PLANT COVER AND LAND USES CHANGES IN THE NORTHWESTERN IBERIAN RANGE (LOS CAMEROS, LA RIOJA, SPAIN) BETWEEN 1956 AND 2001

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Changes on the vegetation cover and land uses are excellent indicators of the environmental dynamics. The expansion of the vegetation cover has large implications on landscape structure and the hydrologic and erosive processes, and also on biotic aspect as biodiversity, increase of fire risk, seasonal balance of grass and CO_2 capture. In this context we are interested in quantifying and understanding the plant cover evolution in Los Cameros (western Iberian Range, La Rioja, Spain) between 1956 and 2001 in relation to the changes of management and land uses. The final objective is to gather the needed information to implement development models aimed to the sustainability of the landscapes and their ecological wealth.

The mountainous region of Los Cameros includes high valleys of the Iregua (Camero Nuevo) Leza, Jubera and Cidacos rivers (Camero Viejo). It is located in the western sector of the Iberian Range, with a surface area of 1,068 km^2 and a population of 4,049 inhabitants in 2006.

The relief of Los Cameros is homogeneous, with moderately steep slopes and rounded summits. In the western sector (Iregua valley), the altitudes surpass the 2000 m a.s.l. (Mesa de Cebollera, 2161 m). They diminish progressively towards the east, where the summits only reach the 1200 m in the valley of the Cidacos (Peña Almonte).

Los Cameros region has a Mediterranean mountain climate, with slight oceanic influences towards the west. The average annual precipitation in the west (Ortigosa, Iregua valley) is 636.3 mm, whereas in the east (Enciso, Cidacos valley) is 438.5 mm. The average temperature is 8.5º C and 10.9º C, respectively. The vegetation type belongs to the Mesomediterranean, Supramediterranean and Oromediterranean belts.

The demographic evolution of Los Cameros shows a regressive tendency since 1840, the year with the highest population (23,200 inhabitants) distributed in 78 villages. In 1900 there were only 14,653 inhabitants and in 1940, 12,036 inhabitants. From 1940 the demographic

crisis was even faster, and the population decreased to 4,049 inhabitants in 60 years (2006 census).

The methodology is based on the analysis of the vegetation and land uses cartography of the 1956 and 2001 years. The first was made from the aerial photography of Geographic Service of the Army. The cartography of year 2001 was provided by the Infrastructure of Spatial Data of the Government of La Rioja. These digitalized cartography allowed to quantify the surface occupied by the different land uses categories and the plant cover in the area of study at two years, as well as to evaluate the magnitude of the changes between both dates. Also it was possible to investigate the role of certain variables in the detected changes.

In 1956, the agricultural surface occupied 34,760 ha (32.5% of the total surface of the study area), although 4,942 ha already had been abandoned. The forest area occupied 66,755 ha (62.5% of the study area), dominating the scrubs (44,099 ha). The dense forests covered only 22,580 ha, and deciduous trees (oaks, mainly) dominated over conifers. The grassland occupied an extension of 2,732 ha (2.5% of the total).

In 1956 there were already signs of productive marginalization in Los Cameros. Nevertheless, the deepest changes are detected after the 1950s. The abrupt decrease in population was accompanied by the reduction of the agricultural surface and by large changes in the stock system. Before 1956, 34,760 ha were cultivated, whereas at the present time only 856 ha are cultivated. The stock census evolved negatively after the crisis of the transhumance system. At the end of century XVII, there were more than 500,000 sheep in Los Cameros, whereas in 1950 only they were 51,492. The number of goats and cows also decreased with the population emigration; in 1950 there were 26,606 goats and 2,132 cows. In the second half of the 20th century the bovine has experienced a positive evolution. The native cow breed (Camerana) was replaced by foreign breeds (Brown-Highlands, Charoleais and Hereford). However, these meat-producing breeds are not fully adapted to Mediterranean pastures.

As a result of the agricultural land abandonment and the smaller stock pressure, Los Cameros has experienced a vegetation cover increase since the mid 20th century. In less than five decades the forest surface (forest, afforestation and scrub covered areas) has extended 31,248 ha, which represents an increase of 43.6%. The increase in plant cover has affected both the natural forest, that cover 44,413 ha, and the afforestation areas. In 1956, 76 ha had been afforested. In 2001, a surface of 9,496 ha had been afforested (8.8% of the study area). The scrub areas maintain a similar surface in both dates: 49,041 ha in 1956 and 49,036 in 2001. About 67% of the scrub is compound of *Genista scorpius* and *Cistus laurifolius.*

The results of the discriminant analysis, that relates the vegetation cover and land uses changes between 1956 and 2001 and some topographic and environmental variables, indicate that the expansion of the vegetation cover in Los Cameros is a complex process. Nevertheless, the distance to the village and the altitude are the most important factors in order to explain the identified changes.

In summary, Los Cameros had an intensive use of their territory during centuries and experienced the productive marginalization, especially of the primary sector, throughout the 20th century. As a result of the under-use (frequently total abandonment) of its resources, an intense revegetation process has occurred since the beginning of the 20th century. This process is characterised by the increase of the density of the areas that already were forested and the increase of the forest surface (natural forest and afforestation).

The increase in vegetation cover surface area during the 20th century is a known process in the mountain of the developed countries. For some authors, the thermal increase related to climate change would be the main cause of the positive evolution of the vegetation biomass. Without ruling out completely a role for climate change, in the Mediterranean mountain the changes of management and land uses would be the primary cause of the expansion of the vegetation cover. In this work it is shown that in Los Cameros this expansion has been preceded of the population loss (more of a 72% between 1900 and 2006), the agricultural abandonment (97.5% of the cultivated area), the reduction of the stock pressure (more of 80% from the 17th century), and the implantation of systems less related to the territory.

This study demonstrates that intense changes in the landscape are occurring in Los Cameros and they and are affecting all the territory. Consequently, these changes must be considered in future programs of economic and environmental management.