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MAPPING SERBIA: MORE TARGETED RURAL AREAS FOR BETTER POLICIES

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Paper prepared for presentation at the 118th seminar of the EAAE (European Association of Agricultural Economists), 'Rural development: governance, policy design and delivery' Ljubljana, Slovenia, August 25-27, 2010

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ABSTRACT

The analysis of the experiences of Central and Eastern European Countries (CEEs) in transition, which became EU members in the historical 2004 (and 2007) enlargement, evidences the importance of timing and targeting policy intervention for a balanced growth (Monasterolo et. al, 2008). In fact, even if the Countries, till the last financial and economic crisis, showed a clear path of convergence (EC, 2008; EC, 2009) with EU average levels of development thanks to a sustained growth in GDP, at the same time they had to face a notable increase in regional inequality (Lackerbauer, 2004; Brasili, 2005), mainly driven by the persisting backwardness of agricultural and rural areas. The European pre-accession funds had limited effect in preventing the spread in internal divergence because of the lack of *ex ante* and *in itinere* monitoring and evaluation (Monasterolo, 2008). Moreover, they failed in addressing specific problems and needs of so variegated areas due to the deficiencies in identifying and defining the characteristics of rural areas[3] (Csáki, 2009).
This paper will introduce a new mapping of Serbia, a current EU pre-accession Country, where a clear identification of rural areas is lacking (Bogdanov, 2007). We identified the dynamic characteristics of urban and rural areas as well as their strengths and weaknesses, computing a principal components analysis on a group of 37 socio-economic and structural variables, which are available periodically at a municipality level, and then delineating homogeneous regions through cluster analysis.

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[3] Within the European Union, rural areas are classified following OECD methodology based on population density. Therefore, a severe loss of information happens.

This disaggregated mapping at the local level represents the fundamental starting point for developing integrated and diversified rural policies, enriched by a bottom up approach, following a neo-endogenous vision (Hubbard, 2009).

Keywords: mapping rural areas, policy targeting, RD policy evaluation, EU enlargement

Reference: O18, P25, R58

I. Introduction

The European Union is going to launch the new budget for the next programming period 2013-2020, facing cuts in expenditure and the need for a redefinition of interventions in the 27 member States, also as a consequence of the recent impressive economic and financial crisis. An important object of the reform will be again the Common Agricultural Policy (CAP), which accounts for more than 40% of the EU's budget (representing its second voice[4]) and is divided in two *pillars*, where pillar I currently embraces the Single Farm Payment (replacing the individual payment schemes) and pillar II refers to Rural Development[5]. Given the relevance of the challenges of defining the CAP of the future, the new EU Agriculture Commissioner Dacian Cioloş launched a public debate on it, involving the general public, stakeholder organisations and think-tanks[6].

At the same time, the EU left its doors open for a possible future enlargement to Western Balkans[7] which would involve a further redistribution of the EU budget from the current EU-27 members to the new ones. The need for the definition of new support lines could be followed by the complaints and hostilities of the main current CAP beneficiaries, as already happened in the last – historical – 2004 and 2007 EU Eastern enlargements, when ten Countries from Central and Eastern Europe set their 'return to Europe' after years of soviet influence. As emerged from the first analysis on the effects of the funds allocated to the programmes and instruments for the convergence of the new member States (Monasterolo, 2008), the expected results didn't take place due to an inefficient use of the resources employed, and to the lack of planning and programming abilities of the interventions at the regional and national level. This is especially true for the agricultural and rural areas where the CAP introduction was, in the best cases, irrelevant for convergence (Bonfiglio et al., 2006), and in general for the programmes directed to the most disadvantaged zones. This outcome was heavily influenced by the unclear mapping of the areas according to their peculiar socio-economic-geographic features, and by the consequent insufficient policy targeting.

The experience of Emilia Romagna, one of the most advanced EU regions in planning regional policies for the convergence, together with the interventions for rural development, evidenced the importance of mapping the territory for drafting better policies which aim at addressing the needs of rural areas, moving from the OECD methodology (currently adopted also by the EU) [8]. New ways of classification, more focused on the regional and local reality, can contribute to increase the effectiveness of policy interventions, to decrease the resources dispersion (economic, physical, human) and to reach an efficiency result in the medium-long term.

Mapping regions and targeting measures is very relevant for all the EU rural areas, in which the highest level of poverty is still located, specially in the ones still highly or totally dependent on agriculture, which drive the process of internal divergence within the EU (Monasterolo, 2008). In particular, this was the case of rural areas in the new member States belonging to the Central and Eastern Europe (CEE), where the real losers of the process of the unfinished transition find place. This last point is true also for Serbia, which has just applied for the EU membership, presenting a current level of development much lower (calculated in GDP/capita)[9] in comparison with the EU

[4] For decades, the CAP maintained the primacy in the budget expenditures, being replaced just in the last programming period by the Cohesion Policy.

[5] Fanfani (1996)

[6] http://ec.europa.eu/agriculture/cap-debate

[7] Albania, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Montenegro and Serbia, as well as Kosovo under UNSC Resolution 1244/99.

[8] The OECD methodology identifies rural areas according to the population density. Therefore, it is considered rural every community (NUTS V level) with a population density lower than 150 inhabitans/km². Based on this, the OECD has further developed a typology of rural areas (at NUTS III or NUTS II level), which classifies rural regions as Predominantly Rural (PR), Intermediate (IR) and Predominantly Urban (PU).

