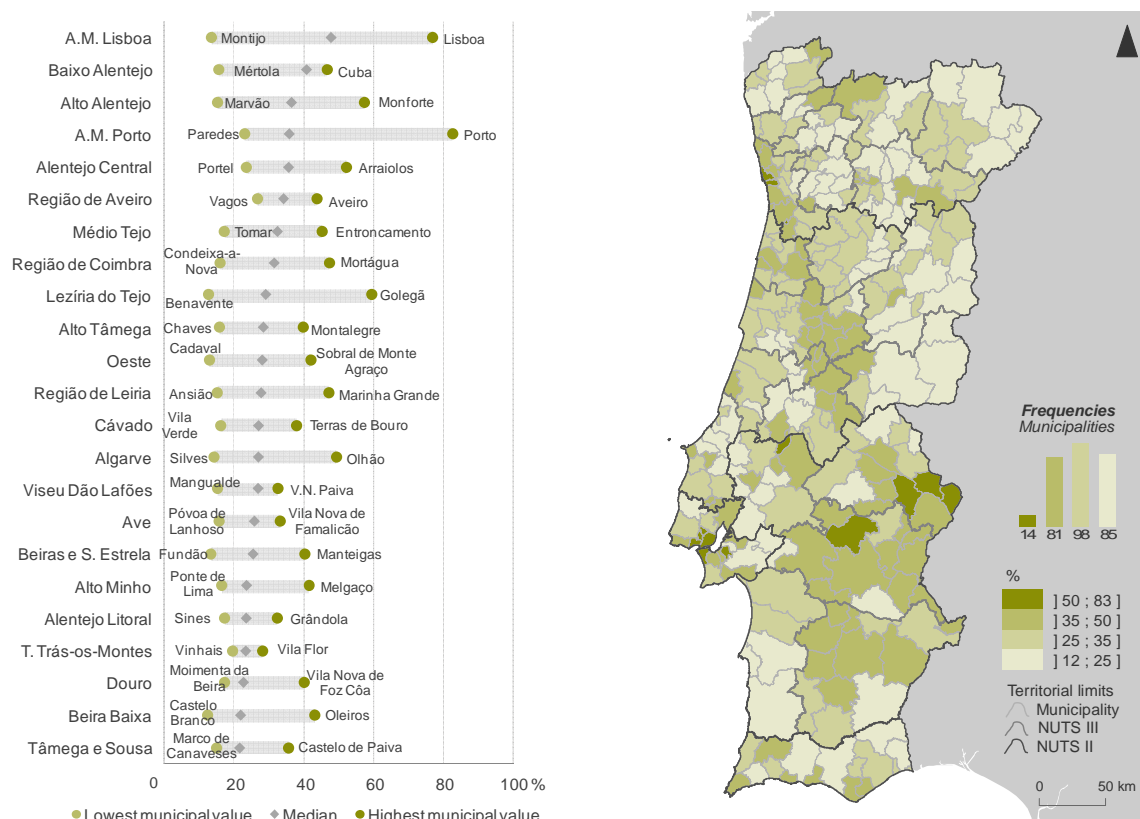
**Source:** Statistics Portugal/DGT, Land use land cover statistics.

***In 2018, 14 municipalities had more distinct land use and land cover profiles than the reference structure observed for Mainland Portugal***

In 2018, of the 278 municipalities located in Mainland Portugal, 85 had lower coefficients of specialization<sup>2</sup>, indicating a greater approximation to the reference structure of land use and land cover classes recorded for Mainland Portugal. Of these 85 municipalities, 35 were located in the Norte region, 28 in the Centro region, 14 in the Alentejo, five in the Algarve, and only three in the Metropolitan Area of Lisboa.

With higher specialization coefficients and, therefore, with more distinct land use and land cover profiles from the reference structure observed for the mainland, a set of 14 municipalities stood out, mostly located in the metropolitan areas of Lisboa (Lisbon, Amadora, Oeiras, Odivelas, Almada and Moita) and Porto (Oporto, São João da Madeira and Matosinhos) and also in Alentejo (Golegã, Monforte, Arronches, Campo Maior, and Arraiolos). Having the distribution of the nine land use and land cover classes on Mainland Portugal as a reference, the highest level of differentiation was recorded in the municipality of Porto (82.8%) - associated with the over-representation of artificial land (but also in Lisboa, 77.0%) - and the lowest in the municipality of Castelo Branco (12.4%).

