Romanian Journal of Regional Science
The Journal of the Romanian Regional Science Association
Vol. 8 No 2, Winter 2014

PERIURBAN AREAS AND POPULATION DENSITY CLUSTERING MODEL

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Biographical Notes

Cristina Lincaru is a researcher at INCSMPS Romania since 1996. Her scientific career on the long term is aimed at achieving high expertise in the field of quality in employment in the knowledge based society context in transition countries. As specific objectives she intends to study how quality in employment is linked to some distinct domains such as: knowledge management, stimulation of innovation, increasing the long term competitiveness, sustainable development, wage developments, improving bargaining and social dialog, as well as identifying new opportunities to create more and better job. She is member in RSA, RRSAI, EALE, SRS and Romanian Professional Association of Human Resources Management Experts.

Draga Atanasiu has a long scientific activity found in the works of innovation, sustainable development, corporate social responsibility made by applying quantitative and qualitative methods and methodologies focused to modernise labour market from the demand side in a competitive global world. Participated in numerous research consortia to promote and achieve large and new projects of complexity, financed in competition from national programs (eg, PNCDI, sectoral programmes, etc.) and international (eg. Progress, Leonardo da Vinci) in the socio-economic field. She is a member in SRS.

Abstract

The late regional practice implementation requested the addition of an intermediate category in between urban and rural area: periurban area. In our paper we use the classification units at the lower LAU level (LAU level 2, formerly NUTS level 5) consists of municipalities or equivalent units in the 27 EU Member States. The model proposed is build with the LAU2 with status of rural areas – communes that are labelled as periurban area if these locations are local positive spatial autocorrelated and has a density of population over 150 person /km^2 (over the OECD rural commune's threshold). We use as instrument for identifying agglomerations spatial correlated locations for the density of population variable. The clusters of LAU2 identification is made using the Local Indicators of Spatial Association (LISA) in GEODA software.

Key words: Size and Spatial Distributions of Regional Economic Activity, spatial analysis, agglomeration, periurban areas
JEL Classification: J11, R12

1. Introduction

The new paradigm imposed by the sustainable development defined in 1987 in *The Brundtland Report*[1] imposes the principle that our decisions and actions „should take into consideration potential impact on society, the environment and the economy", expressed also as:

> *At the core of sustainable development is the need to consider "three pillars" together: society, the economy and the environment. No matter the context, the basic idea remains the same – people, habitats and economic systems are inter-related.* [2]

Integration of the (human) action impact requests the holistic systemic approach, while the compartmented arrangement in divisions and departments is no longer enough (Ministries of agriculture, development, finance, labour, environment, etc). Society, economy and environment "works" together in a complex connection and interdependence localised in a specific geographical area. The land covering areas are shaped based on different criteria accordingly with a specific rationale. Under the socio-economic analyses of the regions and framing of EU regional policies demand for statistical instruments EUROSTAT develops the Nomenclature of territorial units for statistics. Based on several socioeconomic aspects (structure of the employment, population age, population change) areas could be categorised "the rural areas[3] (as well as urban area). The late regional practice implementation requested the addition of an intermediate category in between urban and rural area: periurban area.

As a consequence of increasing demand for impact evaluation of human's economic, social and environment actions on land use the periurban area becomes a research priority on the background of its highest dynamics. Dynamic interaction between the natural and human components based on the synergy of ecological and socio-economic factors in the rapidly urbanizing landscapes represents the research objective of DYNAHU[4] project. This paper provides some early results resulted from this project activity.

2. Rational for studying the Rural-Urban-Regions (RURs) dynamics

Periurban area becomes in rural urban continuum a specific category "often defined as a transition zone with a mixture of urban and rural activities and land uses" (Adell, 1999; SCOPE PUECH

[1] ***, Report of the World Commission on Environment and Development Our Common Future, United Nations, 1987
[2] Strange, T., Bayle, A. (2008), OECD Insights, Sustainable Development: Linking economy, society, environment, OECD, pg.27 file:///E:/cristina/an2014_01_04_2014/proiecte/proiecte_derulare/DYNAHU/Lucru03_09_2014/biblioteca/OECD/sustainable%20development.pdf
[3] Gallego F.J.(2004), Mapping rural/urban areas from population density grids, Institute for Environment and Sustainability, JRC, Ispra (Italy)
[4] Project: Dynamic interaction between the natural and human components based on the synergy of ecological and socio-economic factors in the rapidly urbanizing landscapes represents the research objective of DYNAHU, Grant of the National Authority for Scientific Research, CNDI–UEFISCDI, project number PN-II-PT-PCCA-2011-3.2-0084, Coordinator partnership: National Institute of Research and Development for Optoelectronics INOE 2000, Duration: July 2012- June 2016

project)[5]. Among EU FP6 projects the PLURIEL Project offered a model of integrated research with the objective to develop tools that allows:

> *An improvement of our knowledge and the creation of better tools for the assessment of the future social, environmental and economic impacts of land use changes are necessary. Only then it is possible to identify effective strategies for the planning of sustainable land use systems..*[6]

Rural-Urban-Regions (RURs) dynamics typology is complex and represents a study object accordingly:

> *"Urban regions demonstrate a certain spatial development »lifecycle«, resulting in waves of urbanisation, sub-urbanisation and counter-urbanisation, triggered by increase and decline of drivers (such as birth and migration balance), related activities (housing, production, commuting etc.) and general economic conditions. This urban life cycle exhibits* ***various spatial development patterns****, like core city growth as effect of urbanisation, polycentric growth as effect of controlled (sub-) centre expansion or scattered peri-urban settlement growth (urban sprawl) as effect of uncontrolled settlement dispersion. Other development patterns show declining core cities as effect of counter-urbanisation due to general population and activity loss, or declining peri-urban settlements as effect of population loss in the entire urban region or as effect of core-city re-urbanisation. Different RURs show either identical or oppositional dynamics in core cities and surroundings, resulting in different types."*[7]

PLURIEL recommend a typology of 4 classes for all Europe rural-urban regions (RURs): Rural, Dispersed polycentric, Urban polycentric metropolitan, Urban monocentric.

3. Definition of rur-urban fringe

Rur-urban fringe as urban geography concept was launched by T. L. Smith in 1937 as the „ built area immediately outside the administrative area of the city".

The study of urban-rural relations involves certain region characteristics to distinguish between the influence of neighbouring core cities on their periurban and rural surroundings. The limit of rural and urban concepts which are defined by geographers deters in between there is a large spectrum o

[5] Cited by Tötzer,T.,(2008), RELATIONSHIPS BETWEEN URBAN-PERIURBAN-RURAL REGIONS: FIRST FINDINGS FROM THE EU-PROJECT PLUREL, Proceeding for the Conference "Rurality near the city" | Leuven, February 2 7-8th, 2008

[6] Tötzer,T.,(2008), RELATIONSHIPS BETWEEN URBAN-PERIURBAN-RURAL REGIONS: FIRST FINDINGS FROM THE EU-PROJECT PLUREL, Proceeding for the Conference "Rurality near the city" | Leuven, February 2 7-8th, 2008

[7] PLURIEL, NEWSLETTER, september 2008

grey scale of terms, different by country[8]. This vast typology of terms reflects the huge diversity of applications, each term is correct in a specific framework / school by country as follows (Table 1):

Table 1. Typology for periurban definition

USA	*rural – urban interface*	*Sharp şi Clark 2008*
	exurban areal	*Lessinger 1986, Sharp şi Clark 2008*
	technoburb1	*Fishman 1990*
	posturban surface	*Garreau 1991*
UK	*hinterland*	Hoggart 2005, Gallent 2006
	the edgeland	Gallent et al. 2006
	suburbs, vorort	
China	*urban frinje*	Xu 2004
France	*periurban*	
	banlieu	
Romania	*zonă preorăşenească / suburban area*	
	Urban influenced area	Ianoş 1987
	rur-urabn fringe	Avram 2011
other	*urban basin surrounding urban environment*	

Source: selection from DYNAHU project intermediary results

Without claiming to exhaust the existing definitions that describe the concept of the periuban developed in literature, we shall use as reference the definition for periurban made by Iaquinta, Drescher in 2000:

> *Importantly, what seems to be <u>not</u> essential to the definition of periurban is "proximity to the city". Additionally, concentration on geographic location as a basis for defining periurban also undermines a clear understanding of the* ***rural-urban spectrum as dynamic, interactive and transformative***.[9]

In relation with population density we shall use as complementary instrument the OECD definition[10] regarding a reference threshold for rural location dynamics for rural area spatial unit definition:

> *A commune is classified as rural if the population density is below 150 inhabitants per* km^2 .

