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Relationship between ecological indicators and soil properties (in case of a wetland)

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Abstract

Ecological indicators have been defined for higher plants. In theory with the use of these indicator values we can make predictions for the abiotic environmental factors based on cenological analysis. There are only few publications which have focused on validation of the published indicators. The scale dependence of these indices is poorly studied too. Present paper focuses on applicability of soil related ecological indicators in small scale studies. Three soil related indices were studied along a hydromorph toposequence, such as Simon's *W, R* and Soó's *N* values. Simon 's *T* value also was applied to compare applicability soil related ecological indicators with non-soil related ones for small areas. These values were determined on the basis of cenological measurement and compared with soil physical and chemical properties. Our results suggest that *W* values can be use only for small scale ecological indications.

Keywords: ecological indicator, physical and chemical properties, toposequence, water demand, nitrogen, pH, microclimate

Introduction

Development of soils is affected by several factors. Water and topography as primary environmental factors plays crucial role in soil development (Centeri, Cs. *et al*. 2009). Spatial differences of soil forming factors cause spatial heterogeneity of soil properties (White, R.E. 2006; Szabó Gy. and Czellér, K. 2009;

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Kertész, Á. *et al.* 2010). These phenomena affect on morphology and reflect in spatial distribution soil properties such as amount macronutrients (Sipos, P. 2004; Farsang A. *et al*. 2008; Kocsis, M. *et al.* 2008; Szabó, Gy. *et al*. 2008; Nagy. R. *et a*l. 2012) and organic matter (*OM*) decomposition and humification (Martins, T. *et al.* 2011; Alexis, M.A. *et al*. 2012). Since soil forming factors also have influence on vegetation, cenological properties of flora may have relationship with different aspect of the environment, theoretically.

As a result of floristic research, ecological indicators have been defined for almost the whole vascular flora (Soó, R. 1980; Simon, T. 1992). In theory with the use of these indicator values we can make predictions for the abiotic environmental factors based on cenological analysis (Csontos, P. 1984; Mjazovszky, A. *et al*. 2003; Szabó M. *et a*l. 2007).

As relevant differences may occur along hydromorph toposequences within small distances, changes in physico-chemical properties of the soil can be detected in a small area (Szalai, Z. *et al.* 2010; Varga, Á. 2010). These toposequences allow the validation of ecological indicator values. Present paper focuses on the reliability of the ecological indicators compared with soil properties.

Material and methods

Study area

The 8 ha *Mocsárrét* area located in the vicinity of Ceglédbercel is in the border of the Gödöllő Hills and the Pilis-Alpár Homokhát physical micro-regions *(Figure 1).* It belongs to the former floodplain of the Gerje Stream. The deepest parts of the Mocsárrét are willowy peat-bogs. The fens are differentiated from the sedgy meadows with a definite bench. The pasture-lands also differentiate definitely from the surrounding sandy steppes following a graduated elevation.

Sampling and measurements

Relationship between vegetation and soil properties were studied by Simon's *W* (water demand), *R* (soil pH) and Soó's *N* (soil nitrogen) values. Simon's *T* (Köppens's climate) value also was applied to compare applicability soil related ecological indicators with non-soil related ones for small areas.

Cenological properties of the Mocsárrét were studied by estimation of herbaceous vegetation cover along a 22 m transect. The estimation was carried out along a straight line using 22 neighbouring 1 x 1 m quadrates. The lowest and the highest ones are labelled by 0 and 22, the highest one. The quadrates

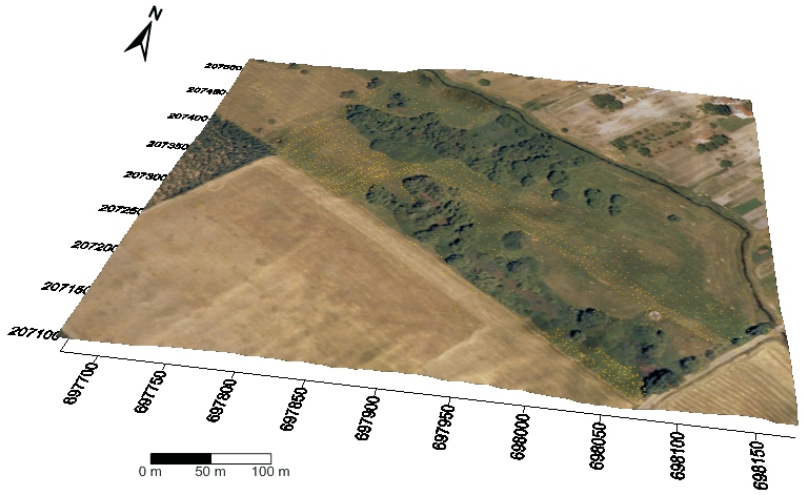

Fig. 1. Ortophoto combined DEM of study site

covered a whole hydromorphic toposequence beginning from the peat-bog to the dry lucerne area (sandy steppe). Species lists and cover estimations were carried out for each quadrats. Applied ecological indicators were assigned to each species from Hungarian Flora Database (Horváth, F. *et al*. 1995). The cover-weighed averages of values were used to the calculations.

Soil properties are studied by boreholes, which made by Edelman Auger. Drills were installed next to the quadrates and each of them reached the groundwater level. After the drilling, the depth of the groundwater level was measured in the borehole by tape-measure. Soil samples were taken and measured from the upper 25 cm densely rooted soil horizon.

Soil organic carbon (*SOC*) and total bounded nitrogen (*TN*) content were measured using NDIR/chemoluminescent analyser. Soil organic matter (*SOM*) content was calculated from the *SOC* values using a 1,72 multiplication factor. Humic compounds were characterized by Hargitai's *Q* value (Buzás, I. 1983). Soil pH was determined electrometrically from 1n KCl extract. $CaCO_3$ content was measured using Scheibler's method (Buzás, I. 1988). Texture of the mineral phase was defined with a laser diffraction particle sizer while the quality of the mineral phase was determined with an XRD (X-Ray Diffraction).

To compare soil data with ecological indicators soil pH values were converted to acidity ($cmol_+ kg^{-1}$) before regression analysis (to transform log scale to linear scale data). Ecological indicator values transformed from ordinal scale to interval scale data by Sneath and Sokal's method (Podani, J. 1997). The relationships were studied using linear regression and correlation coefficient.

Results

Morphological and mineralogical properties of soils

Along the 22 m toposequence SOM content doesn't change consistently with the decreasing water content. In the deepest point of the toposequence (0) starting soil type is peaty meadow soil-gleyic Phaeozem (pachic, arenic, calcaric), where the "*histic*" (H) horizon's thickness reaches 10 cm. Between the 0 and 1 quadrates soil type changes to calcaric meadow soil-gleyic Phaeozem (arenic, calcaric). This calcaric meadow soil is typical until highest point of the toposequence.

The mineral phase's texture sand content increases whilst silt and clay content shows a decreasing tendency starting from the lower endpoint to the upper one. Between the 0 and 1–5 quadrates there is a sudden change in the mineral phase ant this change appears in the herbaceous vegetation too. In the reed *quartz* and *calcite* are dominant, *smectite* is significant and only a little *feldspar* is present. The iron phase is traceable in the form of goethite for which refer reflections between 4.18 and 2.70 Å. Iron concretions and mottles are made of *poorly crystallized goethite*. Practically in the same level as the 0 quadrate lies the sedge dominated 1–5 quadrate. Their matrix consists of mainly quartz and calcite but smectites are also significant. The silt fraction contains little feldspar and amphibole. There is ferrihydrite in the matrix's iron-phase, it is shown by the elevated baseline with maximum values around 1.5 and 2.5 Å. In the iron concretions mineral phase the iron (III) is present mainly in the form of ferrihydrite and less poorly crystallized goethite (shoulder at the quartz's base, around 4.16 Å; weak peak at 2.69 Å). Dominant minerals of the soil matrix are also present in the iron concretions like quartz, calcite and feldspar. This alludes to the fact that iron-oxide concretions seceded around these mineral grains and incorporated them in the course of their growth. Advancing to the upper endpoint of the toposequence goethite becomes dominant in the iron phase again.

$CaCO_3$ and soil SOM contents also changes between the 0 and 1 quadrate. Further in the toposequence does not fall of $CaCO_3$, however quantity of SOM decreases continually. Condensation degree of humic acids degree increases steadily parallel with reduction of hydromorphy (*Table 1*).

Relationship between ecological indicators and environmental factors

From the reed (temporary open water surface) to the slightly elevating area headway of the lower water-demand plants can be observed to the expense of high water-demand (swamp) plants (ex. *Carex riparia*). The association at

Table 1. Chemical properties of topsoil (0–20 cm)

Indicator	0	1	2	3	4	5	6	7	8	9	10
SOM (%, m/m)	27.2	9.7	9.8	8.3	6.1	5.2	5	4.8	4.4	4.5	4.5
Q	0.34	0.32	0.42	0.45	0.46	0.45	0.43	0.51	0.49	0.48	0.48
TN (%, m/m)	0.26	0.08	0.19	0.25	0.28	0.26	0.23	0.21	0.2	0.21	0.19
C/N	60.7	70.3	29.9	19.3	12.6	11.6	12.6	13.3	12.8	12.4	13.7
$CaCO_3$ (%, m/m)	7.69	3.5	3.5	3.3	3.4	3.1	3.3	3.4	3.2	3.6	3.5
pH_{KCl}	7.81	7.81	7.8	7.78	7.81	7.8	7.72	7.65	7.65	7.52	7.54

Indicator	11	12	13	14	15	16	17	18	19	20	22	22
SOM (%, m/m)	4.6	4.3	4.1	3.8	3.2	2.8	2.2	1.9	2	2.1	2.1	2.1
Q	0.48	0.49	0.76	0.93	0.97	0.94	0.95	0.96	0.98	1.02	1.01	1.03
TN (%, m/m)	0.14	0.15	0.17	0.09	0.15	0.14	0.11	0.09	0.08	0.09	0.1	0.1
C/N	19.1	16.6	14.0	24.5	12.4	11.6	11.6	12.2	14.5	13.5	12.2	12.2
$CaCO_3$ (%, m/m)	3.6	3.5	3.7	3.8	3.8	4	4.2	3.7	3.5	3.2	3.0	2.9
pH_{KCl}	7.54	7.51	7.55	7.62	7.66	7.62	7.58	7.51	7.34	7.31	7.79	7.25

the top of the toposequence contains rather species of wet meadow (ex. *Festuca arundinacea*) as well as disturbance tolerating species of dry pasture-lands (ex. *Agropyron repens*). Average *W* value of the vegetation – calculated by the vegetation cover – decreases together with the reduction of water effect (*Figure 2)* while the trend line calculated by linear regression shows very weak connection ($R^2 = 0.60$) with the *T* values.

