UN-GGIM: Europe | Work Group on Data Integration | subgroup 2

The territorial dimension in SDG indicators: the contribution of geospatial data and analysis and its combination with statistical data

15.1.1 | Forest area as proportion of total land area [tier I indicator]

Brief discussion

At the ***global level***, data for this indicator will be provided by FAO (Food and Agriculture Organization).

Conceptually, the indicator measures the relative presence of forest area in a country and is based on two components:

a) The forest area, to be computed according to FAO definition, i.e., "land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds *in situ*. It does not include land that is predominantly under agricultural or urban land use".

b) The total land area, which corresponds to the total surface area of a country excluding inland waters such as rivers and lakes.

The indicator is proposed to be provided at national level, with no further disaggregation and monitoring is set to be repeated at regular intervals of five years, allowing for three reporting points until the year 2030.

This indicator is categorized under Tier I, meaning the indicator is conceptually clear, has an internationally established methodology and standards are available. FAO has been collecting and analysing data on forest area, as part of the Global Forest Resources Assessment (FRA) since late 40's, and the collection frequency has been every five years since 2000. The FRA is based on two primary sources of data: country reports prepared by national correspondents and remote sensing analysis that is conducted by FAO together with national focal points and regional partners. FRA collects country data following a standard format. It includes the original data and reference sources and descriptions of how these have been used to estimate the forest area for different points in time. Detailed methodology and guidance on how to prepare the country reports and to convert national data according to national categories and definitions to FAO's global categories and definitions can be found in the Guide for country reporting for FRA (2015). Data is available for all 234 countries and the last FRA 2015 includes around 120 variables covering the following periods: 1990, 2000, 2005, 2010, 2015.

The analysis of the WG members regarding the metadata on this indicator has pointed:

- Not all countries report data to FAO every five years; therefore a five year release of the indicator is not possible everywhere, and the collection strategy, valid at country level, does not always allow a proper disaggregation of the indicator over smaller units.
- The extension of the total land, not provided by FAO, must have a unique reliable data source for each country, in particular for the exclusion of internal water bodies, that must also clearly defined.

- Geospatial layers, based on remote sensing techniques, could be used for this indicator, allowing for more detailed and an improvement in the computation frequency. Geospatial layers that can be used for this purpose are different at global and at European level and, in general, European geospatial data layers are much more detailed and reliable. In this context, there are several initiatives that map, on a regular basis, the world land cover. The most interesting initiative is the Land Cover generated by European Space Agency (ESA) in support to the Climate Change Initiative [see Box 1]. It is based on automatic workflows for the generation of Land Cover with a resolution of 250 meters (down to 30 meters and less in the very near future), and a land cover map on a worldwide basis is generated annually from which geospatial layers related to forestry areas can be extracted. Nevertheless, it is important to take into consideration that when adopting land cover maps to extract forest areas the legend may not perfectly fit with FAO forestry definition.

Box 1 - Calculation of the indicator based on ESA Land cover data: example for Italy

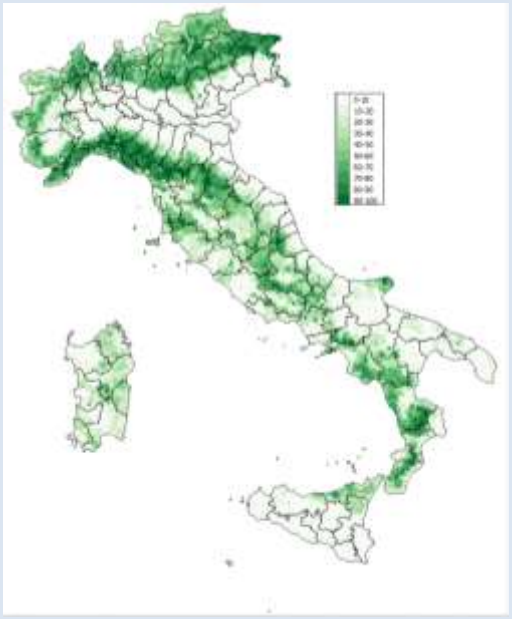
A simulation of the indicator computation has been carried out by e-GEOS using ESA Land Cover and based on the following workflow:

- 2012 ESA Land Cover data and Italy's NUTS 1, NUTS 2, NUTS 3 and commune administrative borders provided by ISTAT
- extraction of the Italy area subset of the ESA Land Cover
- computation of the forest area over Italy by selecting the following classes:
  ESA Land Cover classes: 40 (Mosaic natural vegetation (tree, shrub, herbaceous cover)/cropland), 50 (Tree cover, broadleaved, evergreen, closed to open), 60 (Tree cover, broadleaved, deciduous, closed to open), 70 (Tree cover, needle-leaved, evergreen, closed to open), 80 (Tree cover, needle-leaved, deciduous, closed to open), 90 (Tree cover, mixed leaf type), 100 (Mosaic tree and shrub/herbaceous cover), 110 (Mosaic herbaceous cover/tree and shrub)
- computation of the internal water area to be subtracted by considering class 210
- computation of the total reference unit area from administrative borders
- calculation of the indicator by applying the formula: 100 x (forest area) / (administrative unit area – internal water area)

