Impact of national policies on patterns of built-up development: an assessment over three decades

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A B S T R A C T

Globally, built-up development is taking place at unprecedented rates. To mitigate and limit its effects, recent scientific and spatial planning communities call for built-up management to be addressed on broader scales, from regional to national, and coordinated with multiple policy domains. In this paper, we aimed to analyze the evolution and impact of Romania's national policies on built-up management during the entire period from the fall of the communist regime to the present. The new perspective offered by our study concerns the use of spatiotemporal built-up development assessment with policy analysis and visualization. Moreover, policies and built-up land changes are addressed in direct relationship with major political events and global economic influences. Our findings reveal that policies were influenced by the communist legacy, accession to the EU and the global economic crisis. Most effective were the policies adopted during the pre-EU accession period and after the economic crisis. The strongest impact on patterns of development came from policies in the domains of transportation, regional development, public administration and the environment.

1. Introduction

Urban built-up development is taking place at unprecedented rates (Oakleaf et al., 2015), through the conversion of arable lands, forests, pastures, wetlands and other land uses into impervious surfaces (van Vliet, 2019v). Land take through built-up expansion is one of the major threats that could undermine food security (Seto and Ramankutty, 2016), biodiversity conservation (Ke et al., 2018) and the provision of ecosystems services (Culhane et al., 2019). Moreover, it is among the factors with the potential to transgress planetary boundaries (Sterner et al., 2019) and undermine the long-term sustainability of human societies (Foley et al., 2005). It is in this context that recent calls from land change and spatial planning communities highlight the need for built-up land changes to be better addressed and understood in order to design realistic policies to mitigate their impacts (Hersperger et al., 2018; Oakleaf et al., 2015). Given such an intensifying focus on this topic, generating more and better knowledge for effective interventions is imperative (Acuto et al., 2018).

There is evidence that national policies could play an important role in guiding built-up development towards more sustainable trends and patterns (Ding, 2003). In Europe, Netherlands and the UK are often given as good examples of controlling built-up development, as the two countries have a long history of implementing national urban containment policies (Dawkins and Nelson, 2002). Meanwhile, in Belgium and Poland, planners face difficulties in influencing land use (Halleux et al., 2012). In the United States, Bengston, Fletcher and Nelson (2004) documented a wide range of policies to manage built-up expansion and protect open spaces, while studies by Carruthers (2002); Wassmer (2006) and Paulsen (2014) provide a good overview of their effectiveness. By focusing on a single policy, such as urban growth boundaries (Gennaio et al., 2009) and green belts (Han and Go, 2019; Siedentop et al., 2016), multiple studies from around the world offer the necessary analytical depth to understand how national policies work.

Depending on a country's planning history and system, a collection of instruments can be used to directly manage development (e.g.,

Table 1
Main periods, trigger events and their relationship with the planning system.

Period	Communist period	Transition period	Pre-EU accession	EU membership	Post economic crisis
Trigger event and year	Communist regime (1945)	Fall of communist regime (1989)	Start of the negotiation process for accession to the EU (2000)	Country's accession to the EU (2007)	Global economic crisis (2008–2009)
Planning system	Top-down	Top-down	Top-down	Ongoing administrative decentralization	Shared responsibility of national and local level
Legal framework and planning practice	Development was strictly managed by the central government	Regulations to control built-up development came from other planning domains	Adoption of the first law on spatial planning	Decision-making based on derogations from existing plans, becomes frequent practice	New planning instruments adopted at national level

national targets on land take, built-up allocation rules). Sectorial policies on protection of agricultural land (e.g., establishment of priority areas for preservation agricultural land, elaboration of soil management assessment frameworks) and biodiversity conservation (e.g., protection areas) are also used. Frenkel (2004) and Alterman (2001) showed how growth management policies can be implemented through national spatial plans. Some countries do not embark on a process of national plan-making, but rely on other instruments, such as regulations and incentives (Schmidt et al., 2018). While regulations have an obligatory nature, as they involve an authoritative relationship between the individuals or groups being regulated and the government, incentives involve either offering or taking away (i.e., disincentives) monetary or non-monetary material resources in order to change a certain behavior (Bengston et al., 2004). Several instruments may be used to form a coherent strategy, but it could also be the case that individual instruments are used without any policy consistency or coordination (Meijers and Stead, 2004).

Despite the variety of studies aimed at studying policy effects, the generalization of results in planning evaluation studies is often confronted by contextual situations (Hersperger et al., 2018). Most of the studies so far have been conducted in the context of the United States, in countries with well-known strong planning systems, such as the Netherlands or Germany, and more recently, in Asian countries, such as China and Vietnam. While some countries have self-reinforcing planning systems and institutional contexts capable of nurturing innovative policies, others are faced with huge difficulties to incorporate new initiatives and implement reforms aimed at reinforcing their concrete influence on built-up land (Halleux et al., 2012). The latter situation, is particularly encountered in countries which have gone through rapid political, social and economic changes, such as the post-communist countries. Belonging to the transitional economies, these countries followed a different path to that of industrialized countries, non-transitional economies or their socialist past when it comes to urbanization in general and built-up development in particular (Fan et al., 2018). Research is needed to understand the efficacy of national policies in these countries.

In the post-communist countries, built-up land is rarely investigated by addressing the effect of multiple, entangled policies over longer periods of time. Research is scarce, in part due to the great complexity of economic, social and political variables which influence development (Liu et al., 2018). Distinguishing between the effect of the policies and other factors remains a challenging task, particularly given that such countries often have weak planning systems (Hirt and Stanilov, 2009). Furthermore, the selection and goals of policy instruments which one country applies often evolve over time, further complicating the assessment. Several policies could overlap spatially and in time, or even lag in their effects.

