Edaphic Characteristics of Olive-Tree Areas in the Trás-Os-Montes Region (Portugal): A Map-Based Approach

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Abstract

In the Trás-os-Montes Region (Northeastern Portugal), olive tree plantations cover an area of more than 70 thousand ha (near the 6 % of the regional territory), mostly planted and cultivated under traditional non-mechanised cultural systems. It is fully recognised that the olive sector contributes significantly to the regional agro-economy, as well as to the conservation of certain typical landscapes.

The purposes of this study were (i) to draw a general picture of the olive-tree plantations spatial distribution in the Trás-os-Montes Region and (ii) to identify the main soil characteristics and land qualities of areas where olive-trees are the dominant land use. Information provided by regional soil, land use and land suitability maps (1:100 000) was selected, interpreted and treated in order to achieve those objectives.

Due to the small scale of maps, results have only a reconnaissance level of detail. However, they allow conclusions on the main soil/land constraints of olive-tree cultivation in the region. Development of olive-tree plantations and improvement of actual management techniques have to cope with the identified constraints. For that, research contributions are of primary importance, mainly on the fields of mechanisation, soil and water conservation and soil fertility.

INTRODUCTION

Olive tree culture exists in the Trás-os-Montes region (Northeast of Portugal) since the XVI century. Nowadays olive production has a great importance in the economy of this region, occupying 15% of the agricultural area, involving 45% of the farmers, mainly along the Douro River valley and "Terra Quente" zone (INE, 1991). Olive trees are well adapted to regional environmental conditions.

Traditional orchards (more than 50 years old) have on average 120 trees per ha. More recent orchards (less than 10 years old) have on average 200 trees per hectare. The more important varieties are "Cobrançosa", "Madural" and "Verdeal". Average yield is 15kg per tree and 15kg to 16kg of olive oil are produced with 100kg of olives. In average the region produces 90000 hectolitres of olive oil (Monteiro, 1999).

In order to contribute to improving this culture, this study identifies the main soil characteristics and land qualities of areas where olive trees are the dominant land use. A general picture of olive-tree plantations spatial distribution in this region of Portugal is also drawn.

MATERIALS AND METHODS

This study is based on the regional soil, land use and land suitability maps, scale 1:100000 (Agroconsultores e Coba, 1991). The soil map follows the FAO system (FAO/UNESCO, 1988) and contains descriptions of soils at map unit, soil unit and soil profile levels. The land use map describes main land use types and their proportion in typical associations, at map unit level. The land suitability map addresses soil map units to land suitability classes for agriculture, pasture, forest and conservation uses, following a land evaluation approach.

Area affected to olive-trees was estimated from soil unit descriptions (Table 1). The consistency of the estimates was verified comparing total olive groves area with that measured on the land use map, and corrected applying a factor, f = 0,7541. Regional

spatial distribution of olives was assessed at "concelho" level (municipality regionally averaging about 450km^2) (Santos, 1995; Fernandes, 1996). "Concelhos" were classified according to olive grove density, as follows: I - nil or very low-density (< 2% of "concelho" area); II – low-density (2 - 9/10%); III - medium to high density (> 9/10%, but where area affected to vineyards is higher than 20%); IV – high (> 9/10%). Class III was included in order to separate the Douro River area, mainly producing Port Wine.

RESULTS AND DISCUSSION

Olive groves cover about 73500 ha in the Trás-os-Montes Region (about 6% of the regional territory). "Concelhos" with higher % surface affected to olive-trees lay along the Douro River valley and in the central area of Trás-os-Montes. These fall on the drier "Terra Quente" (warm land) climatic zone (T>14ºC, P<600mm, <400m a.s.l.). Olive-trees are rarer in the "Terra Fria" north-western and north-eastern belts (T<12.5ºC, >700m a.s.l.) (Fig. 1).

Olives land is referenced in 24 soil units in Trás-os-Montes (Table 1). In most cases olive groves represent 20 to 40% of soil unit area and are associated to cereal and vines. Dystric Leptosols, schist derived, represent half of the area with olives. More than 1/4 of this area corresponds to Eutric Leptosols (schist and basic rocks), 15% to schist Anthrosols surribic (dystric and eutric) and less than 6% to granite Dystric Cambisols.