Total nitrogen content of the soil (*TN*) decreases towards the upper endpoint of the toposequence which is also followed by the *N* value (*Figure 3).* Although connection between *TN* and *N* value is "visible", the correlation coefficient between value pairs is very low (R^2=0.61).

Along with the drop of the water effect soil pH decreases from pH8.3 typical of $CaCO_3$ regulated wet systems to slightly alkali values typical of carbonated humic sandy soils. Correspondingly to the previous two ecologic indicator values Simon's *R* value shows a decreasing tendency also. However, there is no connection between alkalinity and its indicator value *(Figure 4).*

Albeit Simon's *T* value is primary for proving dissimilarities between Köppen's climatic zones (Csecserits, A. *et al.* 2009), we were curious if it could indicate microclimatic differences also. Accordingly to our expectations *T* values of the vegetation by the non-indifferent species do not show any distribution pattern *(Table 2).*

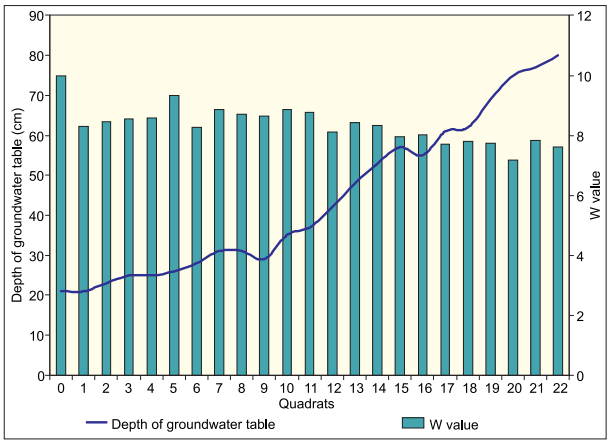

Fig. 2. Spatial distribution of *W* value along toposequence in relation to depth of groundwater table

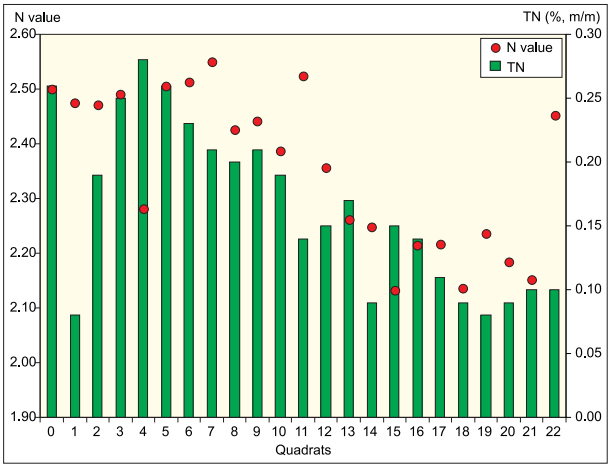

Fig. 3. Spatial distribution of *N* value along toposequence in relation to total bounded nitrogen (*TN*)

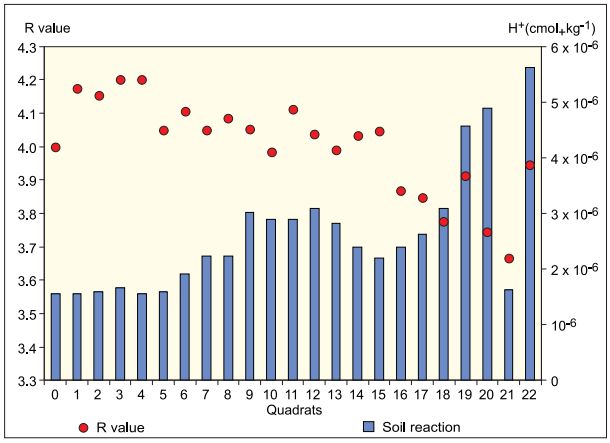

Fig. 4. Spatial distribution of *R* value along toposequence in relation to soil reaction

Table 2. Correlation between soil properties and ecological indicators on the basis of R^2

Soil properties	Simon's W value	Soó's N value	Simon's R value
Depth of groundwater table	0,63	–	–
Total bounded nitrogen	–	0,51	–
Soil reaction ([H^+] $cmol_+ kg^{-1}$)	–	–	0,19
Soil reaction (pH)	–	–	0,20

Distribution of indifferent values

In case of all studied indicators there were some species which had 0 values. These species are not suitable for ecological indications. A question may arise as to whether there is any relationship between spatial distribution indifferent values and spatial distribution of soil pH *TN*, and hydromorphy (depth of groundwater table).

Indifferent species of studied indicators shows different kinds of spatial distribution *(Figure 5).* From the aspect of the water effect-indicating *W*

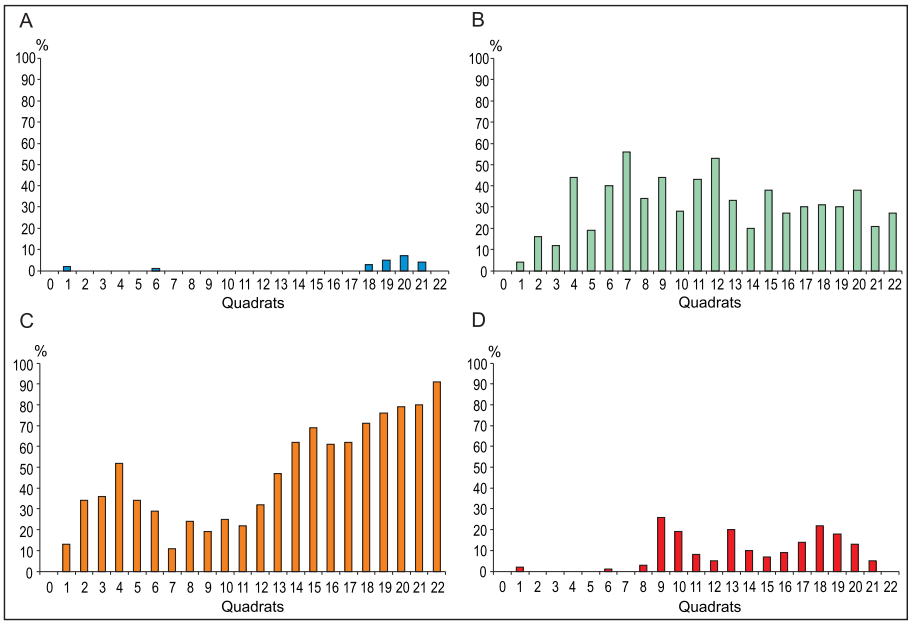

Fig. 5. Proportion of indifferent species within quadrats – A = *W* value; B = *N* value; C = *R* value; D = *T* value

value there were no indifferent species at the study area. This phenomenon supports the indicator's applicability. Species which didn't show an *N* value in the vegetation is negligible in the vicinity of the lower endpoint and that would be likely at the sandy steppe (if the natural vegetation could have been remained) above the upper endpoint of the toposequence, as well. Cover of the indifferent *N* value species exceeds 50% in the middle section.

Contrary with above *N* indicator, proportion of indifferent *R* values increases parallel with the depth of groundwater table. This reaches the 80% in the vicinity of the sandy steppe. However, climate indicator is not suitable for the indication of microclimatic differences, proportion of indifferent species shows similar spatial distribution as in case of water demand index.

Discussion

On the basis of correlation between indifferent species from the aspect of *R* value and soil reaction this indicator was not appropriate for ecological indication in our small scale study. This index is applicable for large differences, eg. acidic soils – slightly alkali conditions – sodic soils. Therefore multiplying sample numbers would not result a closer connection between the indicator and the pH value.

Relationship between *N* value and *TN* is also very poor, enlargement of the number of elements (studying several toposequences) would probably result a stronger connection. The most powerful connection is between the water demand and the *W* value. Here the connection between the water demand and the ecological index can be detected already through a few numbers of elements.

Studied soil related ecologic indices have formed two "groups", which are not sharply distinct, by their small scale applicability. Transition is graduated between the only regional and locally also adaptable indices.

In accordance with our expectations climate indicator *T* value out of the four ecological indices is not suitable for indicating microclimatic differences. The spatial distribution of indifferent climate indicators suggests that the site selection can be essential for such ecological studies which apply this indicator.

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Hungary as receiving country for circulars[1]

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Abstract

The paper presents findings of research on long-term international circular migration. There is scarce information on migratory phenomena interlinked by serial numbers (parity) in literature, so we would like to provide empirical evidences on international circular migrants based on the registered-type of data. The paper draws on a conceptual framework for a sort of definition of international circular migration. We deal with the phenomenon of circulation as one of the systems of the international migration and concentrate on Hungary as a receiving country. The main aim of the paper is to transform the notion of circulation highly theorised to the practice. The paper seeks to gain further insight into the demographic composition and territorial preferences of international circular immigrants in Hungary. Conclusions about circulars indicate the need for future investigations.

Keywords: circulation, international migration, migration system, spatial distribution, parity analysis

Introduction

International migration studies have traditionally focused on residence based assumptions, but the primacy of the concept of usual place of residence is eroding. Migration means a change of usual place of residence. It is a single non-recurring movement from statistical angle. From spatial aspects, migration has a character of processes in order to connect different terrains: sending, transit and receiving areas. Circulation is one of the newly emerging phenomena in which recurring moves are flooding among multiple residences. Based on this research we proposed proto-definitions from spatial angle in order to create macro level statistics. In general, circulation is a spatial mobility system which contains at least three

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interlinked and recurring individual moves. In particular, international circular migration would be conceptualized as an international migration system. It contains at least two or more nation-states and three or more interlinked and recurring international migrations between countries involved.

The paper presents some findings of a quantitative empirical research on long-term international circular migration. Circulation is one of the newly emerging phenomena in the era of globalisation in which recurring moves are flooding among multiple residences (McLoughlin, S. *et al.* 2011). Unfortunately, there is scarce information on migratory phenomena interlinked by serial numbers, which become system of migration (Constant, A. and Zimmermann, K. 2011). We would like to fill this gap. We suggest introducing the old-new notion to migration studies – *circulation*. Circulation refers to a system of multiple, recurring spatial movements of individuals while the characteristic of *multiplicity* is as significant as the spatial moves and the system itself.

