Land Use Policy 51 (2016) 120–134

Contents lists available at ScienceDirect

Land Use Policy

journal homepage: www.elsevier.com/locate/landusepol

Compliance of land cover changes with municipal land use planning: Evidence from the Lisbon metropolitan region (1990–2007)

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ARTICLE INFO

Article history:
Received 21 May 2015
Received in revised form 9 October 2015
Accepted 26 October 2015
Available online 21 November 2015

Keywords:
Land cover patterns
Cross-matrix analysis
Urban–rural gradient
Spatial metrics
Municipal master plan

ABSTRACT

In the past few decades, urbanisation has become a major phenomenon in European cities, thus representing one of the key human land cover changes with socio-economic and environmental impacts. In the Lisbon metropolitan region it is estimated that 17% of natural and farmland have been transformed into artificial areas. Since the end of 1990s, specific EU guidelines have been issued to contain urban sprawl and preserve agricultural land. Spatial planning in Portugal obviously is integrating these assumptions into the statutory land-use master plans. But what is the performance of this land use planning system regarding land cover evolution itself? Based on the Lisbon metropolitan region (LMR), one of the major areas of urban growth in Portugal, we examine spatio-temporal land cover patterns between 1990 and 2007 by integrating cross-matrix analysis, spatial metrics, and gradient analysis. Additionally, we overlay these land cover dynamics with municipal master plans that regulate land development in order to assess the compliance levels of this land-use regulatory system. Results indicate that: artificial areas are growing by coalescence and/or by scattered development along an urban–rural gradient; agricultural land is reducing and fragmentation is increasing to enlarge peri-urban spaces; there are high levels of conversion of agricultural land into urban land in protected areas, thus showing a lack of compliance to the land use regulatory system visible in the existing gaps between the original land-use assignments of the master plan and the actual developments.

1. Introduction

One of the major human changes in terms of land cover is due to urban development. Urbanisation has been conquering more and more land through sprawl and scattered development, fragmenting neighbouring agricultural and natural areas (Başnou et al., 2013; Salvati et al., 2012). Increased mobility, demand for individual housing quality at lower costs, together with poorly controlled private urbanisation initiatives tied with the residential land market dynamics in the urban–rural interface, and the normative gap regarding its recognition are all well-studied factors that have contributed to these processes (Almeida et al., 2013; Dawkins and Nelson, 2002; Gibelli, 2006). This urbanisation model challenges the notion of sustainability because it induces pressure and an encroachment of natural and agricultural land, thus carrying a negative impact on environmental and socio-economic systems (Abelairas-Etxebarria and Astorkiza, 2012; Almeida et al., 2013; Camagni et al., 2002; Gennaio et al., 2009; Morgado et al., 2012). In Europe, thousands of hectares of fertile soils are lost every year to urbanization (European Environment Agency (EEA, 2006, 2011; Gennaio et al., 2009; Nuissl et al., 2009; Potter and Tilzey, 2005). This phenomenon is particularly evident in the urban–rural interface of coastal areas, plains, and metropolitan areas. Alongside this increase of urbanized areas there is an intensification of agriculture, and also agricultural land lost to forest areas that have been expanding due to the abandonment of farmland; this phenomenon is particularly relevant in the Mediterranean basin (Fox et al., 2012; Marraccini et al., 2015; Paül and Tonts, 2005; Sanz et al., 2013; Vaz et al., 2015). In Portugal, urban pressures occur around the major cities of Lisbon and Porto and in a 50-km range along the coast where the majority of productive soils are located (Aguilera-Benavente et al., 2014; Mota et al., 2005). Here, urban (mainly residential) sprawl could account for more than 45% of coastal land transformation into artificial surfaces (Habibi and Asadi, 2011).

For the past twenty-five years, the European Union's policy has recognized the urban sprawl issue and promoted guidelines to develop a model of compact city and also agriculture integration into the green infrastructure (Commission of the European

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http://dx.doi.org/10.1016/j.landusepol.2015.10.023
0264-8377/

Communities, 2008; European Environment Agency (EEA), 2011). Urban perimeters' containment, polycentric development, urban renewal and densification, and agricultural ecosystem services are instruments that have been employed to deal with urban sprawl and that can contribute towards sustainable urban development and resilience (Collier et al., 2013; Holden and Norland, 2005; La Rosa and Privitera, 2013; Zasada, 2011; Williams et al., 2000).

In Portugal, since 1998, specific guidelines have been introduced in the Portuguese Framework Law for the Policy on Territorial Management and Urbanism (LBPOTU: Law No. 48/98 of 11 August, revised by Law No. 31/2014 of 30 May) directly addressing urban sprawl control. Among these objectives, we can find 'properly fitted built-up areas' (. . .) 'appropriate levels of urban densification' (. . .) 'containing scattered built-up areas' (. . .) 'avoiding unnecessary extension of both networks and urban perimeters and promoting rational urban interstices infill' (Almeida et al., 2013). For the first time in the Portuguese context and due to the LBPOTU, this set of aims on territorial development can be implemented through a hierarchical model of spatial planning instruments from the national level to the municipal level (Queirós, 2007).

