Land cover temporal evolution in Northeastern Corfu Island.

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Abstract

This paper explores the possibility of analyzing the diachronical change of land cover and thus grassland transition in Corfu Island through the usage of 18th century Venetian cadastral maps and modern orthophotomaps. GIS software was used to integrate the historical cadastral and modern maps and analyze the impact of physiographic factors of the landscapes, such as altitude, slope and aspect on land cover change. The cadastral maps that were used determined three study areas: the landscapes of Spartillas, Episkepsi and Socraki areas. In 18th century the land cover in all study areas consisted of grasslands, shrublands, agricultural areas and mixed areas, creating diverse heterogenic landscapes. At that time, the impact of aspect proved fairly important, especially at the northern orientated landscapes of Episkepsi and Sokraki areas. Northern aspects in particular, were more likely to be dominated by natural grasslands and shrublands than agricultural land due to the negative effect of the 'Boras' local cold wind on agriculture. Venetians had a significant impact on the landscape by the reinforcement of olive groves, which expanded to their biological height limit. That is clearly illustrated in Spartillas landscape evolution to the 20th century, where the expansion of agricultural land (olive groves) took place over the grasslands. Episkepsi area evolved into a homogeneous agricultural landscape of olive groves, while Socraki area turned out to be more diverse. Overall, the methodology that was used in this paper is suitable for investigating long-term land cover changes with sufficient accuracy.

Key words: 18th century Venetian cadastral maps, grassland – shrubland, physiographic factors, G.I.S.

Introduction

A lot of studies of land cover evolution in landscapes are using historical maps as a source for information about land cover in the past, dating from 19th century or earlier (Hamre et al. 2007). In many of these studies, the diachronic land use/ land cover interaction with physical geographical features is also investigated (Cousins 2001, Bender et al. 2005). There are various examples of historical landscape evolution: in some studies the area covered with grasslands increases (Jordan et al. 2005, Hamre et al. 2007) while in others decreases (Cousins 2001, Papanastasis and Chouvardas 2005). Most of the studies that use historical maps in order to analyze landscape evolution refer to Central and Northern Europe and only a few focuses on Mediterranean landscapes. The General State Archives –

Archives of Corfu Prefecture (GSA – ACP 1750) have a considerable coverage of detailed Venetian cadastral maps from 1722 onwards. Furst – Bjelis (2003) analyzed similar Venetian cadastral records and maps of the 18th century as textual and graphic documents in order to describe the cultural landscape of Dalmatia, but without the usage of GIS software advantages.

The aim of this study is (a) to explore the possibility of analyzing the diachronical change of land cover and thus the grassland transition in Corfu Island through the usage of Venetian cadastral maps register from the 18th century and modern orthophotomaps and (b) to survey the impact of physiographic factors of the landscapes, such as altitude, slope and aspect on land cover changes.

Materials and methods

Five cadastral maps of the 18th century were used (GSA – ACP 1750) delineating three different feuds of Venetian baronies situated at the northeastern part of the island. Their limits determine in total three corresponding study areas, which constitute the landscapes of Episkepsi (349.12ha), Socraki (147.88ha) and Spartillas (555.19ha) areas. The time spam encased by the Venetian maps ranges from 1744 to 1751. For simplicity reasons 1750 is used throughout the paper as the approximate age of the time layer.

The historical cadastral maps were geometrical corrected by using common ground control points (GCP's) on the modern orthophotomaps. Afterwards, the cadastral maps and a set of modern orthophotomaps were digitized using ArcGIS software, in order to create digital land cover map layers regarding the years 1750 and 1990. Five common land cover categories were recognized between the old cadastral maps and the modern orthophotomaps: (1) agricultural areas, (2) grasslands – shrublands, (3) mixed areas (consisted of cultivated and uncultivated areas), (4) abandoned agricultural areas and (5) other (villages, settlements).

ArcGIS was also implemented in order to analyze the impact of physiographic factors, such as altitude, slope and aspect on land cover change. The physiographic conditions were derived from 3D models of the three landscapes.