The aim of the paper is to analyze the evolution and impact of Romania's national policies on built-up expansion. The new perspective offered by our study is threefold: first, we base our investigation on a spatiotemporal assessment covering the entire period from the fall of the communist regime to the present; secondly, we address the policies

and changes in built land in direct relationship with major political events and global economic influences; thirdly, we resort to policy visualization to determine the link with expansion patterns.

Research has shown that resorting to the visualization of geographical areas where policies have an impact (Evers and Tennekes, 2016) can improve the understanding of how policies are pursued and carried out (Harris et al., 2002). Policy visualization has been shown to provide promising results in spatially depicting policy objectives (Palka et al., 2018), including at the national level (Roose and Kull, 2012). The use of visualization in policy assessments is still an evolving research direction, particularly as systematic methods for translating information from planning documents into spatial data are underdeveloped (Hersperger et al., 2018). In this paper, we resort to spatial analysis and policy visualizations to fulfill the aim of the paper.

The objectives of the paper are as follows:

(1) To determine spatial built-up expansion patterns and trends,
(2) To identify the most important policy instruments adopted by national-level with a potential effect on built-up development,
(3) To assess the links between identified built-up development patterns and the priorities set by the policy instruments.

1.1. The Romanian context

To analyze how built-up management was addressed over time in Romania, one must look at the political, social and economic events the country has gone through over the past three decades. In our study, we considered four major events: a) the fall of the communist regime in 1989, b) the start of the negotiation process for Romania's accession to the EU in 2000, c) the country's accession to the European Union (EU) in 2007, and d) the global economic crisis which immediately followed accession. This section briefly explains the context (Table 1).

During the communist period, Romania experienced a planning system characterized by a top-down approach under the total control of the state. Built-up development was largely a centrally planned and controlled process (Gavrilidis et al., 2015). The legal framework imposed strict management over urban growth boundaries and determined where and how much settlements could be expanded (Nae et al., 2019). After the fall of the communist regime, the immediate years were marked by a transition from a centrally coordinated authoritarian system to a free market system (Pascariu, 2012). The period started with a void in the legal framework for spatial planning, as the strict communist laws on built-up expansion were abolished. Most regulations on land use came from other domains, such as construction engineering, transport, the environment and human health (Table 1).

The start of the negotiation process for Romania's accession to the EU, at the beginning of 2000, triggered several institutional and legislative reforms in order to accommodate the new political arrangements (Matei and Dogaru, 2011). A first law on spatial planning was adopted in 2001 to clarify the responsibilities of public authorities from the national to the local level (Benedek, 2013). A stricter environmental legislation was adopted, which exerted influence on spatial planning

Table 2
Combinations used to create the composite map.

Combination number	Hotspot presence				Hotspot category
	Transition	Pre-EU accession	EU membership	Post-economic crisis	
1	Present	–	–	–	Transition period only
2	–	Present	–	–	Pre-EU period only
3	–	–	Present	–	EU membership only
4	–	–	–	Present	Post economic crisis only
5	Present	Present	–	–	Intermittent
6	Present	–	Present	–	Intermittent
7	Present	–	–	Present	Intermittent
8	–	Present	Present	–	Intermittent
9	–	Present	–	Present	Intermittent
10	–	–	Present	Present	Intermittent
11	Present	Present	Present	–	Regular
12	Present	–	Present	Present	Regular
13	–	Present	Present	Present	Regular
14	Present	Present	–	Present	Regular
15	Present	Present	Present	Present	Regular
16	–	–	–	–	No hotspot

activities. However, the governance system was still somewhat centralized (Petrişor, 2010).

Under the EU's influence, administrative decentralization gave more land use decision-making powers to the local level (Dobre, 2010). However, the local level lacked the knowledge and human resources to carry out planning by itself. The strong economic growth, coupled with capital inflows due to the increase in Romania's attractiveness for foreign investments, amplified built-up expansion. It soon became clear that the planning system could not keep up with the growing demand for new housing and service areas (Munteanu and Servillo, 2013) and the pressure of private interests (Nae et al., 2019). Furthermore, decentralization of land use planning activities took place without providing a framework to coordinate development with transport, environment or social aspects (May et al., 2017). Processes such as informal built-up development, urban sprawl, excessive suburbanization (Suditu et al., 2010), and the conversion of fertile agricultural land (Grădinaru et al., 2015) and public green areas into impervious surfaces started to become an issue (Badiu et al., 2019; Grigorescu and Geacu, 2017). After Romania's accession in 2007, the EU exerted a strong influence over domestic policies and practices, particularly at the national level (ESPON, 2007; Munteanu and Servillo, 2013). New instruments were adopted which brought a strategic character to the otherwise sectoral policy approach at the national level. Built-up development continued, despite the constant negative population growth (van Vliet et al., 2019v).

Current challenges in Romania are the establishment of a consistent and informed set of policies to manage development, the decline in the discretionary character of the planning practices taking place at the local level, and better vertical and horizontal coordination at government levels. Particularly regarding built areas, the planning system has been accused of being excessively oriented towards plan-making and assigning responsibilities to institutions, rather than dealing with land transformations and processes (Ianăşi, 2008; Ianoş et al., 2017).

2. Data and methods

2.1. Identification of development patterns and trends

The identification of development patterns was performed in two steps: a) a countrywide estimation of hotspots of new built-up land, in each of the four periods, and b) a classification of the hotspots based on their dynamics over the entire study period. This two-step approach allowed us to identify shifts in development trends from period to period.

For the first step, four local spatial autocorrelations based on the Gi* statistic (Getis and Ord, 1992) were conducted on patches of new built-up development. The Gi* statistic is computed by comparing the local averages with the global average, thus enabling the detection of "pockets of spatial association" or hotspots (Ord and Getis, 1995). It is thus a good means by which to determine and visualize spatial patterns. To allow for comparison, the same scale and distance band was used for all four analysis.