[9] The Serbian GDP/capita in 2007 was circa 4 000 Euro, while the EU-27 average was 24 900. Source: Eurostat

average and where rural regions make up 85% of territory, host 55% of national population and generate 41% of national GDP[10]. Then, great importance on the national economy is played by agriculture, which employ quite 40% of the rural work force[11] and which has an historical position in the production and marketing of agricultural and agri-food products in ex-Yugoslavia[12]. Moreover, the Country so far has no official mapping of rural areas, because the classification system of rural and urban municipalities changed during the last Census (2002). Currently, municipalities which are not explicitly labelled as urban are automatically identified as 'other' without a clear statistical reference base, seriously damaging the results of policies aimed at addressing specific problems in specific areas. The only existing classification of rural areas (Bogdanov et al., 2007), identifies six regions in Serbia using cluster analysis on 41 variables, and compares the results with the mapping of rural areas made according to the OECD methodology.
Being Serbia on its way to the EU candidacy – which means the possibility to obtain IPA funds for regional and rural development programmes – getting a mapping of the territory becomes a priority in order to establish interventions focused on the specific socio-economic area needs, avoiding the backlashes of the last enlargement. Therefore, in this paper we provide two mappings of the Serbian territory using methodologies belonging to the multivariate statistics: the principal components analysis (PCA), and the cluster analysis (CA). Moving from the contributions of Bogdanov for Serbia (2007), and Brasili et al. for Italy and China[13] (2007), we computed the principal components on 37 variables, chosen according to their relevance in explaining the Country's dynamic characteristics, and coherently with the Agenda 2000 indications for analyzing rural areas.
We repeated the operation twice:
-at first we mapped out the whole Serbia (using 158 municipalities) in 7 clusters, which highlight the main structural features of the different areas of the Country;
-the second cluster analysis was made on the 129 rural municipalities, grouped into 5 clusters able to highlight the specific socio-economic, topographic and demographic features which affect the development trend of rural areas.
This methodology, belonging to the group of the explorative techniques, allow us not to make strong assumptions on the model (and to deal with not optimal quality of data and indicators) and was already used in the literature for this kind of analysis with good results (Fanfani et al., 1999). The relevance and representativeness of indicators for understanding rural areas has been inquired by the literature[14], and it appears to be fundamental also for shaping targeted local policies.

II. Insights on Serbian agriculture and rural areas in transition

Rural areas in Serbia show very different features according to the topography and the agro-climatic conditions; the natural resources; the (lack of) infrastructures; the level of development of extra agricultural activities; the demographic characteristics of the municipalities and villages; the traditional and cultural forms of farming; the access to the market; the employment opportunities[15]. All these elements impact on the level of development and quality of life reached by the different regions, to which also the events of the last twenty decades (the breaking up of Yugoslavia, the war period and the recent division from Montenegro), and the consequent and still ongoing transition phase[16] heavily contributed. It is worth to remember that nowadays in Serbia the majority of the population still lives in rural areas, which covers 85% of the whole territory and produce quite 40% of the national GDP[17]. Regions composed mainly by rural areas show negative economic indicators – starting with a much lower GDP/capita in comparison with the national average (-25%) – reflecting the different labour productivity and economic structure. Then, rural areas have been seriously threatened by the migration trends which characterized the Country before the wars, with the expanding industrial activities in the main cities which attracted young and skilled people from the countryside, and in the after war period,

[10] according to the OECD methodology.
[11] Municipalities Yearbook of Serbia 2008.
[12] Bogdanov et al., 2006.
[13] Bogdanov et al., 2006, 2007. Brasili et al., 2007
[14] OECD,1996. Brasili et al., 2007
[15] Bogdanov et al., 2006
[16] Transition in WB assumes a quite different meaning from the CEEs' one, mainly addressing the after war period, which differs according to the specific WB Countries.
[17] Bogdanov, 2008

when fluxes of refugees from the former Yugoslavia arrived[18]. In general, Serbian rural areas are characterised by depopulation, poor equipping in terms of infrastructure and facilities, as well as by a modest, insufficiently developed economic structure, with poor sources of diversification. In fact, extra agricultural income is not generated in the rural area while still 45% of active rural population in Serbia works in agriculture (which provides a very low income)[19].
At the same time, good perspectives arise from 3 structural and historical factors linked to agriculture:
-the range and vitality of natural resources;
-the private ownership of land;
-the experience in business cooperation (cooperatives and agrikombinat)[20].
All these features are present at different levels in the different rural areas, but a clear classification of Serbian regions according to their level of rurality is still missing, due to the lack of clear and comparable statistical rural development indicators, reflecting the scarce availability and accountability of official data describing agricultural and rural areas. Consequently, this problem impacts negatively on the phase of policy making, which is still lagging behind in Serbia.

It is possible to identify three topographic macro-rural areas according to their specific topography, economic features and demographic indicators[21]:
- the lowland region, which comprises the Vojvodina Province[22] and the northern part of Central Serbia (Macva region), representing 28 % of the total land area of the Country and 26 % of the total population. Food production is very important for the economy of the area and it is strongly market-oriented (thanks to the presence of socially-owned agro-processors) and it accounts for most of the national marketed surplus of grains, oilseed, sugar beet, pigs and poultry. Vojvodina is characterized by the presence of large farms (also farmers' cooperatives and other forms of association exist) and food-industries (the most of the Serbian agro-processing capacity for these commodities);
- the hilly and highland region, or the territory of central Serbian uplands, including the valleys of larger rivers in southern Serbia, Kosovo and Methodija, where food production represents the main segment of the rural economy thanks to the good potential of the arable land, fertile soils and favourable climatic conditions. The production is dominated by livestock (cattle breeding), fruit growing (90% of berry fruits, which are a Serbian major export commodity, comes from here) and wine growing, while field crop growing is mostly for fodder. Farms are small or medium size, they don't take part in cooperation forms and part-time farming is extremely common;
- the mountain region, comprising the mountainous land of eastern Serbia, southern Serbia, Kosovo and Methodija, western and south-western Serbia. This area is very depopulated due to the soil conditions, which make livestock breeding (mostly extensive and rarely semi-intensive) the prevalent activity. In fact, the limited arable land and grassland, except for the high mountain pastures, was created by clearing forests. There is also scarcity of public services and infrastructures, and rural communities tend to be located around pockets of arable land, and are small and highly dispersed. A possible source of income diversification is offered by the perimeter of mountains, national parks, historical sites and national monuments that rings southern Serbia, which represents a good opportunity for agro and eco-tourism.

