Regional Spatial and Statistical Analyses of the Urban-Rural Relationships in Romania. Case Study: Romanian Plain

Ines Grigorescu, Gheorghe Kucsicsa, Bianca Mitrică, Irena Mocanu and Monica Dumitraşcu

Abstract In Romania, the majority of settlements are rural. Generally, they are characterised by a high social and economic dependency on the closest urban areas, thus leading to a series of spatial and functional interactions. The paper is aiming to perform a regional scale (Romanian Plain) analysis of the spatial and functional linkages between 34 cities and 318 rural settlements located in their influence area. For the assessment of the urban-rural relationships, spatial analysis and statistical regression models at Local Administrative Level (LAU) were performed. The authors used three independent variables (demographic size, functional profile and connectivity) considered as driving factors for the selected cities, and eight socio-economic dependent variables (population growth, living floor, age dependency, economic dependency, built-up areas expansion, water supply, migratory balance, unemployment rate) reflecting the degree of rural development. The study results help identify areas with different rural development potential and better understand urban-rural interactions of the last decades.

Keywords Urban-rural interactions · Spatial and statistical analysis · Urban sprawl · Regional approach · Romanian plain

I. Grigorescu (✉) · G. Kucsicsa · B. Mitrică · I. Mocanu · M. Dumitraşcu
Institute of Geography, Romanian Academy, Bucharest, Romania
e-mail: inesgrigorescu@yahoo.com

G. Kucsicsa
e-mail: mondy_ghe@yahoo.com

B. Mitrică
e-mail: biancadumitrescu78@yahoo.com

I. Mocanu
e-mail: mocanitai@yahoo.com

M. Dumitraşcu
e-mail: stefania_dumitrascu@yahoo.com

Introduction

Urban and rural areas are the engines behind the urban-rural interactions, each facing different processes conditioning the type and dimension of their relationships. In extended parts of Europe, the settlement pattern cannot longer be understood as either urban or rural (Wandl et al. 2014). Hence, urban and rural areas should be analysed in an integrated manner as the distinction between the two has increasingly blurred, and the interdependency has amplified (Davoudi and Stead 2002; Piacentini and Trapasso 2010). The vitality of rural regions is under threat in large parts of Europe, as they are undergoing a dynamic transition. In many cases, this is the result of a combination between depopulation and agricultural decline (Zonneveld and Stead 2007) or urbanisation, changes in agriculture, new patterns of production and consumption and new societal demands (Horlings and Marsden 2014). In metropolitan landscapes, under the growing interlinking between urban and rural activities, rural areas are no longer lying outside the city, often being placed 'in between' the urbanised spots (Horlings et al. 2009) giving birth to a new spatial development typology 'territories-in-between' (Wandl et al. 2014).

Rural–urban relationships are tightly connected to the evolution and development of the processes that are taking place in urban areas. Moreover, processes related to urbanisation continue to broaden affecting even the remotest small village (Antrop 2004). Hence, the influence of cities on their surrounding territory is also associated with the urban development stages of van den Berg et al. (1982): urbanisation, suburbanisation, desurbanisation and reurbanisation, which rely on the population (growth and decline) and spatial changes between the *core* and *ring*. Suburbanisation, however, holds the most extensive processes of population change and migration from cities to the adjacent hinterland involving the decentralisation of the city (Šimon 2014). It is regularly associated with the rapid growth of population in the commuting suburbs, triggering changes in transport and growth of residential areas driven by lower land prices, high-quality environment and more pleasant surroundings (Stanilov and Sýkora 2014). In post-socialist countries (i.e. Romania), suburbanisation is the most important urban process contributing to reshaping the morphology, land use patterns and socio-economic structure of metropolitan regions (Sýkora and Ouředníček 2007). Overall, urban development (in all its phases), involves a variety of spatial and functional changes between urban and rural areas, mainly involving population shifts from the urban core to suburban areas, as well as the conversion of agricultural land to urban built-up land in the peripheral areas (Frenkel and Ashkenazi 2008).

The concept of urban-rural relationships emerged as a way to promote an integrated model of cities and the surrounding regions based on their spatial and functional interdependencies (Davoudi and Stead 2002). Urban and rural areas have become even more interdependent and connected economically, politically, socially and physically through housing, employment, education, commuting, resource use, etc. (Stead 2002; Zonneveld and Stead 2007). The Study Programme on European Spatial Planning distinguishes eight kinds of relationships: homework (commuting);

central place; metropolitan areas and urban centres in rural and intermediate areas; between rural and urban enterprises; rural areas as consumption areas for urban dwellers; rural areas as open spaces for urban areas; rural areas as carriers for urban infrastructure; rural areas as suppliers of natural resources for urban areas (Strubelt et al. 2001). Tacoli (2003) identifies different types of flows (e.g. agricultural, people, information, financial) which when defining the rural–urban linkages. Bengs and Schmidt-Thomé (2006) sums up a concise classification of the rural–urban linkages referring to the structural and functional relationships they develop.

From a policy viewpoint, the European Spatial Development Perspective (ESDP) was the first document to draw attention to 'urban-rural partnerships' at European, national, regional and local levels as a way to re-evaluate the relationships between city and countryside (Davoudi and Stead 2002; Kawka 2013; Lucatelli and De Matteris 2013). Urban-rural partnerships include a large variety of issues from peripheral rural areas with dispersed small settlements to sprawling spaces in metropolitan areas (Zonneveld and Stead 2007). Later on, build upon the aim of the ESDP, the Territorial Agenda of the European Union 2020 also stressed the importance of developing a balanced and polycentric urban system and new urban-rural partnerships (Jacuniak-Suda et al. 2014). Within the EU Regional Policy on territorial cohesion, urban-rural linkages are seen as partnerships for sustainable urban-rural development (RUR-BAN), through analysing territorial towns/cities–rural areas partnerships practices; attaining better cooperation between different actors in developing and implementing urban-rural initiatives; promoting territorial multilevel governance; assessing possible economic and social gains from enhanced rural–urban cooperation and identify the potential role of urban-rural partnerships for improving regional competitiveness and governance.[1] In line with this, urban-rural cooperation is documented as an essential driver of social and economic success, especially in metropolitan areas (Bański 2014) in view of addressing EU cohesion policy goals or achieving the EU 2020 targets.

Within this broad context, two main objectives have been set for the current paper: (1) to provide quantitative and qualitative investigation of the relationships between cities/town and their surrounding rural areas using several socio-economic indicators in order to (2) understand their role in local and regional development over the last decades.

