Can the dehesa system work as Carbon sink?
Case of the '*Dehesón del Encinar*' (Spain)

S. ROIG[1], C. LÓPEZ-CARRASCO[2], R. BENAVIDES [3], N. SIMÓN[4], E. DÍAZ-PINÉS[4], F. MONTES[5], R. ALONSO-PONCE[1,6], A. RUBIO[4].

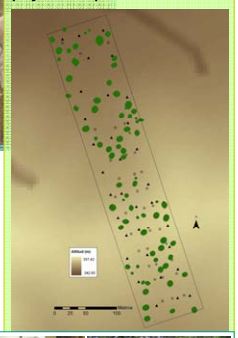
[1] Ecology and Sustainable Forest Management Research Group. Technical University of Madrid. [2] Agricultural Research Centre 'Dehesón del Encinar'. JCCM. [3] Centre for Environmental Sciences. CSIC. [4] Ecology and Landscape Research Group. Technical University of Madrid. [5] Forest Research Centre. INIA. [6] CESEFOR. Castilla y León Gob.

Introduction

Agroforestry systems are considered **multi-purpose** systems, aimed towards achieving an increased and more efficient use of natural resources. This acquires greater relevance in Mediterranean areas where high yield is compromised and **non-timber goods and services** are the main ecosystems products. The dehesa is a well-known agroforestry system that occupies more than 3.10^6 ha in the Iberian Peninsula. In spite of their importance, there is a lack of knowledge of multiple issues regarding the ecosystem functioning and dynamics. One of the potential services of the dehesa is CO_2 fixation which should be incorporated into the management planning. In this work the **potential of dehesas as C sink is analysed in** the framework of a Spanish Research National Plan project carried out in several dehesa system locations in Spain.

'Dehesón del Encinar' location

Study site (over DEM) with pasture production sampling points of years 2008 (black triangles) and 2009 (white stars). Green areas are crown projection of plot trees.



Material and Methods

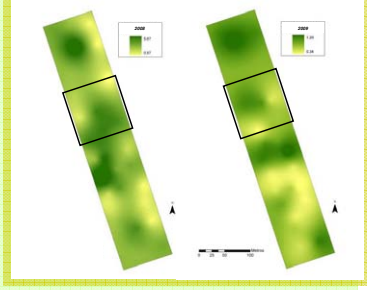
Study site : Intensive sampling-5 ha plot in the experimental field CIA Dehesón del Encinar (Central Spain).
Tree species: holm oak (*Quercus ilex* L.) at very low density (17 sph). Main tree uses are firewood, acorn or forage production .
Climate: Continental-Mediterranean, with a mean annual precipitation of 607 mm and mean annual temperature of 15.1 ºC.
Terrain and Soil: quite sandy and acidic, slight slopes. The pasture belongs to the order *Sisymbrietalia*. The area used to be sown with forage crops for animal feeding until 1993. From that moment on, the area was managed as an agroforestry system with ovine and bovine grazing.

Since 2007, the main components of C cycle have been monitored as a **first approach to the quantification of C stocks** and flows:
Tree biomass through alometric relationships with tree diameter (Montero et al. 2005), using band and electronic point dendrometers .
Annual **acorn production** (López-Carrasco and Roig 2009a) through visual estimates and using nets to harvest and weight the total production
Annual **pasture production** (López-Carrasco and Roig 2009b), and **C content at the top horizon of the soil** (bulk density and C percentage) with **geoestatistical methods and GIS support**.

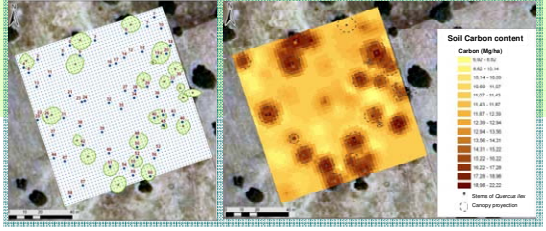
Results and Discussion

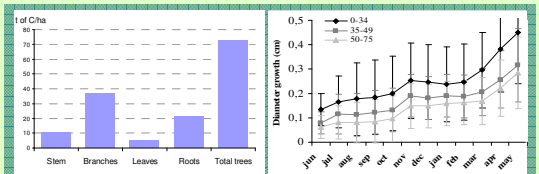
Mediterranean climate causes the **great interannual variability** in pasture and acorn productions. There is also **a strong spatial factor**, according to the presence of the scattered trees in the system that may have different effects depending on the meteorological conditions of the year. Small differences on topographic position, altitude or soil characteristics may also bring about significant differences on some stocks or productions (i.e. pasture biomass). Pasture and acorn yield is usually taken out of the system by livestock or wildlife. The presence of trees, usually big and with large diameters, is important to fix C in stable structures as wood. Therefore **C-tree stock can be very important, in spite of the low tree density and the small growth rates**. The **interaction tree-pasture** is also an important influencing factor in C soil, as well as in other productive and environmental functions of the system.

Pasture producion model for 2008 (left) and 2009 (right) using Ordinary Krigging



Left: Intensive soil sample points (blue points). Green areas are tree crown projections. Right: Soil carbon content through an Universal Kriging.





Left: stock of C in tree components in the 'Dehesón del Encinar' (17 trees/ha). Right: Variability of the accumulated diametrical growth per month of Quercus ilex *in one year (2008) for each diametrical class (class width in cm).*

Conclusions

The highly complex and diverse agroforestry system of the dehesa still needs time and work to synthesize its role in CO_2 fixation. Any approach to tackle the subject should consider the dehesa as a whole, including **vegetation, soil and livestock**.
Temporal and spatial variations in productions and growths at dehesa goods and services are especially important.
Trees and soil stocks showed to have a relevant and significant content of carbon when comparing with other grasslands ecosystems or Mediterranean areas.

This work was developed in the projects RTA2009-00110 and SUM2006-00034-C02 (INIA-Spain)
(http://sites.google.com/site/dehesasytallaresdeencina).
(http://sites.google.com/site/dehesasystemcsink).