

LANDSCAPE INDICATORS

The **LUCAS (Land Use/Cover Statistical Area Frame Survey)** survey is a field survey based on an area-frame sampling scheme. Data on land cover and land use are collected and landscape photographs are taken, enabling detection of changes in land cover/use and in European landscapes. Moreover the transect, a 250 meters walk along which linear elements and land cover changes are recorded, offers comparable indicators on the fragmentation, richness and dominance of the landscape.

The surveyors walking the transect are requested to register all the land cover changes they can observe according to a list of codes including both areal land cover classes and linear elements (Table 1). In the transect, land cover transition and the linear features are recorded in the sequence of their appearance. The results are then aggregated in such a way that different environments (agricultural areas, forestry areas, grassland, etc.) have approximately the same number of items. This procedure was adopted to avoid a bias in terms of heterogeneity being introduced in the results. For a detailed land cover transect classification, see Table 2.

Table 1: List of transect linear elements, LUCAS 2009

Code	Label
1	Grass margins<3 m
2	Heath/Shrub, tall herb fringes<3 m
10	Single tree, single bushes
11	Avenue trees
12	Conifer hedges<3 m
13	Bush/tree hedges/coppices, visibly managed (e.g. pollarded) <3 m
14	Bush/tree hedges, not managed, with single trees, or shrubland deriving from abandonment<3 m
15	Grove/Woodland margins (if no hedgerow) <3 m
21	Dry stone walls
22	Artificial constructions (other than dry stone walls)
23	Fences
24	Electric lines
31	Ditches, channels<3 m
32	Rivers, streams<3 m
41	Ponds, wetland<3 m
51	Rocks outcrops with some natural vegetation
61	Tracks
62	Roads
63	Railways
71	Other linear elements

Table 2: Land cover transect classification, LUCAS 2009

Code	Label
AAA	Artificial land
BS0	Straw cereals
B16	Maize
B17	Rice
B20	Root crops
B31	Sunflower
B32	Rape and turnip seeds
B33	Soya
B34	Cotton
B36	Tobacco
BC0	Other ind crops
B40	Dry pulses, vegetables and flowers
B50	Fodder crops
B70	Fruit trees and berries
B81	Olive groves
B82	Vineyards
BP0	Other permanent crops
C10	Broadleaved and evergreen woodland
C20	Coniferous woodland
C30	Mixed woodland
D10	Shrubland with sparse tree cover
D20	Shrubland without tree cover
E10	Grassland with sparse tree/shrub cover
E20	Grassland without tree/shrub cover
E30	Spontaneous vegetation
F00	Bare land
G10	Inland water bodies
G20	Inland running water
G30	Coastal water bodies
G50	Glaciers, permanent snow
H10	Inland wetlands
H20	Coastal wetlands

Source: Eurostat

A direct measure of the degree of homogeneity or heterogeneity in terms of the physical coverage of the land can be drawn by the number of different land cover types observed in each of the transects surveyed.

Richness diversity indicator: it is computed as the number of different land cover codes in each transect. (Tables: lan_lcs_ric):

Linear feature: they consist in linear elements of the landscape such as walls, hedges, roads, railways or irrigation channels, etc. intersecting the transect; these features are taken into account if their width is larger than 1 meter (exceptions are walls, ditches, electric lines and fences) and at least 20 m long.

Structure Linear Elements (SLE): linear features which structure the countryside: grass and tree margins, shrub, water courses and dry-stone wall. (Tables: lan_lcs_str)

Dissection Linear Elements (DLE) dissection of landscape caused by transport infrastructure, artificial constructions (other than dry-stone walls), fences and electric lines. (Tables: lan_lcs_diss)

The information on different types of land cover and their relative abundance (i.e. whether the same type of land cover recurs in a transect) can be summarised by means of two Shannon indices: the Shannon Diversity Index (SDI) and the Shannon Evenness Index (SEI). The latter, obtained by dividing the SDI by its maximum value, is easier to read, as it varies between 0 (no diversity, i.e. a single land cover type) and 1 (maximum observed diversity combined with complete evenness).

Shannon Diversity Index: the Shannon Diversity index (SDI) provides more information about area composition than simply area richness (i.e., the number of types of land cover present). It takes into consideration both the number of different land cover types (m) observed on the point and their relative abundances (P_i).

$$SDI = -\sum_i^m (P_i * \ln(P_i))$$

(Tables: lan_lcs_sdi)

Shannon Evenness Index: The Shannon Evenness index is obtained dividing the Shannon Diversity Index by its maximum ($(SDI_{MAX}) = \ln(m)$). Therefore it varies between 0 and 1 and is easier to interpret.

$$SEI = -\sum_i^m (P_i * \ln(P_i)) / \ln(m)$$

(Tables: lan_lcs_sei)