Overview of the Rural–Urban Relationships in Romania

In 2017, the system of settlements in Romania included 3,181 LAU (Local Administrative Units), most of which rural (2,861 communes/12,957 villages). In contrast, the urban system appears to be underdeveloped in terms of number of cities (320) relative to the overall population of Romania.[2] After 2000, the urban population has grown

---

[1] http://ec.europa.eu/regional_policy/ro/policy/what/territorial-cohesion/urban-rural-linkages/.

[2] http://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=en&ind=LOC103B.

following the declaration of new cities, rather than the positive demographic dynamics. As a result, the urbanisation rate reached 56.4% (2016), the maximum value ever recorded in Romania mainly based on the rural–urban inflows, the urban status granted to some communes and the inclusion of some villages within the administrative perimeter of towns (Mitrică et al. 2016). Rural–urban migration exceeded 2.2 million inhabitants between 1990 and 2014, while urban-rural migration (especially rural areas surrounding the big cities) reached 1.8 million inhabitants. Therefore, the villages are still exposed to the depopulation started during the industrialisation communist period, which has been recently replaced by the external migration of the rural labour force (Nancu 2016).

Before 1990, the urban-rural relationships have been largely driven by the socialist industrialisation, collectivisation of agriculture and the centralised plan-based system which mainly conditioned the workforce flows from rural to urban areas. After 1990, the dynamics and dimension of the urban/suburban/rural landscapes have been dictated by the general socio-economic transformations which have marked central and south-eastern European cities (Soós and Ignits 2003; Degórska 2004; Popovici et al. 2013; Stanilov and Sýkora 2014). Thus, subsequent to the fall of communism, profound socio-economic transformations conditioned by the transition from a centralised to a market-based society occurred. The relationships between towns and the villages located in their influence area developed within a new economic and legislative context. After the collapse of industry, when the job opportunities in the major cities were no longer available, commuting dropped sharply (Mitrică et al. 2016). Moreover, the main post-communist agrarian reform, which reconstituted the property right over agricultural and forest land to its former owners (Law no. 18/1991) had led to an important return of town dwellers to their places of origin. Steaming from the various differences between the two environments in terms of size, functions or patterns, new types of flows between the surrounding rural territories and urban areas emerged. From a legislative perspective, the increasing transformation of communes, viewed as local polarisation cores, into towns has also influenced the evolution trend in the urban-rural progress.

In the recent years, urban development, in all its stages, has become the main and most visible spatial processes taking place in the rural–urban interface. Thus, its dynamics has been mainly conditioned by urbanisation (Benedek 2006; Furdui et al. 2011; Dumitrache et al. 2016; Guran-Nica et al. 2016) suburbanisation (Nicolae 2002; Benedek and Bagoly 2005; Suditu 2012; Cocheci 2015; Grigorescu et al. 2015; Dumitrache et al. 2016; Guran-Nica et al. 2016; Grigorescu and Kucsicsa 2017), counter-urbanisation (Guran-Nica and Sofer 2012; Guran-Nica et al. 2016) and metropolisation (Ianoş et al. 2012; Guran-Nica et al. 2016; Mitrică et al. 2016). These urban development processes have triggered significant structural and functional transformations at the urban-rural interface. Hence, the urban-rural fringe is progressively shifted even further to the surrounding rural–agricultural space, the first to be consumed as a land resource in the urban sprawl process.

The complexity of urban-rural relationships in Romania steam from the variety of interactions evidencing the territorial transformations, disparities and patterns at different spatial scales (Pavel 2004; Istrate 2008; Stoica et al. 2010; Furdui et al.

2011). Local scales, however, (e.g. Bucharest, Craiova, Cluj-Napoca), have better identified and described the range of urban-rural interactions (Ianoş et al. 2010; Guran-Nica et al. 2011; Stoica et al. 2011; Vânău 2011; Pocol and Jitea 2013; Şoşea 2013). Moreover, the diversity of spatial transformations is dictated by the evolution of the socio-economic characteristics of the urban and rural areas determining the type of linkages that might develop: spatial or functional. The spatial relationships are reflected by the urban development and sprawl-related processes, regularly quantified by the land use/cover changes in general, and built-up areas dynamics, in particular. Among these, land use/cover changes, mainly in relation to urban sprawl and suburbanisation processes are more active in the urban-rural interface (e.g. Gavrilidis et al. 2015; Iojă et al. 2011; Grigorescu and Kucsicsa 2017; Kucsicsa and Grigorescu 2018). On the other hand, functional relationships are largely dictated by the social and economic changes that involve different types of flows (e.g. commuting, economic, demographic, provisioning) (Tălângă et al., 2010; Guran-Nica and Sofer 2012) maintaining strong relations between urban areas and the surrounding suburban villages.

Methodology

General Concepts

Spatial and statistical analyses are important for understanding the relationships between rural and urban settlements, but there is limited research on investigating their interactions using such methods. Spatial analysis has been used to explore the processes taking place in rural areas (Cho and Newman 2005; Van Eupen et al. 2012; Caschili et al. 2015; Bański and Mazur, 2016) or to explain the causes and effects of urban growth-related process and patterns (Sudhira et al. 2004; Rahman et al. 2011; Shahraki et al. 2011). However, through the spatial dimension and the functional and structural changes of the urban growth-related process, urban-rural interactions were indirectly addressed through the ties developed between the urban centres and the rural surrounding territories.

Some studies have focused on particular aspects of urban-rural relations such as migration determinants (Helbich and Leitner 2009), employment (Wójcik 2014) or the different spatial and functional processes taking place at the urban-rural interface (Carrion-Flores and Irwin 2004; Liu et al. 2013). Therewith, spatial-based regional typologies (urban, peri-urban or rural) aimed at providing analysis and modelling of the urban-rural regions were developed within some research projects such as ESPON 1.1.2 (Bengs and Schmidt-Thome 2006) or PLUREL (Zasada et al. 2013) and other approaches (OECD 2007; Dijkstra and Poelman 2008; OECD 2009; Dijkstra and Ruiz 2010; Brezzi et al. 2011; van Eupen et al. 2012; Wandl et al. 2014; Gonçalves et al. 2017).