The main aim of this study is to transform the notion of circulation highly theorised to the geographic, statistic and demographic practice. We address the central concern of this study on the international return migration multiplied to a destination country, namely Hungary. So we concentrate on Hungary as a receiving country.

In the next chapters the paper provides empirical evidence based on the registered-type of data of international migrants arising from the Hungarian Office of Immigration and Nationality. Firstly, the paper draws on a conceptual framework for a definition proposed of international circular migration. We point to the fact that three interlinked and recurring migration steps are necessary for the creation of circulation process. Secondly, we present the data and method utilised. Thirdly, we examine the demographic composition of circulars by gender, age and family status. Fourthly, considering the territorial patterns in Hungary, we analyse the spatial distribution of the residence of circular immigrants on county level. In other words, we put special emphasis on their spatial preferences within the country.

Theoretical framework

According to the conception of the old-fashioned, international migration touched upon at least two independent states. The international migrants are separated from the sending countries and they are connected with the receiving countries. But technical and logistical developments in transport and telecommunications have significantly changed the speed and trajectories of spatial movements of goods, people, information and ideas. As one of the symptoms of integration and globalisation, the volume and average distance of international migration are increasing (Michalkó, G. and Vizi, I. 2005) and

transnational communities are organised with peculiar activities (Bauböck, R. 2003; Hardill, I. 2004; Nell, L.M. 2004). Previously, the members of these above mentioned transnational communities had multiple citizenships and they slightly joined with any other states. It is possible to interconnect the economic, social, cultural and political activities between the sending and receiving countries. Another problem was that the transnational migrants might join with the countries involved.

The analysis of transnational migrants' activities from historical perspective proved that transnationalism was not a brand new phenomenon emerged at the end of the twentieth century (Castles, S. and Miller, M. 1993; Soysal, Y.N. 1994; Sík, E. and Tóth, J. eds. 1999; Gellér-Lukács, É 2004;). Ravenstein claimed that every single significant migration flow – after a certain period of time – creates its reflection, the counter-flow (Illés, S. 2001; Illés, S. and Kincses, Á. 2009). In the early twentieth century travelling to the home country and sending remittances back was sporadic practice. It was only a matter of time that travelling to the country of origin as tourist and the remittances became monthly and weekly routine (Wickramasekara, P. 2003; Rédei, M. 2007). Communication without physical contact made it possible for people to change information through smaller and smaller time gaps (messages via persons, sending postcards, sending telegrams, making phone calls, writing e-mails etc.).

As consequences of mass influx to America, transnational phenomena have been developing since the 20th century with the symptoms below:

– in the course of the assimilation process to the host society, the link of migrant to the receiving society was not disrupted completely;

– migration networks developed (Buchanan, M. 2003; Barabási, A.L. 2008);

– due to gaining citizenship of country of destination, large amount of double citizens developed/appeared but it was inessential for both the sending and receiving sides and the migrants themselves to make any advantages from their multiple legal status;

– different sorts of migrant organisations could be founded in the receiving countries;

– some groups specialised in peculiar economic activities (it was also erected from the home country) did not create interconnection between the two countries.

The end of obligatory military service, the prohibition of multiple tax legislation in international relations, the supranational rules of economic integrations broke the absolute sovereignty of nation states before the epoch of recognition of transnational activities. The last logical argument of the political community of receiving country against the multiple connections would be the break of the rule of "one person has one vote". The immigrants may enjoy the consequences of their wise political decisions without barriers, but in case of

negative consequences, they could emigrate easier than the natives (Sutcliffe, B. 2001; Viszt, E. *et al.* 2001; Ostergaard-Nielsen, E. 2003). Transnationalism can get to a new level after the rapid development of communication technology and transportation (Papademetriou, D.G. 2001; Bernek, Á. ed. 2002; Szentes, T. 2002; Tiner, T. 2009).

The phenomenon of transnational migration has the largest amount of literature in this respect. According to the so called 'old-fashioned' conception reflected the last epoch, international migration touched upon two independent states with one way ticket. The international migrants were separated from the sending countries and connected with the receiving countries. In the new era the migrants don't lose their relations completely with the country of origin. Nowadays, they partly attached to the country of destination via their work, their properties, their family relations and other activities. (Salt, J. 2001; Waldinger, R. 2008). Migrants could adopt dual or multiple residence strategy. In practice, it meant a strategy of moving back and forth (Klinthäll, M. 2006; Tannenbaum, M. 2007).

In the epoch of globalisation, the migratory movements are developing as a sort of events repeated with multiple displacements from one place to another. The transitional nature of migration processes is in growth. Many first time international migrants stayed in the receiving country, but many former emigrants returned after years of wandering or became circular migrants dividing their time and activity between the origin and the destination countries. An increasing number of circulations occupy a system of places rather than a single place of residence. National statistics and data of international organisations are generally poor to catch the movement of people moving together (mobility units), especially in case of multiple moves (for instance circulation) (Borrel, B. 2004; Lukács, É. 2011). All in all, the notion of transnational migration has the largest amount of literature in this respect.

Finally, we depict some research questions relevant in this context. One of the core questions is what the content of transnational status is and how to extend the transnational status. The main problem is how long the transnational status exists during an individual life course? An open question remains whether the multiple belongings of two or more nations will be a transitional phase of the immigrant life or we can expect their permanence across generations. Which conditions are necessary to maintain the transnational status of immigrants?

Definitions

The links between moves attracted the attention of scientists even as early as in the 19th century (for instance, see the vast majority of contributions on nomads,

traders, seasonal labourers). The concept of return migration developed as the very first idea in the second half of the twentieth century (King, R. 1986) and it can be more or less transformed to the concept of serial migration was just linked to it. It is also necessary to mention that the next step on the way towards the recognition of the phenomenon of circulation was the sporadic application of the concept of repeat migration.

The notion of seasonal migration had close relationship with international moves of workers (Borjas, G.J. 1996). Seasonal migrants were employed mainly by the agriculture, construction and the services of mass tourism. International commuting, in other words pendulum migration, is the most frequent in state border zones, but it means not only the movement of workers, but also the daily and weekly periodic movement of service providers. The phenomena connected with international tourist travels without periodicity (tourism of professionals and shopping tourism) were encompassed in the notion of international vacation. In other words, if economic incentives are involved, we get to the notion of long-distance commuting; and if the migration has a recreational purpose, we get to tourism (Williams, A.M. and Hall, M.C. 2002).

Inflow and return are the two sorts of spatial moves. Particularly, final return means the end of migration cycle (King, R. 2002). If the attraction force of sending area is not so strong and the receiving area pushes the immigrants away, a third area develops as the next destination. In case of unsuccessful decision, the immigrants search a fourth area if they exclude coming back to the previous places.

Ossman utilized the term 'serial migration' to indicate non-recurring migrants who undertook a series of migration rather than a simple event of migration (Ossman, S. 2004) With that migration pattern, the series do not break and the serial migration system emerges without no return. Although the serial of remigration happen (multiple moves) and the elements of the moves are three or more but we can not interpret it as circulation because it is not a return to any previous places.

In this contribution we adopted Kritz and Zlotnik's view of system approach (Kritz, M. and Zlotnik, H. 1992). Their international migration system comprised groups of countries flowing significant absolute numbers of international migrants within them. Castles and Miller's (1993) study (cited below) supported that sort of conceptualisation. International migration system linked the sending and receiving areas with fairly regular and relatively permanent structures and flows. Increasing number of circulations occupy a system of places rather than a usual place of residence. National statistics and data of international organisations are generally poor to catch the moment of people moving together (mobility units), especially in case of multiple moves (for instance circulation).

From spatial aspects, migration has a character of processes instead of events in order to connect different terrains: sending, transit and receiving areas. The migration system is nothing else that the sum of migration processes, in other words a set of non-independent moves one another. Utilise the specific classification of regional sciences on the conditions of over time and across space (Nemes Nagy, J. 2009) whereas migration is not a mono-space process. However, as noted above, it was a hetero-space process. If we interconnect the hetero-space character with the simplest duality of time relation, we can get two possible solutions (hetero-space and one-time processes, hetero-space and discrete-time processes). The hetero-space and one-time international migration systems are separated by the centres of attraction.

At global scale, only three gravity centres can be distinguished: North America, European Economic Area and Australia. The attraction power of continental scale has many sub-gravity centres, for instance the international migration systems of South Africa, Middle East and Singapore with hetero-space and one-time character of the system. The simple sum of moves characterises these kinds of relations with the prevalence of one gravity centre. The interconnection of separate flows with discrete-time character is not illustrative of that system. The hetero-space and discrete-time international migration systems have at least two attraction centres. The simplest example is the two-centre system and the flows happen between them. Inflow and return are the two sorts of spatial moves. Particularly, final return means the end of migration cycle (King, R. 2002). If the attraction force of sending area is not so strong and the receiving area pushes the immigrants away, a third area develops as the next destination. In case of unsuccessful decision, the immigrants search a fourth area if they exclude coming back to the previous places.

The introduction of repeated and serial migration is described as the prototype of migration system. Ossman (2004) utilized the term 'serial migration' to indicate non-recurring migrants who undertook a series of migration rather than a simple event of migration. With that migration pattern, the series do not break and serial migration system emerges without any return. Although the serial of remigration happen (multiple moves) and the elements of the moves are three or more but we can not interpret it as circulation because it is not a return to any previous places. First parity return is enough for circulation in the receiving country if the number of residences is at least three. (In case of two residences, the first parity back move is nothing else that a return migration.) According to the arguments pro and con listed above, we can conclude that at least three interlinked and recurring migration steps are necessary between two places for the creation of circulation.

All in all, our proposal for the exact definition of circulation from the spatial angle within the context of human moves is as follows: *circulation is a hetero-space and discrete-time spatial mobility system containing at least three inter-*

linked individual moves in which two have return character. We utilise consciously the broadest concepts related to human moves just as "spatial mobility system" and "move" in order to conceptualise easier the notion of circulation connoted tourism, commuting, residential mobility and migration as well. It usually involves return and repetition. In other words, international circular migration constitutes multiple return moves within the same spatial system.