It is interesting to note that, apart from the most agricultural developed Vojvodina region, the other rural areas share the prevalence of small rural households in the productive structure, which we can therefore consider as a generalization of agricultural households, presenting similar features (lack of endorsement; land considered mostly as a source of food security; same - lower - education level). The conditions of rural households constitutes an important topic for the development of the Country being at high risk of vulnerability, which is recognized to be the first step toward poverty in Serbia[23], and should therefore be addressed with specific policies, regarding the labour market and the sources of employment in particular[24].

[18] It has been calculated that 44% of Yugloslavians changed residency place in the '90s.
[19] Bogdanov, 2008
[20] Bogdanov, 2007
[21] Bogdanov, 2007
[22] Vojvodina is an autonomous province in northern Serbia.
[23] Bogdanov, 2007
[24] The presence of hidden unemployment among the rural farms family members is much common.

II.1 In search for a policy for rural areas.

Rural areas have always been considered as a secondary problem in the Socialist Federal Republic of Yugoslavia (SFRY)**,** while there was instead a long tradition in regional development because of the notable differences existing among the ex Yugoslavian countries. Therefore, a policy assessing the specific needs for development of rural areas in Serbia has still to come. The provisions enacted so far lacked a common reference framework and development model; they were strictly sector-based, characterized by polarized interventions and with a low financial endowment, resulting ineffective and even promoting regional inequality. The most of resources devoted to rural areas was allocated within the agricultural budget, mainly through quite innovative funds directed to less favoured areas (grants for income diversification sources as rural tourism; to address environmental measures and aging population) but presenting a clear allocation problem. In fact, even the disbursements for the most in need areas were not targeted to address the pours, but they were mainly *una tantum* interventions[25]. Since 2003, public policy documents started to refer to rural areas but specifically addressing the poverty and minority discrimination issue[26], and just in 2005, within the Strategy for Development of Agriculture, there was the introduction of a rural development policy which considered territorial specificities, following the EU classification model for the less favoured areas. Then, a specific section within the Ministry of Agriculture was created, but lacking of institutional coordination, managerial abilities and a clear definition of competencies. In 2006, the strategy for the touristic development in Serbia indicated rural tourism as a medium long term objective of development, able to generate income for rural areas and to decrease urban-rural inequalities. Finally, the strategy for regional development 2007-2012, which was the first document to introduce the priorities and instruments for regional development, dealt with the specific problems of rural areas without assessing clear strategies for increasing their latent potential. In particular, it fails to address the most relevant problem emerged from the analysis of rural areas: the underdeveloped labour market.

It is clear that in the next future Serbia needs a development policy targeted on the specific needs of rural areas, and decentralized institutions, at the local level, which could contribute to an increase in coordination and to a better policy implementation.

III. Mapping rural areas in Serbia: application of the PCA and cluster analysis

Being our objective the classification of the Serbian areas according to their characteristics of rurality, our analysis follows a two stages path. At first, we map out the whole Country in order to get a clearer picture of the specific features of Serbian regions. Then, we repeat the operation on the rural municipalities, in order to find out the characteristics and differences among rural areas.

III.1 Methodology

We apply the methodology, belonging to multivariate statistics, of principal components analysis (PCA), which help us to reduce the number of variables of a system preserving the most of the information (represented by the variance). The most famous formulation of PCA is due to Hotelling, while the methodology refers to Pearson[27]. With PCA, we can transform a group of p indicators, obtained on a group of n statistical units, into a much smaller group of variables which are still able to explain a high level of variability present in the original data, therefore avoiding an important loss of information[28]. While the original indicators we use are highly correlated, the variables we get (principal components), which are a linear combination of the original indicators, are uncorrelated. It is possible to compute the components both on the covariance and on the correlation matrix: we have chosen the latter in order to avoid the distorting influence of the indicators with higher variance during

[25] It is interesting to notice that already in the Yugoslav period the beneficiaries of the interventions co-financed the programmes.

[26] The Poverty Reduction Strategy Paper Serbia 2003 focuses on the causes and consequences of poverty, with particular attention to the rural poverty, which is recorded to be much worse than the urban one because of a total lack on income security during the transition period.

[27] Hotelling, 1933; Pearson, 1901

[28] Mazzocchi, 2008

The proportion of original variability explained depends on the method used in choosing the number of principal components. We considered here principal components presenting Eigenvalue over or equal to 1, following the Guttman-Kaiser criterion. They are able to explain more than 70% of the variability contained in the original data.

the extraction[29]. Having obtained the values of the components from the correlation matrix, we calculate the scores of every statistical unit (municipality) for every component.
The *k* principal component (*k*<*p*) comes from the following linear combinations, expressed as a matrix:
Y= XA, where
- Y is the *n*x*k* matrix, containing the scores of the *n* statistical units in the *k* components
- A is the vector matrix *p*x*k* of the normalized coefficients
- X is the *n*x*p* matrix of the standardized data.
The scores of the Y matrix are utilized for the cluster analysis[30], which we use to get regions almost heterogeneous between themselves, and homogeneous within themselves.
This approach allows us to identify areas which show similar structural problems and to describe their peculiarities. The data are processed with statistical software (SPSS).