[8] Selection by the results of Phase I of the project DYNAHU, http://dynahu.inoe.ro/html/dissemination.html
[9] Iaquinta D.L., Drescher A.W, (2000) Defining Periurban: Understanding Rural-Urban Linkages and Their Connection to Institutional Contexts, Paper presented at the Tenth World Congress of the International Rural Sociology Association, Rio de Janeiro, August 1, 2000., pg. 3
[10] OECD, Creating rural indicators for shaping territorial policy, Paris, 1994

4. Methodologies of defining periurban area based on differen criteria:

- **Distance** - „edge of the urban areas - up from where the builded surface is ending - and carried to where there is direct and effective influence of the city ", the term is synonymous with the suburban area, Iordan (1973, p 8);
- **Aggregate Index** that reflects the socio economic activity combined with distance. These aggregate indexes could includes dimensions / pillars like: output value, activity in some specific secors (agriculture, tourism, etc). The method of calculation elaborated and used to determining the development of periurban area includes a number of indices (index of activity in non-agricole sectors, the commuting index, the urban building renewal index) and the share of land and agricultural production, tourism and recreational potential, the value of production in the industrial activities and distance from the urban areas center.
- N. Gallent, J. Andersson, and M. Bianconi (2006)[11] systemised in 13 categorised methods for determining the rural – urban limits: Margin of built-up zones, Land use, Transition zones, Metropolitan zones, Inside the rural, Urban meets rural, pressure zones, population, Territorial – administrative policy, economy, accessibility, landscape, way of life, etc.

5. Research question in Romania

In large scale the Project DYNAHU express the Romania's commitment to identify effective strategies for the planning of sustainable land use system. The general objective of DYNAHU[12] project is the elaboration of the **prediction changes model** for environmental, social and economic rapid of land use, located in periurban area, in relation to current policies and practices, on the background of major processes, at coupled nature-human systems. The final prediction changes model will provide different scenarios of development as information base for decision makers.

The objective of this paper is subordinated to the general objective of DYNAHU and aims to characterise the periurban areas dynamics by the **density of population**. Density of population offers multiple keys in analysis of relationship of anthropogenic activities and land use regimes. The interaction of population expressed by the *density of population mixed with distance to urban areas expressed by the neighbourhood described by contiguity relationship* could provide the instrument to:

- Estimate the risk of over consumption / resource exhaustion and resources recovery cycles projection;
- Finding and maintaining optimum use;

[11] Cited by S. Avram, THE POSITION OF RURAL-URBAN FRINGE IN THE FRAMEWORK OF HUMAN SETTLEMENT SYSTEM, Forum Geografic.Studii şi cercetări de geografie şi protecţia mediului Year 8, No. 8/ 2009, pp. 139- 145

[12] http://dynahu.inoe.ro/html/objectives.html

- Coordinate and improve different policies.

6. Models, variables and data

a. data

The NUTS[13] classification (Nomenclature of territorial units for statistics) is a hierarchical system for dividing up the economic territory of the EU for the purpose of: the collection, development and harmonisation of EU regional statistics, Socio-economic analyses of the regions and framing of EU regional policies. [14]

In PLUREL project the resolution of analysis was NUTS 3 level, imposing some limits to intra regional analysis.

In our paper we use the classification units at the lower LAU level (LAU level 2, formerly NUTS level 5) consists of municipalities or equivalent units in the 27 EU Member States. The LAU2 level represents a specific instrument for ***cohesion policy and multilevel governance***[15] representing the „smallest" comparable **administrative** units in EU relevant for policy application. (Table 2)

Table 2. Romanian national structures of territorial units for statistics[16]

	NUTS 1		**NUTS 2**		**NUTS 3**		**LAU 1**		**LAU 2**	
RO	*Macroregiuni*	*4*	*Regiuni*	*8*	**Judet + Bucuresti**	**42**	**-**		*Comune + Municipiu + Orase*	3181
EU-28		98		272		1315				120970

Source: EUROSTAT metadata

b. variables

Our data for total population variable are from Census INS 2002 provided by ESRI in 3190 LAU2, and for salaried number (2002, 2012) and registered unemployed persons (2012) from TEMPO INS. The data for areas by LAU2 variable are provided by ESRI for 2002. Using these variable we calculate by LAU2 the densities of population /km2, density of salaried persons /km2 and registered unemployed persons/km2.

$$\text{Density}_{\text{Variable}} = \text{N}_{\text{Variable}} \text{ [number of persons]/Area [km2] | LAU2} \quad \text{[person/km2]} \quad (1)$$

[13] Work on the Commission Regulation (EC) No 1059/2003, gave NUTS a legal status started in spring 2000. This was adopted in May 2003 and entered into force in July 2003. (source EUROSTAT)
[14] http://epp.eurostat.ec.europa.eu/portal/page/portal/nuts_nomenclature/history_nuts
[15] To meet the demand for statistics at local level, Eurostat has set up a system of Local Administrative Units (LAUs) compatible with NUTS. http://epp.eurostat.ec.europa.eu/portal/page/portal/nuts_nomenclature/local_administrative_units
[16] http://epp.eurostat.ec.europa.eu/portal/page/portal/nuts_nomenclature/correspondence_tables/national_structures_eu

c. model

The LAU2 with status of rural areas – communes are labeld as periurban area if these locations are local positive spatial autocorrelated and has a density of population over 150 person /km2. The spatial similarity of LAU 2 level unit of commune with the urban area / rural high density area (over the OECD rural commune's threshold) reflects the dynamics of periurban areas. We use as instrument for identifying agglomerations spatial correlated for the density of population variable.