Data and methods

One of the inevitable problems of the statistical measure of international migration is the under-registration of emigrants (Borrel, C. 2004). In the absence of obligatory reporting of emigration in the sending country sources (registration, population census, survey), we cannot gain reliable data of emigration (Tóth, J. 2004; Kovacsics-Nagy, K. 2006). Registration of receiving country could be used as "mirror statistics" for the country of origin. This is the first solution, but it could function in an appropriate way if numerous bilateral agreements are entered into force among the bodies involved. It seems to be a more effective solution if an international organization collects migration data harmonised from its member states. After that the data produced on unified principles and methods will be published by international organization with any possible dimensions. Both methods are used by the Hungarian Central Statistical Office, but the common shortcoming is that the quality of the data compiled echoes the level of the least quality national statistics. Another problem of the data of emigration is that it is not possible to make a sophisticated analysis for instance of gender and age specific analysis, not to mention the other dimensions.

The present study aims to enrich our knowledge of circulation within international migration context focusing on Hungary as a receiving country. One of the main shortcomings of research of circulation is the lack of reliable data. Few circular movements are documented quantitatively so data gathering is essential (Newland, K. *et al.* 2008). Naturally, Hungary is an individual (maybe exceptional) case, however, its statistical system provides us to create unique database on international circular migrants.

The database consists of individual data files on immigrants for each year between 2001 and 2008. According to the official statistical definition, immigrant means a foreign citizen who entered Hungary in the given year and obtained a permanent residence or settlement permit for a year or more. The database originated from the continuous registration system of Office of Immigration and Nationality.

The database was at the disposal of the researchers on identifiable manner. The individual data files contain the immigrants' surnames, forenames, genders, dates of birth and places of birth, marital status, citizenship, the exact

addresses of usual place of residence in Hungary and any important information for administrative purposes. We compared one of the three years under investigation with the previous years started with 2006 (2006 with 2001–2005, 2007 with 2001–2006 and 2008 with 2001–2007). With the help of this data sets, we created a special computer programme for multi-level identification system to fit for distinguish individuals between different time periods.

All in all, we examined three enumerations separately and the number of total immigrants entered Hungary during three calendar years, 2006–2008; the number of immigrants already registered by the immigration office in previous years; differences between circulating migrants and single-moved international immigrants by gender, age, family status, citizenship. In other words, we compared circular international migrants with those who had got the immigrant status for the first occasion (parity).

In the following empirical section we deal with the phenomenon of circulation as one of the systems of the international migration. We concentrate on Hungary as a receiving country. We examine the demographic composition of circulars by gender, age, family status and the country of citizenship. Considering the territorial patterns in Hungary, we analyse the spatial distribution of the county of residence.

Results of research

In this section of paper we deal with the phenomenon of circulation as one of the parts of the international migration as a multi-layered phenomenon. The empirical analysis below on international circular migrants is limited to the Hungarian immigration data. That choice has several advantages. The data set come from full-scope register. The data gathering, processing and methods of analysis are unified to fit for international recommendations. We don't deal with emigrants from Hungary directly. In this study we concentrate on the immigration side of multiple movers with non-Hungarian citizenship. As reference group, of course, we can distinguish the first parity immigrants from international circular immigrants.

Here we employ micro-files, a unique data source consisting of those foreign citizens' data. We utilise flow type of data due to net migration figures disguise the multiple movements in which circulation, as well. Between 2006 and 2008 77,521 foreign immigrants entered Hungary, from among 10,907 people had already stayed in Hungary in immigrant status. This means that more than 14 percent of circulars had personal experiences of the country (that share could be even higher; but we had access only to data since 2001).

Based on the results, 57.3 percent of the total number of immigrants were men and 42.7 percent were women between 2006 and 2008. Among circu-

Table 1. Numbers of international immigrants and international circular immigrants by gender in Hungary from 2006 to 2008

Year	All immigrant	Circular immigrant	Share of circular, %
Male			
2006	10,684	1,820	17.0
2007	12,753	1,904	14.9
2008	20,972	2,321	11.1
Total	*44,409*	*6,045*	*13.6*
Female			
2006	8,683	1,536	17.7
2007	9,854	1,560	15.8
2008	14,575	1,766	12.1
Total	*33,112*	*4,862*	*14.7*
Together			
2006	19,367	3,356	17.3
2007	22,607	3,464	15.3
2008	35,547	4,087	11.5
Total	*77,521*	*10,907*	*14.1*

lar migrants that percentage was the following: men 55.4 percent; women 44.6 percent. We can conclude that male surplus exists among circular migrants, too. But the probability that an international migrant woman can become a circular is higher than a man all years investigated. From gender perspective, the higher probability for females to become circular migrants is one of the symptoms of the feminisation process within international migration.

Examining the circular migrants according to the parity of entering Hungary (*Table 2*), it can be ascertained that parallel with the increasing parity, the circular subpopulation's age structure is growing older. This statement is valid for mainly people age 20–39 years old, economically active population.

Labour mobility would be the overwhelming part of cycles of repeated migration and many of migrants are involved in one or more steps of emigration and return. In the Hungarian labour market the circular immigrants might feel marginalized from the host society and they simultaneously retained links to sending country through remittances, dual entrepreneurial activities (Rédei, M. 2007) and back and forth movement, reflecting attachment to both sending and receiving countries, too. Circular migration is facilitated by changes in transport technology which have contributed to the integration of countries and continents. From the point of view of parity, the highest share of firstly immigrated population has the age group 20–24 (15.7 percent), but the parallel value of circular migrants, the age group of 25–29 marks the zenith (2.7 percent).

In this respect we can conclude that university students and young elders arrived in Hungary first time have no previous migratory experiences (L. Rédei, M. 2009). The relative absence of international retired migrants

Table 2. Age distribution of international non-circular (1) and circular (2–X) immigrants by entering in parity of Hungary between 2006 and 2008, percent

Age groups	Numbers of entering					Total
	1	2	3	4	Together (2–X)	
Male						
0–4	4.4	0.5	0.1	0.0	0.6	4.9
5–9	1.9	0.3	0.1	0.0	0.4	2.3
10–14	1.7	0.2	0.1	0.0	0.3	2.0
15–19	7.2	0.4	0.1	0.0	0.5	7.7
20–24	15.1	1.2	0.4	0.0	1.7	16.8
25–29	13.0	1.9	0.5	0.0	2.4	15.4
30–34	9.9	1.6	0.5	0.1	2.1	12.0
35–39	7.9	1.2	0.4	0.0	1.6	9.5
40–44	6.2	0.8	0.3	0.0	1.1	7.2
45–49	5.2	0.7	0.2	0.0	1.0	6.2
50–54	4.2	0.6	0.2	0.0	0.7	5.0
55–59	3.1	0.4	0.1	0.0	0.5	3.6
60–64	2.7	0.2	0.1	0.0	0.3	3.0
65–69	2.3	0.2	0.0	0.0	0.2	2.4
70–74	0.9	0.1	0.0	0.0	0.1	1.0
75–79	0.5	0.1	0.0	0.0	0.1	0.6
80–84	0.1	0.0	0.0	0.0	0.0	0.2
85–X	0.1	0.0	0.0	0.0	0.0	0.1
Total	*86.4*	*10.3*	*3.0*	*0.4*	*13.6*	*100.0*
Female						
0–4	5.5	0.6	0.1	0.0	0.7	6.1
5–9	2.5	0.4	0.2	0.0	0.6	3.1
10–14	2.2	0.3	0.1	0.0	0.4	2.6
15–19	7.9	0.5	0.2	0.0	0.7	8.6
20–24	16.4	1.9	0.6	0.1	2.7	19.1
25–29	12.6	2.2	0.6	0.1	3.0	15.6
30–34	7.7	1.5	0.4	0.0	1.9	9.6
35–39	5.9	1.0	0.2	0.0	1.2	7.1
40–44	4.5	0.6	0.2	0.0	0.8	5.3
45–49	4.1	0.6	0.1	0.0	0.7	4.9
50–54	3.8	0.5	0.1	0.0	0.6	4.4
55–59	4.0	0.4	0.1	0.0	0.5	4.5
60–64	3.2	0.3	0.0	0.0	0.4	3.5
65–69	2.3	0.2	0.1	0.0	0.2	2.5
70–74	1.3	0.1	0.0	0.0	0.1	1.5
75–79	0.6	0.1	0.0	0.0	0.1	0.7
80–84	0.5	0.0	0.0	0.0	0.1	0.5
85–X	0.2	0.0	0.0	0.0	0.0	0.3
Total	*85.3*	*11.3*	*3.1*	*0.3*	*14.7*	*100.0*

Table 2. continue

Together						
Age groups	Numbers of entering					Total
	1	2	3	4	Together (2–X)	
0–4	4.8	0.5	0.1	0.0	0.6	5.5
5–9	2.2	0.3	0.1	0.0	0.5	2.7
10–14	1.9	0.2	0.1	0.0	0.3	2.2
15–19	7.5	0.5	0.1	0.0	0.6	8.1
20–24	15.7	1.5	0.5	0.1	2.1	17.8
25–29	12.8	2.0	0.5	0.1	2.7	15.5
30–34	9.0	1.5	0.5	0.0	2.0	11.0
35–39	7.0	1.1	0.3	0.0	1.5	8.5
40–44	5.4	0.7	0.2	0.0	1.0	6.4
45–49	4.8	0.7	0.2	0.0	0.9	5.6
50–54	4.1	0.5	0.2	0.0	0.7	4.7
55–59	3.5	0.4	0.1	0.0	0.5	4.0
60–64	2.9	0.3	0.1	0.0	0.3	3.2
65–69	2.3	0.2	0.0	0.0	0.2	2.5
70–74	1.1	0.1	0.0	0.0	0.1	1.2
75–79	0.6	0.1	0.0	0.0	0.1	0.6
80–84	0.3	0.0	0.0	0.0	0.0	0.3
85–X	0.1	0.0	0.0	0.0	0.0	0.2
Totall	*85.9*	*10.7*	*3.0*	*0.3*	*14.1*	*100.0*

within circulars may be partly associated with the return migration of former Hungarian emigrants in the socialist epoch. The return migration might be combined with the increasing trend of amenity seeking migration with previous tourism experiences (Illés, S. and Kincses, Á. 2008; Michalkó, G. 2010).

The distribution of average age by parity reflects unexpected demographic patterns of international circular migrants (*Table 3*). The average ages do not increase in parallel with the growing number of entering. For instance, the average age of three and four times immigrants is lower than once and twice immigrants.