III. 2 Application of the PCA and cluster analysis to the whole territory of Serbia[31]
The sample is composed by the 161 municipalities from which we excluded: the municipality of Paračin (belonging to the Pomoravlje district) because it showed an extreme value in one of the variables considered (unemployment level), altering the results of the analysis; Surčin (district of Belgrade), because it missed too many values; Majdanpek, belonging to the Bor district, because it generated an own cluster due to the way the weight of each sector of the economy (national income) was calculated by the statistical office of Serbia.
The variables: we worked on a data set of 37 variables. The identification of the variables is a critical point for the analysis, because every area shows particular structural and developmental features. Therefore, what we needed was a list of variables able to catch the dynamics of evolving areas characterized by clear structural and socio-demographic differences. We have chosen the ones which are explicative of the characteristics of the development level of the Country, after an in depth analysis and accounting for data quality and availability[32]. We also considered the criteria proposed in the regulations of Agenda 2000 for the analysis of rural areas[33]. Finally we referred to some examples provided by the literature (Bogdanov et al, 2007; Brasili et al., 2007; Fanfani et al., 1999).
For a better understanding of the results obtained, the variables were listed in four groups[34]:
1. economic and productive structure: they present an image of the economic and productive system of the area, with a particular attention to the employment structure;
2. structural indicators for agriculture, which consider the productive features of the sector;
3. socio-demographic structure, to monitor the evolution of the population in its age structure, cultural aspects and accessibility;
4. economic dynamism: indicators reflecting the dynamism of the productive system, which allow us to analyze the fluxes of the structural components of the agricultural sector and the employment structure within the national macroeconomic framework.
There are different methods used to establish the number of principal components to choose: following the Guttman-Kaiser criterion, we considered the principal components able to explain the 70-80% of cumulative variance. In this case, we should take 8 components, which represent 80.5 % of the original variability.

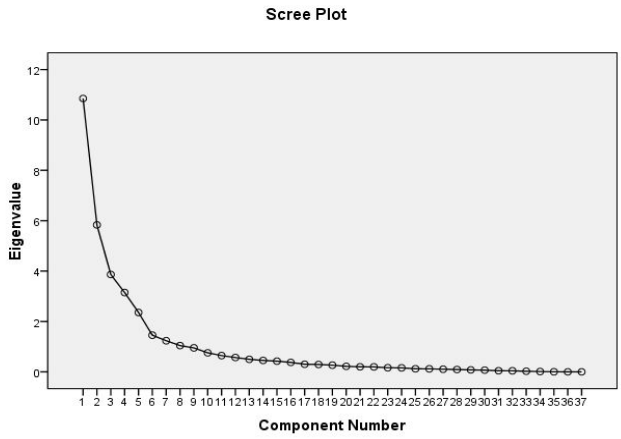
[29] The correlation matrix is used when the original variables we have to deal with have different measurement units. Therefore, a 'standardization' of the original indicators takes place.
[30] Some software, as SPSS (used here), automatically provide standardized values, which are used in the cluster analysis. Then, all the components are supposed to share the same variance equal to 1, and therefore the same weight in the mapping, carrying possible distortive effects.
[31] From the analysis we excluded Kosovo and Methodija due to the lack of comparable data. In this way, the territory of Serbia features 161 municipalities belonging to 24 administrative districts, including the autonomous region of Vojvodina.
[32] We used secondary data provided by the Census 2002 and by the Municipality yearbook 2008, according to the value needed.
[33] The criteria used for the ex Objective 2 refer to: population density, the level of employment in agriculture, the average rate of unemployment, the demographic dynamics. Fanfani et al., 1999
[34] Brasili et al., 2007

Tab. 1 Total variance explained

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	10,850	29,325	29,325
2	5,833	15,764	45,089
3	3,864	10,444	55,533
4	3,151	8,516	64,049
5	2,357	6,370	70,419
6	1,455	3,933	74,352
7	1,237	3,342	77,694
8	1,044	2,822	80,516

Being the 7th and 8th are very contiguous, we preferred not to consider them, in order to easier the interpretation phase. We selected the first 6 principal components, explaining quite 75% of the original variance; this choice was confirmed by the scree plot provided using the Kaiser's method.

Fig. 1 Scatter plot



Tab. 2 Principal components scores[35]

	C1	C2	C3	C4	C5	C6
Density	0,122	0,002	0,041	0,171	0,018	-0,042
Population change (91-02)	0,120	-0,138	-0,219	-0,089	-0,041	0,037
Aging index	-0,039	0,042	0,473	0,071	-0,029	0,027
GDP/capita	0,183	-0,054	-0,018	0,198	0,022	0,034
GDP Serbia = 100%	0,106	-0,069	0,005	0,481	0,035	0,065
% employment primary	-0,241	-0,017	0,041	-0,057	0,108	-0,229
% employment secondary	0,062	0,056	-0,022	-0,040	-0,123	0,305
% employment tertiary	0,278	-0,053	-0,045	0,081	-0,025	0,068
Unemployment rate	0,021	0,007	-0,113	-0,043	-0,089	0,078
% illiteracy	-0,247	0,064	0,206	-0,097	0,001	-0,142
% primary	-0,183	0,022	-0,139	-0,125	0,061	-0,005
% secondary	0,233	-0,108	-0,153	0,014	-0,024	0,147
% college	0,230	-0,006	-0,015	0,248	0,016	0,022
roads length (km)	-0,016	0,194	-0,078	0,000	0,033	0,000