**Figure 3 - Coefficient of specialization of land use/cover classes by municipality, 2018**



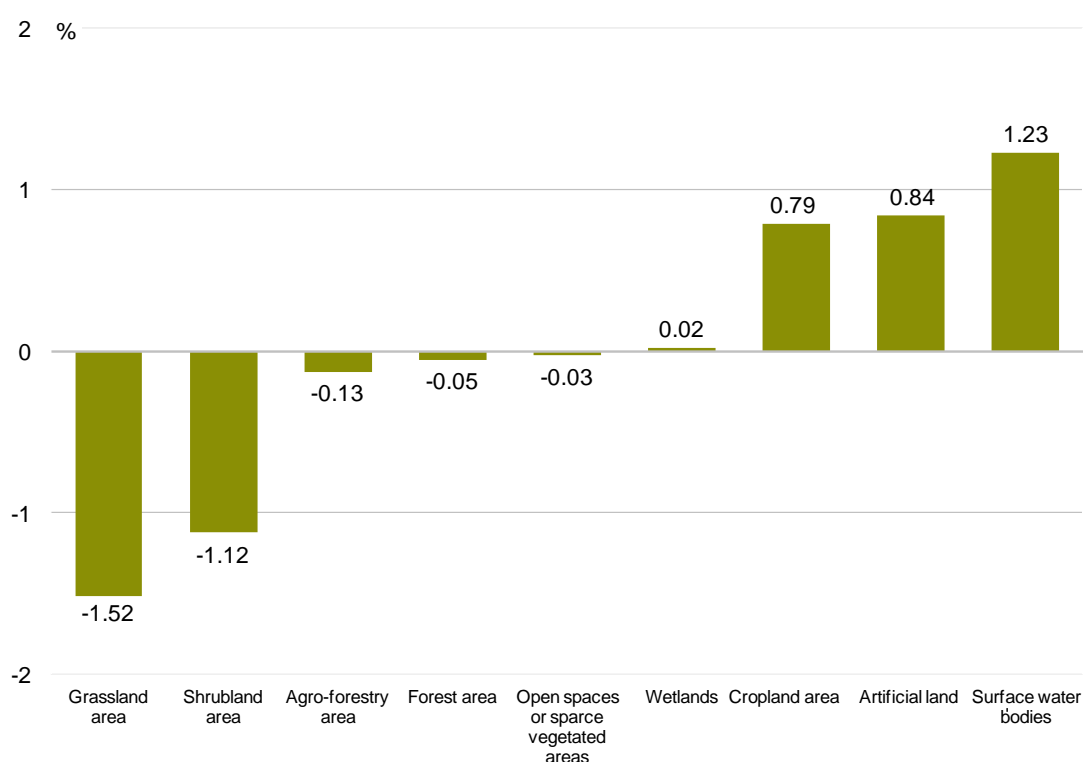
**Source:** Statistics Portugal/DGT, Land use land cover statistics.

<sup>2</sup> The Coefficient of Specialization (CE) allows measuring the degree of differentiation of the area occupied by land use and land cover classes from the reference territorial structure observed for Mainland Portugal.

***Between 2015 and 2018, surface water bodies, artificial land and cropland areas recorded the highest positive variation rates in Mainland Portugal, and grassland areas scored the greatest decrease***

Between 2015 and 2018, the changes registered in Mainland Portugal include a decrease in the area occupied by five of the nine land use and land cover classes, with greater relative decreases being registered in grassland (-1.52%) and shrubland (-1.12%) areas. The area occupied by the class relating to surface water bodies showed a gain of +1.23%, and artificial land and cropland areas registered an increase of +0.84% and 0.79%, respectively.

