THE IMPACTS OF BUILT UP AREA EXPANSION ON ISLAND LANDSCAPE: THE CASE OF SANTORINI ISLAND, GREECE

Abstract

The paper tries to shed light on how the unregulated exurban expansion affects the landscape of Santorini island. The unregulated built up area expansion is a common practice in Greece and mostly on islands. It is driven by the mass tourism development and the demand for second houses. The unregulated built up expansion is followed by social, economic and environmental issues.

Landscapes are the result of the osmosis of material and immaterial features of a place. Landscapes are characterized by dynamic nature and they change according to natural processes and human activities. The islands' landscapes are more vulnerable, owing to their particular socio-spatial systems. There are strong residential pressures principally in areas of high fragility and importance such as: along the coastal zone; on the ridges; in proximity to places with special cultural value such as traditional settlements or archaeological sites.

The built up area of Santorini has been obtained from the orthophoto maps provided by the National Cadastre and Mapping Agency. The built up area is clustered into buildings within official settlements boundaries and in exurban areas. For the management and protection of the cultural heritage, traditional settlements and archaeological sites have been examined, while for the natural heritage, sites Natura 2000, "prominent" areas and coastal zone have been taken into consideration. The negative impacts on islands' landscape by the unregulated urban expansion are interpreted on the basis of the Greek spatial planning framework, so that its weaknesses are addressed in the confrontation of these issues.

Key words: Spatial planning, island landscape, cultural heritage, Santorini, Greece
Introduction

The unregulated built up area expansion is a typical practice in Greece, mostly on islands and coastal zones. Some of the main driving forces to unregulated built up area expansion are the mass tourism development and the demand for second houses (Salvati, 2013; Kizos et al., 2017) in combination with the loose and incompetent spatial planning framework.

Significant social, economic and environmental issues are linked to this mode, which are even more pronounced on islands due to their fragile socio-spatial systems and the limited carrying capacity (Baldacchino, 2004). The clusters that are created by this mode are usually concentrated in areas with significant natural or cultural importance such as: along the coastal zone attracted from the sea proximity, on the ridges because of the attraction for the view, in proximity to places with special cultural value such as traditional settlements or archaeological sites (Kizos et al., 2017; Tsilimigkas et al., 2018). This lead to pressures on the landscape of the islands.

Landscape is the result of the osmosis of cultural and natural environment and its value concerns not only the outstanding landscapes but all types of landscapes: (landscapes of everyday life, rural landscapes, urban landscapes, industrial landscapes etc.) (Council of Europe, 2000). Islands have limited carrying capacity and the establishment of large-scale activities and constructions will lead to negative impact on their landscape and on their identity (Tsilimigkas and Derdemezi, 2017).

In that context, it is recognized the significant of the incorporation of the landscape in the spatial planning system (Tsilimigkas and Derdemezi, 2017, Tsilimigkas and Kizos, 2014). At European level this fact was mainly propounded by the European Landscape Convention (ELC) (Council of Europe, 2000). In Greek national policy, the adoption of the European Landscape Convention was by the Law 3827/2010 (OGG, 2010). Thus, for first time there is a Greek law for the integral landscape protection and management. Concerning the culture heritage of islands, the traditional settlements are of great importance. The traditional settlements of Cyclades islands have been nominated and delineated by the Presidential Decree (PD) 594/D/78 which was completed by the 504/D/88 (OGG, 1978; 1988). According to PD 345/D/89 (OGG, 1989) the building regulations for the traditional settlements are defined. Completions and modifications are laid down subsequently by the Law 3201/2003, (OGG, 2003).

The delineation and the determination of buildings regulations in traditional settlements was late for some islands such as Mykonos, Santorini etc., because of the massive tourism development (Tsartas, 2010) and the tendency of built up expansion that was already existence.
Today, the delineation of settlements is inadequate in most cases and there is need for re-delineation.

The archaeological sites have significant value for islands' landscapes. The Law 3028/2002, (OGG, 2002) nominates spatial regulations that refer to the archaeological sites delineation and the areas in proximity.

