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Historical review of land use changes in Portugal (before and after EU integration in 1986) and their implications for land degradation and conservation, with a focus on *Centro* and *Alentejo* regions

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A B S T R A C T

Changes in land use and production systems are to a large extent responsible for land degradation. In Portugal this process has been triggered mainly by socioeconomic drivers, such as agricultural technology, demography and policy changes. In this article land use changes in Portugal are discussed in terms of their main drivers and impacts, focussing on land degradation and conservation. The discussion includes a brief outline of historical land use changes in Portugal and a more detailed account of the changes in the period after 1986, when Portugal joined the European Union. An assessment of recent (1986–2006) land use changes and their impact was conducted for two selected research areas in the *Centro* and *Alentejo* regions. This assessment was based on information from the CORINE Land Cover programme (1985 and 2006) and the National Agricultural Census (1989 and 1999). In the *Centro* research area the land under forest declined from 52% to only 22% of the area, mainly as a result of forest fires. In the *Alentejo* research area the major change was the decline of miscellaneous shrub, declining from 23% to 11%, to open forest land, increasing as a result of afforestation measures from 1% to 22%. These land use changes resulted in a significant increase of soil loss estimates through RUSLE. In the *Centro* research area soil losses greater than 10 t ha^{-1} yr^{-1} were estimated to occur in 57% of the area in 1990, increasing as a result of land use change to 64% in 2006. In the *Alentejo* research area this change was from 65% in 1990 to 72% in 2006. The research raises questions regarding land use management, in relation to the Common Agriculture Policy support during the 1986–2006 period. Despite the increase in forest and permanent grassland areas, soil loss rates remain very high in the two research areas.

Introduction

Similar to the trend seen elsewhere in Europe, the use of land for agriculture in Portugal has been decreasing since the mid-1950s, in favour of forest and shrubland (Daveau, 1995; Geri, Amici, & Rocchini, 2010; Serra, Pons, & Saurí, 2008). This change has been constrained by the contrasting farm structure, which characterises Portuguese farming, namely the minifundia associated with family farming in the North and Central (hereinafter, *Centro*) regions and the *latifundia* in the South region. As a result of the distinct farm structure, socioeconomic drivers such as agricultural technology, demography, and policies (Caldas, 1998; Moreira, Rego, & Ferreira, 2001; Pereira, 1971) have led to quite different farming rationalities. In the North and *Centro*, farming systems favour self-provision of farm households, while in the South region rent maximization for landowners is more common (Baptista, 1993). The way in which the socioeconomic drivers just mentioned have stimulated the appearance of multifunctional agro-ecosystems in the past is used in this paper as a starting point to address the less well-defined recent land use changes and their impact on land degradation and conservation. Today, the intensification of some farming systems occurs simultaneously with the reduction and ultimate abandonment of others. The abandonment of agricultural land constrains the sustainability of multifunctional agro-ecosystems and leads to poorly managed forest areas (De Graaff, Zuazo, & Jones, 2008b; Duarte, Jones, & Fleskens, 2008; Moreira et al., 2001; Van Doorn, 2007).

In general, forest and pastoral land use causes less soil loss than agricultural land use (Pimentel, 2006). While their increase can be beneficial, inadequate management practices can jeopardize investment as a consequence of new species distribution or increased fire risk, currently exacerbated by the warming trend associated with climate change (Pereira, Martins, & Borges, 2007).

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Shakesby et al. (2002) claim that the protective effect of the arable land and oak forest combination – known as "*montado*", and which is traditional in the South – is strongly dependent on land management practices. Kosmas et al. (1997) also show the importance of land management on the soil-protection qualities of permanent crops. In his research, olive trees with understory vegetation ranked higher in soil protection than vines and Eucalyptus forest. Roxo (1994) documented the extent of erosion problems in the *Alentejo* region due to intensive tillage and grazing.

Considering the historical and recent land use changes, two research areas were selected in the *Centro* and *Alentejo* regions. Together they represent the two main trends: increase in shrubland and abandonment of agricultural land. Under favourable management this re-naturalization of agricultural areas could have beneficial impacts in terms of land degradation. However, the question is whether these land use changes will indeed reveal such benefits in the long term (Rosário, 2004).

The goal of this paper is twofold: 1) to clarify the way in which socioeconomic drivers have influenced land use change, and 2) to investigate the implications of land use changes on land degradation. After providing an historical review of the main land use changes in Portugal and their socioeconomic drivers, we focus on the changes that have occurred in the last 20 years in the two research areas. It is hypothesized that although afforestation measures of marginal agricultural areas have been effective, the control of land degradation on those areas will demand in the future a more integrated management in order to avoid poor cover development.

