CURRENT EXTENT OF AGROFORESTRY IN EUROPE

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Introduction

An accurate and objective estimate on the extent of agroforestry in Europe is critical for the development of supporting policies. Although agroforestry practices are widespread in some parts of Europe, it is hard to find reliable data on the extent of agroforestry. The CORINE land cover classification (European Environment Agency, 1995) contains land cover data for Europe and includes the land cover class "agroforestry". Nevertheless, it is obvious from previous studies that agroforestry is practiced on a much wider scale than estimated by the CORINE database. A recent literature study summarising the currently available data sources estimated that agroforestry is practiced in Europe at least on an area of 10.6 million hectares equivalent to 6.5% of the utilized agricultural area (den Herder et al. 2015a) which is considerably more than the 3.3 million hectares as estimated by CORINE. However, even though literature studies are useful to understand the context, these data are derived in different ways in different countries which makes it difficult to derive reliable estimates. For this reason, a more harmonized and uniform pan-European estimate is needed. In this assessment, we try to answer the question: How much agroforestry is there in Europe and where is it?

Material and methods

In this assessment, we defined agroforestry as the deliberate combination of trees and shrubs with crops and/or livestock on the same land unit (Nair 1993; Leakey 1996). Agroforestry can be classified in different ways, for example on the basis of components, products, agro-ecological zones, and socio-economic groupings (Nair 1993; Sinclair 1999; McAdam et al. 2009). In this assessment, agroforestry systems have been grouped into three categories based on their components. These components are: trees, crops, or livestock (Burgess at al. 2015). Based on these components, we classified agroforestry into three main types of agroforestry systems: arable agroforestry, livestock agroforestry and high value tree agroforestry (Burgess et al. 2015; den Herder et al. 2015a). Based on the distribution of these three main types of agroforestry, we then defined certain areas of high natural and cultural value which can include agroforestry of any of the three main categories.

Agroforestry areas were mapped using LUCAS Land Use and Land Cover data (Eurostat 2015). During the LUCAS 2012 survey, a sample of 270 000 points was visited by field surveyors, producing a quasi-regular grid with on average a LUCAS sample point in every block of 4 km x 4 km. LUCAS uses a double land cover classification system for land covers with multiple layers, such as for instance agroforestry systems. By identifying certain combinations of primary and secondary land cover and/or land management it is possible to identify agroforestry points and stratify them in the three different systems studied in this assessment (**Table 1**).

Table 1 Criteria used for identifying arable, livestock, high value tree (grazed and intercropped) and all agroforestry systems. LC1 = primary land cover, LC2 = secondary land cover.

Land cover / variable[a]	Arable agroforestry	Livestock agroforestry	High value tree agroforestry		All agroforestry
			Intercropped	Grazed	
Crops (LUCAS class B11-B54)	LC2		LC2		LC2
Permanent crops (B71-B84)	LC1	LC1	LC1	LC1	LC1
Woodland (C10-C33)	LC1	LC1			LC1
Shrubland with sparse tree cover (D10)	LC1	LC1			LC1
Grassland with sparse tree cover (E10)		LC1			LC1
Land management		Signs of grazing		Signs of grazing	Signs of grazing

[a]See Eurostat (2012) for more detailed information on the LUCAS land cover classification.

Areas with a high likelihood of containing high natural and cultural value agroforestry were identified by a cluster analysis. The analysis was used to indicate in which areas agroforestry practices would occur in clusters, and these were assumed to be an indication for a high natural or cultural value. Clusters of agroforestry points could indicate that for example wood pastures are relatively well-connected in a particular area or that they would cover larger areas. We can assume that large extents of wood pastures or wood pastures with a low level of fragmentation are more likely to have a high natural value compared to single isolated or fragmented patches. In addition, many of the remaining high cultural value agroforestry practices are a legacy of past traditional land use. Clusters of agroforestry points would indicate areas where these mostly traditional practices possibly having a high cultural value still exist.

Results

According to our estimate using the LUCAS database the total area under agroforestry in the EU 27 is about 15.4 million ha which is equivalent to about 3.6% of the territorial area or 8.8% of the utilised agricultural area (**Fig. 1**). This estimate is considerably higher than the previous estimate by den Herder et al. (2015a) who suggested that agroforestry occupies at least 10.6 million ha representing about 6.5% of the utilised agricultural area in Europe. Of our three studied systems, livestock agroforestry covers about 15.1 million ha which is by far the largest area. High value tree agroforestry and arable agroforestry cover 1.0 and 0.3 million ha respectively.