At national level, the indicator for Italy computed for 2012 based on ESA Land Cover is 33.4%, a value that should be compared with the one reported in FRA 2010 (36.7%) and FRA 2015 (37.7%). The following figures show the results obtained for the case of Italy considering a disaggregation at NUTS 3 [Figure 1] and commune level [Figure 2].

Figure 1 – Forest area as a proportion of total land area based on 2012 ESA Land Cover data, NUTS 3 level

Figure 2 – Forest area as a proportion of total land area based on 2012 ESA Land Cover data, Commune level



Source: ESA Land Cover.

At the ***EU level***, the 15.10 EU-SDG indicator *Share of forest area*, defined by Eurostat, has a direct correspondence with the one defined at the global level. Forests in the EU are covered under the EU Forest Strategy, which stresses the importance and multi socioeconomic and environmental benefits of sustainable forest management. The indicator measures the proportion of forest ecosystems in comparison to the total land area. The data used for this indicator derives from the Land Use and Cover Area Survey (LUCAS) and they have been mapped according to FAO definitions, distinguishing between the categories 'forests' and 'other wooded land'. LUCAS survey is based on *in-situ* data, this means that observations are made and registered on the ground by field surveyors. A mixed panel approach is used, so some points are visited in subsequent years. In the field, the surveyor classifies the land cover and the visible land use according to the harmonized LUCAS Survey land cover and land use classifications. Since relying on surveys, no spatial processing in raster or vector format can be applied. The indicator is delivered every three years, with data at NUTS 2 level comparable for all EU Member States.

In the framework of Copernicus Pan-European High Resolution Layers, geospatial data layers are available at the EU level, allowing the whole computation of the indicator [see Box 2], namely:

- the geospatial data layer Copernicus Forest High Resolution Layer (HRL)
- the geospatial data layer Copernicus Water Bodies HRL

These datasets, available for all EU Member states, can provide very detailed statistics on forest cover, allowing for a disaggregation below NUTS 3 level. The Copernicus HRL permanent water bodies' geospatial layer provides the detailed measure of inland waters (to be subtracted to total land area for indicator computation).

Copernicus Forest HRL is updated with a three years frequency (2012-2015-2018). A Commission task team has been launched to understand if Copernicus information could complement statistical data with the goal to improve coverage, timeliness and resolution.

The Copernicus HRL Forest is based on two products:

- The tree cover density geospatial layer maps the level of tree cover density in a range from 0-100% and minimum mapping width of 20 m.
- The forest type geospatial layer allows to get as close as possible to the FAO forest definition. It Minimum Mapping Unit (MMU) of 0.5 ha, as well as a 10% tree cover density threshold applied. For the final 100m product trees under agricultural use and urban context from the support layer are removed, in line with FAO forest definition

Additionally, at the EU level, the CORINE Land Cover (CLC) data could also be used to calculate this indicator, since it provides a strategy for the identification of inland water, and in particular of rivers, that are considered or not in the global measure according to their size. CORINE Land Cover data are ready to be used, but spatial resolution is relatively coarse (25 ha). Nevertheless, the next generation of CLC (reference year 2018) is expected to provide features at a 0.5 ha spatial resolution.

Box 2 - Calculation of the indicator based on Copernicus High Resolution Layers (HRL): example for Italy

A simulation of the indicator computation has been carried out by e-GEOS using Copernicus HRL and based on the following workflow:

- 2012 Copernicus HRL Forest Type geospatial layer and Copernicus HRL Water Bodies geospatial layer
- administrative borders geospatial layer provided by ISTAT
- computation of the total country area by administrative borders geospatial layer
- computation of the total land area by subtracting water bodies geospatial layer from the total country area
- computation of indicator based on the ratio HRL Forest Type / Total land area

At national level, the indicator for Italy computed for 2012 based on Copernicus HRL 36.9%, also a close values to those reported in FRA2010 (36.7%) and FRA2015 (37.7%).The following figures show the results obtained by using only Copernicus geospatial layers for the case of Italy considering a disaggregation at NUTS 3 [Figure 3] and commune level [Figure 4].