[35] The principal components are orthogonally rotated (maintaining uncorrelation of the factors) with VARIMAX because the first interpretation of factor loadings was not straightforward.

high roads (km)	0,028	0,053	-0,005	0,015	0,021	0,068
% of agricultural land	-0,040	-0,320	-0,048	0,030	0,015	-0,079
Land productivity	0,095	-0,082	-0,020	0,006	-0,029	-0,058
% farms without income from agriculture	-0,141	0,018	0,024	-0,080	0,062	-0,119
employment rate	0,128	0,026	0,042	0,491	-0,001	0,012
less than 1 ha	0,193	-0,119	-0,084	0,143	-0,112	0,092
1 - 3 ha	-0,026	0,021	0,060	-0,072	-0,591	0,064
3-10 ha	-0,162	0,080	0,071	-0,091	0,239	-0,113
over 10 ha	-0,072	0,088	-0,041	-0,051	0,549	-0,053
Number beds /1000 pers.	0,022	0,104	0,019	0,026	0,037	-0,031
index generational change	-0,048	0,021	0,470	-0,025	-0,064	-0,055
dependency ratio	-0,164	0,065	0,340	-0,021	-0,060	-0,146
% cereals	0,015	-0,387	-0,058	0,023	-0,010	-0,016
% industrial crops	-0,005	-0,144	-0,059	0,020	0,120	0,004
% pastures	-0,024	0,364	-0,017	-0,012	0,050	0,012
% meadows	-0,023	0,357	0,090	0,002	0,073	0,094
Topography	-0,045	0,374	0,013	-0,017	-0,022	-0,008
Cattle*100 ha agric. area	-0,021	0,037	-0,041	0,001	-0,048	-0,035
Pigs*100 ha agric. area	-0,016	-0,202	-0,035	0,006	-0,094	-0,066
Ewes*100 ha agric. area	-0,052	0,122	-0,021	0,015	0,062	-0,028
% primary sector in ND*	-0,215	-0,077	0,047	-0,082	0,023	-0,502
% secondary sector in ND	0,075	0,036	-0,034	0,021	-0,069	0,762
% tertiary sector in ND	0,254	0,079	-0,035	0,106	0,046	-0,124

* Due to the data accountability, the weight of each sector of the economy is calculated on the national income. Therefore, it can be negative.

Below we provide the interpretation of the six principal components:
C.1 - component of economic development (29%). It identifies areas characterized by a high level of GDP/capita, higher education, employment in tertiary sector and the weight of the tertiary sector on national income. This interpretation is confirmed by the negative values, which are associated to the dependency ratio, employment in the primary sector, illiteracy and weight of the primary sector on the national income.
C.2 – component of agricultural activity (16%), where positive values show the relevance of agricultural land used for meadows and pastures, the importance of topography for the economic activity, infrastructures and touristic accommodation. Coherently, negative values are shown for land used for agriculture, for the percentage of agricultural land used for cereals and industrial crops, and for pigs breeding.
C.3 - component of demographic structure (11%). Positive values are recorded for the indicators of population aging; the dependency ratio; the index of generational change; illiteracy and the percentage of employment in the primary sector (even if weak).
C.4 – component of employment and life quality (9%). This component has positive values associated to the employment rate; GDP in comparison with the Serbian average; higher education, the prevalence of tertiary sector on the national income; population density.
C.5 – component of farm structure (6%). Values are positive for farm size over 3 and over 10 hectares; percentage of agricultural land used for industrial crops; percentage of employment in the primary sector.
C.6 - component of productive structure (4%). Positive values are associated to the employment in the secondary sector, to the weight of the secondary sector on the national income, to an average education level. Negative values are recorded for the employment in the primary sector and for the weight of the tertiary sector on the national income.

The next step was the application of the cluster analysis on the 6 components, using a non hierarchical method of clustering, the *k-means algorithm*, where *k* stand for the number of clusters chosen to start

the process. With this method, all individual observations are assigned to the nearer cluster seed[36]. The choice for 7 clusters was compared with the results we got from the application of the *Ward's* (hierarchical) *method.*

Tab. 3 Final cluster centres

	Cluster						
	1	2	3	4	5	6	7
C.1	1,00	-1,66	-,54	6,62	7,40	-,35	-2,88
C.2	-1,80	1,98	3,65	,81	-,07	1,66	-,94
C.3	-,46	8,47	-1,28	,25	,29	2,09	-,27
C.4	-,21	,45	-,08	13,60	-1,05	-,55	,12
C.5	-,16	-1,72	,19	,13	-,09	1,80	-,34
C.6	,29	1,45	,30	-1,40	-,24	-,65	-,25

