Modern silvoarable agroforestry in Portugal and its potential for CO_2 sequestration

Palma JHN & Tomé M

[1] ForChange -Forest Ecosystem Management under Global Change, Centro de Estudos Florestais

Instituto Superior de Agronomia, Universidade Técnica de Lisboa, Portugal

joaopalma@isa.utl.pt

From traditional

Agroforestry is a traditional system present in Portuguese landscapes for centuries covering large areas of the territory. Although Cork oak (*Quercus suber* L.) and Holm oak (*Quercus ilex* subsp *rotundifolia* L) are present in about 1 million ha through the landscape (DGF, 2001), approximately 0.5 million ha may be considered as agroforestry systems (Corine, 2000), either as silvoarable or silvopasture management, providing different traditional valued products such as firewood, fodder acorns and cork.

Pictures taken by Christian Dupraz, Anil Graves

To modern

Modern silvoarable agroforestry design has a linear design, as opposite to the traditional randomness, allowing machinery a good working flow and is open to industrial tree species, including fast growing trees. Recent European research evidenced the sustainability and resource efficiency of these systems (Graves et. al 2007, Palma et al 2007a,b) which could be attractive, not only for wood and pulp industry, but also in the carbon sequestration needs to help meet Kyoto protocol country targets for *new afforestation areas*. Where and how much these systems can contribute?

Pictures taken by Christian Dupraz, Anil Graves

Assessment

Soil, climate and land use datasets (DGA 1992, CLC 2000) were used to 1) generate high yield tree distribution from literature and expert knowledge thresholds and 2) intersect with rain-fed arable land distribution. The resulting dataset provided the total arable land where trees could be planted (Fig 1).

In a second step, YieldSAFE a parameter-sparse, process-based dynamic model for predicting resource capture, growth and production in agroforestry systems (van de Werf, 2007), previously calibrated for Portuguese forest species, predicted tree biomass yields for an agroforestry system with 50 trees/ha in an low and high soil water capacity, under a typical crop rotation of wheat-wheat-fallow, for a 630 mm rainfall area (Evora).

With the potential area and the range of tree biomass yields, scenarios for 10, 30, 50 and 70% implementation of the arable land were calculated for the CO_2eq.

Acknowledgements: This research was carried out with funds from the Portuguese National Science Foundation under the contract SFRH/BPD/26346/2006. The support is gratefully acknowledged.

Preliminary results and discussion

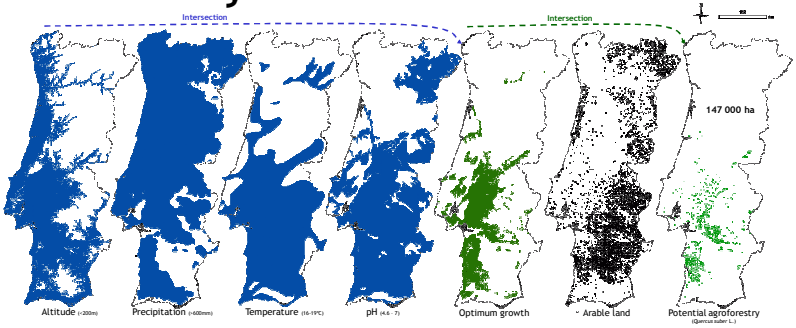

Figure 1. Procedure to locate potential agroforestry for cor oak (*Quercus suber* L.). Conservative tree growth thresholds were considered to evidence high yield areas.

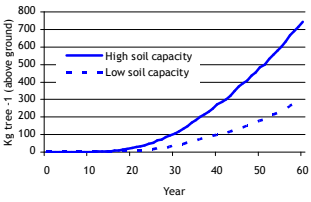

Figure 2. Range of aboveground tree biomass for high and low soil capacity

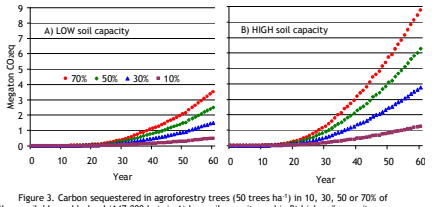

Figure 3. Carbon sequestered in agroforestry trees (50 trees ha^{-1}) in 10, 30, 50 or 70% of available arable land (147 000 ha), in A) low soil capacity and in B) high soil capacity.

• Productive cork oak growth distribution in existing arable land is about 147000 ha. The tree above ground biomass ranged from 300-750 Kg after 60 years for low and high soil capacities respectively. The CO_2eq for the different implementation scenarios ranged from 1.1 to 18.1 Kton (at year 10), 11.7 to 27.3 Kton (at year 20) and 0.5 to 8.8 Mton (at year 60) in 10% low soil capacity and 70% high soil capacity respectively. These calculations did not take into consideration soil carbon from litter fall and root turnover.

• There is a wide sequestration variability between tree growth and target area implementation. This work provides comparative results that could help delineate strategies for policy makers. For example, funds could be focused on good quality arable land because 30% implementation in these areas have a similar sequestration than 70% of those in poorer quality areas. This would allow efficiency, not only in the sequestration but in the support schemes themselves.

•This preliminary study only focused in one specie. Expanding the study to other species will widen the potential for agroforestry carbon sequestration, in particular with species with a faster growth.

•Converting arable land to a forest may not be interesting for farmers. Agroforestry trees could be an intermediate solution. This would allow tree plantations in agricultural fields which, otherwise would not be planted.

References

DGA1992, Atlas Digital de Portugal
CLC 2000, Corine Land Cover, European Environmental Agengy
Graves et al 2007.Ecological Engineering, 29: 434-449.
DGF 2001, Portuguese National Forest Inventory, 3rd revision
Palma et al. 2007a. Agri Ecos & Env, 119: 320-334.
Palma et al. 2007b. Ecological Economics, 63: 759-767.
van der Werf et al. 2007. Ecological Engineering, 29: 419-433.