Spatial and Statistical Analysis of the Urban-Rural Relationships in the Romanian Plain

The main scope of the current paper is to perform a regional-scale analysis of the spatial and functional linkages between cities/towns and their surrounding rural LAU in one of the most dynamic areas in Romania, Romanian Plain. The region has been the most affected by the structural and functional transformations of the last century, generally driven by the continuous population growth which required the expansion of agricultural areas for extensive and intensive farming, followed by the intensification of the urbanisation and forced industrialisation processes. After 1990, the gradual transition from the traditional rural–agrarian society to the urban–industrial society (Mitrică 2016) has been followed by the spatial and structural changes brought in by the fundamental political and socio-economic transformations of the post-communist period. Hence, urban-rural relationships have changed significantly in the last decades due to the increasing pressures of the cities on the surrounding agricultural land which occupies nearly 80% of its territory.

The Romanian Plain is located in the southern and south-eastern part of the country. It includes about 650 LAU which are totally overlapping its territory and more than 100 LAU located at the border with the neighbouring relief units. For the current analysis, out of the border localities, the authors took into the consideration the LAU with more than 50% built-up area included within the Romanian plain limits, that is 762 LAU (67 urban LAU and nearly 695 rural LAU) (Fig. 1).

Establishing the cities of influence. For the urban-rural relationships analysis, several areas were selected, evenly distributed throughout the Romanian Plain, so as to better reflect the spatial influence of the cities in the development of rural localities
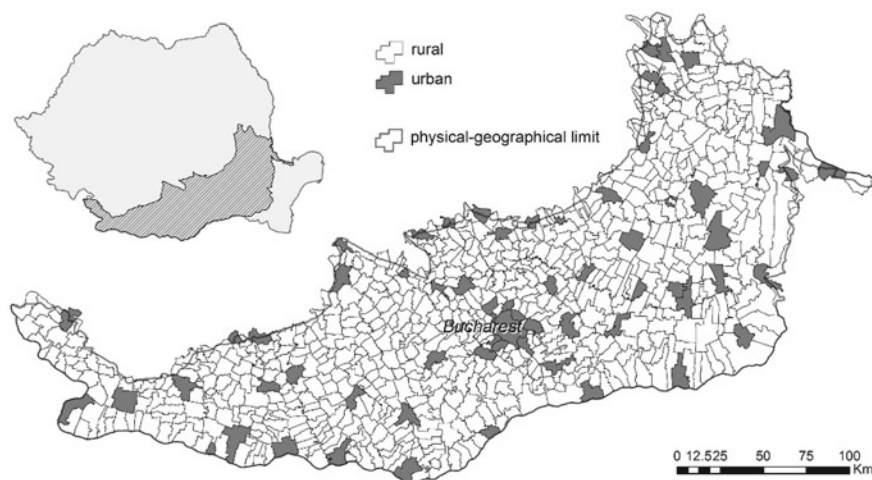
Fig. 1 The local administrative units (LAU level) included in the Romanian plain

in their surrounding territory. Thus, out of a total of 71 cities located in the Romanian Plain, 34 were considered to be cities of influence, territorially significant in terms of demographic size and functional profile (Table 1).

Establishing the areas of influence. In order to identify and assess the influence of the urban areas on the neighbouring rural territory, the authors delineated the area of influence (rural LAU) for the selected cities. Given that, in geographical terms, the spatial extent of urban-rural relationships refers to commuting and time-travel distances and socio-economic interactions, they require either spatial adjacency or accessibility provided through the transport infrastructure (Zasada et al. 2013). The analysis of the location of the rural territorial units and their transport-wise accessibility to urban centres within the differentiated administrative settlement hierarchy is an important component in delineating rural areas under the urban influence (Bański and Mazur 2016). As a result, the areas of influence were set based on the degree of accessibility, calculated as the distance between the city of influence and each rural locality in the surrounding area. Thus, based on this criterion, the inclusion of rural LAU in the area of influence was made as follows: ≤15 km distance from the influence cities with less than 100,000 inhabitants, ≤30 km distance from the influence cities with a population of 100,000–400,000 inhabitants and ≤45 km distance from the influence cities with over 400,000 inhabitants. The rural LAU included in the

Table 1 Ranking the selected cities according to their demographic size and functional profile. Number of localities included in the influence area

Name	Demographic size	Functional profile	No. of rural LAU2 included in the influence area
BUCHAREST	>400,000	industrial and services	72
GALAȚI	200,000-400,000	industrial and services	13
CRAIOVA	200,000-400,000	industrial and services	11
PLOIEȘTI	200,000-400,000	industrial and services	29
BRĂILA	200,000-400,000	industrial and services	11
BUZĂU	100,000-200,000	industrial and services	18
PITEȘTI	100,000-200,000	industrial and services	7
FOCȘANI	50,000-100,000	industrial and services	13
TÂRGOVIȘTE	50,000-100,000	industrial and services	6
SLATINA	50,000-100,000	industrial and services	2
CALARAȘI	50,000-100,000	industrial and services	5
ALEXANDRIA	50,000-100,000	industrial and services	9
SLOBOZIA	50,000-100,000	mixed	7
BAILEȘTI	<50,000	mixed	7
CALAFAT	<50,000	industrial and services	3
CARACAL	<50,000	industrial and services	7
FETEȘTI	<50,000	services and industrial	3
GIURGIU	<50,000	industrial and services	5
OLTENIȚA	<50,000	industrial and services	5
RÂMNICU SĂRAT	<50,000	industrial and services	7
ROȘIORI DE VEDE	<50,000	industrial and services	8
TECUCI	<50,000	mixed	7
TURNU MĂGURELE	<50,000	industrial and services	7
URZICENI	<50,000	industrial and services	12
BECHET	<50,000	agricultural mixed	4
GAEȘTI	<50,000	industrial and services	5
ÎNSURAȚEI	<50,000	agricultural mixed	3
ISACCEA	<50,000	mixed	1
LEHLIU GARĂ	<50,000	mixed	6
POGOANELE	<50,000	mixed	3
TITU	<50,000	industrial and services	9
VÂNJU MARE	<50,000	mixed	4
VIDELE	<50,000	mixed	6
ZIMNICEA	<50,000	mixed	3

influence area of each city based on this criterion is shown in Table 1. Thus, of the 318 rural LAU (Fig. 2), the majority are located in the influence area of Bucharest (72), Ploiești (29), Buzău (18), Galaţi (13), Focşani (13) and Urziceni (12).