**Figure 4 - Rate of surface variation of territorial units by land use/cover classes, Mainland Portugal, 2015/2018**

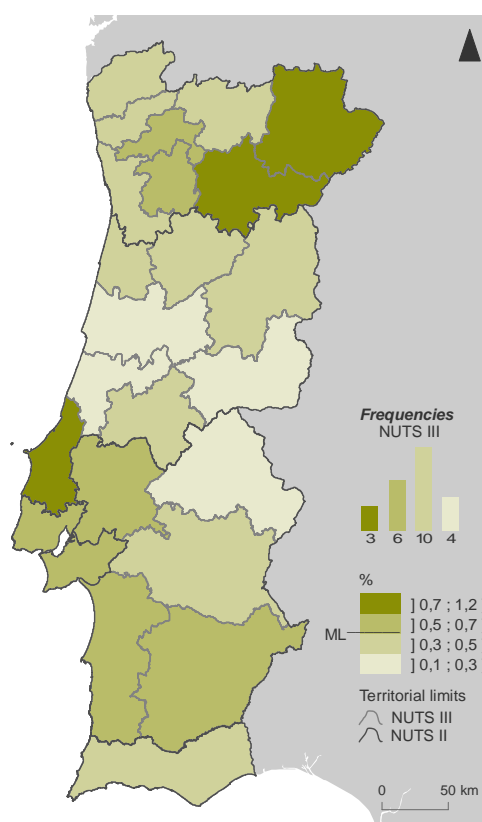


**Source:** Statistics Portugal/DGT, Land use land cover statistics.



**Figure 5 - Proportion of area of territorial units with changes in land use/cover classes by NUTS 3, 2015-2018**

In terms of NUTS 3 sub-regions, between 2015 and 2018, nine sub-regions had a proportion of area with changes in land use and land cover classes above the figure recorded for the total of Mainland Portugal (0.5%) - Oeste, Douro, Terras de Trás-os-Montes - highlighted in Figure 5 - and also, Baixo Alentejo, Metropolitan Area of Lisboa, Ave, Tâmega e Sousa, Alentejo Litoral and Lezíria do Tejo. On the other hand, it is important to point out that of the four sub-regions with less expressive values in this indicator, three were located in the Centro region - Região de Leiria, Região de Coimbra and Beira Baixa - and the fourth corresponded to the Alto Alentejo.



**Source:** Statistics Portugal/DGT, Land use land cover statistics.

### ***Between 2015 and 2018, cropland forest, grassland and shrubland areas presented more expressive territorial changes***

Figure 6 presents the gains (or inflows) and losses (or outflows) in terms of area in each land use and land cover class between 2015 and 2018. For Mainland Portugal, it can be seen that the classes relating to artificial land and surface water bodies showed practically only gains in area.

Cropland, grassland, forest and shrubland areas presented, in turn, a greater territorial dynamic, registering more expressive area transitions. The classes corresponding to shrubland, forest, grassland and cropland areas were those with the greatest loss of area - between 56 and 140 km<sup>2</sup>. However, in the case of cropland areas, these losses were compensated respectively with 239.8 km<sup>2</sup> of new areas, resulting in a positive balance. The same was not observed for forest, shrubland and grassland areas, whose loss of area was not compensated by the new 92.7 km<sup>2</sup>, 14.1 km<sup>2</sup> and 13.1 km<sup>2</sup> affected, respectively, to these classes. In the case of agro-forestry areas, a negative balance of -9.3 km<sup>2</sup> was recorded and the class referring to surface water bodies showed a positive balance of 18.8 km<sup>2</sup>.

The dynamics of land use and land cover changes have not been uniform across the mainland territory. In the Centro, Alentejo and Algarve regions, unlike the mainland, there were gains in forest area - the balance between new forest areas, coming from other land use and land cover classes, and areas converted to other classes resulted in a positive balance.

The cropland area class showed a positive balance in all NUTS 2 regions of Mainland Portugal, with the Alentejo and Norte regions showing the greatest area gains in cropland, with the balance between new areas and converted areas showing positive balances of 78.2 and 70.8 km<sup>2</sup>, respectively. The Alentejo region was also noteworthy for the greater loss of grassland area, the 78.1 km<sup>2</sup> of converted areas were not compensated by the 5.3 km<sup>2</sup> of new grassland areas.