Research areas and methods

Research areas

Portugal's climate features a hot and dry summer, with rainfall concentrated in the winter. The rainfall distribution is mainly influenced by altitude and proximity to the Atlantic Ocean. Northern and central mountains provide a natural division between the North and South. In the North 95% of the area is above 400 m; while in the South 62% of the area is below 200 m (Ribeiro, 1955). The Portuguese mainland comprises about 9.2 million ha.

The total population of the country is about 10 million, concentrated mostly in the coastal areas. More than 60% live in the suburban area of the two major cities: Lisboa and Porto. The less densely populated areas are located in the eastern part of the *Alentejo* and *Centro* regions.

For this research two areas were selected: one in the *Centro* region and another in the *Alentejo* region. The *Centro* research area (112,000 ha) includes three municipalities: Mação, Proença-a-Nova, and Vila Velha de Rodão, which lies on the border of the subhumid climate area with desertification risk identified by DISMED project (Rosário, 2004, Fig. 1). The average annual rainfall in the area ranges between 700 and 1400 mm and is distributed over 50–75 days. The average temperature lies between 12.5 °C and 15 °C. The most common soil types are Eutric Lithosols (more than 70% of the area) and Hortic Luvisols. The dominant land use is forest, mainly maritime pine (*Pinus pinaster L.*). Terraced olive groves and grain crops are found, respectively, at medium altitude and in the valleys (Ribeiro, Lautensach, & Daveau, 1991).

The *Alentejo* research area (128,000 ha) includes one municipality – Mértola, which lies in the semiarid climate area highly susceptible to desertification (Fig. 1). The average annual rainfall ranges between 400 and 600 mm, distributed over 50–75 days, and the average mean temperature is between 15 °C and 17.5 °C. The most represented soil types are Eutric Lithosols – more than 65% of the area – and Ferric Luvisols. The dominant land use consists of grain crops combined with open oak stands (*Quercus ilex L.* and *Quercus suber L.*). Harvested fields are often grazed for the stubble, and on the poorer schist hills, Mediterranean shrubs

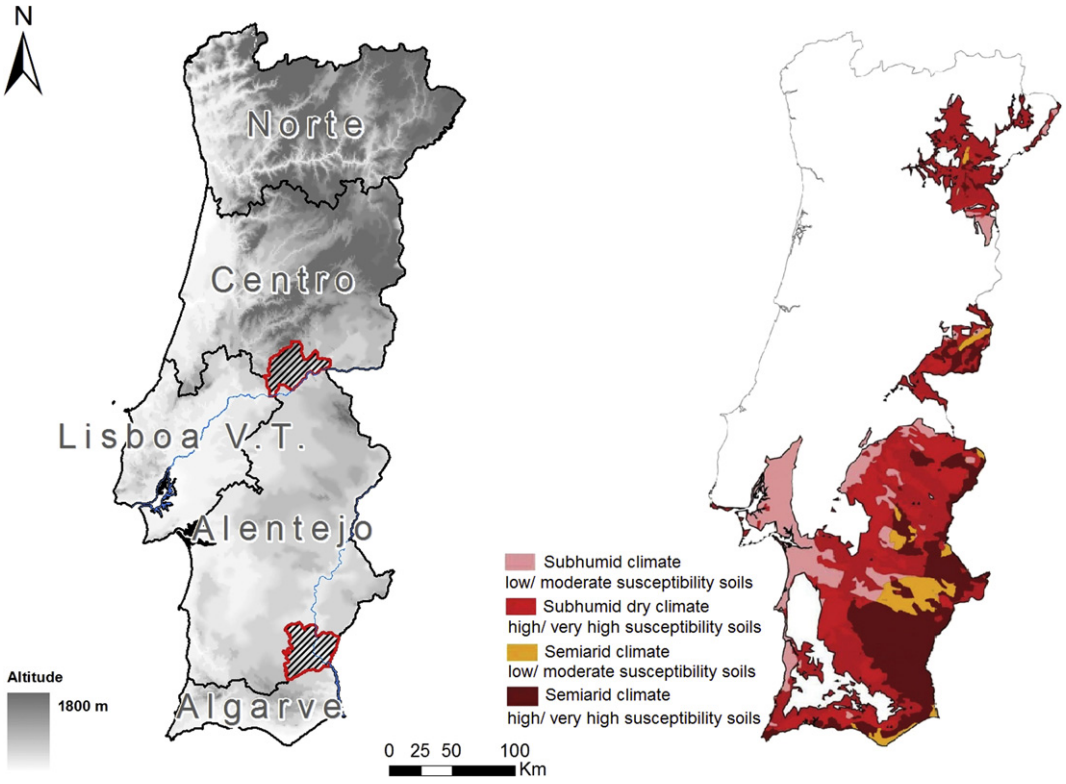

Fig. 1. Research Areas.