Spain (5.6 million ha), France (1.6 million ha), Greece (1.6 million ha), Italy (1.4 million ha), Portugal (1.2 million ha) and Romania (0.9 million ha) have the largest absolute extent of agroforestry. However, if we would look at the extent of agroforestry in relation to the utilised agricultural area (UAA), countries like Cyprus (40% of UAA), Portugal (32% of UAA) and Greece (31% of UAA) have the largest percentage of agroforestry cover.
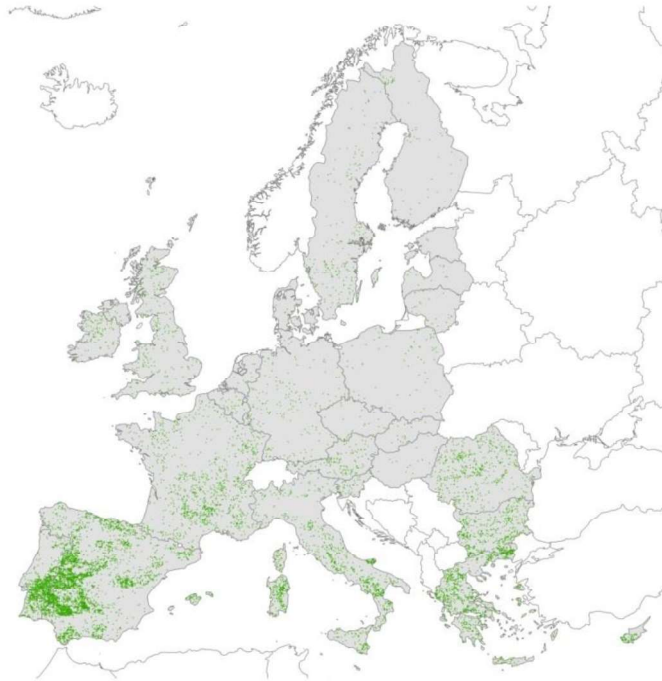
Fig. 1 Extent and distribution of agroforestry in Europe

A hot spot analysis revealed that a high abundance of agroforestry areas can be found in south,
central and north-east Portugal, south-west, central and parts of north Spain, south of France,
Sardinia, south and central Italy, central and north-east Greece, south and central Bulgaria, and
central Romania (**Fig. 2**). It is likely that high natural and cultural value agroforestry is still
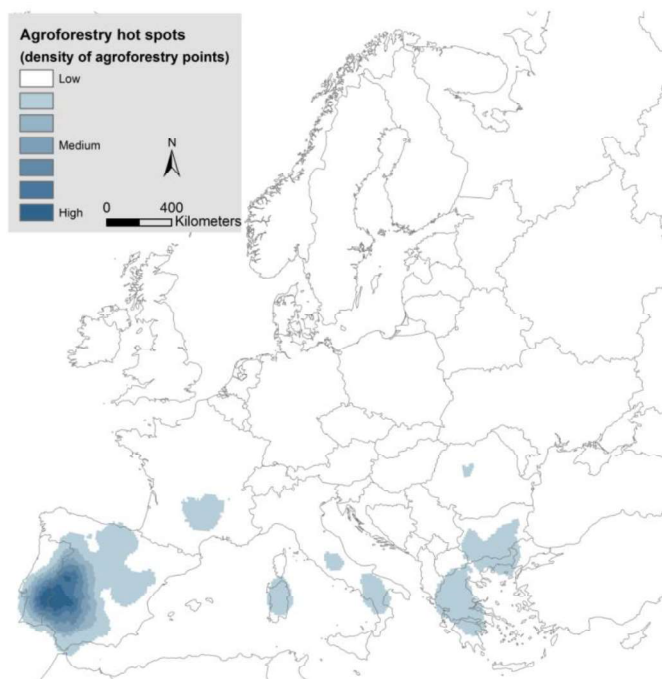relatively widespread in these areas.

Fig. 2 Agroforestry hot spots in Europe. Hot spot areas (dark blue) are represented by a high
density of points which were defined as "agroforestry" in the LUCAS database

Discussion

The higher estimate for the agroforestry area using the LUCAS data (15.4 million ha) than the
literature review (10.6 million ha) (den Herder et al. 2015a) can be partly explained by the
addition of data for Romania (1.76 million ha) and Bulgaria (1.39 million ha), plus higher
estimates for Spain (+1.8 million ha), France (+1.0 million ha) and Italy (+0.4 million ha). To
verify the results, LUCAS estimates were compared with results from national inventories (den

Herder et al. 2015b). For Spain and Portugal a straight comparison among LUCAS estimates and estimates based on different national surveys yielded surprisingly similar values. When the LUCAS estimates for Spain were compared with a more detailed analysis of national inventories (den Herder et al. 2015b), the higher estimate for agroforestry in Spain of about 5.6 million ha from LUCAS, rather than the 3.84 million ha from the literature study, seems valid. The higher estimate for Spain is primarily a result of including silvopastoral systems in addition to the dehesa.

The current estimate of the extent of agroforestry in Europe was difficult to undertake. Considering the fact that agroforestry covers a considerable part of the agricultural land in the EU (up to about 8.8% of the UAA), agroforestry deserves a more prominent place in EU statistical reporting. In addition, it stresses the need that statistical reporting could be improved. This would not be too difficult to implement. For example, identifying agroforestry areas using Eurostat's LUCAS database could be made easier and more straightforward by introducing a few simple changes in data collection, taking advantage of the experience in national forest inventories in southern European countries.

Most likely there is still some error in the extent of agroforestry, but since the data were collected and analysed in a uniform manner it is now possible to make comparisons between countries and identify regions in Europe where agroforestry is already widely practiced and areas where there would be opportunities for practicing agroforestry at a larger scale or introducing novel practices. A more uniform reporting method (for example a more uniform (LPIS) Land Parcel Identification System) would make it easier to give more precise estimates on the extent of agroforestry in Europe and changes in its extent. This would help to give agroforestry a more prominent place on European policy agendas and provide decision makers with more reliable information on the extent of agroforestry and its changes. Without reliable and up-to-date information on the extent agroforestry area and its changes over time, it will be very hard to plan and evaluate the effectiveness of measures promoting this sustainable land use practice.

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