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GIS ASSESSMENT OF DEVELOPMENT GAPS AMONG ROMANIAN ADMINISTRATIVE UNITS

Sorin Daniel MANOLE
"Constantin Brâncoveanu" University, Calea Bascovului 2A, 110095, Piteşti, Romania
sorin.daniel.manole@yahoo.com

Alexandru-Ionuţ PETRIŞOR
"Ion Mincu" University of Architecture and Urbanism, Academiei 18-20, 010014, Bucharest, Romania; alexandru_petrisor@yahoo.com

Antonio TACHE
National Institute for Research and Development URBAN INCERC, Nicolae Filipescu 53-55, 020961, Bucharest, Romania, tache@incdurban.ro

Ecaterina PÂRVU
National Institute for Research and Development URBAN INCERC, Nicolae Filipescu 53-55, 020961, Bucharest, Romania, ecaterinajeana@yahoo.fr

Abstract
A new set of indices for monitoring the effects of implementing new regional development policies of the European Union, as well as other sectoral policies with territorial effects, resulted into the creation of new flexible systems, able to increase the administrative capacity to access structural and cohesion funds. The novelty of this study consists of the original methodology embedding mathematical methods (i.e., the ELECTRE and the index of development methods) in a GIS in order to produce hierarchies of the territorial indices at the NUTS levels III and V, displayed as charts and maps underlining the disparities between the socioeconomic, cultural and environmental aspects of the development. Our results suggest that the Romanian poorly developed regions are located in the south. Methodologically, the potential of the approach developed by this study recommends its usage as a planning tool of regional development. The limitations are due to the sparse monitoring and lack of data covering Romania.
Keywords: spatial development, GIS, ELECTRE method, method of the development index, EUROSTAT indices.

1. INTRODUCTION

The goals of socioeconomic cohesion changed in the European Union (EU) during the last two decades as a consequence of political changes. The first driver of changes was the Lisbon Strategy (Lisbon European Council, 2000), establishing the ambitious goal to turn the EU economy into the most competitive and dynamic economy based upon knowledge worldwide, providing for increased and better opportunities and enhancing the social cohesion. Consequently, additional environmental objectives were added in 2001 by the Gothenburg Strategy (Göteborg European Council, 2001). EU funds are available to meet these targets based on projects aiming to increase the welfare, and monitored based on complex sets of territorial statistical indicators. The main engine for economic development in Europe is an assessment and monitoring system formed by indicators provided by the Statistical Office of the European Communities (EUROSTAT) and the European Spatial Planning Observation Network (ESPON). In addition, the European Space and Territorial Integration Alternatives (ESTIA) project, part of INTERREG Programs, established a southeastern European branch of ESPON based on an integrated system of territorial indices compatible with ESPON and the European Spatial Development Perspective (ESDP).

The Romanian research experience includes participation to these projects with contributions aiming to pinpoint a minimal set of 82 indices quantifiable at the level of administrative-territorial units (Institutul Naţional de Statistică, 2007), develop regional strategies by using spatial data (INCD Urbanproiect, 2006a) or create a polycentric and well-balanced urban system (INCD Urbanproiect, 2006b), propose a concept of interregional cooperation for the spatial development of the Danube space (Ministry of Construction and Regional Development of the Slovak Republic, 2008), promote new type rural-urban partnerships (INCD Urbanproiect, 2006c), and model medium and long term economic development, by using statistics and forecasts to elaborate governmental programs for development (Popescu, 2004). In 1998, the Romanian Ministry of Agriculture and Food had implemented a PHARE program resulting into a green book of rural development (Ministerul Agriculturii şi Alimentaţiei, 1998). The National Plan of Development for 2007-2013 involved a precise evaluation and monitoring of development, compliant with both spatial planning principles and the Nomenclature of Territorial Units for Statistics (NUTS): II, regions of development; III, county; and V, administrative territorial units). According to the European experience, regional development policies cannot be assessed by a single monitoring unit, namely EUROSTAT, regardless of its complexity. The implementation of projects using EU funds resulted into the creation of flexible systems used to monitor their results, such as ESPON. Using a similar reasoning, the Romanian accession to the EU represents the start point of a process consisting of the implementation of both EU-funded projects and flexible spatial planning systems at national, urban and rural levels, aiming to increase the administrative capacity of accessing European funds (structural and cohesion).