   Statistical analysis. Based on data availability, several indicators (dependent and independent variables) resulting from statistical and spatial data processing have been considered (Table 2).
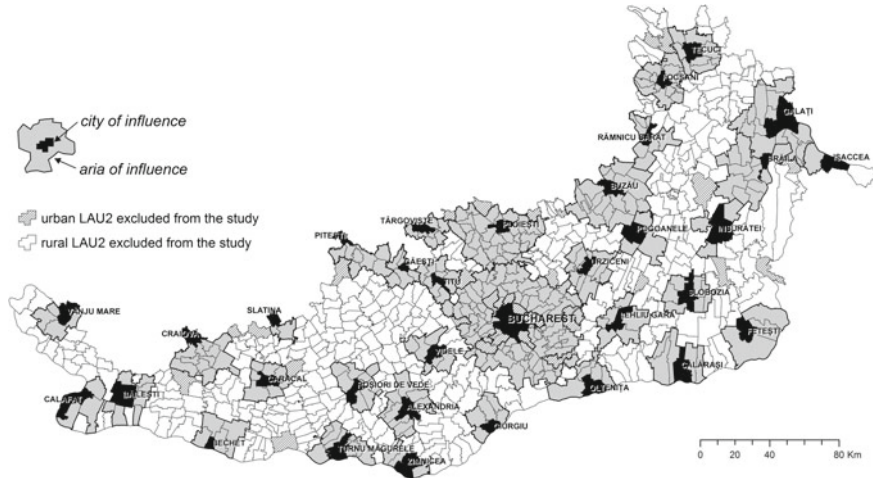
Fig. 2 The cities and their influence area established based on the connectivity criterion

Table 2 Dependent and independent variables included in regression models to assess urban-rural relationships in the Romanian Plain

Dependent variable	Explanation	Processed based on
Y_1	Built-up areas dynamics (1990–2015)	LANDSAT satellite images
Y_2	Living floor space dynamics (1992–2011)	NIS
Y_3	Population growth dynamics (1992–2011)	NIS
Y_4	Age dependency ratio dynamics (1992–2011)	NIS
Y_5	Migratory balance dynamics (1992–2011)	NIS
Y_6	Unemployment rate trend (1992–2011)	NIS
Y_7	Economic dependency index trend (1992–2011)	NIS
Y_8	Water supply network trend (1992–2011)	NIS
Independent variable		
X_1	Functional profile hierarchization (1992)	NIS
X_2	Demographic hierarchization (1992)	NIS
X_3	Connectivity (by roads)	Google maps

The dependent variables were used to assess the level of socio-economic development in the area of influence of each town.

Built-up areas dynamics. The existing built-up space is more likely to trigger further development with similar or different land use functions (e.g. residential, commercial). For the current research, the thematic layers containing built-up areas extracted using visual interpretation of Landsat 4/5 TM and Landsat 8 OLI_TIRS images were quantified and analysed.

Living floor space. This variable refers to the total amount of living rooms surface measured by the interior dimensions at floor level.[3] This indicator is associated with built-up areas dynamics, mainly triggering suburban residential areas (residential suburbanisation) which, in time, is more likely to attract better-educated population with high incomes (Sýkora and Ourednicek 2007), but also residential segregation and exclusion (Soós and Ignits 2003).

Population growth dynamics, considered as the average annual rate of population change during a specified period, is generated by the positive birth rates and migration. In relation to the influence of the urban centre over the neighbouring rural territory, it is mainly caused by urban-rural migration or vice versa. During the early stages of suburbanisation, the outward moving of population brings in infrastructure and new functions, generally influencing higher land consumption (Frenkel and Ashkenazi 2008). Hence, higher population growth rates trigger increased spatial changes, especially built-up areas expansion, resulting in the spatial redistribution of the population inside metropolitan areas under residential deconcentration (Sýkora and Ourednicek 2007).

Age dependency ratio (% of the working-age population) is the ratio between the elderly population (65 + years) and the working age (15–64 years) population.[4] Regularly, this indicator has a negative meaning with respect to the socio-economic progress of rural areas (Bański and Mazur 2016) which, in time, reflects itself in the economic dependency of population.

Migratory balance. Rural–urban migration lessens population pressure in rural areas, helping improve economic conditions and reduce poverty. However, disparities between urban and rural areas in terms of income, employment and the availability of basic infrastructure and services still remain (Sheng 2002). Also, under urban-rural migration, new suburban areas are experiencing an influx of well-educated, affluent and demanding urban residents which claim services, commerce and infrastructure (Bański 2014).

Unemployment rate in suburban areas is an important indicator which expresses the labour functional relationships with urban areas. Thus, higher unemployment rates in urban areas lead to the shift of population in the suburbs where land resources are more accessible ('suburbanisation of poverty') (Hochstenbach and Musterd 2017). In addition, the relocation of businesses in the suburbs attracts the available workforce from the city—'job suburbanisation' or 'job sprawl' (Raphael and Stoll 2010).

---

[3]http://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=en&ind=LOC103B.

[4]https://data.oecd.org/pop/elderly-population.htm.

Economic dependency index, defined as employee's upkeep of another person who does not carry out a remunerative activity, is calculated as the number of non-occupied persons (inactive and unemployed)/100 occupied persons (Simion 2000). This indicator influences the socio-economic development of the rural areas, generally leading to migration flows to more developed regions.

Water supply network (the length of water supply network at LAU level) mainly relates to the built-up areas dynamics and the migratory balance in terms of the increased demand for the development of technical infrastructure (Bański and Mazur 2016) under the expanding urban influence over the rural surroundings.

The independent variables have been set to categorise each selected town according to the functional profile, demographic size and accessibility.

The *functional profile* and *demographic size* of the influence cities are important in explaining their effects on the surrounding rural LAU, thus determining the degree of urban influence and the types of relationships that might be developed. Furthermore, the accessibility was considered assuming that better connectivity to the influence cities can increase the development degree of the nearby rural LAU. This was calculated as road distance between each rural locality included in the area of influence and its influence city. The *connectivity* (accessibility degree) was essential for the initial selection of influence cities/towns given that the physical distance has a significant impact on the urban-rural relationships: the closer the rural areas are to the cities, the stronger their interaction is. In this way, the role of the city is essential in reducing the 'rurality' degree (Pascariu and Czischke 2015), as well as in quantifying the driving time necessary for the population of a region to reach a populated centre (Dijkstra and Ruiz 2010).