This regularity is stronger for women than men. In addition, the average age of female international circular migrants is lower (younger) by parity than male counterparts. We can hypothesise with grand probabilities that women started their immigration careers to Hungary earlier than men and the emergence of the circulatory patterns of international migration is not a long-lasting phenomenon. We suppose that economic reasons dominate but beyond economic motives people also circulate as members of migration units (mainly children and other dependents) to seek better educational opportunities (student migration), to be closer to families among other particular reasons (for instance retirement).

Table 3. Average age of international non-circular (1) and circular (2–X) immigrants by parity of entering in Hungary from 2006 to 2008, percent

Year	Numbers of entering					Total
	1	2	3	4	Together (2–X)	
Male						
2006	31.4	33.6	30.1	38.4	33.3	31.7
2007	32.2	29.4	32.5	34.4	31.4	32.0
2008	33.0	34.2	35.7	34.9	34.3	33.2
2006–2008	32.4	33.1	32.7	34.6	33.1	*32.5*
Female						
2006	30.5	31.0	28.7	29.5	30.9	30.5
2007	32.6	28.7	29.6	27.6	29.1	32.0
2008	32.3	33.7	31.2	29.2	33.5	32.4
2006–2008	*31.9*	*31.8*	*29.8*	*28.0*	*31.2*	*31.8*
Together						
2006	31.0	32.4	29.5	33.7	32.2	31.2
2007	32.4	29.0	31.3	31.7	30.3	32.0
2008	32.7	34.0	33.8	32.3	33.9	32.9
2006–2008	*32.2*	*32.5*	*31.4*	*31.9*	*32.3*	*32.2*

As the next step of data analysis, we examine the demographic structure regarding the family status (*Table 4*). Perhaps, the most interesting finding is that the share of single people (53.6 percent) among the circular migrants is higher than in case of others (47.4 percent). It suggests us that this "mobile way of life" is not typical for those who have formal partnerships with or without children. But we can not state that the probability of circulation is higher among people without formal partnership than among people with partners due to the lower share of widowed and divorced circulars. Such findings feed arguments related the erosion of traditional family concept and the creation of new types of community.

The analysis of spatial distribution of all immigrants shows that they are concentrated in two typical areas in Hungary (*Table 5*). Firstly, 60.1 percent of them live in Budapest and its surroundings. Budapest and Pest county are the general dynamic migration centres of Hungary. We can suppose that the group of highly-skilled and/or creative foreigners is an overrepresented group amongst circulars in this region (Williams, A.M. and Balaz, V. 2008; Egedy, T. *et al*. 2009; Egedy, T. and Kovács, Z. 2011).

The proximity of the border is an important geographic motive, which is not a barrier but a contact zone from the aspect of migration flows. Secondly, migrants from neighbouring countries prefer to settle down on the Hungarian side of the border and become frequently commuters or self-employed/entrepreneurs. Border counties are traditionally considered as disadvantageous

Table 4. Family status distribution of international non-circular (1) and circular (2–X) immigrants by parity of entering in Hungary between 2006 and 2008, percent

Family status	Numbers of entering					Total
	1	2	3	4	Together (2–X)	
Male						
Single	49.4	52.5	52.0	48.7	52.3	49.8
Married	43.9	42.6	42.9	46.2	42.8	43.7
Widowed	1.9	1.0	1.9	1.3	1.2	1.8
Divorced	4.9	3.9	3.3	3.8	3.8	4.7
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Female						
Single	44.7	52.8	62.6	70.9	55.2	46.2
Married	44.7	36.6	30.3	23.6	35.0	43.3
Widowed	5.0	4.9	3.2	3.6	4.5	4.9
Divorced	5.6	5.7	3.9	1.8	5.2	5.6
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Together						
Single	47.4	52.6	56.6	57.8	53.6	48.3
Married	44.2	39.9	37.4	36.9	39.3	43.5
Widowed	3.2	2.8	2.5	2.2	2.7	3.1
Divorced	5.2	4.7	3.6	3.0	4.4	5.1
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

territories according to location theories and because of the barriers in international trade and the threats of military invasions. The alteration of this unfavourable image could generate a new increase in traffic in the border counties through deeper international economic integration – with lower trade barriers mainly ethnic Hungarians (Kocsis, K. *et al.* 2006). These counties (Csongrád, Hajdú-Bihar and Szabolcs-Szatmár-Bereg) have characteristics by which they can be defined as active contact regions.

The residence of international circular migrants is highly concentrated in the capital, Budapest (51.2 percent) and its surrounding area, namely in Pest county (12.1 percent). The capital is the main receiving areas of Hungary. The circulation is more or less typical for border regions of neighbouring countries (Romania, Ukraine and Serbia) as well, but the level was below the average. According to *Table 5,* we can explore an extreme territorial pattern among the fourth parity circular immigrants. Their shares are relatively high in the border counties of Serbia (Csongrád), Romania (Hajdú-Bihar, Szabolcs-Szatmár-Bereg) and Austria (Vas). We can presume that this phenomenon is strongly correlated with the growing importance of cross border activities. A significant Hungarian minority live in Slovakia with a low share of international circular migrants (1.6 percent) to Hungary. But this phenomenon focused in the western part of the border area.

Table 5. Territorial distribution of international non-circular(1) and circular (2–X) immigrants by county (NUTS 3 level) and parity of entering in Hungary between 2006 and 2008, percent

County	Numbers of entering					Total
	1	2	3	4	Together (2–X)	
Budapest	47.4	51.1	53.8	13.3	51.2	48.0
Baranya	1.7	1.7	2.7	0.0	1.8	1.7
Bács-Kiskun	2.3	2.5	2.7	6.7	2.5	2.3
Békés	0.9	1.4	1.1	0.0	1.4	1.0
Borsod-Abaúj-Zemplén	2.2	1.7	0.8	0.0	1.6	2.1
Csongrád	5.4	4.8	12.6	26.7	5.5	5.4
Fejér	2.0	2.0	1.1	0.0	1.9	2.0
Győr-Moson-Sopron	5.9	3.7	1.9	6.7	3.5	5.5
Hajdú-Bihar	3.8	4.1	5.3	13.3	4.2	3.8
Heves	1.5	1.2	1.1	0.0	1.2	1.4
Komárom-Esztergom	2.1	2.3	0.8	6.7	2.2	2.1
Nógrád	0.7	0.6	0.4	0.0	0.5	0.7
Pest	12.1	12.6	6.1	13.3	12.1	12.1
Somogy	1.7	1.1	2.3	0.0	1.2	1.6
Szabolcs-Szatmár-Bereg	2.8	2.6	2.3	6.7	2.6	2.8
Jász-Nagykun-Szolnok	1.1	1.1	0.4	0.0	1.0	1.1
Tolna	1.0	0.7	0.4	0.0	0.7	1.0
Vas	1.3	1.6	3.4	6.7	1.7	1.4
Veszprém	1.3	1.8	0.8	0.0	1.7	1.4
Zala	2.9	1.4	0.0	0.0	1.3	2.6
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

We could shade the county-level analysis of the territorial distribution of international circular migrants if we depict the small-region level share of circular migrants within all immigrants. But any attempt to identify the emergent spatial characteristics in international circular migration over a period of investigated must be inevitably full of caveats, to some degree speculative, certainly debatable. However, it is out of the scope of the current study.

Another interesting aspect of international circular migration concerned spatiality is the latest choice of residence of international circular migrants. In this context two questions arise: 1. Which regions were preferred by circulars? 2. Did the international circular migrants return to their previous county of residence and to what extent? Regarding the territorial preferences, we examine if there are attractive areas for circular migrants. It is also an interesting question whether those who return to Hungary decide to stay in their previous county of residence or they choose a new one.

Our insight is limited by virtue of our exclusive focus on counties (*Figures 1–3*). Based on the territorial distribution, we conclude that the county of residence of the international circular migrants changed in high extent. The

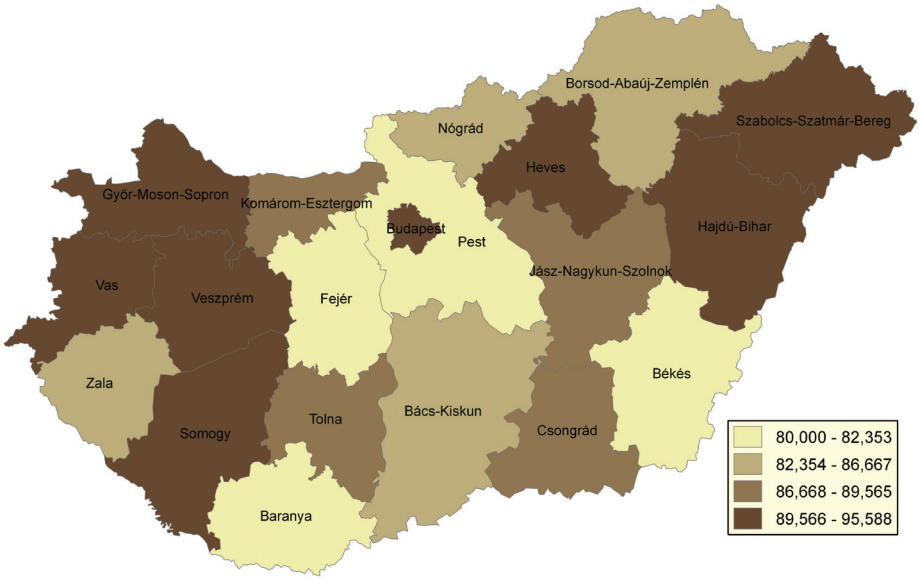

Fig. 1. The proportion of the same county of residence of circular migrants last entering in Hungary as their previous (2001–2005) county of residence in 2006, percent