Several methods had been used to generate hierarchies of administrative-territorial units and territorial comparisons, particularly useful in order to provide for a balanced and sustainable development of all regions of the country and their dynamics, and analyze the impact of regional policies: the rank method, matrix methods, methods based on the relative distance between the units (Fülöp, 2005; Manole, 2007; Stroe and Buciuc, 2008), the ELECTRE - Elimination et choix traduissant la réalité - method (Roy, Benayoun and Sussmann, 1966), or the index of development method (Hjøllund and Svendsen, 2000). Geographical Information Systems (GIS) represent decision support systems involving the integration of spatially

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referenced data in a problem solving environment (Cowen, 1988; Constantin and Radu, 2008) and had also been extensively used in spatial and urban planning (Petrescu, 2007; Petrişor, 2007).

The novelty of this study consists of using GIS in conjunction with mathematical assessment and forecasting methods (ELECTRE and the index of development), by embedding a Visual C++ code in the GIS model. The result was a mathematical and informational model called GISTEREG. The results produced using this model were hierarchies of the territorial indices at the NUTS levels III and V, displayed as charts and maps underlining the disparities between the socioeconomic, cultural and environmental aspects of the development. The purpose of this paper is to introduce the methodology, without focusing on the results that have, in this setting, the value of a case study and are not necessarily generalizable, even though they are consistent with other findings.

TABLE 1 - CHAPTERS AND INDICES USED WITH THE ELECTRE AND DEVELOPMENT INDEX METHODS TO ASSESS REGIONAL DEVELOPMENT DISPARITIES IN ROMANIA

Chapter	Indices (Weights %)
Natural potential	Reserves of the biosphere (10), Special Conservation Areas - presence (10), Scientific reserves, natural monuments - presence (5), national parks - presence (10), natural parks - presence (10), RAMSAR sites - presence (5), Sites of Communitary Importance - presence (5), Special Avifaunistic Areas - presence (5), settlements with dominant natural resources - presence (20), settlements with dominant anthropic resources - presence (20)
Demogra-phic potential	Population (20), structure by gender (2), people age 0-14 (4), people age 15-24 (3), people age 25-49 (3), people age 50-64 (3), people age 65 and over (3), population density (10), rate of demographic dependence (6), demographic aging (6), natality rate (6), mortality rate (6), infant mortality rate (6), rate of internal migration (5), rate of external migration (4), number of marriages (2), number of divorces (2), number of people able to work (9)
Housing	Livable area - m^2/house unit (25), livable area - m^2/person (25), number of people/house unit (25), number of house units/1000 people (25)
Town equip-ment	Percentage of total length of streets (10), potable water distributed - m^3/person (13), percentage of potable water for household use (18), length of sewerage networks (18), natural gas distributed - m^3/person (10), percentage of natural gas distributed for house-hold use (13), thermal energy distributed - Gcal (10), green spaces - m^2/person (8)
Economic potential	Number of employed people/1000 (20), agricultural area/person (15), forested area/person (10), attested touristic resorts - presence (20), number of medium and small enterprises by size class (7.5), number of employed people by size class of medium and small enterprises (7.5), number of medium and small enterprises/1000 people (20)
Social / cultural aspects	Number of hospital beds/1000 people (8), number of physicians/1000 people (10), number of hospital staff with high school education/1000 people (6), number of dental doctors/1000 people (6), number of pharmacists/1000 people (4), number of high schools (8), number of professional, complimentary or apprentice schools (2), number of colleges/universities (7), number of students/1000 people (8), number of teaching staff in pre-school units (1), number of teaching staff in school (grades 1-4) units (1), number of teaching staff in school (grades 5-8) units (1), number of teaching staff in high school (grades 9-12) units (3), number of teaching staff in post-high school units (1), number of teaching staff in professional school units (1), number of theatres and musical units (10), archeological monuments - presence (2), architectural monuments - presence (4), public forum monuments - presence (2), memorial/ funeral monuments - presence (2), UNESCO monuments - presence (13)

2. METHODS

This study had used the ELECTRE and the index of development methods for the following six chapters, based on indices presented in *Table 1* and discussed below. (1) The natural potential did not account for the presence of communication and transport routes and natural hazards areas, as no recent assessments of these indices had been produced at the level of administrative-territorial units. (2) The demographic potential analyses lacked data on the evolution of population, as some 500 new communes had appeared during the last five years through territorial reorganization, and results would have been incorrect. (3) Housing was assessed only based on only four indices, due to the lack of recent data on utilities (water, sewerage, heating, indoor bathroom or toilet), construction materials, age of the construction stock, number and type of units built in the last five years. These data are made accessible by censuses, and the latest census was in 2002; such data cannot reflect the situation in 2006. (4) The town equipment lacked data on town cleaning vehicles, urban transportation, personal cars, and access to information. (5) The economic potential could not be assessed on important indices, such as agricultural production, number of animals, industrial production, the number of unemployed people, or the number of people commuting for work. (6) Social and cultural aspects did not account for the infrastructure for sport and leisure and Internet access due to the lack of data.