Most soils under olive-trees are shallow (Leptosols<50cm depth, 76% area). A significant part correspond to originally shallow soils, deepened by ripper operations (Anthrosols, 16% area) (Fig. 2). Dystric secondary units dominate (70% of area), indicating that soils are mostly acid or very acid and poor in organic mater. Schist derived soils (>80% olive-trees area) are dominantly loam with high silt and fine sand percentage. Basic rocks and sedimentary deposits (recent alluvial and Tertiary, 9% area) originate soils generally with higher clay content (loam or clay-loam). Coarser textures (sandy-loam and loamy-sand) are normally found on granite derived soils (8% area).

In about 60% olive-trees area precipitation is lower than 600mm and in 90% lower than 800mm. Limited water availability conditions prevails as summer accounts for 5-10% of annual precipitation and soils rooting depth is low. Olives are planted on slopes >12/15% on 2/3 of the area, and >25/30% on 1/3. Erosion risk may be reduced due to surface stoniness protection, which is higher than 30% rock fragments in 3/4 of the area. However, both land qualities combined affect trafficability and mechanisation. Almost 3/4 of olives area are considered not suitable for agriculture and only 2% are included on highly suitable land classes. Terraced landscapes (12% olive-trees area) were made suitable through heavy investments prior to plantation (Fig. 3).

CONCLUSIONS

Olive groves are an important element on regional landscapes and, in some municipalities they may represent more than 20% of the area. Their occurrence and density closely corresponds to drier and warmer climatic conditions, where the Mediterranean character is more clearly expressed.

Soils under olive groves are generally shallow, acid and poor in organic matter. Dominantly covering steep slopes, these soils are also medium textured and gravely.

All land constraints considered, most soils under olives are apparently not suitable for agriculture. Yet, olive groves are well adapted to actual edapho-climatic conditions and regional olive oils are of good quality. Land suitability classifications have then to be specifically designed; otherwise, they may provide unreliable information. Improvements on olive groves plantation and management are nevertheless recognised as necessary. Therefore, the identification of land constraints, as was done for the Trás-os-Montes area, is an important step towards that purpose.

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Tables

Table 1. Soil Units with Olive Land Use (% Soil Unit area and % Regional area).

Soil Units with Olives (FAO/UNESCO) SU	Land Use of Soil Units with Olives: Olives Area (%SU)	Other Land Uses with %SU [1] higher	or	lower	Regional Area (%)
Leptosols dystric schist	30	Cereal		Vines/Shrubs	49.2
eutric basic rocks	30	Cereal		Almonds/Shrubs	7.9
eutric schist (orthic)	20	Cereal/Almonds		Vines/Shrubs	18.3
eutric schist (cambic)	30	Cereal		Almonds/Shrubs	0.3
eutric basic rocks (cambic)	40	Cereal			0.5
Fluvisols calcaric	100				0
eutric	20	Irrigated/Fruits		Vines	0.6
Cambisols dystric granite	30	Cereal		Vines	5.6
dystric granodiorites	40	Cereal			0.9
chromic basic rocks	40	Cereal			0
chromic basic rocks2 [2]	20	Forest/Shrubs/Almonds			0
chromic sedimentary	30	Vines		Cereal	0.2
eutric schist	40	Almonds/Cereal			0
Luvisols chromic schist	30	Cereal		Vines	0
chromic sedimentary	20	Cereal/Vines		Perennials	0
Regosols eutric schist	20	Irrigated/Mixed [3]		Perennials	0
Anthrosols terracic dystric granite	30	Mixed [3]		Vines	1.1
terracic eutric schist	50	Vines/Mixed [3]			0
Anthrosols surribic dystric schist	30	Vines		Fruits	12.8
surribic dystric granite	30	Vines		Fruits	0
surribic eutric schist	40	Vines			2.6
Para-Regosols dystric schist	10	Cereal/Shrubs/Chestnuts			0
eutric basic rocks	40	Cereal			0
calcaric schist	100				0

[1] Other Land Uses were compared with % Soil Unit area affected by Olives, areas being estimated from Soil Unit descriptions.
[2] Developed over slope deposits.
[3] Annual or perennial crops around villages.