Regression models. Urban-rural relationships were carried out using regression models in order to identify and evaluate the interactions between the (*influence*) determinants and the degree of development of the rural LAU in the area of influence, as reflected into a series of socio-economic and demographic indicators. *Multiple linear regression* (MLR) and *binary logistic regression* (BLR) estimated for eight sets of variable combination were applied (Fig. 3). Thus, based on the resulted regression
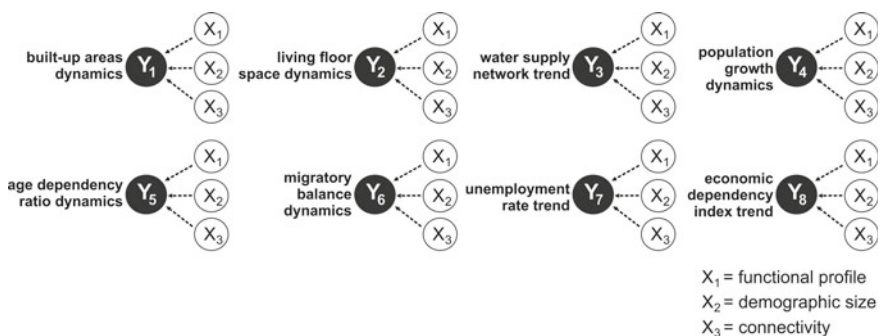

Fig. 3 The sets of variables combination included in regression models

Table 3 The classification (coding) of the dependent variables to apply BLR

Dependent variables	Classes	
Built-up areas dynamics	<50 ha	≥50 ha
Living floor space dynamics	<50 m^2	≥50 m^2
Water supply network dynamics	<1,000 m	≥1,000 m
Population growth dynamics	Negative	Positive
Age dependency ratio dynamics	Negative	Positive
Migratory balance dynamics	Negative	Positive
Unemployment rate dynamics	Negative	Positive
Economic dependency index	Negative	Positive
Code	0	1

coefficients, the factors that contributed to the development of the rural areas near the selected towns were identified, compared and ranked.

Using MLR, the influence of each explanatory factor was investigated. For this, the categorical independent variables, i.e. functional profile, was classified as continuous data from 1 to 4 considering their importance in the development of the region: agricultural mixed (1), industrial and services (2), mixed (3), services and industrial (4). Before developing the MLR models, all variables were normalised into the range 0–1 by *Min–Max linear transformation*, to achieve similar data range. Furthermore, in order to assess the influence of each explanatory factor's classes on the independent variables against the established reference category, the BLR was used. Thus, each dependent variable was divided into two classes (Table 3) in order to show the magnitude of the process (low–high, negative–positive). Additionally, each considering continuous explanatory factor was classified and prepared as categorical (Table 4).

Results and Discussions

The relative contribution of the explanatory variables was evaluated using the corresponding coefficients in the regression models. In the case of MLR, the relative contribution of the explanatory factors was assessed using the standardised estimated coefficients β (Table 5). Significant differences have resulted between values, suggesting that the explanatory factors have different effects on the considering dependent variables. The highest positive values indicate that the demographic size is the best predictor mainly for the Y_1–Y_3. This means that the probability of built-up areas, living floor space and population growth to increase occurs if the demographic size in the influence cities increases. Furthermore, the negative β values resulted for Y_4–Y_6 indicates a significant influence of the demographic size and connectivity in the negative dynamics of age dependency ratio, migratory balance and unemployment rate dynamics. The influence of connectivity on the degree of development of the rural

Table 4 The categorical data obtained by classification of the continuous explanatory factors. The established reference category

Explanatory factors	Category			
Functional profile	Agricultural mixed	Industrial and services	services and industrial	Mixed
Demographic size	Very small (<50,000 inh.)	Small (50,000–100,00 inh.)	Medium-sized (100,000–200,000 inh.)	Large (200,000–400,000 inh.)	Very large (>400,000 inh.)
Connectivity	Very weak (>40 km)	Weak (30–40 km)	Average (20–30 km)	Good (10–20 km)	Very good (>10 km)
Code	1 (reference)	2	3	4	5

Table 5 Standardized estimated coefficients (β) for the multiple linear regression models

	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7	Y_8
Functional profile	0.034	0.061	0.016	−0.058	−0.027	−0.159	0.015	0.029
Demographic size	0.870	0.707	0.704	−0.123	−0.195	−0.142	0.045	0.142
Connectivity	0.473	0.471	0.480	−0.053	−0.169	−0.074	−0.121	0.114

LAU included in the area of influence is also evident, the regression coefficients showing important contribution mainly to Y_3, Y_1 and Y_2. It means that better roads connectivity (decrease in distance) will trigger population growth, built-up areas and living floor space expansion due to better accessibility to the influence cities. Also, the β coefficients for Y_5 (−0.169) and Y_6 (−0.074) indicate that migratory balance and unemployment rate decrease when the connectivity to influence cities is very good.

The regression models pinpoint that the functional profile has low significance in the socio-economic indicators dynamics after 1990 compared to demographic size and connectivity. However, the β coefficients show that unemployment rate has negative dynamics and built-up areas and living floor space positive dynamics when the functional profile of the influence cities grows in importance. Furthermore, the water supply network is more developed when the functional profile of the influenced cities increases in importance.

In case of the BLR, ranking the classes of each explanatory factor compared to the established reference category was evaluated using the corresponding β coefficients (Table 6). First, for the functional profile, the positive β values show that *industrial services* and *mixed* profile have the most important contribution mainly to built-up areas expansion and population growth, compared to the *agricultural mixed* profile (reference category). On the other hand, the negative β values indicate that the *industrial and services*, *mixed* and *services and industrial* profiles contribute more to the negative dynamics of age dependency ratio, unemployment rate and economic dependency index than the *agricultural mixed* profile. In case of the demographic size, the influence to the built-up areas expansion, living floor space dynamics, population growth and water supply network extension is more evident in the rural LAU situated near the largest cities than in the rural LAU near the smallest cities. Furthermore, the negative dynamics of age dependency ratio and migratory balance is also more evident in the rural LAU situated close to the cities with more than 100,000 inh. In terms of connectivity, it is also obvious the contribution of the very good connectivity between rural LAU and influence cities mainly to population growth, built-up areas and living floor positive dynamics comparing to the influence of the very low connectivity. Hence, the negative dynamics of the age dependency ratio and unemployment rate are better explained for the rural LAU located closer to the influence cities.