The **first cluster** is composed by 48 municipalities, mainly belonging to Vojvodina and therefore sharing the same characteristics of the lowland region, as it clearly emerges from the principal components scores and from the cluster values. In fact, there is a strong negative component 2, reflecting a prevalence of agricultural land on the total municipality area (quite 80%) and land used for cereals (60%), industrial crops, and also many heads of pigs for 100 hectares (107). This area is one of the most developed in the Country thanks to the favourable topography and to the quite good infrastructures, which allow for a good agricultural productivity and farmers' income (positive values for component 1). Moreover, positive values for component 6 highlight the relevance of the secondary sector both on the GDP and on the employment structure of the area. In fact, in Vojvodina (e.g. in Senta, Sombor, Zrenjanin) the main food processing industries of the Country are located.
4 municipalities belong to the **second cluster** - Gadžin Han, Svrljig, Babušnica and Crna Trava – which are identifiable as the most rural and backward areas. Here, the main socio-economic activities are linked to the topography of the area, where the hilly-mountainous territory affect the high percentage of land used for meadows and pastures (50% of the total), and the overall economic situation is very difficult, as shown by a negative value for component 1, with a much lower GDP in comparison with the Serbian average (53). As a consequence, it is no surprise the presence of aging population, low generational change and illiteracy (quite 50% of the population), reflecting the low attractiveness of the area.
Cluster 3 gathers 27 rural municipalities, mainly located in the mountainous areas at the western border with BiH, where the overall economic situation is not positive (neither 60 on the Serbian average). They are mainly characterized by the relevance of livestock breeding (land used for meadows and pastures account for 60% of the total), and by the importance of topography for the economic activity of the area. In fact, here are located some of the most beautiful naturalistic areas of Serbia such as Zlatibor, Tara and Mokra Gora, and therefore the principal components show the presence of infrastructure and touristic accommodation. It is also remarkable the role of the secondary sector on the national income (41%) and on the employment (35%), being heavy industries set in Ljubovija, Čačak and Užice.
Clusters 4 and 5 identify the urban areas. To the former one belong just the two central and richest districts of Belgrade, Stari Grad and Savski Venac, which host universities, political headquarters and services. Components 1 and 4 are positive, with a GDP well over the Serbian average (578), higher education (quite 80% of the population) and good employment rate. The latter cluster gathers 14 municipalities, mainly the other main Serbian towns as Novi Sad, Niš and, of course, the other inner Belgrade districts. They are characterized by positive overall economic conditions and by a negative demographic trend.

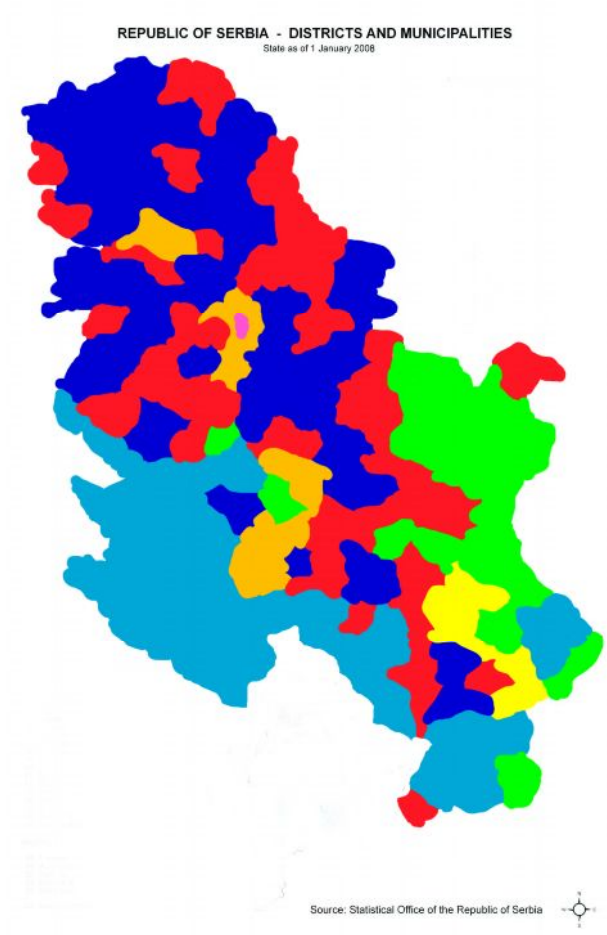
The rural and mountainous areas at the eastern border with Romania compose **cluster 6** (15 municipalities), where the economic activity is also heavily influenced by the topography, due to the presence of the Đerdap national park and the Danube gorges. The role of the primary sector is really

[36] The main obstacle in using k-means derivates from the need of the researcher to specify the number of clusters.

relevant, making up quite 50% of the overall sources of income; land is mainly used for meadows and pastures (quite 50%), occupation in the primary sector is high (41%). It is interesting to see that component 6 is negative, which coherently with our analysis shows the importance of the primary sector on the occupation but also the relevance of the tertiary sector on the national income, which should be intended as the presence of the public sector on the economy (due to the not easy development conditions of the area).
Finally, **cluster 7** identifies the remaining 48 municipalities which include the peripheries of the main towns and the worse off areas of Vojvodina, where a negative component 1 reflects a not positive overall situation of the areas.

Fig. 2 Map of Serbia featuring 7 clusters

Cluster 1: dark blue; cluster 2: yellow; cluster 3: light blue; cluster 4: violet; cluster 5: orange; cluster 6: green; cluster 7: red.



After having analyzed the resulting map of the whole Serbia, it is interesting to repeat the same process just on the 129 rural municipalities, using the same 37 variables and following the same methodology for the PCA and for the cluster analysis[37]. In this way, we can get a clearer picture of the main features of rurality in Serbia, and we can compare it with the national trend.
We could identify again 6 principal components, differing from the previous ones both in the values and in the interpretation.

[37] We assumed the OECD methodology for classifying rural areas. By the was, we compared the result with the results we got from clustering the whole Serbia: 'our' rural municipalities (as we consider mainly urban cluster 4 and 5) resemble the OECD ones.