The ELECTRE method is recognized for its high performances in complex decisional problems and the interest of researchers into this approach had resulted into numerous models (each with more variants): ELECTRE I, II, III, IV, IS, TOPSIS, SAW etc. (Milani *et al*., 2006; Huang *et al*., 2005; Kangas *et al*., 2001; Zanakis *et al*., 1998). These approaches had been extensively used; many published papers employ some variant to solve a specific practical problem. In order to analyze spatial development, the method is based on establishing hierarchies of settlements by chapters consisting of more indices.

Consider $L_1, L_2, \ldots, L_m$ - settlements within a country (region) and $I_1, I_2, \ldots, I_n$ - indices within a chapter. Also, assume that the values of these indices are known for all settlements, *i.e.*, R_{ij}, the value of index I_j in settlement L_i, $i = 1,2,...,m$, $j = 1,2,...,n$. Since some indices are more important than the others, introduce the weights K_j, $j = 1,2,\ldots,n$, established based on the opinion of researchers from different fields. A total number of N specialists provide scores, each of them out of a total of P points, assigned to the m indices. Denote by $p_{k1}, p_{k2}, \ldots, p_{kn}$ scores assigned by specialist Sp_k to indices $I_1, I_2, \ldots,$ through I_n. The weight K_j of index I_j is simply the ratio of

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scores given to this index by all specialists and the total number of points ($N \cdot P$): $K_j = \frac{\sum_{k=1}^{N} p_{kj}}{N \cdot P}$, $j = 1,2,\ldots,n$

Since the values R_{ij} of index I_j in the settlement L_i, $i = 1,2,...,m$ are not always quantifiable (qualitative results are permitted) and there is much variation among values, results must be transformed into utilities. Consider that utilities range between 0 and 1 and assign 1 to the most favorable value, and 0 to the least favorable among values of an index corresponding to all settlements. To obtain the utilities u_{ij} corresponding to the values R_{ij} of index I_j for all settlements of a region or country use the linear transformation: $aR_{ij} + b = u_{ij}$, $i = 1,2,...,m$. To apply this transformation, find the constants a and b : denote by $R_{\max}$ and $R_{\min}$ the maximum, respectively minimum of the values R_{ij} of index I_j in all settlements. If the greater the values of an index, the more favorable are, obtain the system of equations:

$\begin{cases} a \cdot R_{\max} + b = 1 \\ a \cdot R_{\min} + b = 0 \end{cases}$ with the solution $a = \frac{1}{R_{\max} - R_{\min}}$, $b = -\frac{R_{\min}}{R_{\max} - R_{\min}}$.

To transform the values R_{ij} in utilities use the formula:

$$u_{ij} = \frac{R_{ij} - R_{\min}}{R_{\max} - R_{\min}}, \; i = 1,2,...,m \qquad (1)$$

The smaller the values of an index, the more favorable; we obtain the equation system:

$\begin{cases} a \cdot R_{\min} + b = 1 \\ a \cdot R_{\max} + b = 0 \end{cases}$ and derive the formula for utilities:

$$u_{ij} = \frac{R_{\max} - R_{ij}}{R_{\max} - R_{\min}}, \; i = 1,2,...,m \qquad (2)$$

If the optimal value R_{opt} of an index differs from both minimum and maximum, use separate linear interpolation for the intervals $\lfloor R_{\min}, R_{opt} \rfloor$ and $\lfloor R_{opt}, R_{\max} \rfloor$, and determine utilities using the formula:

$$u_{ij} = \begin{cases} \frac{R_{ij} - R_{\min}}{R_{opt} - R_{\min}}, \text{if } R_{ij} \le R_{opt} \\ \frac{R_{\max} - R_{ij}}{R_{\max} - R_{opt}}, \text{if } R_{ij} > R_{opt} \end{cases}, \; i = 1,2,...,m \qquad (3)$$

The study had used a variant of the ELECTRE method most suitable for the investigated problem (Oprescu *et al*., 1999; Milani *et al*., 2006; Huang *et al*., 2005). The first step consists of determining the concordance indices for settlements based on weights assigned to each criterion individually:

$$C_{gh} = \sum_{j \in J_{gh}^{+}} K_j , \; g = 1,2,\ldots,m, \; h = 1,2,\ldots,m, \; g \neq h, \qquad (4)$$

where $J_{gh}^{+} = \{ j \in \{1,2,\ldots,n\} / u_{gj} \geq u_{hj} \}$.

Therefore, the index of concordance between two settlements is the sum of weights of indices for which the utility of the first settlement is greater or equal than the corresponding value for the second settlement. The greater the gap, the closer is the index of concordance to 1; a value of the index of concordance equal to 1 indicates a total gap.