Results and discussion

The landscape of Episkepsi area (elevation zone from 0 to 480 m) is dominated by medium slopes (38.88%), followed by mild (20.87%) and steep (20.63%) slopes, while flat surfaces prevail (23.67%) followed by

northern (15.31%) and northwestern (15.31%) aspects (Figure 1). Due to its variable physiographical conditions the 18th century (1750) land cover structure shows a great variety and spatial diversity, consisting of natural grasslands and shrublands (38.02%), mixed areas (35.58%) and agricultural areas (25.02%). On the contrary, in 1990 the same landscape is dominated by a large homogeneous agriculture area (95.36%) where the limited natural grasslands and shrublands areas (2.07%) are located to the upper and steeper slopes. The Socraki area (Figure 1) is a semi-mountainous landscape (elevation zone from 340 to 465 meters) dominated by medium slopes (30.97%) and mainly northern (24.46%) and flat (23.91%) aspects. In 1750 the area was predominated by mixed areas (69.52%). During the time period (1750 – 1990) there was a substantial increase (249.38%) of grasslands - shrublands and agricultural lands (68.55%) due to the elimination of mixed areas. Furthermore, the observed mixed area elimination was also promoted by a significant amount of abandoned agricultural areas (34.37%) in 1990. The abandonment of agriculture in the area was due to economic and social reasons (Skarlatou 2011). The Spartillas area (Figure 1) is mainly facing southern (34.65%) and flat (21.88%) aspects (elevation zone from 0 to 780 meters). The Spartillas area is dominated by medium (20.94%) or flat (19.83%) slopes, however in the middle of both parts of the area there is a very steep streak called *"Mega Gkremos"* meaning "*Mega escarpment*". In general, a significant increase of agricultural areas (386.60%) took place during the time period (1750 – 1990), mainly by occupying the mixed areas and in a lesser extent grasslands and shrublands.

Venetians had a significant impact on the landscape by reinforcing olive groves, which expanded to their biological height limit (500m at most). According to the registers that came with the Venetian maps, the agricultural land consisted of olive trees planted in a sparse union (10x10m) with vineyards and probably cereals in between them. The number of olive trees almost doubled (74.1%) from 1761 to 2006 resulting in the decrease of Corfiot landscape heterogeneity (Skarlatou 2011). The factor of altitude in regard to olive plantation height limit is clearly illustrated in Spartillas landscape evolution to the 20th century, where the expansion of agricultural land confined grasslands and shrublands at the uppermost parts of the landscape. Furthermore, olive groves expanded almost all over Episkepsi area, while the less favorable for olive planting landscape of Socraki area turned out to be more diverse, occupied by agricultural land, abandoned agricultural land and grasslands - shrublands.

As far as slope factor is concerned, in the 18th century landscapes of Episkepsi and Spartillas area, grasslands – shrublands cover developed on the steep upper sections of hill slopes or on the highest flat plateau (over 600m) (Figure 1). In the landscape of Socraki area, the terraces constructed over the hills counterbalanced steep slopes. In 1990 though, agricultural areas develop in steeper surfaces than in 1750 due to the increase (Episkepsi and Spartillas area) or the introduction (Socraki area) of olive trees. The impact of aspect proved fairly important in 1750, especially at the north orientated landscapes of Episkepsi and Sokraki areas, since the northern aspects were more likely to be dominated by natural grasslands and shrublands than agricultural land. The reason was the negative effect of the 'Boras' on agriculture, a local cold wind coming in winter from Andriatic sea. At that time in Spartillas area, where southern aspects prevail, land cover pattern was less interspersed than in the two other landscapes. In modern time (1990), aspect factor was not considered important for landscapes evolution, especially in the areas that olive groves are dominating.

Conclusions

The 18th century (1750) landscapes of Episkepsi, Socraki and Spartillas areas consist of grasslands, shrublands, agricultural areas and mixed areas, creating diverse heterogenic landscapes. In modern times (1990), the landscapes of Spartillas and Episkepsi areas became less diverse, comprised basically of monoculture of olive groves that were expanded till their biological limit. Only the semi-mountainous landscape of Socraki area partially kept its heterogeneity. Slope factor is counterbalanced by the plantation of olive trees. Aspect factor proved fairly more important in 18th century rather than in modern time, since the northern aspects (due to the negative effect of the 'Boras' on agriculture) were more likely to be dominated by natural grasslands and shrublands than agricultural land. Overall, the Venetian cadastral maps can be digitized and analyzed with GIS and give a quite good idea of the landscape in 1750 in Corfu Island. The methodology that is used in this paper is suitable for investigating long-term land cover changes with sufficient accuracy and survey the possible contribution of the physiographic factors to the evolution of the landscape.