The clusters of LAU2 identification is made using the Local Indicators of Spatial Association (LISA) in GEODA software [17]. Our model at this stage, is based on univariate LISA and has a main limit the ignoring of multivariate associations, variability related to scale mismatch, and other spatial heterogeneity.

Conceptualization of Spatial Relationships

We use Contiguity-Based Spatial weights where „spatial weights manipulation with the construction of contiguity-based spatial weights, where *the definition of neighbor is based on sharing a common boundary*"[18] named also as Rook-Based Contiguity (Figure 1).

Based on this definition of neighbour we calculate the spatial lagged values[19] for population density.

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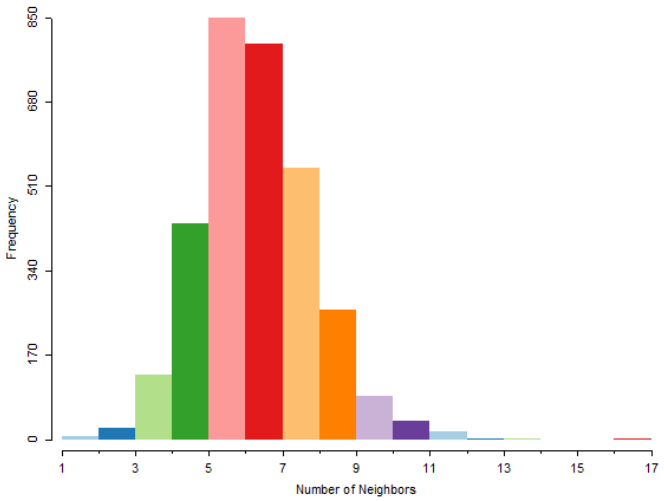


Figure 1. Connectivity Histogram (rook contiguity, 1 order)
Data Source: 2002 ESRI Census INS data, calculated by authors in GeoDa Software

[17] https://geodacenter.asu.edu/node/390#lisa2
[18] Luc Anselin, Exploring Spatial Data with GeoDaTM : A Workbook, pg.106, Spatial Analysis Laboratory Department of Geography University of Illinois, Urbana-Champaign Urbana, IL 61801 http://sal.agecon.uiuc.edu/, Center for Spatially Integrated Social Science http://www.csiss.org/, Revised Version, March 6, 2005, Copyright c 2004-2005 Luc Anselin, All Rights Reserved
[19] the spatial lag of a value in a unit space is the average values in the neighbourhood units of the reference unit

Global Spatial Autocorrelation – Moran's I spatial autocorrelation statistic and its visualization in the form of a Moran Scatter Plot (Anselin 1995, 1996)[20] indicates an slightly positive slope for regression line of the Univariate Moran Scatter Plot of spatial lagged population density in function of population density (Figure 2).

A spatial lag is a variable that essentially averages the neighboring values of a location (the value of each neighboring location is multiplied by the spatial weight and then the products are summed). It can be used to compare the neighboring values with those of the location itself. Which locations are defined as neighbors in this process is specified through a row-standardized spatial weights matrix in GeoDa. By convention, the location at the center of its neighbors is not included in the definition of neighbors and is therefore set to zero.

Spatial lags are used in the computation of global and local Moran's I, as well as in spatial lag (Wy) and spatial error models (We). They can also be computed as separate variables (e.g., WX) in GeoDa.[21]

Global Moran's I[22] is defined as:

$$I = \frac{N}{\sum_i \sum_j w_{ij}} \frac{\sum_i \sum_j w_{ij} (X_i - \bar{X})(X_j - \bar{X})}{\sum_i (X_i - \bar{X})^2} \qquad (2)$$

where N is the number of spatial units indexed by i and j;
X is the variable of interest;
$\bar{X}$ is the mean of X;
w_{ij} is an element of a matrix of spatial weights.