A new problem is to determine the intensity of opposition arisen when one opts out for a settlement in favor of another one, or the risk assumed by someone deciding to choose some settlement instead of another one. This risk is measured by the index of discordance between two settlements L_g and L_k computed using:

$$D_{gh} = \begin{cases} 0, \text{ if } u_{gj} \geq u_{hj}, \forall \, j \in \{1,2,\ldots,n\} \\ \max\limits_{j \in J_{gh}^{-}} \{ |u_{gj} - u_{hj}| \}, \text{ otherwise} \end{cases}, \; g = 1,2,\ldots,m, \; h = 1,2,\ldots,m, \; g \neq h \qquad (5)$$

where $J_{gh}^{-} = \{ j \in \{1,2,\ldots,n\} / u_{gj} < u_{hj} \}$.

Therefore, the index of discordance between two settlements is the largest absolute value of the differences between the utilities of the two settlements for all indices where the utility of the second settlement is strictly greater than the corresponding value for the first settlement.

In the following, a single discrimination will be preferred to more types (*i.e*, weak, strong). The statement "some settlement L_g exceeds another settlement L_h" is denoted by $L_g O L_h$ and marked graphically by an arch starting from L_g to L_k, if $C_{gh} \geq p$, $D_{gh} \leq q$, where *p* and *q* are limits between 0 and 1 chosen by the person deciding (*p* is the acceptability threshold, therefore its value should approach 1, while *q* is the risk assumed, and should approach 0). More over, the limits *p** and *q** are imposed to the threshold values, *i.e*., $p \geq p^*$ and $q \geq q^*$.

After determining all gaps (dominance relationships) between settlements, classification is performed based on them. The first place is assigned to the settlement dominating most other settlement, the second to the next one dominating lesser others, but more than next places in the hierarchy etc.; therefore, ranking

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is based on the decreasing number of dominance relationships. To discriminate between settlements dominating the same number of other settlements, look at the number of settlements dominating them. The classification obviously allows for ties.

To classify settlements take the following steps: 1) determine weights of indices; 2) assign qualifications to all qualitative indices; 3) determine utilities of quantitative indices using equations (1), (2), (3), associating scoring scales to the qualifications of qualitative indices, and fill in the matrix of utilities; 4) compute coefficients of concordance using equation (4) and fill in the matrix of coefficients of concordance A; 5) compute coefficients of discordance using equation (5) and fill in the matrix of coefficients of discordance B; 6) determine dominance relationships and represent them graphically; if there are too many settlements, the construction of the graph becomes difficult; and 7) rank settlements based on the determined dominance relationships.

To determine dominance relationships use the following algorithm: start from the concordance threshold $p=1$ and discordance threshold $q=0$ and look for settlements L_g and L_k such that $C_{gh}=1$ and $D_{gh}=0$. For all pairs (L_g, L_k) verifying the two equations, the relationship is L_gOL_k. The discrimination process is iterative; at each stage, p decreases up to some maximum value C_{st} among those unexplored and $q = 1 - p$. Look for the pairs (L_g, L_k) for which the inequalities $C_{gh} \geq p$, $D_{gh} \leq q$ are verified simultaneously. For these, mark the dominance relationship L_gOL_k, unless it was found previously. Also, if the inverse dominance L_kOL_g was found previously, keep it and abandon L_gOL_k. The search for pairs (L_g, L_k) verifying concomitantly the two previous inequalities continues up to finishing the exploration of matrices A and B or finding all dominance relationships. In order for the dominance relationships not to be too weak, decrease acceptability threshold p up to some value p^*, meaning that q could increase only up to the threshold $q^* = 1 - p^*$. The disadvantage of the algorithm described above is that it requires the usage of very large matrices of concordance and discordance indices (3174 x 3174), as there are 3174 settlements in Romania. Therefore, dominance relationships between two settlements are established directly, without memorizing all concordance and discordance indices. To do this, consider two settlements L_g and L_k. If L_g exceedsL_k, *i.e.*, $C_{gh} \geq p$ and $D_{gh} \leq 1 - p$, where $0<p\leq 1$, denote by p_1 the maximum value of the threshold p. It can be shown that:

$$p_1 = \begin{cases} 1 - D_{gh}, \text{if } C_{gh} + D_{gh} \geq 1 \\ C_{gh}, \text{if } C_{gh} + D_{gh} < 1 \end{cases} \qquad (6)$$

To validate the dominance relationship, the following must be true: $p_1 > p^*$. Denote by p_2 the maximum value of the threshold if L_k exceeds L_g, and

$$p_2 = \begin{cases} 1 - D_{hg}, \text{if } C_{hg} + D_{hg} \geq 1 \\ C_{hg}, \text{if } C_{hg} + D_{hg} < 1 \end{cases} \quad (7)$$

Therefore, the following situations are possible: (1) if $p_1 > p_2$ and $p_1 > p^*$, then L_g dominates L_k; (2) if $p_2 > p_1$ and $p_2 > p^*$, then L_k dominates L_g; (3) otherwise, there is no dominance relationship between the two settlements. To determine the dominance relationships, for $g = \overline{1,m}$ and $h = \overline{g+1,m}$ determine p_1 and p_2 using equations (6), respectively (7); comparing p_1, p_2 and p^* (given) one of the situations 1), 2) or 3) above is found and leads to L_gOL_k, L_kOL_g, or the lack of any dominance relationship.

