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Profiling Rural Landmarks over Time: An Integrated Approach

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Abstract

The present study illustrates an approach to map a landscape element typical of the Mediterranean rural landscape by integrating digitization from topographic maps and photo-interpretation on recent Google Earth imagery. The approach was applied to a case study in Greece. The location of water open reservoirs used for crop irrigation, taken as a typical element of the rural landscape in the area, was mapped through (i) digitization of Hellenic Military Geographical Service (HMGS) maps scaled 1:25,000 referring to late-1970s and (ii) interpretation of Google Earth Imagery referring to early-2010s with the support of ancillary data sources. Maps have been included into a Geographic Information System (GIS) incorporating layers, which describe land-use and population distribution. The cartography was processed to develop landscape indicators by using spatial analysis tools. The integration of digitization techniques with geographic information systems and spatial analysis represents an original approach for landscape assessment in areas suffering from the lack of digital information on the environment.

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1. Introduction

Landscape may be considered as composed by six compositional elements: landform, vertical structure, horizontal structure, vegetation, water and climate. Landscape forms, structures and diversity reflect a complex system of interrelated biophysical and anthropogenic elements that change rapidly according to external pressures of both natural and human origin. This system definitely needs a permanent monitoring to inform effective

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conservation policies, especially for landscapes, which result more threatened by the human pressure. Landscape analysis benefits of integrated approaches encompassing geography, environmental science and information systems to evaluate characteristics and dynamics of different land-use types and elements (Detsis et al., 2010; Feranec et al., 2010; Geri et al., 2010). While nowadays monitoring techniques for land-use changes detection are relatively diffused, the characterization of specific (e.g. point) landscape elements over time and space is a research issue that deserves further efforts in both the theoretical and practical perspective.

The Mediterranean rural landscape is one of the most rich in term of cultural and natural biodiversity in the world since it is characterized by specific structures, multifaceted functions and millenary interactions between humans and nature (Economidou, 1993). This landscape type, however, is shaped by drastic land-use changes mainly driven by urbanization, infrastructural development and cropland abandonment and needs specific approaches to map elements that could be degraded or destroyed by intense anthropogenic pressure (Skowronek et al., 2005). One typical example is provided by the traditional rural landscapes along the coasts or around the main cities in southern Europe (Couch et al., 2007). These landscapes are characterized by diversity in land-use and land cover, high vegetation and animal biodiversity, traditional crops and agricultural practices (irrigation, mechanization, rotation), local communities, archaeological places and millenary cultures which are being progressively threatened by urban sprawl (Galli et al., 2010). Just to cite three widely known cases, the peri-urban areas in Rome, Athens and Barcelona may properly describe changes in traditional and cultural landscapes at the fringe of large Mediterranean cities (Catalàn et al., 2008; Chorianopoulos et al., 2010; Salvati and Sabbi, 2011).

Land-use changes in peri-urban areas are the results of multifaceted drivers and reflect the stratification of immediate and underlying factors determining urbanization-driven land conversion (European Environment Agency, 2006). In the Mediterranean Europe urbanization primarily involved poor-quality land, such as pastures, abandoned fields, and areas with spontaneous vegetation at the fringe causing only a moderate impact on high-quality landscape and high-biodiversity ecosystems. More recently, however, an increasing proportion of rural high-quality land experienced changes in use and cover due to dispersed urbanization with important implications on landscape structure, quality, and diversity and the progressive destruction of traditional landscape elements (Weber et al., 2005; Catalàn et al., 2008; Frondoni et al., 2011).

Cultural landscapes in rural areas represent the ‘combined works of nature and man’ (Birks et al., 1998; David et al., 1998; Farina, 2000; Fowler, 2003) and are widely regarded as coupled natural-human systems due to the emergence of traditional techniques and practices that have shaped the land for centuries (Head, 2000; Marcucci, 2000; Agnoletti, 2007; Green, 2012). Many cultural landscapes are currently listed in the World Cultural Heritage list of UNESCO since they are “irreplaceable sources of life and inspiration” (UNESCO, 2012). However, human activities in rural and peri-urban areas can both create cultural landscapes with high aesthetic, cultural and ecological value or may result in land degradation and loss of biodiversity (Droste et al., 1995; Fraser Hart, 1998; Garcia Latorre et al., 2001; Wrbka et al., 2004).

The present study contributes to the diachronic mapping evaluation of an element typical of the Mediterranean rural landscape by introducing a cartographic approach that integrates digitization from topographic maps and photo-interpretation on recent Google Earth imagery. The exact location of water reservoirs used for crop irrigation, taken as a typical rural landscape element in the area and in several other rural regions in southern Europe, was mapped through digitization of Hellenic Military Geographical Service (HMGS) maps scaled 1:25,000 and referred to late-1970s and interpretation of Google Earth Imagery dated 2011-2013 with the support of ancillary data sources like Landsat imagery and recent high-resolution land-use cartography. The approach was applied to a case study in Greece (Thriasio, Attica), an area characterized as rural at the beginning of the study period that experienced a rapid urban development and industrialization following land abandonment and migration from abroad.

Maps have been included in a Geographic Information System (GIS) incorporating layers, which describe land-use, settlements and population distribution. The derived cartography was processed with the aim of developing landscape indicators using spatial analysis tools (e.g. density of reservoirs, mean neighbor distance, regularity or clumpiness in spatial distribution). The integration of mapping and digitization techniques with geographic information systems and spatial analysis produces novel approaches for landscape assessment in areas suffering from the lack of digital layers describing the basic characteristics of landscape.

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