Data on new built-up were derived from CORINE Land Cover data sets in vector format, available for the years 1990, 2000, 2006, 2012 and 2018 (Copernicus LMS 1990, 2000, 2006, 2012, 2018). Corine Land Cover classifies land uses in four broad classes: artificial surfaces, agricultural areas, forest and seminatural areas, wetlands and water bodies. In our study, built-up land was defined as comprising the land use classes associated to artificial land (i.e., urban fabric including housing and mixed uses, industrial and commercial areas, airports, port areas, roads and rail, construction sites) with the exception of mineral extraction sites. Mapping accuracy of Corine data is generally above 85 %, but it can reach values over 90 % for artificial land classes (Copernicus LMS 2018).

Analysis was performed on grids with a cell size of 1 km × 1 km, where each cell contained information on the amount of built-up land developed within each period. A direct reporting of built-up land area was preferred to an aggregation approach, as in the case of Romania, aggregation would have led to development underestimations (van Vliet et al., 2019). The four hotspot maps resulting from this analysis were complemented by graphs which represented the classes of new built-up development (e.g., residential, industrial) and classes of land uses lost due to conversion into built-up development (e.g., arable land, forests).

In the second step, the four hotspot maps were overlaid to create a composite map for the entire study period. The overlay resulted in 16 combinations of hotspot presence as shown in Table 2. The combinations were then split into 6 categories by accounting for the period in which the hotspot was present and on how many occasions, as follows: (1) Transition period only, (2) Pre-EU period only, (3) EU-membership only, (4) Post-economic crisis only, (5) Intermittent, to show if development took place intermittently in two of the four periods), and (6) Constant, to show if development took place in all or in three of the four periods.

Evolution of GDP and of the inflow of migrant remittances was used as a proxy for explaining the country's wealth and capacity to invest in built-up development. Population data were also reported. Annual data for the period 1990–2017 were retrieved from the World Bank (2018a).

Table 3

Policy instruments used for analysis.

Code	Policy domain	Policy instruments	Year of adoption	Time frame*	Spatial dimension	Policy impact area**
Transition period (1990–2000)						
NSP_T1	Transportation	National Spatial Plan Section I – Transport Infrastructure	1996	L	Explicit	Derived
NSP_W	Water management	National Spatial Plan Section II – Water Management	1997	L	Explicit	Derived
NSP_PA	Environment	National Spatial Plan Section III – Protected Areas	2000	L	Explicit	Retrieved
Pre-EU accession period (2001–2006)						
NSP_SN	Urban growth	National Spatial Plan Section IV – Settlements Network	2001		Explicit	Derived
L_SP	Land use	Law on Spatial Planning	2001	L	Implicit	Derived
NSP_NH	Natural hazards	National Spatial Plan Section V – Natural Hazards	2001	L and S	Explicit	Derived
NDP	Regional development	National Development Plan for the Period 2007-2013	2005	L	Implicit	Derived
NSP_T2	Transportation	National Spatial Plan Section I – Transportation Network (Revision)	2006	S	Explicit	Derived
L_PF	Public finances	Law on Public Finances	2006	L	Implicit	Derived
Start of EU membership (2007–2012)						
B_N2000	Environment	Ministerial Bill for the Establishment of the Natura 2000 Network	2007	S	Explicit	Retrieved
NSDS	Environment	National Sustainable Development Strategy	2008	L and S	Implicit	Derived
SC	Regional development	Strategic Concept of Spatial Development – Romania 2030	2008	L and S	Explicit	Derived
NSP_Tm	Tourism	National Spatial Plan Section VI – Tourism	2009	S	Explicit	Derived
L_SP2	Land use	Amendment to Law on Spatial Planning	2011	L and S	Implicit	Derived
L_PM	Environment	Amendment to Law for the Protection of Meadows	2011	L and S	Implicit	Derived
Post-economic crisis (2013–2018)						
L_EP	Environment	Amendment to Law on Environment Protection	2015		Implicit	Derived
T_MP	Transportation	Transportation Master Plan	2016	L and S	Explicit	Derived
NTDS	Urban growth	National Territorial Development Strategy – Polycentric Romania 2035	2016	S	Implicit	Derived
NSP_PA2	Environment	National Spatial Plan Section III – Protected Areas – Revision	2016	L and S	Implicit	Derived

* Time frame: L-long term, S-short term.

** Policy impact area was derived from the documents (e.g. from maps and/or text) or retrieved from government sources (e.g. as spatial data).

2.2. Selection and content analysis of national policies with potential impact on built-up development

Considering the characteristics of the Romanian spatial planning system, and in order to take as broad a perspective as possible, all kinds of national policies were considered as potentially affecting built-up development. By potential impact, we refer to the impact a policy is expected to have, due to its purpose within the spatial planning system, the type of enforcement (e.g., law, binding plan) or objectives that specifically target built-up development. Thus, we did not limit the analysis to land use policies targeting built-up development, but broaden the perspective to include domains such as public administration and environment.

The policies with potential impact on built-up development were identified through a review and analysis of the national planning instruments adopted between 1990 and 2018. An initial list of 26 instruments was created based on information provided by the Romanian Government and the Ministries of Environment, Regional development and Transport systems. It included plans, strategies, laws and their subsequent amendments. Out of the 26 instruments, 19 were identified as being the most important and analyzed in detail. Their selection was based on findings from previous research on policy instruments' role within the Romanian spatial planning system (Petrişor, 2010; Munteanu and Servillo, 2013; Benedek, 2013; Pascariu, 2012; Grădinaru et al., 2017), studies on factors influencing the urbanization process in Romania (Săgeată, 2010; Suditu, 2012) and the results of three comparative ESPON projects concerning territorial development (ESPON, 2006, 2007; ESPON, 2018). Table 3 lists the documents chronologically to correspond with major political and economic events in Romania, as detailed in Section 1.1.