The expected value of Moran's I under the null hypothesis of no spatial autocorrelation is:

$$E(I) = \frac{-1}{N-1}$$

[20] Luc Anselin, GeoDa™ 0.9 User's Guide, Spatial Analysis Laboratory, Department of Agricultural and Consumer Economics University of Illinois, Urbana-Champaign, Urbana, IL 61801, http://sal.agecon.uiuc.edu/ and Center for Spatially Integrated Social Science http://www.csiss.org/, Revised, June 15, 2003, Copyright © 2003 Luc Anselin, All Rights Reserved
[21] https://geodacenter.asu.edu/node/390#lag
[22] http://en.wikipedia.org/wiki/Moran's_I

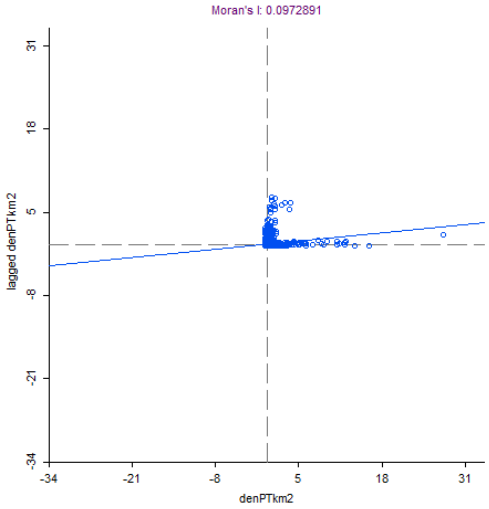


Figure 2. The global Moran's I for population density
Data Source: 2002 ESRI Census INS data, calculated by authors in GeoDa Software

Inference of the model

Observed Moran's I = 0.0973 shown as yellow bar in fig 3 is higher than its theoretical mean E(I)=-0.0003 indicating an significant statistical correlation (at p=0.001). The mean of sampling distribution is 0.003 and the Standard Deviation of Sampling Distribution (standard Error) is 0.0111 (Figure 3).

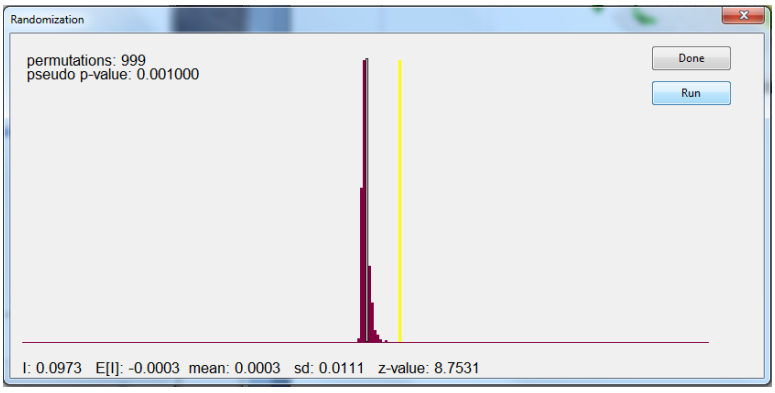


Figure 3. Randomisation simulation for Global Moran I's, calculated by authors in GeoDa software

Because the z - score is 8.7531 SD[23] >2.58 SD for pseudo significance coeficient p=0.001, we reject the null hypothesis[24] and the pattern exhibited is very likely to be the result of significant clustering pattern (while the Moran Index value is positive) at significance level of p=0.01, Randomisation 999 permutations.

[23] SD = Standard Deviations
[24] The Global Moran's I tool calculates a z-score and p-value to indicate whether or not you can reject the null hypothesis. In this case, the null hypothesis states that feature values are randomly distributed across the study area.
http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/Spatial_Autocorrelation_Global_Moran_s_I/005p0000000n000000/

Spatial Clusters identified using Univariate LISA in GeoDa (Anselin) software

The high-high and low-low locations (positive local spatial autocorrelation) are typically referred to as spatial clusters, while the high-low and low-high locations (negative local spatial autocorrelation) are termed spatial outliers.[25] (Figure 4 and Figure 5).