No thresholds were used for direct discrimination between concordance or discordance indices were used, as no absolute discrimination between settlements was needed. Also, there were no more types of dominance relationships considered, because the comparison of two settlements when the number of weakly dominated settlements, strongly dominated settlements, and number of settlements strongly dominating them are known would be difficult, eventually requiring equivalences of the dominance relationships. Moreover, no individual (index) thresholds were used, as their determination is very difficult. In addition, the problem does not motivate the use of pseudo-criteria instead of criteria, as there is no uncertainty with respect to the information analyzed.

In order to present the method of the index of development, return to the context of the problem and consider L_1, L_2, ..., L_m settlements of a country (region), I_1, I_2, ..., I_n indices within a chapter and their values for each settlement (R_{ij}= value of index I_j in settlement L_i, $i=1, 2, ..., m$, $j=1, 2, ..., n$). Results are also transformed into utilities, and weights K_1, K_2, ..., K_n assigned to indices I_1, I_2, ... through I_n. Based on all these, utilities of each settlement within a chapter are averages of utilities of settlements corresponding to the indices weighted by the aforementioned coefficients; the utility of the settlement L_i corresponding to the chapter is:

$$u_i = \sum_{j=1}^{n} u_{ij} K_j, \; i = 1,2,...,m \quad (8)$$

The value u_i is called index of development corresponding to the chapter. A different classification of each chapter is obtained based on this index by ranking all values decreasingly.

Classifications obtained using the two methods (ELECTRE and the index of development) can differ, but not too much. The methods do not exclude each other, as they use different criteria, and complete each other. The method of the index of development is based on quantitative criteria and cumulates values of indices for each chapter; poor results for some index do not influence good results for a different index. The ELECTRE method presents some qualitative aspects. Values of each index are

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considered; some settlement with poor results for some index, even if all other values are good, cannot dominate other settlements and will receive a lower rank. One could question the appropriateness; the degree of development concerns aggregated values as well as individual values. A unit with low values for some index cannot have a good overall level of development. Consequently, if its position is lower when using the ELECTRE method than its position in the index of development method, one could tell that some indices present unfavorable values even without looking at the raw data. Furthermore, the fact that classifications do not shift too much when the weights present little changes pleads for the stability of the methods and for their use in establishing a hierarchy of the territorial units. The ELECTRE method provides very good results in multi-criteria decision, and the particular type and variant are chosen based upon the nature and characteristics of the problem. Matrix methods and approaches based on the relative distance between units have simpler mechanisms than ELECTRE, consequently discriminations are less correct. Furthermore, no weights are assigned to criteria, resulting into their equal importance and distortions in the discrimination of variants. The index of development method was preferred instead of the relative distance from the optimal performance due to a better aggregation of the values of characteristics. While the two methods are somewhat similar, the difference between the two indices could indicate the distance between the two territorial units. Moreover, the index of development method is preferred due to the naturalness of evaluating the level of development.

The weight of each index was established based on opinions provided by at least three experts in each case; an improvement could be in this case a methodology for determining the average weight, such as the Delphi method. However, simple averaging was used.

The application of the Visual C++ code on the spatial data set for regions and administrative-territorial units involved the following steps: (1) identify groups of qualitative and quantitative indices for each chapter; (2) assign weights to indices within each chapter, summing up to 100; (3) apply the program for each chapter and establish decreasing rankings of administrative-territorial units; (4) exchange the format of data in order to provide compatibility with the GIS; (5) import data into GIS; (6) analyze data with GIS - natural limits, natural breaks.

The hierarchies established using the individual administrative-territorial unit values of indices by chapters resulted into relatively homogeneous areas of different sizes. Therefore, spatial clusters must be analyzed taking into account the importance and weight of each index accounted for. For an overall hierarchy, correct and useful to decision factors, repeated analyses, using different weights, are required in order to reveal aspects used in sectoral strategies and policies governing the development process and meeting particular needs.