Each policy instrument was subject to a content analysis in order to identify: a) the time frame of the policies (i.e., long or short term), b) the specific policies with a potential effect on built-up development, and c) if policies aimed to anticipate and prevent a certain trend, which we classified as proactive, or if they aimed to counteract and manage existing trends, which we categorized as reactive, or if they take no account of the trends. These aspects helped us to establish a potential

implementation time lag and determine shifts in policy objective approaches to existing and predicted built-up development. The content analysis was aided by MAXQDA (2018) (VERBI Software 2018). Each instrument was read in detail in order to answer the three questions. The results were summarized in a table and presented in detail in the textual part.

2.3. Linking policies and built-up development patterns

To examine the links between policies and built-up development, we developed a three-step procedure, as explained in the paragraphs bellow. First, based on the overall goal of each policy, we operationalized its intended impact as encouraging ("+" symbol), restricting ("-" symbol) or having no effect ("/" symbol) on built-up development. For example, the policy that prioritized investments in municipalities with high touristic potential was operationalized as "+ in targeted municipalities".

Secondly, we analyzed each policy instrument to identify the explicit or implicit spatial dimension of the policies, as recommended by Harris et al. (2002). Explicit spatial dimension was considered to be found in policies containing clear designation of areas with restrictions on built-up development (e.g., nature protection area) and municipalities prioritized for the development of new transport routes. Policies would be identified as having an implicit spatial dimension if they referred to certain development patterns (e.g., reduce urban sprawl) or land use transition (e.g., protection of meadows from conversion into built-up development), but without a formal identification of locations where these processes should take place.

Finally, the link between policies and built-up development was analyzed. For policies with explicit spatial dimension, the link was explored by resorting to policy visualization and heat maps. Individual policy visualization was constructed by mapping the impact as a) polygons with clear boundaries when the exact implementation area was known (e.g., protected areas), b) polygons with fuzzy borders when the impact was considered as a zone of influence (i.e., zone of influence of policies on urban growth), and c) lines to represent the planned transportation system. Information about policy impact area was either
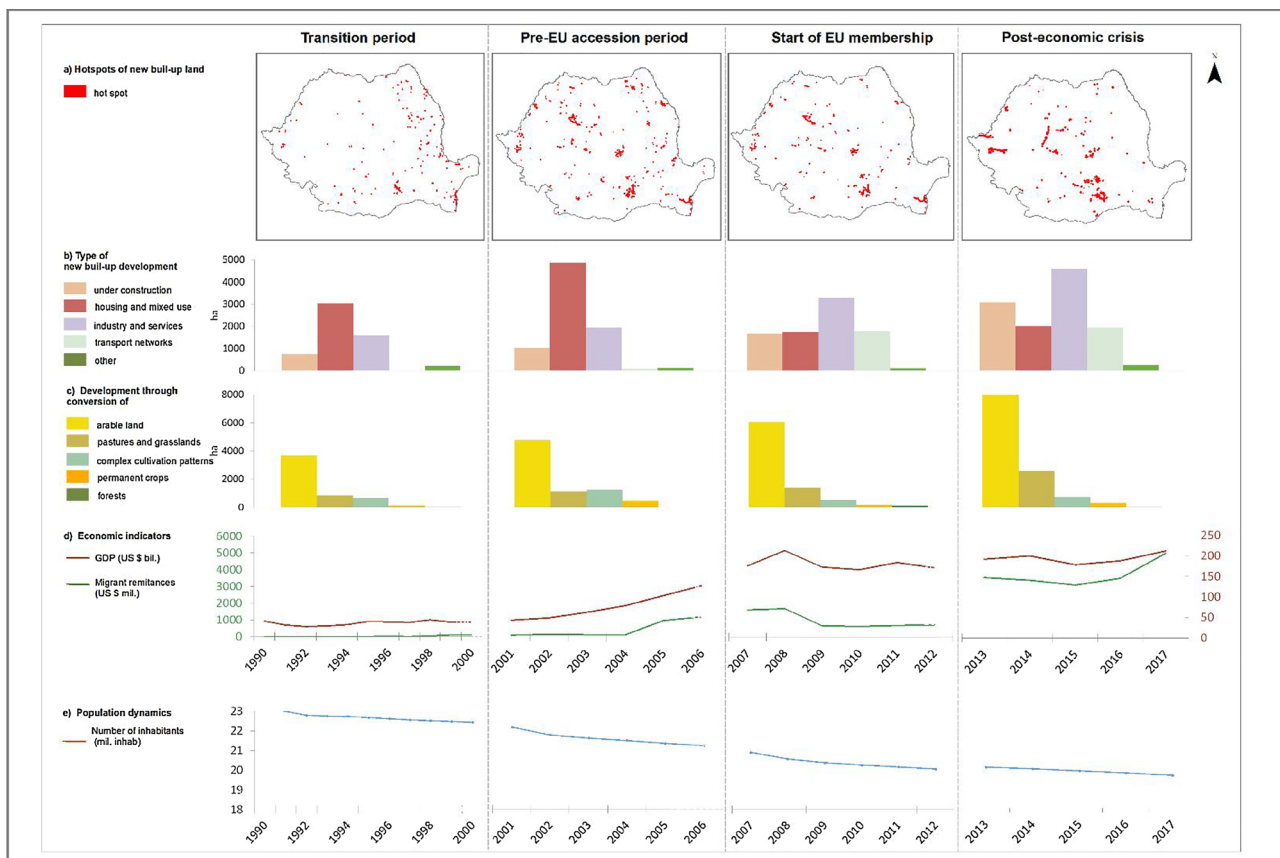
Fig. 1. Patterns of development for each analyzed period.

derived from the document (i.e., from maps and the main body of the textual part) or retrieved from government sources (i.e., as spatial data) (Table 3). Policy visualization was overlapped with corresponding hotspots of built-up development identified during the same period when each policy was approved. To visualize the potential lag effect of the policies, we produced heat maps which show a) amount of development before and after policy adoption, and b) amount of development within and outside policy impact area. The color scheme of the heat maps corresponds to the high (dark orange) or low (light orange) amount of development relative to the sum of all the built-up development taking place between 1990 and 2018.