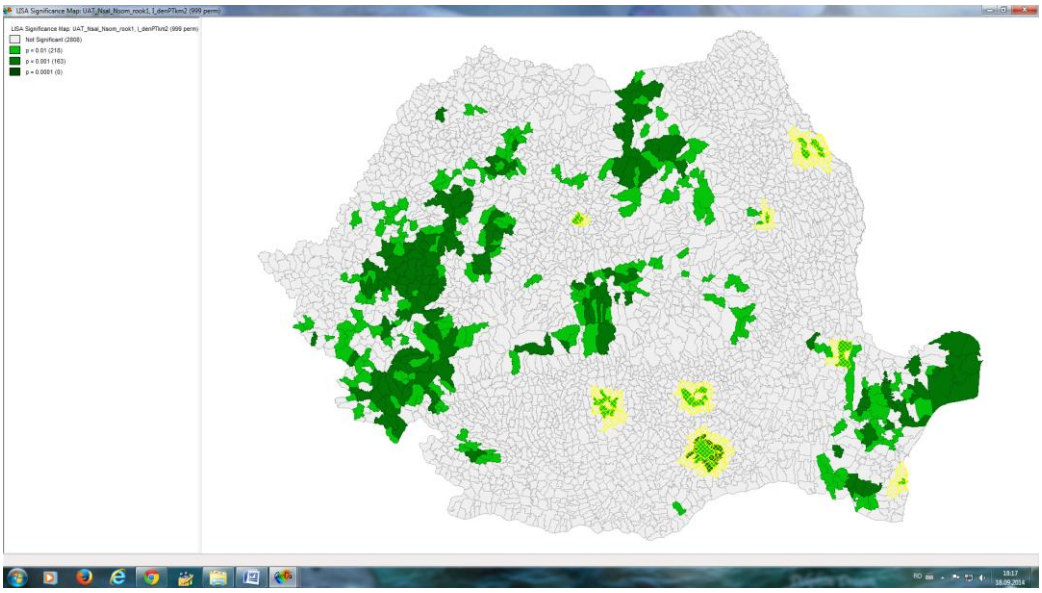
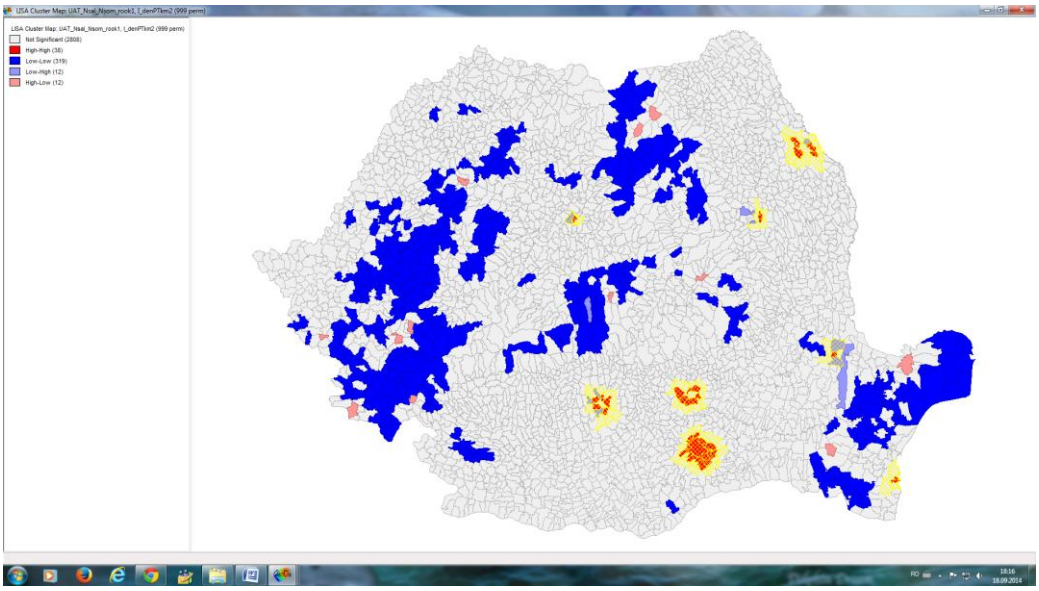


Figure 4. LISA significance map - with yellow hallow the HH positive auto correlated locations.
Data Source: 2002 ESRI Census INS data, calculated by authors in GeoDa Software



p = 0.01, Randomisation = 999 permutation

Figure 5. LISA cluster map - illustration of significant locations by type of spatial correlation – with yellow hallow the HH positive auto correlated locations.
Data Source: 2002 ESRI Census INS data, calculated by authors in GeoDa Software

[25] "It should be kept in mind that the so-called spatial clusters shown on the LISA cluster map only refer to the core of the cluster. The cluster is classified as such when the value at a location (either high or low) is more similar to its neighbours (as summarized by the weighted average of the neighbouring values, the spatial lag) than would be the case under spatial randomness. Any location for which this is the case is labelled on the cluster map. However, the cluster itself likely extends to the neighbours of this location as well." Exercise 15 Contiguity-Based Spatial Weights http://www.uam.es/personal_pdi/economicas/coro/courses/Geoespacial/SesionPractica3_AEDE_avanzado.pdf

In Figure 6 we present an detail from Figure 5 for the cluster identified around the Ploiesti city as a periurban area:

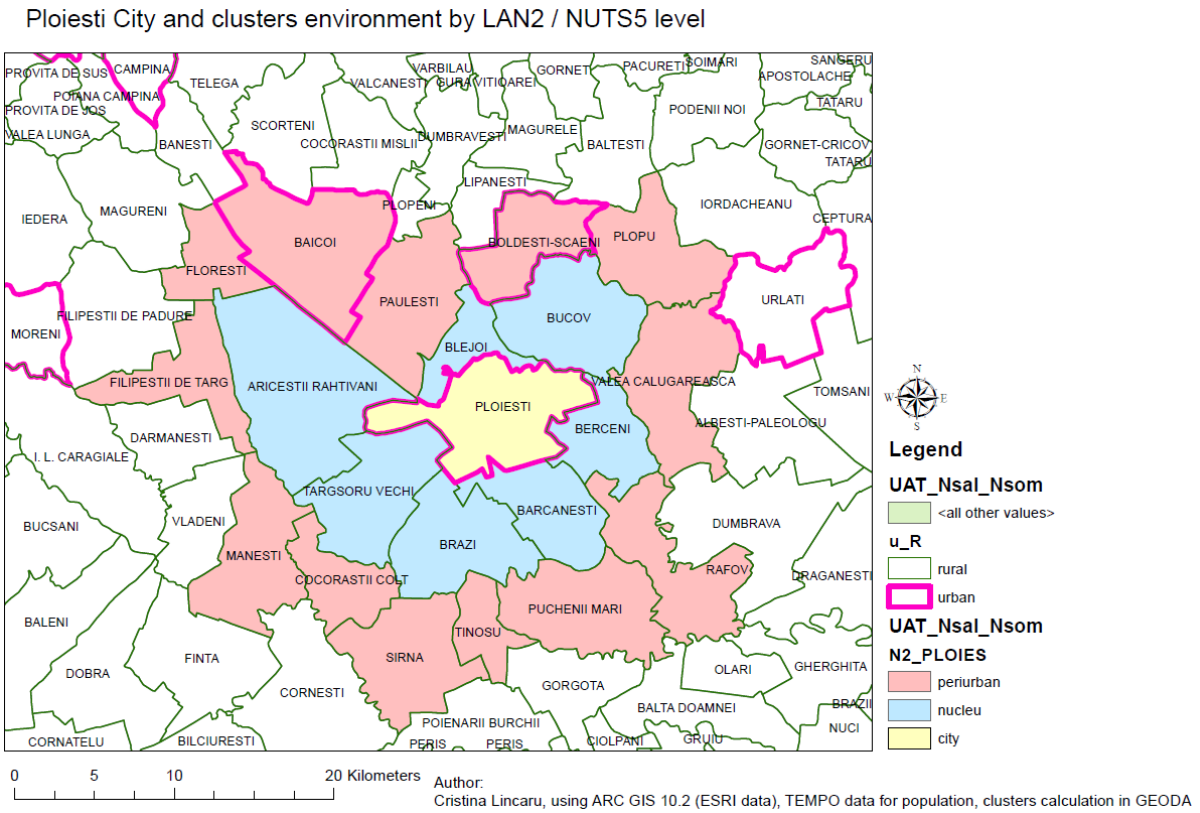


Figure 6. Ploiesti city and LAU2 nucleus periurban area.

In Table 3 we present the details from Figure 5 regarding the main clusters identified as significant. Next to condition of positive spatial autocorrelation condition for the LAU 2 with communes status we apply the final filter of minimum density 150/km^2 for urban areas (OECD criteria). Based on this model we could predict that the LAU 2 communes *(validated status in 2014)* with yellow mark form this table are periurban areas reflecting both the spatial, administrative and dynamic criteria. In other words these locations should change its status from rural to urban area de facto with the perspective of changing their administrative status to urban area in short term.

Table 3. The total population density in selected significant High – High agglomerations at LAU 2 level with an significance level $p \leq 0.01$ for 999 permutations, by type of administrative unit (commune rural area and town urban area) in 2002:

judet	LAU2 type	LAU 2 name	total population density / km2
ARGES	Comuna	BRADU	206,43
		MARACINENI	257,55
	Oras	STEFANESTI	244,03
BACAU	Comuna	MAGURA	170,98
		LETEA VECHE	140,25
		LUIZI-CALUGARA	111,93
BRAILA	Comuna	CAZASU	105,27
CONSTANTA	Oras	LUMINA	212,36
		OVIDIU	174,38
DOLJ	Comuna	ISALNITA	112,42
		PODARI	104,44
IASI	Comuna	TOMESTI	301,63
		CIUREA	242,85
		HOLBOCA	228,93
		POPRICANI	104,68
*BUCURESTI**	*Municipiu*	*BUCURESTI*	*7806*
ILFOV	Comuna	CHIAJNA	879,18
		DOBROESTI	852,19
		JILAVA	453,53
		MOGOSOAIA	310,37
		GLINA	305,5
		CERNICA	249,34
		DOMNESTI	229,08
		BERCENI	217,14
		VIDRA	143,57
		AFUMATI	129,53
	Oras	BRAGADIRU	731,18
		CHITILA	1097,36
		MAGURELE	252,62
		OTOPENI	421,1
		PANTELIMON	376,49
		POPESTI LEORDENI	415,08
		VOLUNTARI	1079,51
MURES	Comuna	LIVEZENI	127,22
		SANCRAIU DE MURES	306,83
PRAHOVA	Comuna	BARCANESTI	263,1
		BERCENI	212,91
		BRAZI	173,95
		BUCOV	206,02
		TARGSORU VECHI	190,91
VRANCEA	Comuna	GOLESTI	314,59