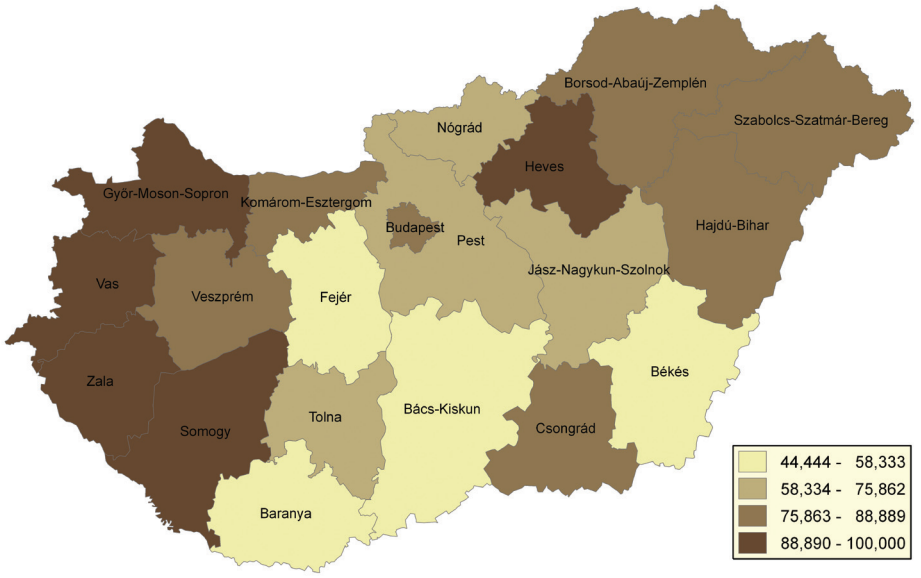

Fig. 2. The proportion of the same county of residence of circular migrants last entering in Hungary as their previous (2001–2006) county of residence in 2007, percent

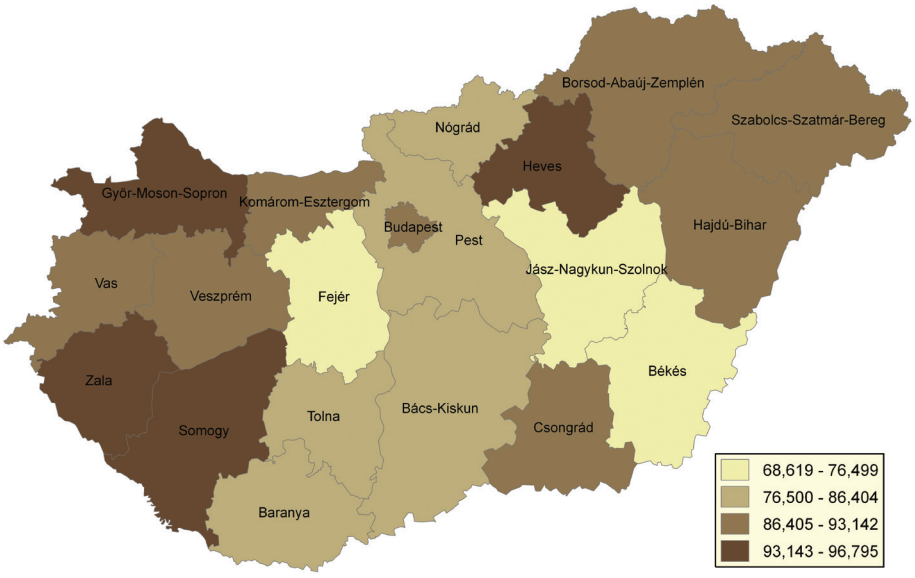

Fig. 3. The proportion of the same county of residence of circular migrants last entering in Hungary as their previous (2001–2007) county of residence in 2008, percent

share of the resettlement of the same county was above 81.9 percent among all Hungarian counties in 2006 but varied highly later, in 2007 (44.4 percent) and in 2008 (68.6 percent).

In 2006 Vas county (95.6 percent), the capital, Budapest (94.4 percent) and Hajdú-Bihar county (93.7 percent) had the highest attracting force for circulars. In contrast, the lowest pulling force characterised Pest county (81.9 percent), Békés county (82.4 percent) and Nógrád county (84.2 percent). The weak force of return could be explained by the fact of the relative underdevelopment in case of Békés and Nógrád counties, but the situation of Pest county was peculiar in this context so as to its non-returnees arrived mainly in Budapest (15.1 percent) and the 3 percent residuum dispersed even in Hungary.

The highest share of non-returnees of Békés (7.8 percent) and Nógrád (5.3 percent) counties also chose the capital as their next residence, but a larger extent of residuum was concentrated in the neighbour counties, as well. If the previous county of residence were Pest, Fejér, Békés, Baranya, Bács-Kiskun, Komárom-Esztergom, Csongrád and Győr-Moson-Sopron counties, the non-returnees tended mainly towards the capital. This relationship was not valid for Vas, Tolna, Hajdú-Bihar, Borsod-Abaúj-Zemplén, Veszpém, Zala, Somogy, Heves and Szabolcs-Szatmár-Bereg counties where the main county of return was not Budapest, except for themselves.

The circular international migrants who previously lived in Budapest were attracted secondly by Pest county, surrounding the capital. They fuelled the suburbanization processes, just as internal migrants in Hungary, but to smaller extent (2.4 percent). The so called counter-flow from Pest county to Budapest increased much more than the general concentration trend.

In 2007 all circulars who previously lived in the county of Győr-Moson-Sopron, Heves, Somogy, Vas and Zala returned to the same county. Békés county (44.4 percent), Fejér county (57.1 percent), Tolna and Jász-Nagykun-Szolnok counties (both 66.7 percent) had the lowest attracting force. That year the weak force of return could not be explained by the fact of the relative underdevelopment in case of Fejér and Tolna counties. Pest county was peculiar again so as to its non-returnees arrived mainly in Budapest (17.2 percent) and the 6.8 percent residuum concentrated in two counties only in Hungary. With the exception of Pest county, the highest share of non-returnees of Békés (33.3 percent), Bács-Kiskun (33.3 percent), Jász-Nagykun-Szolnok (33.3 percent), Fejér (28.6 percent), Csongrád (12.2 percent) and Komárom-Esztergom counties selected mainly the capital as their next residence, but a larger extent of residuum was concentrated in the neighbour or non-neighbour counties. In contrast, if the previous county of residence was Baranya, Borsod-Abaúj-Zemplén, Győr-Moson-Sopron, Heves, Nógrád, Somogy, Szabolcs-Szatmár-Bereg, Tolna, Vas, Veszprém and Zala counties for international circular migrants, they did not move to Budapest. The circular international migrants who previously lived in Budapest were attracted secondly by Pest county (6.5 percent). They fuelled strongly the suburbanization processes that year just as internal migrants in Hungary. The counter-flow from Pest county to Budapest was much stronger (17.2 percent) and demonstrated the general concentration trend again.

In 2008, which was the last year under investigation, Győr-Moson-Sopron county (96.8 percent), Heves (96.0 percent), Zala (95.6 percent), Somogy (93.8 percent) and the capital, Budapest (91.5 percent) had the highest attracting force. At the same time Jász-Nagykun-Szolnok (68.6 percent), Békés (75.6 percent), Fejér (76.5 percent) Baranya (79.4 percent) and Bács-Kiskun (80.9 percent) had the lowest pulling force. The weak force of return could be explained by the fact of the relative underdevelopment in case of Jász-Nagykun-Szolnok, Békés and Bács-Kiskun counties, but Baranya and Fejér counties were in relatively strong developmental position in Hungary. Pest county was a peculiar case again so due to its non-returnees who arrived mainly in Budapest (11.9 percent) and the 3.8 percent residuum who dispersed more or less evenly in Hungary. With the highest shares, most of the non-returnees of Jász-Nagykun-Szolnok (28.7 percent), Fejér (16.3 percent), Békés (13.7 percent) and Bács-Kiskun (13.0 percent) counties also chose the capital as their next residence.

That relationship was not valid for Vas, Tolna, Zala, Borsod-Abaúj-Zemplén, Somogy and Heves counties where the main county of return was not Budapest, except for themselves. The circular international migrants who previously lived in Budapest were attracted secondly by Pest county. They enhanced the suburbanization processes, just as /similarly to internal migrants in Hungary, but to a smaller extent (3.6 percent). The residuum was dispersed among other counties. The streams from Pest county to Budapest were much more stronger (11.9 percent) than the so called counter-streams and this part of circulars fuelled the general concentration trend without exception.

Conclusions

In our study we put special emphasis on the spatial aspects of the Hungarian appearance of the newly emerging phenomenon, namely circulation, which return moves are flooding among multiple residences. Circulation is one of the interesting and rarely studied patterns of migration not only in Hungary but also worldwide. What is perhaps most symptomatic but has not been well documented yet is the increase of circulatory movements within migration systems. The interest of this research lies in long-term, spontaneous international circular migration where the governments of receiving countries did not take any attempts to encourage it. Based on that research, we proposed a proto-definition of international circular migration: International circular migration is a hetero-space and discrete-time system. It contains at least two or more destinations and three or more interlinked and repeating international spatial moves between countries involved.

The database originated from the continuous registration system of Office of Immigration and Nationality and contained individual data files on immigrants each year between 2001 and 2008. The full scope and comprehensive administrative database indicates that multiple immigration (circulation) of foreigners to Hungary as the host country is a mass phenomenon, so we provides empirical evidences of international circular migrants. The contribution relates to the common patterns and central issues of international circular migration.

Between 2006 and 2008 more than 14 percent of all immigrants who arrived in Hungary were circular migrants having experience of living conditions in the host country due to their previous stay as the status of immigrants. The gender composition of international circulars corresponds to general sex ratio of immigrants for the period investigated. It means that men dominate among international circular migrants as well as among all international migrants but to a smaller extent. We pointed out that international migrant women become circulars with higher probability than corresponding men

value. The most characteristic age group is the age group of 25–54 which comprises people who have received immigrant status more than once. We assume that labour mobility would be the overwhelming type of repeated migration and many of migrants are involved in one or more parts of emigration and return. The female age composition is younger than that of male counterpart. In other words, the average age of female international circular migrants is lower by parity than that of males. We suppose with grand probabilities that women started immigrate to Hungary earlier than men. The vast majority of circular migrants are single people (53.6 percent). This is the main vigorous demographic result of our research.

The Hungarian county of residence of long-term international circular migrants highly concentrates in the capital, Budapest (51.2 percent) and in its surrounding area, namely in Pest county (12.1 percent). The circulation is more or less typical for border regions of neighbouring countries (Romania, Ukraine and Serbia) as well.