In the case of policies with an implicit spatial dimension, information about policy impact was based on the interpretation of policy objectives (e.g., on built-up patterns, land use conversions). The link was explored by comparing the policy objectives with the results of the built-up spatiotemporal analysis. More precisely, we looked at the correspondence between intended impact and built-up patterns as highlighted by the hotspot analysis, the lost land uses due to conversion into built-up development and the built-up development within the urban region as revealed by the composite map. The lagged effect was interpreted based on changes in the land uses and patterns before and after policy approval.

3. Results

3.1. Development patterns and trends

The amount of built-up development steadily increased after the fall of the communist period, following a similar trend in the country's wealth dynamics. However, development took place in parallel with declining population (Fig. 1). Over time, several differences occurred with regard to location and type of development. Housing and mixed land use were dominant in the transition period and accentuated during

the pre-EU accession, but were surpassed by land take by industry and services after EU accession (Fig. 1b). We observed an increase in construction sites and an abrupt increase in the development of transportation networks with EU membership. During the entire study period, development occurred mainly through the conversion of arable land, pastures and grasslands (Fig. 1c). Findings show a transition from development occurring mainly in the east and southeast of the country as small hotspots occurring in settlements of all sizes, through development that was somewhat evenly distributed across the country during the pre-EU accession period, to development taking place in large cities in the center and west of the country after EU accession and following the economic crisis (Fig. 1a). The capital city remained the main development hotspot over the entire period.

The spatiotemporal analysis revealed that, locally, development took place following different patterns with respect to the cities and their surrounding areas (Fig. 2). Constant development occurred in the capital and the large cities revealing an overall growth of the urban regions. A visible linear development occurred in the most recent period in the center and west of the country. Cities such as Craiova, Oradea, Arad and Brăila concentrated most of the development within city boundaries, in contrast with Ploiești and Galați, which experienced a constant development of the surrounding municipalities. Most medium sized cities and towns developed sporadically during one of the analyzed periods or intermittently across the three decades. Development occurred in rural areas also, mainly during the pre-EU and post-economic crisis periods.

3.2. Policy impact on patterns and trends of development

3.2.1. Transition period

Three national policy instruments were adopted during the transition period, all part of the National Spatial Plan. Policies followed a
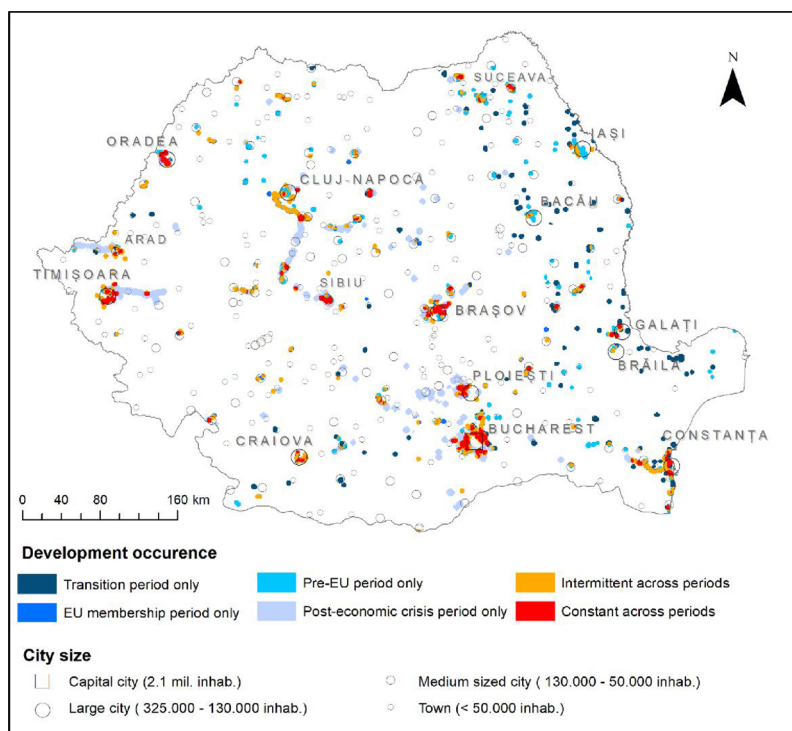
Fig. 2. Composite map showing development occurrence for the period.1990–2018.

sectorial approach and largely continued the vision set during the communist period. Despite the long-term time frame for implementation, they contained no reference to anticipated built-up development trends (Table 4). Visualizations showed that transportation and environmental policies had the intended impact of concentrating development along major transport routes, while restricting it in protected areas (Fig. 3a and c). Water management policy had little impact on encouraging development in key areas prioritized for investments (Fig. 3b). However, the heat map showed that the policy had some effect during the pre-EU accession period, suggesting a lagged effect.

3.2.2. Pre-EU accession period

The pre-EU accession period was marked by the establishment of the Romanian planning system as we know it today, and by the co-ordination of the country's policies with the EU's requirements for becoming a member. Two new sections of the National Spatial Plan were adopted to prioritize investments in areas affected by population loss (i.e., NSP_SN) and to identify areas prone to natural hazards (NSP_NH). The two planning instruments were highly descriptive. Similar to the sections adopted during the transition period, the two new sections largely continued the priorities set during the communist period. Policy visualization and heat maps showed that urban growth policy had an insignificant impact on built-up land (Fig. 3d), as development occurred predominantly outside targeted municipalities. Contrary to the intended impact, development occurred in the areas identified as prone to floods and landslides, processes which increased in the most recent period (Fig. 3e).