Data source: ESRI data, based on 2002 Census, INS Romania, calculated by authors
Note: *, for Bucharest p=0.02

7. Results and discussion

This first version of our model is still simple, ignoring of multivariate associations, variability related to scale mismatch, and other spatial heterogeneity. There is space to improve the statistical analysis, objective of the following stages o research activity in DYNAHU project (2015-2016). This model offers some insights regarding the rapidly urbanizing landscapes characterisation (Table 4) using a periurban area definition that links: the lowest administrative unit LAU2, with main socio economic characteristic rural / urban area in a dynamic perspective.

Table 4. Some insights that emphasis the dynamic interaction between the natural and human components based on the synergy of ecological and socio-economic factors in the rapidly urbanizing landscapes [mean values]

	Total population density /km2	Salaried number density /km2 in 2002 [*]	Salaried number density /km2]n 2012 [*]	Registered unemployed persons/km2 2012 [*]	Ratio of salaried persons at 1 unemployed person
Comuna / Commune	63,2	5,6	5,6	2,0	3
Comuna HH (p 0,01)	255,1	32,1	54,6	2,6	21
ratio by UAT type HH	*4,0*	*5,8*	*9,7*	*1,3*	*7,5*
Municipiu / Municipality	587,8	215,4	179,8	12,7	14
Oras / Town	160,2	43,9	37,7	3,6	11
Oras HH (p 0,01)	500,4	107,0	176,8	3,0	60
ratio by UAT type HH	*3,1*	*2,4*	*4,7*	*0,8*	*5,7*
Resedinţa de judeţ / county residence	1513,0	617,2	579,7	22,5	26
Total national	98,2	19,9	18,4	2,6	7
Total HH (p 0,01)	316,4	50,9	85,1	2,7	32
ratio by UAT type HH	*3,2*	*2,6*	*4,6*	*1,0*	*4,4*

Data sources:

[*] Census 2002 data, ESRI & INS
[**] TEMPO INS data base
HH positive spatial autocorrelation LAU2 with pseudo significance level of p=0.01, Randomisation 999 permutations

Based on the result of our model we can provide a short profile of the mean characteristics of periurban areas in comparison with national means as follows, by LAU 2 type level:

a. For commune:

In 2002 the population density in periuban areas is 4 time higher than in national level. Using the LAU 2 structure at 2002 (ARC GIS map provided by ESRI) the salaried person density in

periurban areas is 5.8 times higher than national mean for the same category in 2002, increasing at 9.7 times in 2012. (without actualising the administrative status of LAU 2 communes). On the same methodological background the registered unemployed person in periurban area were 1.3 higher than the national level for communes, while the ratio of salaried persone t 1 registered unemployed person was 7.5 times higher in periurbna area than in rural area.

b. For towns (in the hypothesis of polycentric towns development, it is not our subject, could be treated if we use the PLURIEL project's recommend typology of 4 classes)

8. Conclusion

The model proposed is build with the LAU2 with status of rural areas – communes are labelled as periurban area if these locations are local positive spatial autocorrelated and has a density of population over 150 person /km2 (over the OECD rural commune's threshold).

On the background of increasing access to LAU2 data (provided by TEMPO INS for a large typology of indicators – population, demography, mobility, economy, education, etc) our model is a useful step toward multicriterial analysis. We consider that the interaction of population expressed by the *density of population mixed with distance to urban areas expressed by the neighbourhood described by contiguity relationship* could provide the instrument to offer some insights that emphasis the dynamic interaction between the natural and human components based on the synergy of ecological and socio-economic factors in the rapidly urbanizing landscapes accessible for the decision makers and with low costs for indicators.

9. Acknowledgements

This work was supported by a grant of the Romanian National Authority for Scientific Research, CNDI– UEFISCDI, project number PN-II-PT-PCCA-2011-3.2-0084.

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