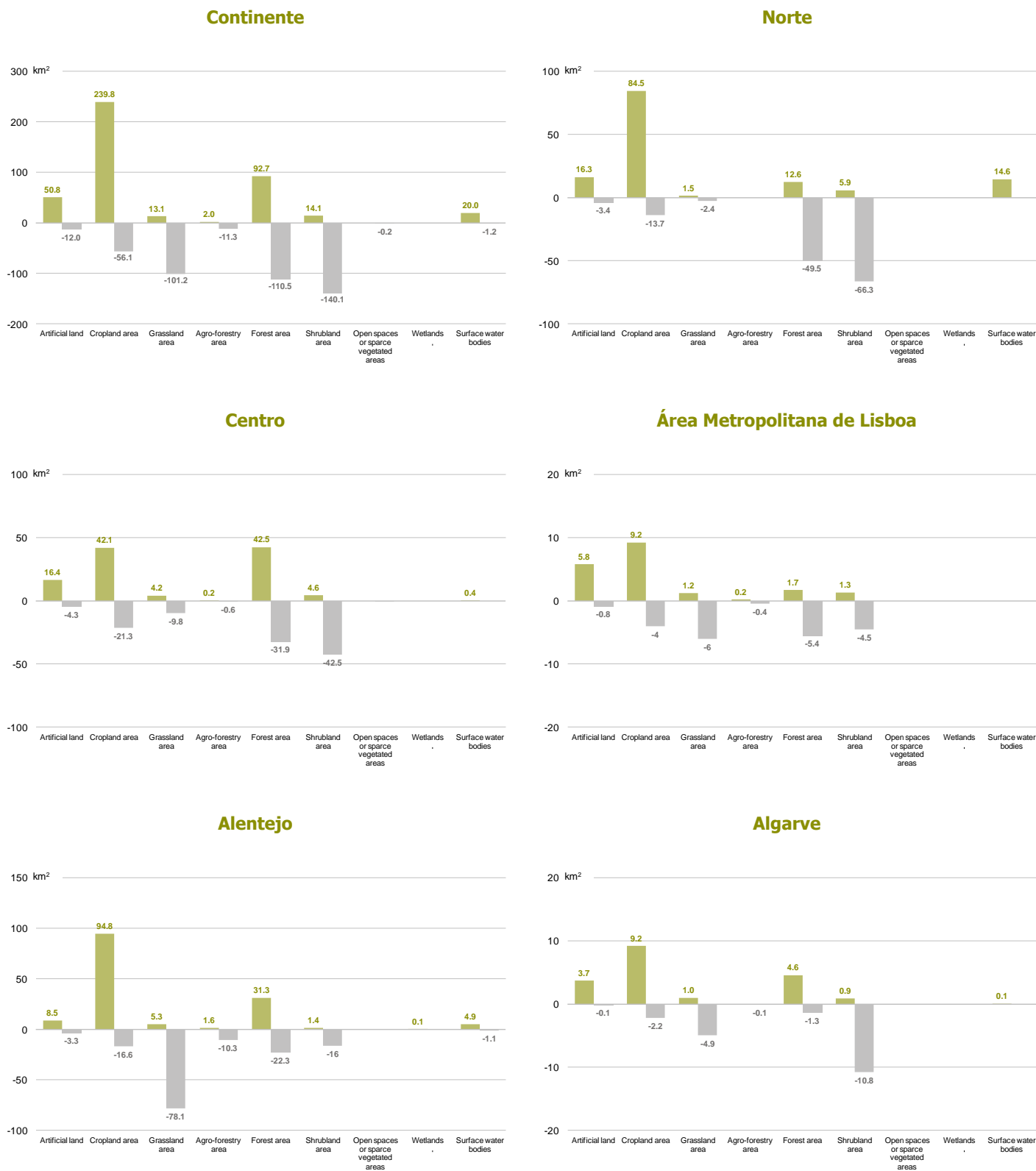
Figure 7 corresponds to a Sankey diagram<sup>3</sup> and presents a representation of surface flow transitions between land use and land cover classes, at the level of Mainland Portugal and its NUTS 2 regions. This type of visual representation of information allows an analysis in terms of the origins and destinations of changes between land use and land cover classes between 2015 and 2018.

For Mainland Portugal as a whole, it should be noted that new cropland areas in 2018 resulted mainly from the conversion of area affected in 2015 to grassland, forest and shrubland areas and that, in the case of forest areas, new surface in this class resulted, mainly, from the conversion of shrubland, grassland and cropland areas. It is also relevant to point out that the conversion of forest, shrubland, cropland and grassland areas has resulted in new artificial land.