Revisions of the section on transportation in the National Spatial Plan (i.e., NSP_T2) were undertaken to connect Romanian infrastructure with the EU policy on trans-European transport networks. The results showed that hotspots of development occurred along planned transportation (Table 3, Fig. 3g).

In coordination with the EU's spatial planning policy, Romania's regional development policy (i.e., NDP) introduced the concepts of urban growth poles as the basis for allocating funding and encouraging investments. Cities designated as growth poles enjoyed large amounts

of investments in the city and suburbs. Visualization showed that the policy had a strong impact on built-up land (Figure 4f), as the designated growth poles are among the largest development hotspots. The impact was strongest during EU membership, as visible on the heat map (Figure 4f).

Policies on land use and public finance domains adopted before EU accession had contrasting aims. The land use policy aimed to promote the rational use of land and to limit built-up expansion (L_SP). In contrast, the fiscal incentives (L-PF) encouraged expansion by linking the amount of built land to the allocation of funding from the national budget. The results suggest that incentives had a strong influence, as development continued its increasing trend (Fig. 1b), especially in the suburbs of large cities (Fig. 2).

3.2.3. Start of EU membership

The start of EU membership was characterized by the adoption of policy instruments addressing built-up development in parallel with the protection of agricultural land. New policy instruments (NSDS, SC, NSP_Tm) encouraged land recycling, the development of settlements of all sizes, and investments in municipalities with high touristic potential. Amendments to the legislative framework on land use (L_SP2) and environmental policy domains (L_PM) aimed to limit the loss of fertile agricultural land, to reduce ongoing sprawling development and to protect meadows from conversion into second homes and touristic resorts. However, the results showed that most policies had an insignificant impact, despite a better policy coordination compared to the period before EU accession. Built-up development expansion continued to increase (Fig. 1b), concomitant to a loss of arable land, pastures and grassland (Fig. 1c). In contrast to those intentions which aimed to encourage development in cities of all sizes, most development was concentrated in a few large cities (Fig. 1a). Tourism policies (Figure 4 j) encouraged investments in mountainous areas and the center of the country, but the heat map shows almost no effect, either immediately after approval or later on.

During the same period, the Natura 2000 Protected Areas Network was established. The results show that the policy indeed limited

Table 4

Policies with a potential effect on built-up development and their intended and observed impact.

Code	Policies with a potential effect on built-up development	Reaction to built-up development	Policy impact on built-up development*			
			Intended		Observed	
Transition period (1990–2000)						
NSP_T1	Development of major transport routes	No account	/	No effect	+	Along planned routes
NSP_W	Prioritized investments in the water provision system in targeted municipalities	No account	+	In targeted municipalities	+	Little impact which decreased in time
NSP_PA	Nature protection through designated protected areas	No account	-	Within protected areas	-	Within protected areas
Pre-EU accession period (2001–2006)						
NSP_SN	Prioritize investments in municipalities affected by population loss	No account	+	In targeted municipalities	/	Insignificant effect
L_SP	Rational use of land and limited built-up expansion	Reactive	-	Built-up expansion	/	Insignificant effect
NSP_NH	Define areas prone to natural hazards (i.e., floods and landslides)	Proactive	-	In targeted municipalities	+	In targeted municipalities (opposite effect)
NDP	Prioritize investments in designated urban growth poles	Reactive	+	In selected urban areas	+	In selected urban areas
NSP_T2	New priorities for development of major transport routes	Proactive	/	No effect	+	Along new planned routes
L_PF	Allocate local budgets based on the share of built-up area at municipal the level	No account	/	No effect	+	Sprawling built-up development (opposite effect)
Start of EU membership (2007–2012)						
B_N2000	Nature protection through designated Natura 2000 sites	No account	-	Within protected areas	-	Within protected areas;
NSDS	Cover the demand for new built-up land through land recycling, assure a balanced development of major cities	No account	-	Restrict urban expansion, growth of major cities	/	Insignificant effect
SC	Development based on a polycentric urban system	Proactive	+	In selected urban areas	+	Partial effect, in some of the selected urban areas
NSP_Tm	Investments prioritized in municipalities with high touristic potential	Proactive	+	In targeted municipalities	/	Insignificant effect
L_SP2	Reduce urban sprawl, preserve agricultural land	Reactive	-	Restrict sprawling development, reduce agricultural land loss	/	Insignificant effect
L_PM	Protection of meadows from conversion into built-up development	Reactive	-	Restricts conversion of meadows into built-up development	/	Insignificant effect
Post-economic crisis (2013–2018)						
L_EP	Protection of green areas	Reactive	-	Restricts conversion of green areas to built-up	-	Restricts conversion of green areas into built-up development
T_MP	New priorities for the development of major transport routes	No account	/	No effect	+	Along new planned routes
NTDS	Prioritize development based on a new polycentric urban system	Reactive	+	In selected urban areas	/	Not yet visible
NSP_PA2	Encourage coordination between environmental and spatial planning policies	Reactive	-	Within protected areas	/	Not yet visible