The high concentration of the elements of demographic composition and the destination choice in Hungary mirrored that the international circular immigrant subpopulation was regarded as multiply selected group. With their first immigration to Hungary, they left from the internationally immobile group of people. With their second parity immigration, they rose above the crowd of foreign citizens with immigrant status who emigrated firstly from Hungary and they became international circular immigrants. The circular migrants transformed smaller and smaller groups via the increase of parity. As the results of their multiple metamorphoses, they became more and more self-resembling subpopulation. The multiple selection mechanisms caused the peak of the economically active singles and Budapest just the main destination.

We explore attractive areas for international circular migrants. One who returns to Hungary may decide to stay in his previous county or they choose a new one. Based on the research, we conclude that the county of residence of the international circular migrants changed in huge extent. The share of the resettlement of the same county oscillated between 44.4–81.9 percent in the Hungarian counties during the studied period. It means that returners went back to their Hungarian county of emigration.

We conclude that the demographic data of long-term international circulars and the territorial patterns of circulation could change a lot year by year in particular, in general from time to time. Our research also underlined that a highly changeable character of circulation was the only common feature concluded studies, worldwide (Cassarino, J-P. 2008; Newland, K. *et al*. 2008).

Through the process of circulation thousands of return migrants flowed to Hungary year by year who had had former positive experiences on the country. The results that emerged from this study raised several ques-

tions for the future research. Finally, we can draw a framework for our future research steps planned. We can explore the circulars' individual motivational systems, social networks and social capitals with the series of ground works with a large variety of adequate methods. The sampling and the choice of the places of surveys rely on the data and the research results of administrative registers (for instance, see this contribution) and the relevant international literature.

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GIS mapping in the geodemographic studies (Case study of the Republic of Belarus)

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Abstract

The work deals with the options of using geoinformational technologies in the population geography as exemplified by the GIS-models of the rural population of the Republic of Belarus (RB). The methods to create GIS-model with a brief characteristic of the stages are presented. The comparative analysis of two methods of mapping of the relative demographic values (colour scales and map-image transformation) is conducted. Technical and practical aspects of the map-image transformation method in geodemography are considered in the first part of the article.

Trends of dynamics of rural population size for the period of 1959–2009 years are detected and characterized in the second part of the article. Spatial patterns were identified in accordance with these trends of the rural population of the RB. The area of RB is typified on the basis of the character of demographic dynamics and natural movement processes of rural population. There have been identified three types of districts by the nature of the dynamics of rural population for the period of 1970–2009 years: stable, growing and shrinking; and three types of natural population movement dynamics for the same period in accordance with spatial and temporal heterogeneity of rural depopulation.

Keywords: population geography, GIS-modelling, demographic dynamics, rural population of the RB, spatio-temporal shifts.

Introduction

The recent trends in the development of geodemographic studies show the significant growth in their number and the use of increasingly sophisticated tools. The considerable amount of demographic statistical information calls for their systematization using the mathematical methods and the application of computer software.

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The characteristic feature of the modern cartographic tools is the wide use of the computer and GIS technologies. For processing spatial data, the Environmental Systems Research Institute (ESRI) has created the ArcGIS package, which allows visualising data, performing mathematical calculations, spatial and geostatistical analysis in 2- and 3-dimensions. This software package has been customized in the economic and geographical studies on the population of RB in the Scientific Research Laboratory of Regional Demographic Problems on the Faculty of Geography of BSU since 2002 with the participation of the authors.

The first GIS developed was the Demographic Atlas of Belarus (2002), followed by the Rural Areas of Belarus GIS featuring the rural population places in 1959–1999 and the GIS-Gallery of the demographic potential of the rural areas of the country using the grid-model and the method of pseudo-isolines (2003). In 2004 the Rural Population of Belarus GIS was created, showing the dynamics and the spatial patterns of the development of demographic processes in 1989–1999, which was updated with the results of the 2009 census of the RB (Antipova, E. 2008).

Methods and information basis of the "Rural Population of Belarus" GIS

The current demographic record materials from the National Statistical Committee of the Republic of Belarus, the 1989 (USSR), 1999 and 2009 (RB) population censuses formed the information basis of the research. The works of the Russian scientists in the field of geoinformatics and geoinformational thematic mapping served as the theoretical and methodological background of the research (Tikunov, V.S. and Tsapuk, D.A. 1999; Kapralov, E.G., Koshkarev, A.V. and Tikunov, V.S. 2004).

The research resulted in the development of the new methodological approach to the geographic systematization through the solution of the following theoretical and practical tasks:

1. Creation of the electronic database of the rural areas of Belarus in the regional level – according to the administrative divisions since 1989;
2. Creation of the demographic GIS "Rural population of Belarus" of the regional level (based on the data of the 1989, 1999 and 2009 population censuses);
3. Elaboration of the dynamic comparative geographic GIS-model of the rural population of Belarus on the basis of the GIS-technologies and the ArcGIS software package.

The structure of the general DemoGIS "Rural population of Belarus" comprises several projects that are grouped into thematic blocks with a system of special indices (*Table 1).*

Table 1. Structure of the "Rural population of Belarus" DemoGIS

GIS project name	GIS level	DemoGIS thematic groups	Demographic indices of the thematic groups	Number of themes in the project	Demographic datatimelines	Data dependence structure	Map themes in the project
GIS project 1'Rural population of Belarus'	regional	1. Natural population movement	birth rate, mortality rate, natural population increase/decrease	64	retrospective (1989, 1999), present (2004)	plex	Analytical maps of the demographic indices
		2. Population structure by sex and age	population size and the share of the main age groups		retrospective (1989, 1999), present (2004)	plex	
		3. Migration	number of immigrants, number of emigrants		retrospective (1999)	plex	
		4. Population settlement	population size of the rural settlements		retrospective (1959, 1979, 1989, 1999), present (2004)	hierarchical	
GIS project 2 'Rural population of Belarus'	local	Demographic potential	rural settlements population size	354	retrospective (1959, 1979, 1999), present (1999), perspective	relational, hierarchical	Analytical maps of the demographic potential
GIS project 3 'Complex demographic zoning of the rural area of Belarus'	regional	1.Demographic situation	Demographic types identifying: dynamics of the population increase/decrease, dynamics of the birth- and mortality rate, degree and speed of depopulation, demographic load, population ageing, agricultural load, settlement distribution	4	retrospective (1989, 1999), present (2004)	hierarchical	Integral maps of the demographic conditions
		2. Settlement system					

The study indicated that the work on the creation of a demographic GIS using the ArcGIS 9.3, regardless of the GIS level chosen, has a consistent methodology and can be theoretically performed in three steps (Antipova, E. 2007a).

The first step consists of the analysis of the demographic data that is processed to choose the raster map basis and to create the necessary layers of the spatial data. As the second step, attribute table of the vector polygonal theme are created. The third step involves mapping on the basis of the values of a certain field in the attribute table. A major part of the derived demographic indices was calculated using the tools for the attribute information processing in the GIS.

The most widespread method of illustrating the area population rate is creating population density maps (*Figure 1*) using the method of isolines in conjunction with the method of colour scales (isolines with layer colouring). It consists of the interpolation of the population density values on the surface, each point of which is defined by the pair of the x and y coordinates.

The method of the scaled map symbols (dot method) is best suited for the mapping of the average rural settlement size.

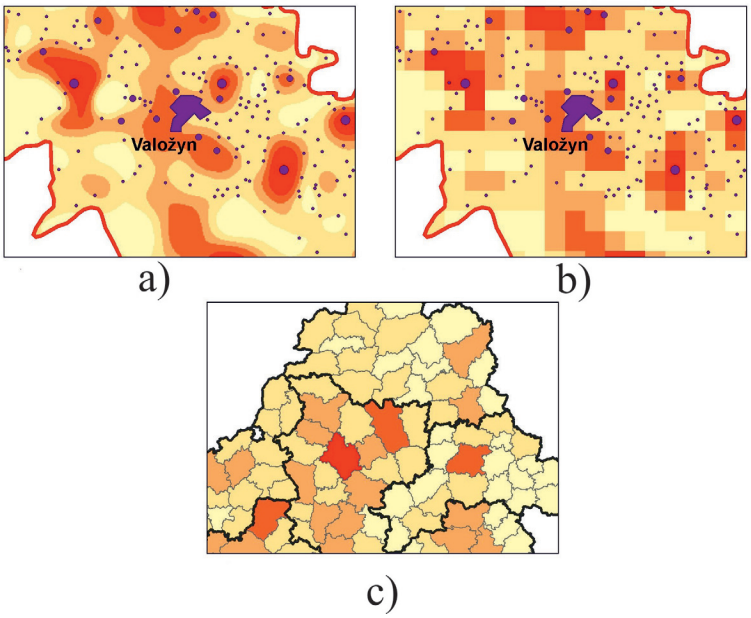

Fig. 1. Methods of the population density mapping. – a = method of isolines with a layer colouring; b = method of grid networks; c = cartogram method. (Hereinafter inscriptions are developed according to Resolution of the State Committee of Land Resources, Geodesy and Cartography of the Republic of Belarus, 23.11.2000, No. 15 "Transliteration Instruction of the Republic of Belarus geographical names by Latin alphabet")

It implies building a population density marker in a semi-centre point of each region, the sizes of the markers depending on the selected classification key.

The best suited methods of mapping the relative demographic values are the methods of the diagrammatic maps and colour scales (cartograms), which give an illustrative view of the cartographic image transformation method, that involves scaling dispersion of the total data for every region, as well as the anamorphosis method or the area of the administrative-territorial unit according to the value of the index (Gusein-Zade, S. 2008). For instance, the map "Structure of the rural settlements in Belarus according to the population classes" was created with the use of the method of localised pie-charts *(Figure 2*).

The colour scales method is widely used in geodemographic studies and it was developed in the previous works of the authors (Myshlyakov, S. and Fakeyeva, L. 2005).

For mapping the characteristic with substantial regional differences, the transformed image – anamorphosis – is the most informative form of visualising the spatial differentiation of the index *(Figure 3).*

Let's have a closer look at the map-image transformation method. The creation of such transformed maps (*density-equalized maps* or *cartograms*) is methodically based on the work of American researchers Gastner and Newman "Diffusion-Based Method for Producing Density-Equalizing Maps" (Gastner, M. and Newman, M. 2004).

The use of the method that is physical by its nature that was proposed by these scientists was organised in the ArcGIS 9.3 software package with the help of the tool for the cartogram creation (created by T. Gross, ESRI) that is distributed for free (www.esri.com/arcscripts). The source data should be the polygons (object class and layers can be used too) with the necessary attribute parameters for the calculations.