<sup>3</sup> A Sankey diagram is a non-spatial analysis tool for visualizing flows between categorical data grouped into categories (in this case, land use and land cover classes). The flows are represented by bidirectional lines and their size is determined by the volume of the flows between the categories.

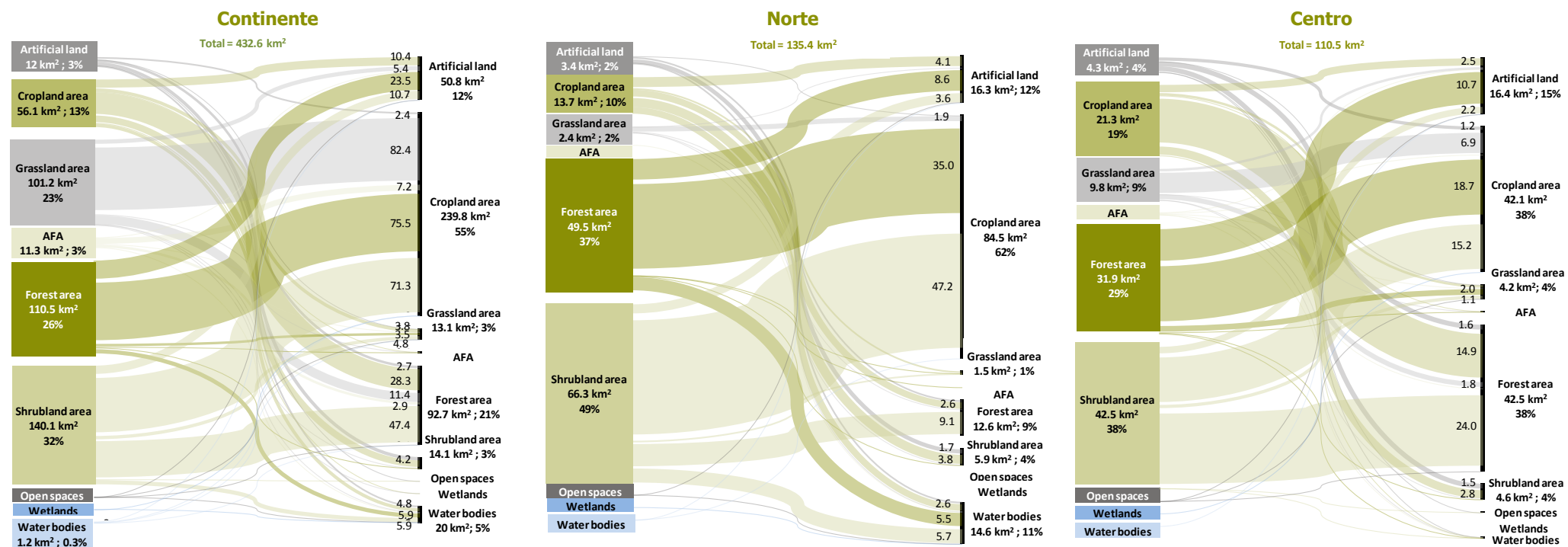


**Figure 6 - Surface of land use/cover class transitions (gains and losses), Mainland Portugal and NUTS 2, 2015-2018**



**Source:** Statistics Portugal/DGT, Land use land cover statistics.

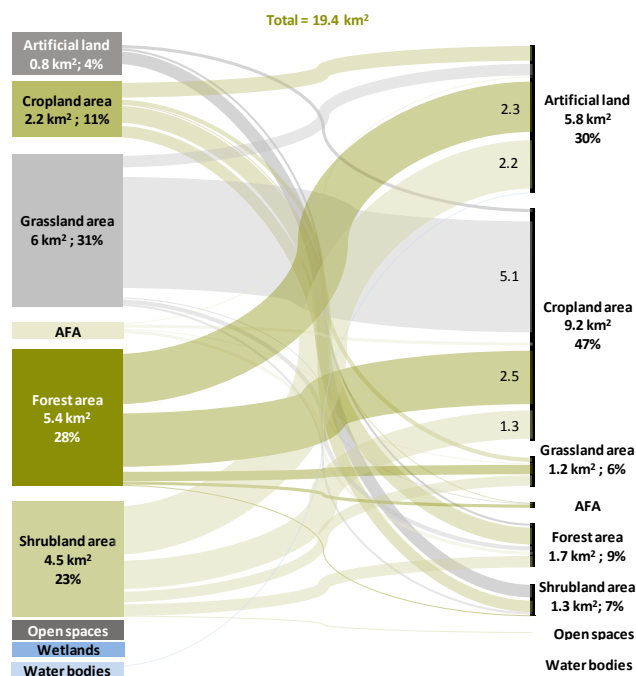
**Figure 7 - Surface flows of transitions (losses and gains) between classes of land use/cover and Proportion of area with changes by land use/cover compared to the total surface of transitions, Mainland and NUTS 2, 2015-2018**