* Policy impact: encouraging ("+" symbol), restricting ("-" symbol) or having no effect ("/" symbol) on built-up development.
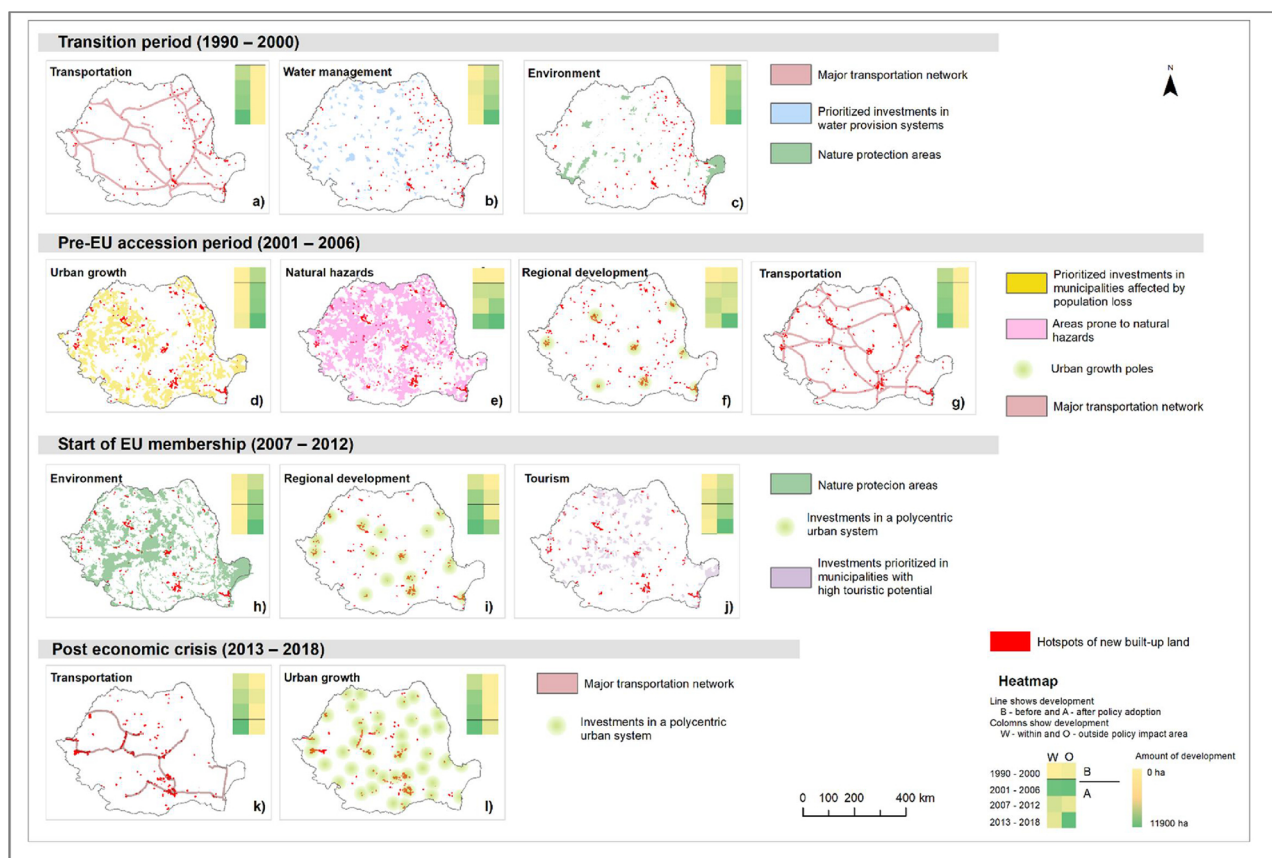
Fig. 3. Visualization of policies with explicit spatial dimension. The letters correspond to the following policies: a) NSP_T1; b) NSP_W; c) NSP_PA; d) NSP_SN; e) NSP_NH; f) NDP; g) NSP_T2; h) B_N2000; i) SC; j) NSP_Tm; k) T_mp; l) NTDS.

development within designated areas. However, limits of the protected areas were set without accounting for development trends. Fig. 3h) shows that a few protected areas are in close proximity to or even overlap built-up development hotspots.

3.2.4. Post-economic crisis

The post-economic crisis period is characterized by new priorities in the transportation and the urban growth domains, as well as changes in the legal framework to better coordinate environmental and spatial planning objectives. An amendment to the Environmental Protection Law was adopted to protect green areas from conversion into development sites. The connection between urban development and transport networks, already required during the start of EU membership, was strengthened in the new Transportation Master Plan (T_MP). Compared to the previous period, projects targeting the east of the country were dropped (Fig. 3k). Visualization only showed a few development hotspots in areas where major transportation was not planned. A new long-term strategy (NTDS) was adopted in 2016 to counteract the concentration of development in large cities. Although visualization shows that hotspots still tend to be concentrated in large and medium cities, two years after adoption is a rather short period to evaluate the its impact of the strategy.

4. Discussions

4.1. Shifts in development trends and patterns

The land change analysis showed that built-up development followed the increasing trend in the country's wealth. This increase, including housing land, was simultaneous with a decline in population, a situation which can be found in other post-communist countries (Haase et al., 2013). The continuous increase in land for industry and services

followed the European trend observed by Cortinovis et al. (2019). Although the lack of data does not allow for a detailed investigation into the causal links, Sandu (2010) showed that the high amount of remittances was often invested in new housing and businesses. The significantly higher amount of new built-up after 2013 confirms that the Romanian real estate market recovered quickly after the economic crisis and that development is expected to continue (Colliers International, 2018).

4.2. National policy impact on built-up development

The findings show that both efficient and less efficient policies were adopted throughout the three decades analyzed in our study. Policies adopted immediately after EU accession were least efficient, this period being characterized by an overall lower ability of the government to formulate and implement policies (World Bank, 2018b). A possible cause is the shift to new institutional arrangements and approaches in policy making (Dobre, 2010). Development patterns were mainly influenced by policies in the domains of transportation, regional development and environment and by fiscal incentives provided to the local governments. In the following paragraphs we will provide further details on these aspects.

A clear connection was observed between the changes in planned transportation projects and the shift from east to west in new built-up land. As the new policies aimed to increase accessibility to European markets, they also encouraged an overall higher economic growth than in the east of the country (Mykhnenko and Turok, 2008). Coupled with few available workforce as result of high long term migration and the presence of highly fertile agricultural land (MRDPA, 2015), the low accessibility of the east and south east of the country led investments to focus more on agriculture (Land Matrix, 2017) than services and

industry.