The case of Santorini

Santorini island belongs to Cyclades islands complex in Aegean Sea. The surface of Santorini is 76.05km² and the permanent population 15,231 people (ELSTAT, 2011). It is one of the most popular tourist destinations worldwide due to its unique natural and cultural heritage.

Santorini is characterized by its volcanic landscape with the caldera that has been shaped by the eruption of 17th century BC. The islets Nea and Palia Kameni and the mountain of Prophet Elias belong to the network Natura 2000. The whole island is considered as Landscapes of Special Outstanding Natural Beauty (LSONB) [“Topia Idiaiterou Fysikou Kallous or TIFK”, in Greek] (OGG, 1950).

In Santorini there is a plethora of archaeological sites and traditional settlements with special architecture. Specifically, there are 15 settlements with official delineation and 16 traditional settlements of which four have not institutionalized boundaries. The traditional settlements: Vothon, Emporio, Thira, Megalochori, Oia and Pyrgos have nominated by the PD 594/D/79 (OGG, 1979), the traditional settlements: Akrotiri, Exo Gonia, Episkopi Gonia, Imerovigli, Karterados, Mesaria, Foinikia, Tholos, Ammoudi Bay and Armeni Bay are nominated by the PD 504/D/1988 (OGG, 1988) (Figure1). These two PD contains the terms and building restrictions for traditional settlements. For the Cycladic traditional settlements that have been nominated by PD 594/D/79 there is completion and modification according to the PD 345/D/89 (OGG, 1989).

The archaeological sites of Santorini with institutionalized boundaries, according to the PD 108/D/2016 (OGG, 2016b), are: Akrotiri, Gavrilos Hill, Ancient Thira - Prophet Ilias - Saint Nikolaos, Monolithos, Fira Mines, Koloumpo, Castle of Skaros, Castle of Pyrgos, Castle of Emporio and Castle of Oia (Figure1).

Materials and methods

In this study the working scale is fixed on 1:20.000, considered as a typical scale for physical spatial planning and is appropriate for the study questions. It has used the Aster DEM with 30x30 meters cell size, ASTER GDEM is a product of METI and NASA (METI & NASA, 2011) so, the DEM
has been resampled in 20x20m pixel size (Waldo, 1988). For the digitalization of the built up area the working scale was 1:1000.

Digitalization is considered the most accurate method for the data of built up area of Santorini because of island's fragmented geography, as well as buildings' scale and their complex shapes. The orthophoto maps from National Cadastre and Mapping Agency were used as base map, the shooting was during 2007 - 2009, but Santorini is an island of constant tourist development and the built up areas are expanded, so in order to achieve the most accurate result of the current image the satellite images of google earth was used too. The process of digitalization is time consuming and in some cases there are difficulties to distinguish the roofs of buildings. Generally the roofs are white but there many buildings with grey or brown roofs, so it was taken into consideration the shape of roofs too (Tsilimigkas and Derdemezi, 2017).

For the management and protection of the cultural heritage, both traditional settlements and archaeological sites has been examined. The digitalization of the boundaries of traditional settlements and archaeological sites was based on the OGGs as they have been described in the former section.

Concerning the natural heritage, the Natura 2000 site Prohet Elias has been taken into consideration. The Aster DEM that has been resampled in pixel size 20x20m. has provided the elevation, the slopes, the ridges and the peaks of Santorini island (METI & NASA, 2011).

This is an attempt to quantify the negative impact of the unregulated built up expansion on both cultural and natural environment of Santorini island. Thus, for the cultural heritage the exports are percentage of the buildings that are inside or outside the traditional settlements boundaries or the archaeological sites boundaries, while for the natural heritage there are percentage of the built up area that is within Natura 2000 network area of Santorini, on "prominent" areas and in coastal zone (Tsilimigkas and Derdemezi, in review).