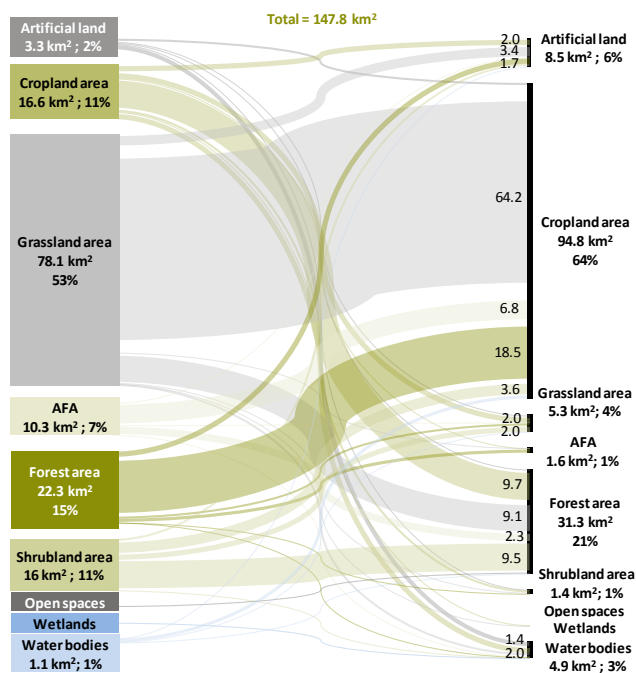
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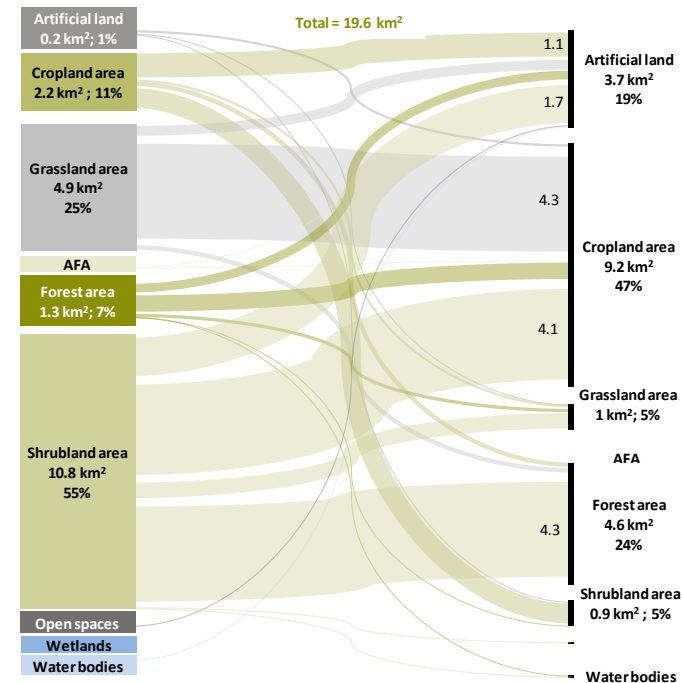
### Área Metropolitana de Lisboa



### Alentejo



### Algarve



**Source:** Statistics Portugal/DGT, Land use land cover statistics.

Note: The surface that remained affected to the same class was not contemplated in the graphical representation in order to be possible to visualize only the flows corresponding to surface transitions. The land use and land cover classes represented on the left side show the surface value that moved to another class in 2018 (classes represented on the right side). The values associated with the flows correspond to the surface values (km<sup>2</sup>) that were carried over to the land use and land cover class in 2018 and, for a better reading of the information, only the flow values above 1 km<sup>2</sup> are indicated.