Regional policy, particularly encouraging development in the growth poles, led in time to a concentration of development in a few selected urban areas. Moreover, the effect continued despite the new policies being adopted to encourage a balanced development in cities of all sizes. This is consistent with previous findings which indicate that the growth poles attracted most of the investments (Benedek, 2016).

A strong impact on built-up development was exerted by the coupled impact of fiscal incentives and administrative decentralization. Decentralization gave local governments the opportunity to tailor development strategies based on their growth ambitions. Many perceived built-up expansion as a factor of local growth (Suditu, 2012). The new housing and, particularly, industrial and service areas, not only generated revenue from taxes, but also led to higher funding allocated from central government. However, decentralization and the fiscal incentives were not accompanied by mechanisms to coordinate development priorities of adjacent municipalities and resist the pressure of the private investors (Pascariu, 2012; May et al., 2017). Most often, development took the form of sprawl (Grădinaru et al., 2017). Similar effects of decentralization on land use dynamics were observed in other transitional economies in Europe (Wasilewski and Krukowski, 2004) and Asia (Fan et al., 2018).

The way each city approached development was a mediator of land changes within city boundaries, but most importantly, in the surrounding municipalities. The different approaches were particularly evident in the large and several of the medium sized cities, which expanded constantly throughout the three decades. The increasing relevance of cities in managing growth could be a topic of further research. For example, housing development is the main type of land change in the suburbs (Grigorescu et al., 2012). However, little is known about the way existing planning mechanisms, such as the voluntary association in metropolitan areas, are used to coordinate such development.

Environmental policy was shown to limit development in designated protected areas. However, spatial analysis and visualization highlighted the potential for conflict to occur due to the tension between objectives for environmental conservation and built-up development. Iojă et al. (2010) note that the establishment of new protected areas was conducted without consultation with landowners and stakeholders and with no consideration of development trends. As conflicts arise, the resolution process was time-consuming and not always successful (Tudor et al., 2014; Niculae et al., 2017). It was back in 2016 that the government addressed this issue by encouraging a stronger coordination between environmental and spatial planning policies. However, it is rather early to evaluate whether coordination efforts were indeed effective.

The economic crisis was used as an opportunity to adopt a series of policies to better manage sprawling development and the depletion of agricultural land. This was particularly a context of reduced pressure from the real estate market (Suditu, 2012). It is arguable as to whether these policies will indeed curb existing trends over the long term. Ianoş et al. (2017) notes that recent policy changes at national level came more as a form of passive adaptive management, instead of developing a clear planning vision.

Several planning instruments were adopted without a well-grounded vision or anticipation of future built-up development trends. This was particularly the case of the ones adopted during the transition period and the environmental policy on the Natura 2000 Network adopted after EU accession. The preoccupation with planning instruments' adoption and compliance with EU requirements, rather than any actual focus on the processes at stake (Ianăşi, 2008; Munteanu and Servillo, 2013), reduced the instruments' use in decision making. For example, the National Spatial Plan, which should have been the main document with a coordination role at the national level, became less relevant in guiding development due to its highly descriptive character and poor connection to the new economic and social realities.

There are means to increase the effectiveness of Romania's national policies to manage development. Paired policies on built-up management and the protection of agricultural land, which Alterman (2001) demonstrated to be crucial to increasing effectiveness, have been adopted. However, they require constant political support to assure implementation (Hinţea et al., 2019) and regular assessments of their effectiveness (Matei and Dogaru, 2011). A shared vision of planning authorities at national and local planning levels regarding where and how development should take place needs to be built (Niţă et al., 2018; Dobre, 2010). Finally, local authorities require efficient mechanisms to balance the public and the private interests on development (Nae et al., 2019).

4.3. Method and study limitations

In this paper, we have developed a three-step procedure to investigate the impact of national policies on built-up development, based on the interpretation of explicit and implicit spatial dimensions of policies. Even though not all planning cultures rest on spatially explicit policies at the national level, recent research has shown a growing interest in integrating spatial depictions in policy instruments (Roose and Kull, 2012). Moreover, several European countries, including Denmark, Norway (Fertner et al., 2019) and Switzerland (Kanton Zürich, 2015), have already developed open databases with spatial planning information. We are confident that our procedure, combined with such open-source data, can offer new possibilities for policy evaluation.

The CORINE Land Cover data used in the study did not allow for identification of redevelopment or changes in built-up density. However, data allowed for a historical analysis at the national level, along with a good association with major events that affected the country. More detailed land use data are either not available for Romania or suffer from inconsistent reporting methodologies (Badiu et al., 2016). When more data become available in the future, a comprehensive analysis of historical changes in processes, such as sprawl and land recycling, can be performed. Future research may consider combining policy visualization with spatial modeling to identify the contribution of other built-up development drivers.

5. Conclusions

In this study, we demonstrated that major political and economic events affect the way national policies address the expansion of built areas. In Romania's case, the communist regime, the accession to the EU and the global economic crisis influenced the narrative surrounding built-up management. The policies shifted from encouraging growth in large cities to managing local patterns of expansion.

Romania's experience showed that in guiding development towards more sustainable trends and patterns, countries should consider a) stronger coordination between built land changes and various sectoral policies, and b) a good balance between national and local interests. Lack or poor policy coordination could have unwanted effects, such as uneven development across the country and land use conflicts, or could limit the use of the planning instruments in decision making. Cities are becoming increasingly relevant in managing development. Fiscal incentives which encourage growth should be accompanied by mechanisms to coordinate development across city and surrounding municipalities to avoid sprawling patterns.

The combined use of policy impact visualization and heat maps allowed for a concurrent understanding of the spatial impact as well as its dynamics over time. The method could be used to explore policy impacts at various planning levels, including coordination between policy domains.

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