Figures

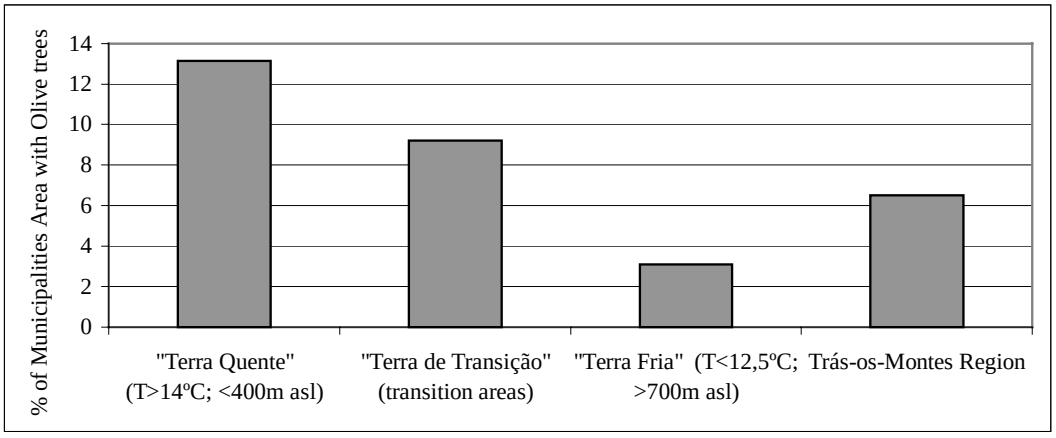

Fig. 1. Area affected to Olive Land Use (% of municipality area, "Concelho") varying according to dominant climatic zone and altitude.

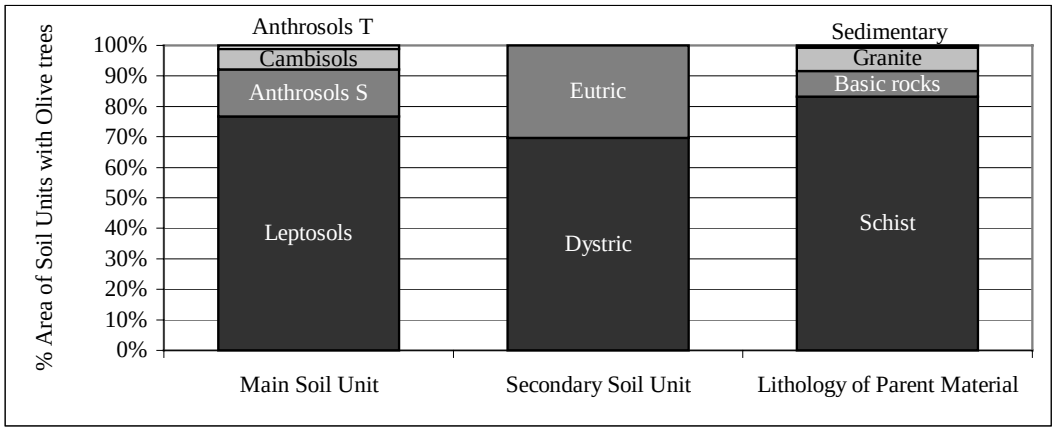

Fig. 2. Distribution of Soil Units with Olives (% area) according to FAO Main and Secondary Units and Lithology (T - terraced; S - deep ripped prior to plantation).

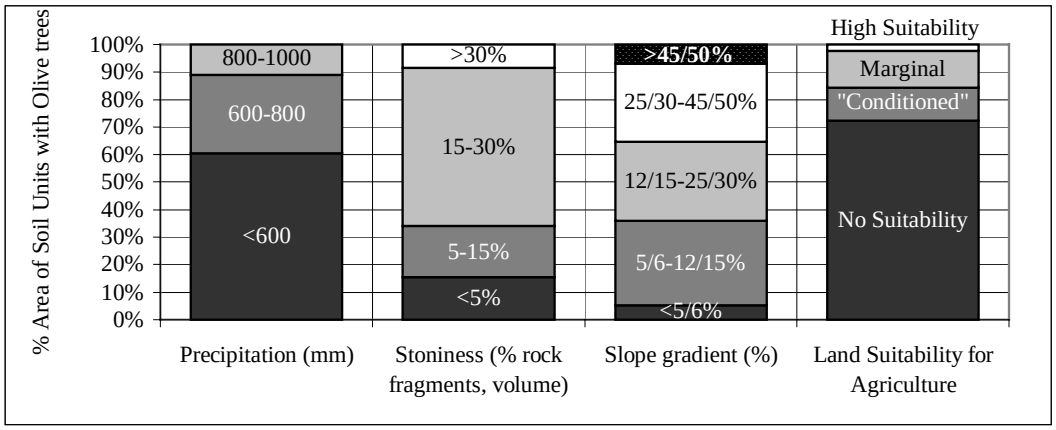

Fig. 3. Distribution of Soil Units with Olives (% area) according to Precipitation, Slope, Stoniness and Land Suitability for Agriculture ("Conditioned" - terraced areas).