"Prominent" areas have been considered here as locations with wide visibility to and from them. For the spatial determination of the “prominent” areas a synthesis of elevation and slope was composed with the peaks, the ridges and the planar areas (Tsilimigkas et al., 2016).

For the determination of the coastal zone the synthesis of elevation and slope has been composed with three buffers with different distance from the coastal line: 200m., 500m. and 1000m.

Results
The total area of Santorini is 76km², the total built up area is 3km², which means approximately 4% of the total island area. From the 3km² about 1km² is within settlements boundaries which means approximately 33% of the built up area and 1% of the total island area and about 2 km² is outside settlements' boundaries which means approximately 67% of the built up area and the 3% of the total island area (Figure 1) (Table 1).
Figure 1: Areas of environmental or cultural interest in Santorini and the effect of built up expansion

Source: authors’ analysis
Table 1: Areas of environmental or cultural interest that are affected by the built up area

<table>
<thead>
<tr>
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<th>Within settlements</th>
<th>Exurban expansion</th>
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<tbody>
<tr>
<td>Built up areas</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Cultural heritage</td>
<td></td>
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<tr>
<td>Traditional settlements</td>
<td>31</td>
<td></td>
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<tr>
<td>Archaeological sites</td>
<td>8</td>
<td>12</td>
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<tr>
<td>Natural heritage</td>
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<tr>
<td>Natura 2000</td>
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<tr>
<td>Prominent areas</td>
<td>7</td>
<td>10</td>
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<tr>
<td>Coastal areas</td>
<td>3</td>
<td>8</td>
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</tbody>
</table>

Source: authors’ analysis

According to the above analysis there is intense built up area expansion in Santorini that demonstrates the need for re-delineation of the official boundaries. Heed should be given to construction outside the limits of traditional settlements but within a proximity area to them, which could lead to pressure on their landscape.

Some nominated settlements contain archaeological sites are or they are parts of them. In this case, buildings that are outside settlements boundaries but inside archaeological sites could lead to intense pressure on the archaeological sites.

A small percentage of buildings are in the Natura 2000 area because Prophet Elias is mountainous area. The percentage of buildings that are placed on prominent areas is 17%. Buildings on prominent areas are able to provoke negative impacts on landscape qualities, when they do not follow the prevailing architecture and the local scale (Tsilimigkas and Derdemezi, 2017).

In the coastal zone the percentage of buildings that are outside settlements' boundaries is bigger than the percentage of buildings within settlements' boundaries. The coastalization can be developed either in a coastal zone that there are only a few houses, so the process is unplanned.
and the residential tissue is not compact, or it can be developed around preexisting settlements (Kizos et al., 2017).

**Discussion and conclusions**

The built up area expansion is very often directed in rural areas, and especially on islands and coastal zones that have mass tourist development. Since the insular socio-spatial system and the landscape is fragile, the consequences of the built up area expansion are more intense.

As the primary and secondary production sectors have been shrunk in most of the islands, the tourism has been the main driver of economic growth that lead to new constructions, facilities and built up expansion. Santorini is one of the most touristy islands in Greece, so the built up expansion by the construction of second homes, tourist facilities and first homes is very intense. Fragile balances in island's ecosystem and socio-spatial system, the limited carrying capacity and the tourism pressure combined with the loose spatial planning in Greece lead to landscape degradation issues.

The cultural and natural value of the islands' landscape is the principal driving force of local growth but this tendency of uncontrolled built up expansion leads to landscape degradation. The avoidance of mass tourism and the shift to alternative forms of tourism such as agrotourism, geotourism, ecotourism etc. combined with the improvement of spatial planning that concerns the settlements management and the built up expansion management should be considered necessary for the sustainable islands' development.

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**References**


Tsartas, P. (2010). Greek tourism development, characteristics, examination, proposals. AthensKritiki. ['Elliniiki touristiki anaptyxi charaktiristika dierevniseis protaseis', in Greek]


Tsilimigkas, G. and Derdemezi E-T. (in review). Unregulated built up area expansion on Santorini island, Greece. European planning studies