In addition, the *Nagelkerke R Square* indicator (Table 6) shows how socio-economic development of the rural LAU is differently explained by the analysed explanatory factors together. Thus, the highest values (0.437 for Y_1 and 0.40 for Y_3)

Table 6 Estimated β coefficients for the logistic regression models. *Nagelkerke R Square* values

		Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7	Y_8
Functional profile	Agricultural mixed[a]								
	Industrial and services	18.059	0.212	19.175	−19.723	19.781	−2.984	−2.700	−1.316
	Services and Industrial	−0.014	1.603	−0.014	−21.897	−0.023	−22.118	−22.993	−21.487
	Mixed	19.107	−0.093	18.551	−19.732	19.616	−3.639	−2.366	−0.428
Demographic size	Very small[a]								
	Small	1.073	1.366	1.644	−0.977	−0.128	1.043	0.474	−0.014
	Medium-sized	2.472	2.542	2.568	−0.737	0.178	−1.317	−0.291	0.314
	Large	2.290	1.040	2.045	−1.290	−0.451	1.500	0.676	0.598
	Very large	6.179	3.529	5.247	−3.618	−0.339	−0.564	−0.037	0.815
Connectivity	Very weak[a]								
	Weak	0.288	0.916	−0.709	−1.179	−1.743	0.633	0.633	−0.470
	Average	2.406	1.575	0.534	−1.727	−1.688	−0.174	1.129	0.336
	Good	3.929	2.975	2.911	−2.690	−0.657	−0.435	1.226	0.503
	Very good	4.212	3.222	19.175	−3.135	−0.194	−0.824	0.929	0.423
Negelkerke R square		0.437	0.254	0.400	0.267	0.088	0.223	0.102	0.057

[a]Reference category

indicate that functional profile, demographic size and connectivity explain 44% of the built-up areas expansion and 40% of the increase in population in the influence area.

On the other hand, the lowest values for Y_8, Y_5 and Y_7 indicate that the water supply network extension, negative dynamics of migratory balance and economic dependency index could be better explained by other explanatory factors of the influence city, as well as by local drivers (e.g. investments, entrepreneurial initiatives, development projects, external migration) which were not included in the present study.

Conclusions

Assessing the relationships between urban areas and the surrounding rural territory is essential in understanding the dimension of the spatial and functional linkages between the two types of settings. Spatial and statistical analyses, in particular can provide quantitative upshots on the types and variety of connections developed between cities/towns and their rural surrounding territory.

In Romania, urban-rural relationships have been addressed at different spatial scales and focused on a variety of linkages (e.g. spatial, functional). The dimension and the complexity of the urban-rural relationships is highly influenced by the size and functions of the urban area, thus county seats, large and medium-sized towns trigger a wider diversity of linkages than the small towns. Thus, the complex relationships between these two types of settings (urban and rural) are better understood using a combination of statistical and spatial analysis methods, providing two- or three-dimensional image of the spatial phenomena taking place in the surrounding of cities. As a result, in order to reflect the degree of rural development, the urban-rural relationships assessment were performed as the interaction between three independent variables (demographic size, functional profile and connectivity) of the selected urban LAU and eight socio-economic dependent variables (population growth, living floor, age dependency, economic dependency, built-up areas expansion, water supply, migratory balance, unemployment rate) of the rural LAU. The estimated coefficients of the regression models indicate that after the 1990 the socio-economic development in the Romanian Plain's rural LAU has been mainly triggered by the demographic size and connectivity to the influence cities. Their effect is more visible on the population increase, built-up areas and living floor space expansion in the surroundings of Bucharest, Pitești, Galați, Craiova, Ploiești, Brăila, as well as in the decline of the migratory phenomena and unemployment in the surroundings of Bucharest, Pitești, Buzău, Călarași. Moreover, the spatial and statistical analysis shows a reduced influence of the functional profile in the socio-economic development degree. Thus, it can be assumed that the future socio-economic development of the rural LAU in the study area is more likely to occur near larger cities, with good connectivity, as well as characterised by mixed and industrial and services functional profiles (e.g. Bucharest, Ploiești, Galați, Brăila, Craiova). Conversely, a low devel-

opment degree of the rural LAU is mainly expected in the influence area of the small towns characterised by a dominant rural–agricultural profile and industrial decline (e.g. Însurăţei, Bechet, Feteşti, Vânju Mare, Titu, Zimnicea, Videle). Overall, the current results help in identifying areas with different rural development potential and better understand the urban-rural interactions.

References

Antrop M (2004) Rural-urban conflicts and opportunities. the new dimensions of the European landscape. In: Jongman RHG (ed) The new dimensions of the European landscapes. Springer, pp 83–91

Bański J (2014) Social and economic success in metropolitan areas and the role of urban-rural cooperation. In: Dej M, Janas K, Wolski O (eds) Towards urban-rural partnerships in Poland, preconditions and potential, pp 33–40

Bański J, Mazur M (2016) Classification of rural areas in Poland as an instrument of territorial policy. Land Policy 54:1–17

Benedek J, Bagoly P (2005) Procesul de suburbanizare din România. Studiu de caz, zona suburbană a municipiului Târgu Mureş, Studia Universitatis Babeş-Bolyai, Geographia, L(2):117–126

Benedek J (2006) Urban policy and urbanisation in the transition Romania. Romanian Rev Reg Stud 2(1):51–64

Bengs C, Schmidt-Thome K (2006) ESPON 1.1.2. urban rural relations in Europe, Final Report, ESPON Luxembourg

Brezzi M, Dijkstra L, Ruiz V (2011) OECD extended regional typology: the economic performance of remote rural regions, In: OECD regional development working papers, 2011/06, OECD Publishing. http://dx.doi.org/10.1787/5kg6z83tw7f4-en

Carrion-Flores C, Irwin EG (2004) Determinants of residential land-use conversion and sprawl at the rural-urban fringe. Am J Agr Econ 86(4):889–904

Caschili S, De Montis A, Trogu D (2015) Accessibility and rurality indicators for regional development. Comput Environ Urban Syst 49:98–114

Cho SH, Newman DH (2005) Spatial analysis of rural land development. For Policy Econ 7(5):732–744

Cocheci V (2015) Typical and distinctive characteristics of suburbanization in the metropolitan area of Cluj-Napoca. Acta Tehnica Napocensis Civil Engineering and Architecture. Acta Technica Napocensis: Civil Engineering Architectur 58(4):56–66

Davoudi S, Stead D (2002) Urban-rural relationships: an introduction and brief history. Built Environ 28(4):269–277

Degórska B (2004) Spatial conflicts between the shaping of open spaces and the socio-economic development in the metropolitan area of Warsaw. In: Kovacs AD (ed) New aspects of regional transformation and the urban-rural relationship centre for regional studies of the hungarian academy of sciences, Pecs, Hungary. http://discussionpapers.rkk.hu/index.php/DP/article/viewFile/2221/4137