Tab. 4 Total variance explained

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	10,256	27,719	27,719
2	7,172	19,383	47,102
3	3,942	10,653	57,756
4	3,058	8,264	66,020
5	2,357	6,370	72,390
6	1,354	3,660	76,050
7	1,226	3,312	79,363
8	1,019	2,753	82,115

Tab. 5 Principal components scores

	CP1	CP2	CP3	CP4	CP5	CP6
Density	0,137	0,094	0,205	0,198	0,086	0,224
Population change (91-02)	0,105	0,050	0,280	0,034	0,040	0,111
Aging index	-0,019	0,023	-0,469	0,029	0,005	-0,063
GDP/capita	0,080	0,128	0,109	-0,027	0,252	0,124
GDP Serbia = 100%	0,129	0,147	0,032	-0,044	0,011	-0,101
% employment primary	0,031	-0,243	-0,118	-0,098	-0,064	-0,178
% employment secondary	-0,055	0,227	0,062	0,101	0,019	0,015
% employment tertiary	0,050	0,161	0,159	0,017	0,083	0,322
Unemployment rate	-0,013	0,074	0,164	0,083	-0,040	0,041
% illiteracy	-0,051	-0,167	-0,344	0,013	-0,067	-0,184
% primary	-0,009	-0,047	0,096	-0,058	-0,081	-0,007
% secondary	0,081	0,157	0,266	0,004	0,029	0,173
% college	0,011	0,183	0,201	-0,024	0,202	0,180
roads length (km)	-0,151	0,015	0,075	-0,037	0,287	0,153
high roads (km)	-0,056	0,057	0,018	-0,041	0,597	0,117
% of agricultural land	0,252	-0,040	0,045	-0,015	-0,058	-0,020
Land productivity	0,216	-0,048	0,088	0,113	0,023	-0,010
% farms without income from agriculture	-0,013	-0,124	-0,069	-0,055	0,038	-0,015
employment rate	-0,041	0,216	-0,046	0,010	0,080	0,106
less than 1 ha	0,116	0,137	0,172	0,135	-0,057	-0,002
1 - 3 ha	-0,016	0,045	-0,074	0,517	-0,036	0,007
3-10 ha	-0,064	-0,130	-0,127	-0,221	0,063	-0,005
over 10 ha	-0,065	-0,046	0,049	-0,516	0,024	0,005
Number beds /1000 pers.	-0,074	0,005	-0,006	-0,035	0,021	0,116
index generational change	-0,009	-0,027	-0,460	0,059	0,011	-0,024
dependency ratio	-0,039	-0,106	-0,422	0,067	-0,055	-0,036
% cereals	0,293	-0,020	0,068	0,019	-0,047	-0,038
% industrial crops	0,116	0,016	0,081	-0,109	-0,068	-0,053
% pastures	-0,278	0,035	0,018	-0,031	0,039	0,139
% meadows	-0,268	0,054	-0,088	-0,065	0,038	0,008
Topography	-0,284	-0,002	-0,019	0,022	0,018	0,038
Cattle*100 ha agric. area	-0,036	-0,055	0,054	0,062	0,070	0,046
Pigs*100 ha agric. area	0,157	-0,065	0,025	0,089	0,005	0,019
Ewes*100 ha agric. area	-0,085	-0,032	0,024	-0,046	0,062	-0,038
% primary sector in ND	0,073	-0,329	-0,088	-0,054	-0,074	-0,248
% secondary sector in ND	-0,038	0,354	0,042	0,063	0,020	-0,139
% tertiary sector in ND	-0,081	0,047	0,107	0,002	0,114	0,752

Below we provide an interpretation for the principal component.
C.1 - component of rural development (28%). Positive values identify areas with the prevalence of extensive agriculture and good overall economic conditions. They are associated to good percentage of agricultural land on the total municipality land, land productivity, prevalence of cereals and (at a lower level) industrial crops and pigs, and a GDP level well over the Serbian average. This component shows negative values for pastures and meadows, ewes, topography.
C.2 – component of employment (19%). Positive values identify municipalities with noticeable employment level and the importance of the secondary sector both on the national income[38] and on the employment structure; GDP over the Serbian average; farms with extra-agricultural income. Coherently, negative values are recorded for employment in primary sector and weight of the primary sector on GDP.
C.3 – component of demographic structure (11%). Positive values are associated with good population change and population density, and with a relevant presence of unemployment. At the opposite, negative values are recorded for the aging index, index of generational change and dependency ratio, illiteracy.
C.4 – component of farm structure (8%). Positive components are linked to the presence of farms between 1 and 3 hectares, good land productivity, cereals production.
C.5 – component of infrastructural endowment (6%). Positive values go with roads, high roads endowment, and good GDP/capita.
C.6 – component of economic development (4%). This component shows highly positive values for the employment in tertiary sector, high weight of tertiary sector on the national income, the provision of touristic services and the employment rate.

As a difference form the previous computation of the components values, here it the relevance of the topographic and geographical characteristics in determining the aspects of an area clearly emerges. In fact, the variable topography shows heavy – and negative – values in the first component, which is the one usually explaining the most of the variability.

Then, we applied the cluster analysis on the 6 principal components, using again the *k-means algorithm.*

Tab.6 Final cluster centres

	1	2	3	4	5
C.1	-2,89	,73	-4,29	-1,88	3,11
C.2	2,63	-2,79	-1,26	3,21	1,51
C.3	,70	-,13	,10	-7,71	,42
C.4	,81	,57	-1,44	1,60	-,45
C.5	,04	-,07	,18	-,47	,00
C.6	-,57	-,22	,67	-,42	,24