3. RESULTS AND DISCUSSION

The results are displayed in Fig. 1 through 6 below, each corresponding to the chapters presented in the Methods section as well as in the first column of *Table 1*:

1) The analysis of the natural potential (*Fig. 1*) suggests that most administrative-territorial units exhibit a poor potential. Average and higher values are present in mountain areas and the Danube Delta, where most natural reserves are concentrated (natural and national parks, natural monuments, reserves of the biosphere, scientific reserves, or RAMSAR sites). Compared to other countries adjacent to the Danube, the riparian area of Romania, situated between Turnu Severin and Călăraşi, is poorly valorized, as the settlements within this territory do not exhibit dominant natural or anthropic resources, scientific reserves, or Special Conservation Areas.

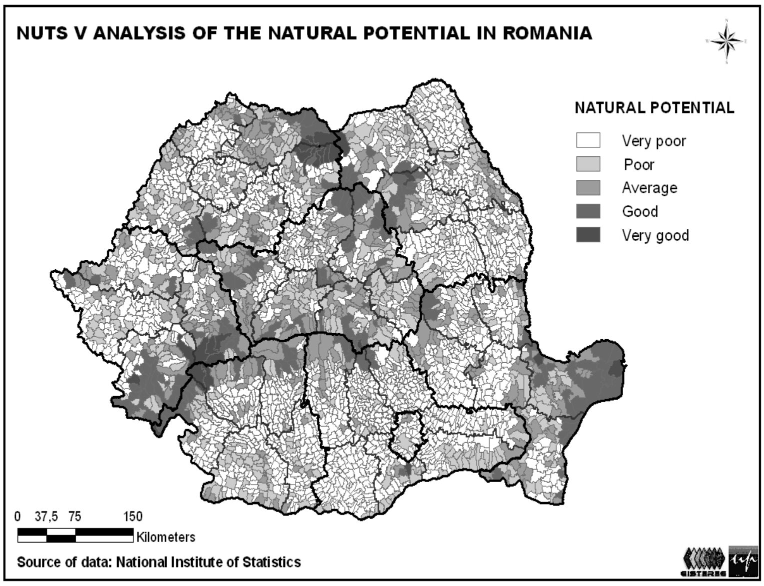

FIGURE 1 - MAP OF THE NATURAL POTENTIAL IN ROMANIA BY ADMINISTRATIVE-TERRITORIAL UNITS. DARKER SHADING INDICATES BETTER POTENTIAL.

2) The results focused on the demographic potential (*Figure 2*) suggest that most frequently administrative-territorial units exhibit average and good potentials situated in the sub-Carpathian area of Muntenia, the rural/urban areas adjacent to Bucharest, Dobrudja, Moldova, Transylvania, but also west of Banat (in the urban agglomeration Timişoara-Arad). Areas with a very low demographic potential, determined mainly by an accentuated aging of population, low natality, and high mortality concentrate in southern Oltenia and Muntenia, the Apuseni Mountains, and Crişana.

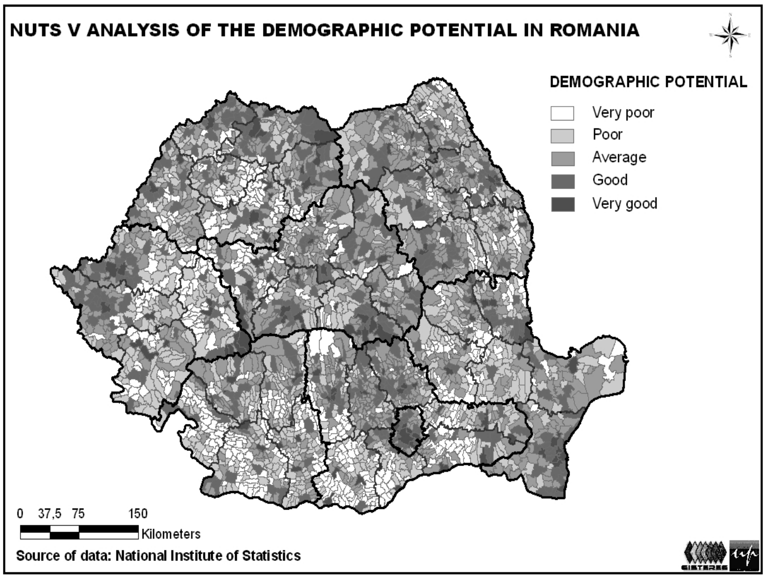

FIGURE 2 - MAP OF THE DEMOGRAPHIC POTENTIAL IN ROMANIA BY ADMINISTRATIVE-TERRITORIAL UNITS. DARKER SHADING INDICATES BETTER POTENTIAL.