## Technical note

The Land Use and Land Cover Statistics are based on the Land Use and Land Cover Map (COS) produced by the Directorate-General of Territory (DGT), are a statistical operation with irregular periodicity and the target population is the Portuguese municipalities of Mainland Portugal, with reference to the administrative division of the Official Administrative Map of Portugal (CAOP) and the Administrative Division Code. The periodicity of COS is not defined, and the production of new editions has varied between three and five years.

COS is a thematic cartography that divides surface area into landscape units, that share the concepts of land use and land cover. The cartography is obtained by visual image interpretation of ortho-rectified aerial photographs, with a spatial resolution of  $\leq 50$  cm and four spectral bands (blue, green, red and infrared). The unit of land use/land cover represents any area of land greater than or equal to the minimum mapping unit (UMC) of 1 ha, with a distance between rows of 20 m or more and where a given land use/land cover class has a percentage greater than or equal to 75% of the total delimited area. The nomenclature of COS 2018 consists of four levels of detail that can be grouped into 9 classes of first level of detail: 1 - Artificial land; 2 - Cropland area; 3 - Grassland area; 4 - Agro-forestry areas; 5 - Forest area; 6 - Shrubland area; 7 - Open spaces or sparse vegetated areas; 8 - Wetlands; 9 - Surface water bodies. Based on COS2018v1.0 there is a common subset of 83 land use and land cover classes (DGT, 2019).

Within the scope of Land Use and Land Cover Statistics the following indicators are made available: (i) status indicators, through the direct extraction of the surface occupied by each of the 9 first level COS class; (ii) evolution and transition indicators of the 9 first level classes, for the analysis of the dynamics of land use and land cover change; (iii) summary indicators, for characterising the performance of artificial land (artificial land per capita, the evolution of the efficiency of the artificial land by inhabitant, and the productivity of artificial land) and of open water (rate of surface variation of open water); and (iv) context indicators, which include the total surface area, the land surface of territorial units, and the surface of open waters.

As regards to summary indicators, the indicator "Evolution of the efficiency of artificial land by inhabitant" is released, which consists of a *proxy* indicator, as proposed by the Joint Research Centre (Corbane et al., 2017), of the indicator 11.3.1 "Ratio of land consumption rate to population growth rate" defined for the monitoring of the Sustainable Development Goals (SDG) of the 2030 Agenda. Also within this scope, the indicators "Natural and artificial open water surface area" and "Rate of surface variation of open water" have been made available to correspond to one of the sub-indicators defined for the overall monitoring of indicator 6.6.1 "Change in the extent of water-related ecosystems over time".

## Concepts

**Artificial land:** Land surface designated to human intervention activities that includes built fabric, industrial and commercial, service and tourism areas, gardens, equipment and infrastructures, and the road and rail networks.

**Cropland area:** Area used for agriculture consisting of annual and permanent crops, and of protected cropland and nurseries.

**Grassland area:** Area with or without human intervention, mainly occupied with herbaceous vegetation, either seeded or spontaneous, that is not included in a rotation system and covers an area equal or higher than 25%.

**Agro-forestry areas:** Surface of land cultivation consisting of the co-association of temporary crops and/or pastures (improved or poor spontaneous), and/or permanent crops with forest species with a cover degree of 10% or more.

**Forest area:** Area of land for forest use, occupied by forest trees, or temporarily deforestation as a result of cultural cutbacks or extraordinary cuts due to biotic (pests, diseases) or abiotic (fires, storms) disorders. Area occupied by forest trees resulting from natural regeneration, seeding or planting. The trees, in normal weather conditions, must reach a height greater than or equal to 5 meters and constitute an area with a coverage degree of more than 10%, as a whole.

**Shrubland area:** Area of natural and spontaneous vegetation, with low or high density, where the shrub cover (i.e. heather, brambles, brooms, gorse) is equal to or higher than 25%. Includes abandoned olive groves if less than 45 trees/ha.

**Open spaces:** Natural areas including bare land, rocks, beach and sandy areas.

**Sparse vegetated areas:** Natural areas with low or no shrub and herbaceous vegetation covering an area inferior to 25%.

**Wetlands:** Inland or coastal areas temporary or permanently covered by fresh, salty or brackish water, running or stagnant water which include mosses, peat bogs, salt marshes, reeds, halophytic reeds and intertidal areas.