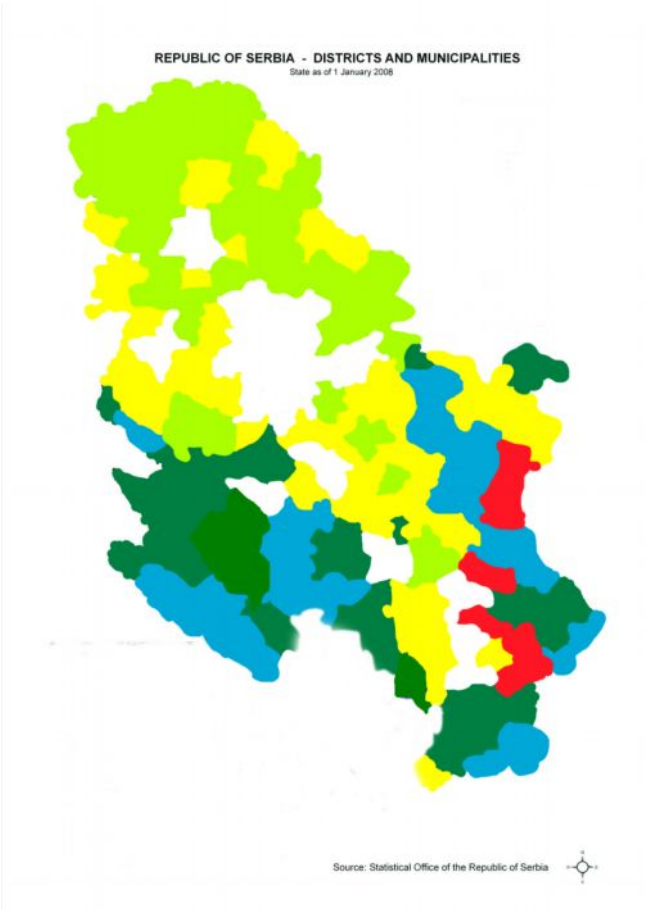
We found out 5 clusters, which identify 5 different rural regions in Serbia.
23 municipalities compose **cluster 1**, which includes the mountainous areas at the border with BiH and the southern-eastern border. They are characterized by the prevalence of meadows and pastures due to the conformation of the landscape (more than 50% of the utilized land), and by small size farms (component 1 negative, component 4 positive). An important role is played by the secondary sector,

[38] The official data only allowed us to calculate the relevance of the three sectors of the economy on the national income, which refers to the new value created during the accounting year. Therefore, if no new richness has been produced and the economic condition has worsened, it can turn into negative.

both on the occupation level (38%) and on the national income (52%), due to the presence of heavy industry sites (Užice) and hydro-electric plants (Kladovo, Mali Zvornik, Bajina Bašta).
The peri-urban areas are identified by **cluster 2**, which is composed by 40 municipalities. They are characterized by an average level of development (lower than the average GDP and low population density), which can benefit from the influence of the surrounding main city centres (Belgrade, Novi Sad, Niš). Noticeable is the role of the primary sector both on the economic activities (quite 65%) and on the employment (quite 50%), as indicated by component 2 negative, and low diversification.
Cluster 3 includes 20 municipalities, which are the depressed rural ones, mainly located in south, eastern and western Serbia. They are characterized by the strong and negative influence of topography on the activities, which therefore are linked to the primary sector (40% of employment, 44% on the national income), with the prevalence of meadows and pastures (over 60% of the utilized land) and ewes breeding.
Interestingly, in **cluster 4** we find the same 4 worse off rural municipality – Gadžin Han, Svrljig, Babušnica and Crna Trava - belonging to the second cluster of the previous analysis conduced on the whole Serbia. There is a confirmation of the prevalence of aging population, no generational change, strong illiteracy and low population density.
Cluster 5 is composed by 42 municipalities, mainly set in Vojvodina. They are characterized by a well developed agricultural sector (positive component 1) showing a high percentage of agricultural land on the total municipality one (more than 80%), good land productivity and the prevalence of cereals and industrial crops (70% of the land used).

Fig. 3 Map of Serbia featuring 5 clusters

Cluster 1: dark green; cluster 2: yellow; cluster 3: light blue; cluster 4: red; cluster 5: green.
White: municipalities not included in the analysis.



IV. Conclusions

The analysis highlights the relevance of the different developmental features of rural areas in Serbia. Therefore, mapping rural municipalities represents a first – but essential - step in planning and drafting future economic and rural development policies for the specific areas. The results obtained are easy to be read and to be interpreted by policy makers interested in policy drafting and implementation, and by project managers, as a difference from the complexity of interpretation of the numerous indicators proposed by the EU for the evaluation of rural development measures[39].

Moving from this study, next analysis could concern the computation of a sensitive analysis of the municipalities to the financial support of rural development interventions, in order to evaluate the effects of future European rural development policies in farm structure, rural development and environment, and their relevance for the convergence of the Country. This point assumes a particular relevance nowadays, when the EU is going to decide about giving Serbia the status of candidate Country, opening the way to the disbursement of IPA funds for regional and rural development interventions.

Then, being the mapping methodology here applied able to show the dynamic evolution of strengths and weaknesses of specific areas also at the local level, it could be used for analyzing in a spatial way the structural changes occurred in the Western Balkans as well as in the CEEs in the transition period, and their effects at the socio-economic level.

Moreover, displaying the peculiarities of the municipalities within a Country with a set of periodically update and observable indicators could pave the way for a in depth analysis of the characteristics of poverty in rural and urban areas, and its evolution, starting to look at the causes and consequences (migration *in primis*) of rural poverty on the development and growth path of the Country. This topic seems to be even more relevant under the light of a future integration within and already competitive and globalized EU market.

Finally, this study evidenced the points in working with still not fully harmonized and limited national statistical sources, and consequently the difficulties in undertaking minute statistical analysis. It is therefore important to increase the strengths devoted to methodological development in the identification of multiple indicators able to give a more accurate and useful definition of rural areas, and to the study of the distribution of variables (specially the variance), in order to avoid the still relevant loss of information occurring standardizing the data.

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[39] DG Agri counts more than 150 indicators to assess rural development.

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