3) The housing situation (*Figure 3*) is average or good in most Romanian settlements, with respect to the restrained set of indices used in this study. Poor living conditions of Moldova are determined mostly by smaller livable area per inhabitant, due to the fact that larger families (with more children) are characteristic to this region. Critical situation appear in larger areas of the counties Teleorman and Mehedinţi and partially in the counties Călăraşi, Ialomiţa, Constanţa and Dolj; the situation is mainly due to the low income of population, preventing the construction of new units.

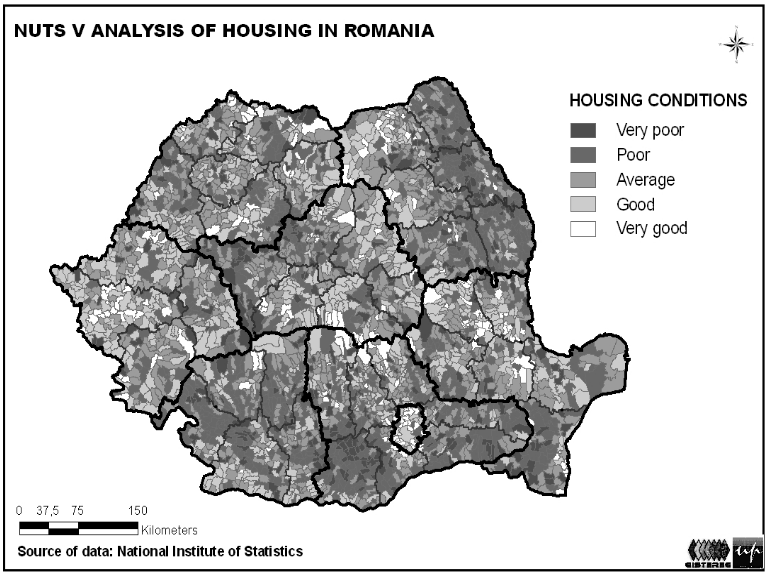

FIGURE 3 - MAP OF HOUSING IN ROMANIA BY ADMINISTRATIVE-TERRITORIAL UNITS. BRIGHTER SHADING INDICATES BETTER STATUS

4) The town equipment (*Figure 4*) exhibited in 2006 a poor and very poor status in most Romanian settlements; a better situation was found in towns (municipalities) with the "residence of the county" status and larger cities. However, rural areas met the minimal standards or completely lacked the provision of town equipment.

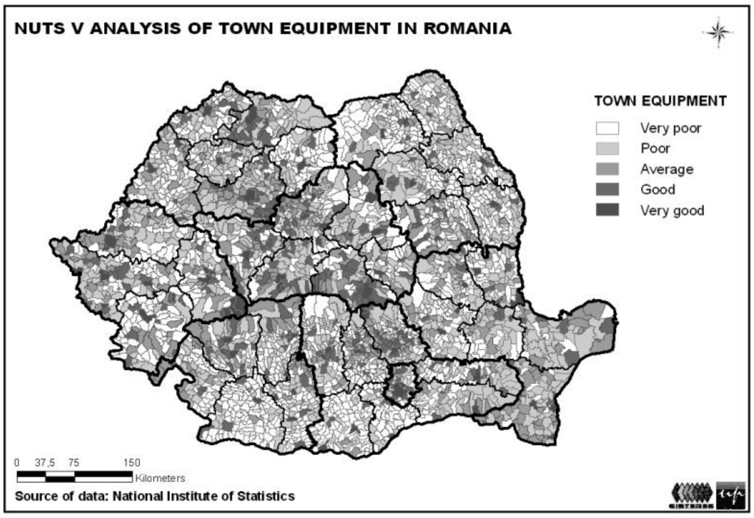

FIGURE 4 - MAP OF TOWN EQUIPMENT IN ROMANIA BY ADMINISTRATIVE-TERRITORIAL UNITS. DARKER SHADING INDICATES BETTER ENDOWMENT

5) The analysis of the economic potential (*Figure 5*) indicates a concentration of regions were the administrative-territorial units with poorer potentials are predominant in Banat, south of Crişana, the rural/urban areas adjacent to Bucharest, Dobrudja, and mountain areas (for the latest, due to the influence of large forested areas allocated to each person and their touristic potential).