Figure 3 – Forest area as a proportion of total land area based on 2012 Copernicus HRL, NUTS 3 level

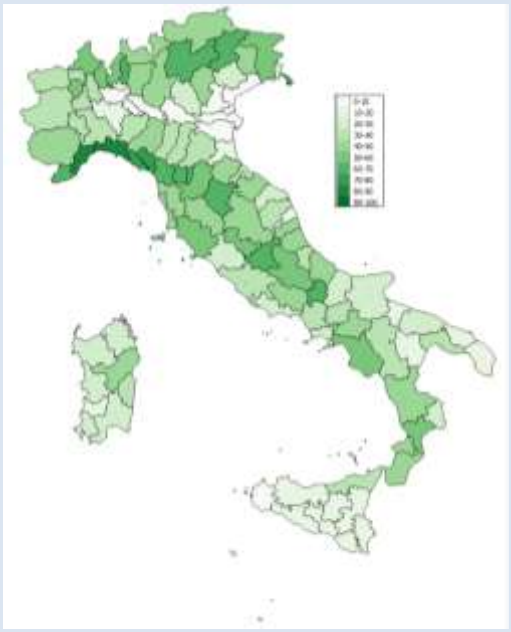
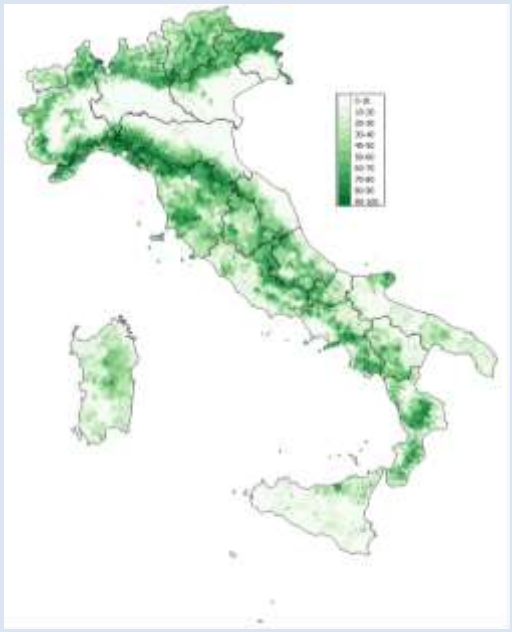


Figure 4 – Forest area as a proportion of total land area based on 2012 Copernicus HRL, Commune level



Source: Copernicus High Resolution Layers.

Both the experiences described in Box 1 and 2 show how the adoption of geospatial information allows a proper disaggregation on a geographical basis of the indicator, providing a more powerful representation of its spatial variability, for its better understanding and management for a single country. It must also be considered that the usage of geospatial layers generated with a stable methodology, enable also an easy comparison of data across different countries at high spatial detail.

At the ***national level***, from the cases analysed (Austria, Finland, France, Germany, Italy and Spain), it is possible to identify that this indicator can be calculated based on national data sources. Countries have identified different agencies with responsibility for data relevant for the indicator calculation, namely Ministries, NMCA and NSI. Cases have stressed the relevance of geospatial layers and remote sensing techniques in order to improve national data sources disaggregation over small reference units. Finland, France, Italy and Spain have identified National Forest Inventories (NFI) as the main data sources to derive the indicator, and in the cases of Austria and Germany, forest

areas are derived from cadastre information. The Austrian cadastre is updated every year and is based on a thematic description, so no geometric representation is available. In the case of Germany, the cadastral data comes from the land surveying authorities based on analysis of orthophotos and *in-situ* measurements. The data is transferred from the cadastral institutions to the Federal Statistical Office and each parcel object within the cadastral data contains a land use type, such as “forest”. The indicator relies on the sum of all cadastral parcels with the use type “forest”. The data is updated either on a cyclic basis or occasion-based, namely when a parcel is divided or other cadastral surveying is accomplished.

Forest inventories collect data by applying statistical procedures without a geometric representation, and remote sensing based techniques, when not used for the delimitation of forest area, are used for the collection of additional information over sampled area. For example, in the case of Finland, in addition to sample plot field measurements, the NFI multi-source inventory method employs remote sensed data and other digital data sources such as land-use maps and elevation models, and with the aid of satellite images, the forest characteristics can be estimated for areas lying between the relatively sparse networks of NFI sample plots. In the case of Spain, besides the NFI, an Information System on Land Cover and Land Use (SIOSE) is also available. The SIOSE is part of the National Monitoring Plan (PNOT), managed and coordinated by the NMCA (National Geographic Institute of Spain), and integrates different data of regional and national administrations. SIOSE is produced in conformity with INSPIRE implementing rules on interoperability of spatial datasets and services and four versions have been made available (2005, 2009, 2011 and 2014). It includes 85 classes and a resolution of 2 ha for forest and natural areas.