Dijkstra L, Poelman H (2008) Remote rural regions: how the proximity to a city influences the performances of rural regions, Regional Focus No 1, DG Regio. European Commission. http://ec.europa.eu/regional_policy/sources/docgener/focus/2008_01_rural.pdf

Dijkstra L, Ruiz V (2010) Refinement of the OECD regional typology: economic performance of remote rural regions. DG Regio, European Commission

Dumitrache L, Zamfir D, Nae M, Simion G, Stoica V (2016) The urban nexus: contradictions and dilemmas of (post) communist (sub) urbanization in Romania. Hum Geogr 10(1):39–58

Frenkel A, Ashkenazi M (2008) Measuring urban sprawl: how can we deal with it? Environ Plan 35(1):56–79

Furdui LM, Pruteanu EM, Serbu MV (2011) Dynamics of rural-urban relations in urbanization context. Econ Seri Manag 14(2):484–491

Gavrilidis AA, Grădinaru SR, Iojă IC, Carstea EM, Pătru-Stupariu I (2015) Land use and land cover dynamics in the periurban area of an industrialized East-European city. an overview of the last 100 years. Carpath J Earth Environ Sci 10(4):29–38

Gonçalves J, Gomes MC, Ezequiel S, Moreira F, Loupa-Ramos I (2017) Differentiating peri-urban areas: a transdisciplinary approach towards a typology. Land Policy 63:331–341

Grigorescu I, Kucsicsa Gh, Mitrică B (2015) Assessing spatio-temporal dynamics of urban sprawl in the Bucharest metropolitan area over the last century, In: Bicik I, Himiyama Y, Feranec J, Kupkova L (eds) Land use/cover changes in selected regions in the world. Charles University in Prague, Faculty of Science, Prague, X:19–27

Grigorescu I, Kucsicsa G (2017) Spatial and temporal dynamics of urban sprawl in the Romanian plain over the last century. Rev. Roum. Géogr Rom J 61(2):109–123

Guran-Nica L, Sofer M (2012) Migration dynamics in Romania and the counter-urbanisation process: a case study of Bucharest's Rural-Urban Fringe, In: Hedberg C, Miguel do Carmo R (eds) Translocal ruralism: mobility and connectivity in European rural space, vol 103, pp 87–102

Guran-Nica L, Sofer M, Bistriceanu-Pantelimon C (2016) From urbanization to metropolization. In: A case study of Romania, procedia of economics and business administration, vol 3, no 1, pp 106–113

Guran-Nica L, Sofer M, Ştefan N (2011) New rural-urban relationships in Romania. In: Issues at the rural-urban fringe of Bucharest. Studia Universitatis Babes-Bolyai, Geographia, vol 1, pp 127–140

Helbich M, Leitner M (2009) Spatial analysis of the urban-to-rural migration determinants in the Viennese metropolitan area. a transition from suburbia to postsuburbia?. Appl Spatial Anal Policy 2(3):237–260

Hochstenbach C, Musterd S (2017) Gentrification and the suburbanization of poverty: changing urban geographies through boom and bust periods. Urban Geogr 39(1):1–28

Horlings I, Tops P, van Ostaaijen J (2009) Regimes and vital coalitions in rural-urban regions in the Netherlands In: Andersson K, Lehtola M, Eklund E, Salmi P (eds) Beyond the rural-urban divide: cross-continental perspectives on the differentiated countryside and its regulation Emerald Group Publishing Limited, pp 191–220

Horlings LG, Marsden TK (2014) Exploring the 'New Rural Paradigm in Europe: eco-economic strategies as a counterforce to the global competitiveness agenda. Eur Urban Reg Stud 21(1):4–20

Ianoş I, Cercleux AL, Pintilii RD (2010) Remarks on identity building of rural and urban communities in the Bucharest metropolitan area. Analele Universităţii din Oradea—Seria Geografie, vol XX, no 2, pp 173–183

Ianoş I, Peptenatu D, Drăghici C, Pintilii RD (2012) Management elements of the emergent metropolitan areas in a transition country. Romania, as case-study, J Urban Reg Anal IV(2):149–172

Iojă C, Onose D, Niță M, Vanău G, Pătroescu M, Gavrilidis A, Saghin I, Zarea R (2011) The conversion of agricultural lands into built surfaces in Romania. In: USCUDAR Proceedings of the recent researches in urban sustainability and green development, pp 115–120

Istrate M (2008) Relaţiile urban-rural în Moldova în perioada contemporană, Edit. Universităţii "Alexandru Ioan Cuza", Iaşi, p 352

Jacuniak-Suda M, Knieling J, Obersteg A (2014) Urban-rural partnerships as a tool of territorial cohesion?. In: Dej M, Janas K, Wolski O (eds) Towards urban-rural partnerships in Poland, preconditions and potential, pp 15–31

Kawka R (2013) Rural-urban partnerships and rural development. In: Kolczynski M (ed) New paradigm in action—on successful partnerships. Polish Ministry of Regional Development, pp 51–64

Kucsicsa G, Grigorescu I (2018) Urban growth related to distance explanatory factors in Bucharest Metropolitan area. spatial and temporal assessment using logistic regression. J Urban Plan Dev (ASCE Library), 144(1). http://ascelibrary.org/doi/10.1061/%28ASCE%29UP.1943–5444. 0000415

Liu Y, Lu S, Chen Y (2013) Spatio-temporal change of urban-rural equalized development patterns in China and its driving factors. J Rural Stud 32:320–330

Lucatelli S, De Matteis P (2013) Rural urban partnership for sustainable development. In: Kolczynski M (ed) New paradigm in action—on successful partnerships. Polish Ministry of Regional Development, pp 87–97

Mitrică B, Grigorescu I, Urucu V (2016) Dezvoltarea urbană și ariile metropolitane. In: Bălteanu D, Dumitraşcu M, Geacu S, Mitrică B, Sima M (eds) România. Natură şi Societate. The Publishing House of the Romanian Academy, pp 250–291

Nancu D (2016) Satul – dezvoltare teritorială și tendințe sociodemografice. In: Bălteanu D, Dumitraşcu M, Geacu S, Mitrică B, Sima M (eds) România. Natură şi Societate. The Publishing House of the Romanian Academy, pp 292–328

Nicolae I (2002) Suburbanismul, ca fenomen geografic în România. Edit, Meronia, Bucureşti p, p 397