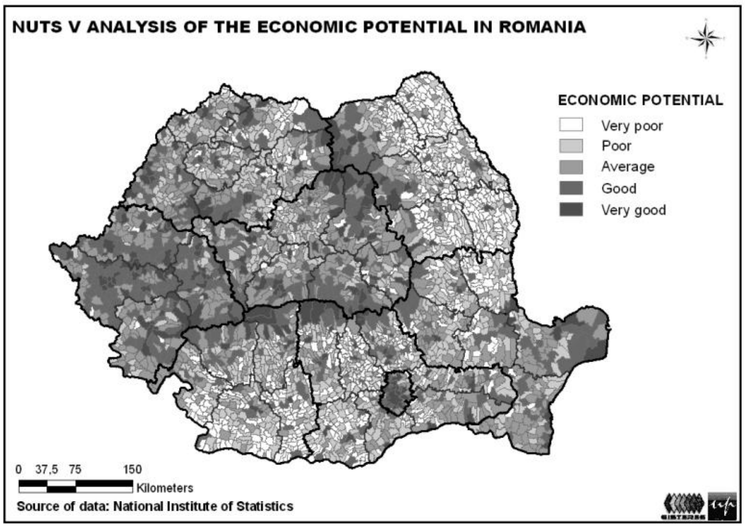

FIGURE 5 - MAP OF THE ECONOMIC POTENTIAL IN ROMANIA BY ADMINISTRATIVE-TERRITORIAL UNITS. DARKER SHADING INDICATES BETTER POTENTIAL

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Similarly, most settlements specialized to a singled function, predominantly agricultural, from Moldova, Oltenia and part of western Muntenia (counties Teleorman and Dâmboviţa) exhibit a poor economic potential. However, we must underline that the assessment is based on potential resources and lesser on the results of their valorization.

6) Social and cultural aspects (*Figure 6*) showed overall an average level of the infrastructure from a quantitative viewpoint (number of units and/or staff). Nevertheless, the quality of services is completely insufficient by the precarious status of buildings, qualification of the personnel, diversity of services provided etc. The fact that the Danube Delta and rural areas containing fortified churches in Transylvania (e.g., Câlnic, Prejmer, Biertan), monasteries, churches, or Dacian fortresses exhibited a good social and cultural potential is due to their enlisting with UNESCO world heritage.

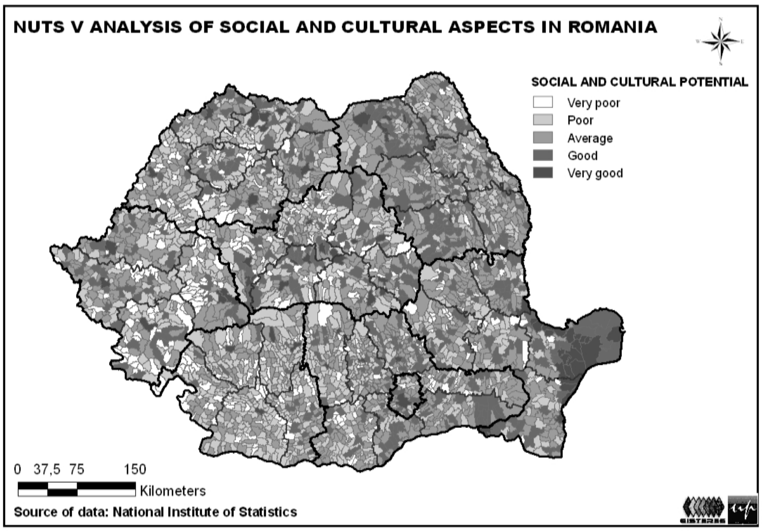

FIGURE 6 - MAP OF THE SOCIAL AND CULTURAL ASPECTS IN ROMANIA BY ADMINISTRATIVE-TERRITORIAL UNITS. DARKER SHADING INDICATES BETTER POTENTIAL

These findings are consistent with the results of the 1998 assessment of rural development in Romania (Ministerul Agriculturii şi Alimentaţiei, 1998), including the location of areas with poor development and high levels as well. Some small local differences can be explained by the fact that the previous study had looked only at the rural regions. It is also noteworthy mentioning that data on administrative-territorial units available from the National Institute of Statistics are relatively diminished by the reduced number of indices monitored for each settlement as well as the lack of cohesion between them. Excepting for demographic indices, that provide wider opportunities to assess the status and evolution, all other indices do not allow for exhaustive analyses. For example, the housing chapter lacks annual indices characterizing equipment and utilities, number of new units built in the last 10 years and their type; the economic potential cannot be described completely without the GNP, value of industrial and agricultural production, unemployment, people working abroad or in other places. Other missing indices are the number of new or renovated units used to assess socio-cultural infrastructure, and the number of people accessing centralized water supplies, sewerage, or waste management.

4. CONCLUSIONS

Overall, our results suggest that the regions with a low potential of development are situated in the south of Romania, in the east of Moldova and in Bărăgan. However, the focus of this article is methodological. Our analyses had shown that the proposed methodology has a great potential to be used as a planning tool in regional development, and its flexibility allows for an input with particular focus determined by specific interests of different stakeholders, resulting into the selection of different indices and different weights assigned to them. The limitations of the methodology are due to the sparse monitoring and lack of data covering Romania for indices currently used in the EU.

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