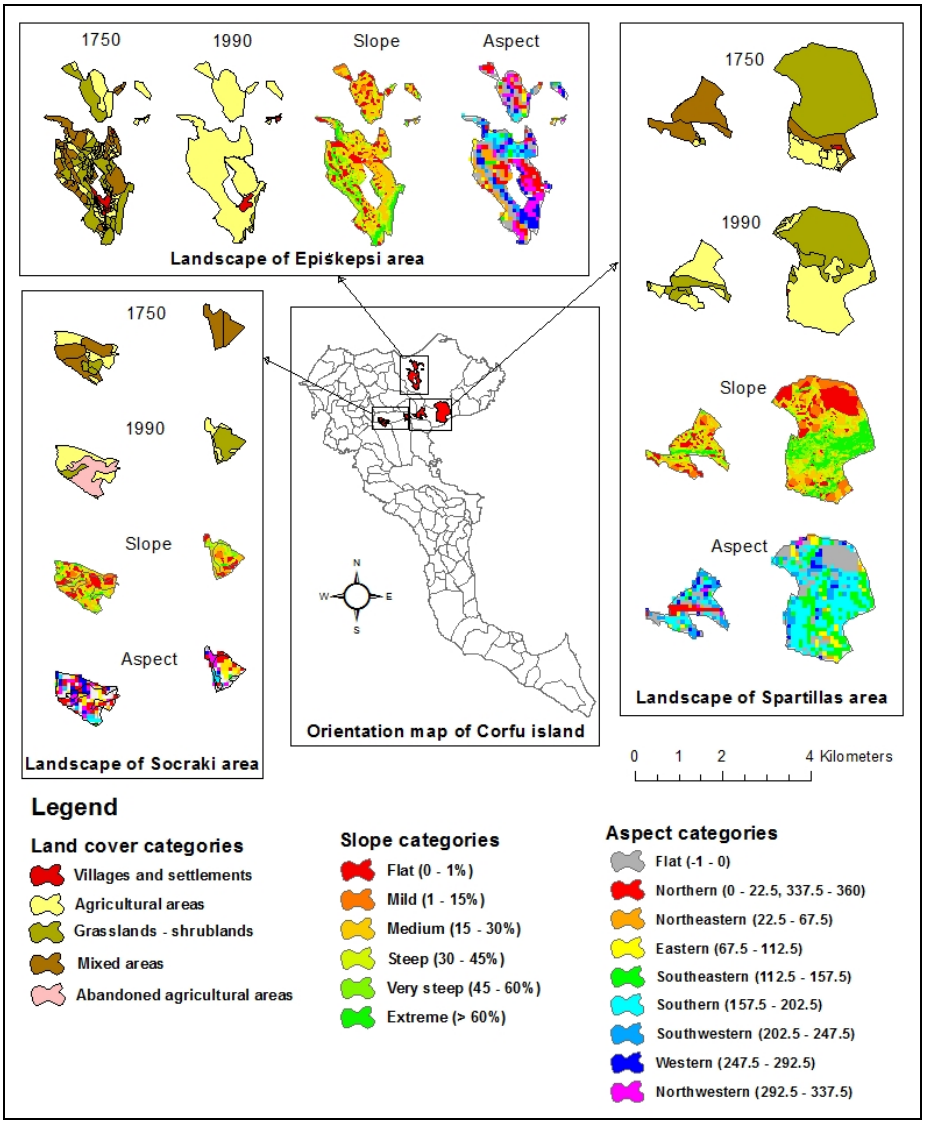

Figure 1. Maps of land cover (1750 – 1990), slope and aspect, showing the landscapes of Episkepsi, Socraki and Spartillas areas.

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