OECD (2007) OECD regions at a glance, 2007th edn. OECD Publishing, Paris, p 252

OECD (2009) Regional typology: updated statistics. www.oecd.org/gov/regional/statisticsindicators

Pascariu S, Czischke D (2015) Promoting urban-rural linkages in small and medium sized cities, URBACT study new concepts and tools for sustainable urban development 2014–2020, Final Thematic Report. http://urbact.eu/sites/default/files/urban-rural_thematic_report.pdf

Pavel S (2004) Urban and rural spaces of western Romania transformations and evolutions. Geogr Timisiensis 13(1):83–93

Piacentini M, Trapasso R (2010) Urban-Rural linkages: issues, measurement and policies in OECD countries. In: Paper presented to the joint meeting of the working party on territorial development in urban areas and the working party on territorial development in rural areas of the OECD's Territorial Development Policy Committee, Paris, 30 Nov 2010

Pocol CB, Jitea IM (2013) The residential function of the countryside and the development of the peri-urban area of Cluj Napoca City. Bull Univ Agric Sci Vet Med (Cluj-Napoca, Horticulture) 70(2):368–373

Popovici EA, Bălteanu D, Kucsicsa G (2013) Assessment of changes in land-use and land-cover pattern in Romania using Corine Land Cover Database. Carpathian J Earth Environ Sci 8(4):195–208

Rahman A, Aggarwal SP, Netzband M, Fazal S (2011) Monitoring urban sprawl using remote sensing and GIS techniques of a fast growing urban centre, India. IEEE J Sel Top Appl Earth Obs Remote Sens 4(1):56–64

Raphael S, Stoll MA (2010) Job sprawl and the suburbanization of poverty. Metropolitan Policy Program at Brookings, Washington, DC. http://gspp.berkeley.edu/assets/uploads/research/pdf/0330_job_sprawl_stoll_raphael.pdf

Shahraki SZ, Sauri D, Serra P, Modugno S, Seifolddini F, Pourahmad A (2011) Urban sprawl pattern and land-use change detection in Yazd, Iran. Habitat Int 35(4):521–528

Sheng YK (2002) Poverty alleviation through rural-urban linkages: policy implications. In: Economic and social commision for Asia and the Pacific, Bangkok. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.556.3990&rep=rep1&type=pdf

Simion M (2000) Potenţialul uman al României. Repartiţia teritorială şi perspective la începutul secolului XXI, Analele Institutului Naţional de Cercetări Economice, 2–3, Centrul de Informare şi Documentare Economică, Bucureşti, p 350

Soós G, Ignits G (2003) Suburbanization and its consequences in the Budapest metropolitan area. In: 3rd EuroConference "the european city in transition, the city and the region". Bauhaus-Universität

Weimar, Germany, Supported by the European Commission. https://core.ac.uk/download/pdf/11871881.pdf

Stanilov K, Sýkora L (eds) (2014) Confronting suburbanization: urban decentralization in postsocialist Central and Eastern Europe. Wiley, p 360

Stead D (2002) Urban-rural relationships in the west of England. Built Environ 28(4):299–310

Stoica IV, Tălângă C, Zamfir D (2010) Urban-rural interface: general remarks. Application in the Romanian system of settlements. Ann Univ Oradea, Geogr Ser XX(2):238–245

Stoica IV, Tălângă C, Braghină C, Zamfir D (2011) Ways of managing the urban-rural interface. Case study: Bucharest. Ann Univ Oradea Geogr Ser 21(2):313–322

Strubelt W, Gatzweiler HP, Kaltenbrunner R (2001) Study programme on European spatial planning: final report. Federal Ministry of Transport, Building and Housing, Bonn, p 58. http://www.bbr.bund.de/BBSR/EN/Publications/BMVBS/Forschungen/1999_2006/DL_forsch_103_2.pdf?__blob=publicationFile&v=3

Sudhira HS, Ramachandra TV, Jagadish KS (2004) Urban sprawl: metrics, dynamics and modelling using GIS. Int J Appl Earth Obs Geoinform 5(1):29–39

Suditu B (2012) Urban sprawl—the legal context and the territorial practices in Romania. Hum Geogr J Stud Res Hum Geogr 6(1):73–77

Sýkora L, Ourednicek M (2007) Sprawling post-communist metropolis: commercial and residential suburbanisation in Prague and Brno, the Czech Republic. In: Razin E, Dijst M, Vazquez C (eds) Employment deconcentration in European metropolitan areas. GeoJournal Library, vol 91, pp 209–233

Şoşea C (2013) A conceptual viewpoint on the urban periphery. Craiova, Romania as a case study, geographical phorum. Geogr Stud Environ Prot Res XII(2):187–193

Tacoli C (2003) The links between urban and rural development. Environ Urban 15(1):3–12

Tălângă C, Zamfir D, Stoica IV (2010) Urban-rural interface, polycentric development and transportation systems. Case study: Bucharest metropolitan area. Hum Geogr 4(2):47–52

Van den Berg L, Drewett R, Klaasen LH, Rossi A, Vijverberg CH (1982) Urban Europe: a study of growth and decline. Pergamon Press, p 184

Van Eupen M, Metzger MJ, Pérez-Soba M, Verburg PH, Van Doorn A, Bunce RGH (2012) A rural typology for strategic European policies. Land Policy 29(3):473–482

Vânău GO (2011) Interfaţa spaţial-funcţională dintre Municipiul Bucureşti şi teritoriul suport al acestuia. Editura Universitară, p 204

Wandl DA, Nadin V, Zonneveld W, Rooij R (2014) Beyond urban-rural classifications: characterising and mapping territories-in-between across Europe. Landsc Urban Plan 130:50–63

Wójcik M (2014) Rural-urban collaboration in a large metropolitan area. The Łódź metropolitan area case study. In: Dej M, Janas K, Wolski O (eds.) Towards urban-rural partnerships in poland, preconditions and potential, pp 123–148

Zasada I, Loibl W, Berges R, Steinnocher K, Köstl M, Piorr A, Werner A (2013) Rural-urban regions: a spatial approach to define urban-rural relationships in Europe. In: Nilsson K, Pauleit S, Bell S, Aalbers C, Nielsen TS (eds) Peri-urban futures: scenarios and models for land use change in Europe. Springer, Berlin, Heidelberg, pp 45–68

Zonneveld W, Stead D (2007) European territorial cooperation and the concept of urban-rural relationships. Plan Pract Res 22(3):439–453