**Surface water bodies:** A distinct and significant body of surface water which includes natural, heavily modified and artificial waters such as a reservoir, stream, river or canal, a section of stream, river or canal, transitional waters or a stretch of coastal water.

### Indicators available at Statistics Portugal Official Website

The Land Use and Land Cover Statistics indicators are available at [www.ine.pt](http://www.ine.pt), in Products, Statistical Data, Database.

[Area \(km<sup>2</sup>\) of territorial units by Geographic localization \(NUTS - 2013\) and Surface by land use and cover; Irregular](#)

[Territorial surface \(km<sup>2</sup>\) of territorial units by Geographic localization \(NUTS - 2013\); Irregular](#)

[Rate of surface variation \(%\) of territorial units by Geographic localization \(NUTS - 2013\) and Surface by land use and cover; Irregular](#)

[Surface of land use/cover class transitions \(km<sup>2</sup>\) by Geographic localization \(NUTS - 2013\), Surface by land use and cover and Land use/cover classes \(Initial\); Irregular](#)

[Efficiency evaluation of the artificial land by inhabitant \(%\) by Geographic localization \(NUTS - 2013\); Irregular](#)

[Artificialized territories per capita \(m<sup>2</sup>/ inhab.\) by Geographic localization \(NUTS - 2013\); Irregular](#)

[Productivity of artificialized territories \(Base 2016 - €\) by Geographic localization \(NUTS - 2013\); Irregular](#)

[Area \(km<sup>2</sup>\) of open water by Geographic localization \(NUTS - 2013\) and Open water classification; Irregular](#)

[Rate of surface variation \(%\) of open water by Geographic localization \(NUTS - 2013\); Irregular](#)

The conceptual and computational methodological options of the Land Use and Land Cover Statistics (LCLUStats) are presented in the methodological document *Estatísticas de Uso e Ocupação do Solo*, código 672 / versão 1.1, INE (available at [www.ine.pt](http://www.ine.pt), in Metadata, Metadata System, Methodological documentation). The need for updating the previous 1.0 version results from the publication of the Land Use and Land Cover Map - 2018 (COS 2018), with changes to the technical specifications in relation to previous versions of COS, and from the inclusion of indicators relating to the extent and evolution of open water.

The results of the Land Use and Land Cover Statistics calculated on the basis of version 1.1 of the methodological document are not directly comparable with the previous results released by Statistics Portugal within the scope of this statistical operation.

The Location Quotient (QL) corresponds to a measure that makes it possible to calculate the over-representation (or under-representation) of a given class in a territorial unit (in this analysis, the municipality) in relation to a wider territorial context (in this analysis, Mainland Portugal) based on the following expression:

$$QL_{rj} = \frac{X_{rj}}{X_r} \bigg/ \frac{X_{pj}}{X_p} \quad (0 \leq QL_{rj} < \infty) \quad \text{where:}$$

$X_{rj}$  - Surface area of class j in territorial unit r

$X_r$  - Total surface area of territorial unit r

$X_{pj}$  - Surface area of class j in territorial context p

$X_p$  - Total surface area of territorial context p

QL with values above (below) the unit are indicative of an over-representation (under-representation) of class j in the territorial unit r in relation to the territorial reference context.

The Coefficient of Specialization (CE) measures the degree of concentration a territorial unit holds in relation to the main land use and land cover classes that are implanted in it. It corresponds to half of the result obtained in the sum of the module of deviations from the importance that class i assumes in the territorial unit j compared with the importance that class i assumes in the standard territorial unit p, which in this analysis corresponds to Mainland Portugal. If the coefficient is equal to 0, it means that the territorial structure of land use and land cover classes of the territorial unit under review is fully equivalent to the structure presented by the standard territorial unit; conversely, the closer the coefficient is to 100, the more specialized the structure of the territorial unit is in relation to that of the reference territorial context.

where:

$$CE_j = \left( \frac{1}{2} \sum_{i=1}^n \left| \frac{X_{ip}}{X_p} - \frac{X_{ij}}{X_j} \right| \right) * 100 \quad (0 \leq CE_j \leq 100)$$

$X_{ip}$  : Surface area of class i in the standard territorial unit p

$X_p$  : Total surface area of the standard territorial unit p

$X_{ij}$  : Surface area of class i in the territorial unit j

$X_j$  : Total surface area of territorial unit j