Hence, in 2007, the National Program for the Territorial Management Policy (PNPOT) recommended urban densification associated with the containment of urban perimeters as a solution to urban sprawl. It also recognized that agriculture must play a role in structuring ecological and spatial planning systems in urban and peri-urban areas. PNPOT recommendations should be integrated at the regional level with regional plans (PROTs) specifying land use planning requirements and strategies, and then implemented at the municipal level through a new generation of municipal master plans targeted at managing and regulating urban development through land use zoning and land use constraints (Ferreira et al., 2010). Two examples of land use constraints relevant to protect agricultural land and natural land are the national agricultural reserve (RAN) and the national ecological reserve (REN). Together these are nationwide 'public utility restrictions' laws that are specific of the Portuguese planning system context and date back to the 1980s. They aim at defending land that has the greatest potential for agricultural purposes, safeguarding essential ecosystem services, and promoting the conservation of nature and biodiversity. They are usually delimited at the municipal scale and after the delimitation proposal is approved by the central authorities they are integrated into the municipal master plan zoning. The RAN and REN prohibit any kind of construction in the delimited areas, although exceptions are possible. The most common ones are permitting relevant public interest actions, or allowing non-agricultural uses such as farmers' household constructions whenever there is no alternative outside RAN areas. These exceptions are found all over the country and are considered by many authors as drivers of loss and fragmentation of these spaces (Abrantes et al., 2013; Pardal, 2006; Vaz et al., 2015).

In previous studies, we have verified that there is a significant gap between the guidelines for urban sprawl control and natural and agricultural preservation deriving from the LBPOTU and what is actually happening at the operational scale (Abrantes et al., 2013). Why? Because the first generation of municipal master plans prior to the LBPOTU – with more than 20 years old and separately implemented without any systemic model – is still in force or is undergoing a revising process that in most cases started in 2007, when the PNPOT entered into force. Consequently, the existing plans are neither adapted to the spatial dynamics that had been established by the end of the 1990s nor to the new guidelines. They continue to use large urban perimeters that reflect the population growth levels of the 1980s, they allow construction in agricultural and forest spaces departing from the concept of a minimum measure of plot size, and they look at restrictions, in particular the national reserves, as an obstacle to spatial development rather than as an element of landscape value (Pereira and Nunes da Silva, 2008; Bruno Soares, 2004).

Additionally, some of these municipal master plans have been partially suspended, thus contributing to increase artificial uses in areas that originally were defined as non-urban. In fact, due to the lengthy review processes (that can last from 3 to 6 years), the frequent use of partial suspension in municipal master plans and the preventive measures ended up being used mostly to evade the rigidity of the plan rules and enable changes in the land use originally allocated by evoking the need to promote social and economic development. The most frequent requests for partial suspensions are for the installation or expansion of industrial zones, tourism projects or public facilities; and the vast majority occur in areas classified as agricultural or agro-forestry, but also in RAN or REN. These subterfuges are a way to start speculation because of the subsequent allocation changes to the municipal master plan revising or amending process (Abrantes et al., 2013; Catita, 2009; Gonçalves, 2009; Padeiro, 2014).

In this paper we aim to analyse land cover spatio-temporal dynamics of the LMR based on two time periods, 1990 and 2007. What major land cover patterns are occurring in this metropolitan system? To answer this question we propose 3 integrated spatially-oriented analytical phases: (1) we make use of a cross-matrix analysis between 1990 and 2007 to analyse land cover changes; (2) we use 6 metrics deriving from landscape ecology to characterize and understand land cover patterns (Herold et al., 2005; Kong et al., 2012; Liu et al., 2010); (3) and we analyse how these patterns are distributed across space through a gradient analysis. This three-step analysis can give insights into which land cover changes and major patterns are occurring within a specific distance from the Lisbon metropolis centre.

Another objective involves confronting these spatio-temporal patterns with land use planning. Several studies (across developed and developing countries) have revealed that existing urban and land use planning seems to have limited impact on land cover configurations, that transgressions are consistently made, and that the regulatory planning system becomes rapidly obsolete from a functional perspective (Abrantes et al., 2013; Alfasi et al., 2012; Sharifi et al., 2014; Lobo, 2011; Loh, 2011; Morgado et al., 2012). Did this rigid (zoning) perspective really work in Portugal regarding land cover changes? Did the real land cover dynamics comply with the uses that were originally proposed and allocated in the municipal master plans? Can a more flexible or strategically oriented planning practice contribute to a better functioning of the whole Portuguese land use planning system? We analyse the spatio-temporal patterns and especially built-up patterns regarding land use allocation in the municipal master plans zoning system and protected areas (RAN and REN) in order to assess the compliance levels.

The 1990–2007 time frame is essential to analyse urban development because – just as in other European Mediterranean regions – 1990 was the turning point between a previously compact and dense city to a much more sprawled one (Salvati et al., 2013a). In Portugal, this period coincided with incoming European funding that allowed for large investments, especially in motorways (Padeiro, 2014). These investments coupled with improved living conditions ended up inducing new patterns of economic and residential development to enlarge Lisbon's peri-urban spaces. Hence, 1990 gives us the starting point – where changes are barely visible – and the year 2007 enables us to observe what happened 17 years later. We have an extensive period of spatial dynamics analysis that also coincides with the term of the cycle of first-generation municipal master plans.

Finally, this analysis enables us to discuss how it can contribute to provide insights into a more educated spatial planning, especially since Portugal is establishing a second generation of municipal master plans. The originality of the study lies in the combination of