The data is output exclusively to the created object class (in the existing personal database). The additional key parameters are the density smoothing factor and the number of cells in the analytical grid. The first parameter, having the default value of 1, can have values from 0 to 100. The second parameter is the number of cells in the analytical grid and it varies from 128 to 4,096 with the default value of 512.

The lower is the cell size, and the bigger is the number of cells, respectively, the more precise is the cartogram in showing the differentiation of the phenomenon.

Therefore, the use of the new methods of dynamic mapping in the population geography allows to use the special advantages of the GIS technology (functionality, scalability, use of visual aids, easy way of updating, efficiency, compatibility, modelling) and develop the interactive reference informational GIS projects for practising the regional management.

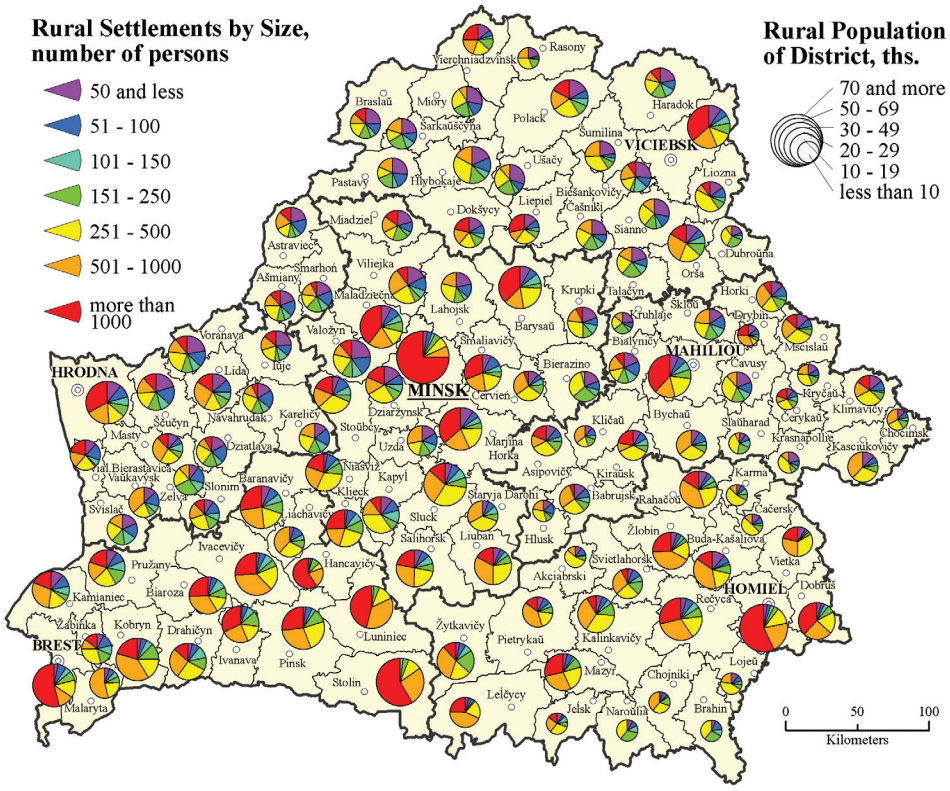

Fig. 2. Structure of the rural settlements in Belarus by the population classes, 2009

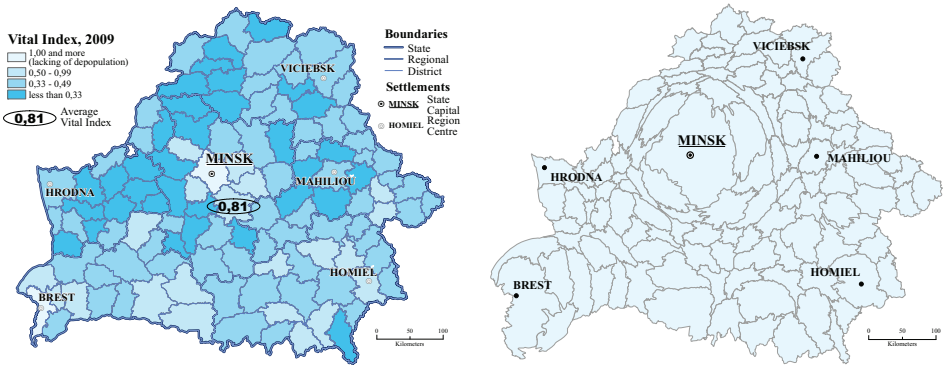

Fig. 3. Comparative characteristics of the cartographic images shown with the use of the method of colour scales (left) and transformations (right)

Trends of rural population size dynamics in Belarus

Natural increase or decrease, migratory movement, losses caused by warfare and by other political cataclysms (deportation, repression), the harmful effects of the Chernobyl disaster, population loss caused by the waves of emigration determined population dynamics in Belarus over the 20th century.

The distinctive features of the periods between censuses and the main types of population trends have been identified. It was based on the analysis of factors controlling rural population dynamics: the rate of increase or decrease in population size and of the ratio of the rural segment within the total population of Belarus (Antipova, E. 2008).

The period between 1959 and 1970 was characterized by the dominance of economic factors and it proceeded up to 1986. Urbanization played the role of the key factor at that time. It was the first period of the negative rural population dynamics on macro geographical level. Micro geographical level of research indicated the first wave of rural demographic disaggregation and the territorial differentiation of demographic dynamics. Thus, some districts with a positive dynamics of population size were elicited against the general background of rural population decline (0.1 percent per year for Belarus) as a result of migratory outflow. 69.2 percent was rural within the overall population of Belarus in 1959. Thus, the rural population prevailed in the demographic space during this period.

The period of 1970–1979 years was characterized by an accelerated rate of rural population decline (1.5 percent per year), the second wave of rural demographic disaggregation, the demographic space frame of settlement violation and the overall restructuring. The urban transition was completed on macro geographical level in the first place and a natural decrease of the rural population started.

The period between 1979 and 1989 is distinguished by the influence of ecological factor. Rural population experienced further decline and spatial redistribution of demographic potential during this period. Ecological decline under the influence of the Chernobyl accident and the socio-economic development of the country did not change trends in the dynamics of rural population essentially at this stage. Negative dynamics had not strengthened.

The transformation between 1989 and 1999 changed the demographic course in the country due to the impact of several factors. There had been political and socio-economic changes during these years: the disintegration of the Soviet Union, the switch of the former member republics of the USSR to the independent development, restructuring and the economical and social reforms. The emerging socio-economic crisis had deteriorated the living conditions of people. This caused a breach in the dynamics and spatial distribution of the population, the nature of demographic reproduction.

The process of urbanization slowed down markedly. The scale of internal rural to urban migration has been reduced thoroughly. Changes in population reproduction started following the disturbances in the migration process. Radio phobia and insecurity, unemployment, indigence caused a sharp decline of fertility. Deterioration of living conditions and health contributed to the increase of mortality.

In the end, natural increase had turned into natural population decline that affected not only elderly rural population, but also the relatively young urban cohorts (Manak, B. 1992; Manak, B. and Antipova, E. 1998).

The major trends in rural population size dynamics of the period 1989–1999 were:

1. Rural areas of Belarus were characterized by a persistent negative dynamics (1.2 percent per year), but the peak of the greatest annual rate of decrease (2.0 percent per year) was already passed in the late 1980's.

2. On micro geographical level only few districts retained positive or stable dynamics of the rural population as acceptor areas of demographic capacities. These districts usually were located in the gravity zone of cities (Brest, Homiel, Minsk) but none of them were found in Hrodna and Mahiliou regions.

3. The type of districts with negative demographic dynamics had become dominant in the rural regions (113 out of 118 districts) with the threshold rate of annual population decline from 0.01 percent in Stolbtsy district, Minsk region up to 4 percent in Narovlya district, Homiel region.

This period is characterized by a second evolutionary trend of Belarus rural population dynamics: there was a structural castling on the macro level between the ratio of urban and rural populations. In 1959 the rural population made up 70 percent and the share of urbanites accounted for 30 percent, and the ratio became diametrically opposed by 1999. Urban transition was completed in Minsk region later than in all other regions of meso geographical level (Antipova, E. 2008).

The above mentioned trends strengthened the structural imbalances and increased spatial polarization in the distribution of demographic potential of the rural population. There was a third wave of demographic disaggregation of rural areas that changed the usual pattern.

Thus, RB started the 21st century with negative population dynamics. The total population decline was 0.05 percent, the rural one was 0.2 percent for the period of 1999–2009.

Major trends in rural population dynamics at the end of the twentieth century remained typical at the beginning of the twenty-first century:

a) Negative dynamics develops under the influence of various factors, major among them are: ageing, changes in reproductive attitudes of the population, migration outflow of the young working population from the rural areas;

b) The annual decline of the rural population tends to increase compared to 1999: in Brest region – 1.3 percent, in Viciebsk – 2.4 percent, in Homiel – 1.9 percent, in Hrodna – 2.2 percent, in Minsk – 1.9 percent, in Mahiliou region – 2.5 percent as a result of combined impact of the above mentioned factors.

The study of the demographic development of Belarus since the first population census in the year 1897 until present allowed to conclude that the general dynamics of the demographic processes is the function of social and demographic evolution, while the spatial differentiation is influenced by a complex of features in the development of agroeconomics, settlements, transport, communications and ecology, as testified by the findings of the correlation and regression and factor analyses (Fakeyeva, L. 2008a).

Socio-demographic factor has the evolutionary dependency and has been determinant in the genesis of the depopulation process of the rural areas in Belarus that could already be observed back to the year 1975.

Over the 1970–1979 period, the territorial disparities were caused (similar to the first half of the 20th century) by the *agroeconomic* factor, that was studied with the involvement of indices such as the gross revenue in agriculture, land quality, and the power available in farming. Between 1989 and 2008 the *settlement* factor (the population change of rural settlements, the degree of urbanization) and the *transport and communication* factor (e.g. the density of paved roads) had been the dominant (*Figure 4*). The *ecological* factor have not had a substantial impact on the dynamics of the natural population movement in Belarus since the year 1986 in general.

In accordance with the trend of the rural population dynamics of Belarus characterized by the gradual downsizing for the period of 1970–2009 years, the following spatial regularities were identified:

– persistent long-term negative rural population dynamics is distinctive for peripheral districts with low agricultural potential or with extensive natural systems;

– the reduction of the rural population had set in later in areas of transition type with high agricultural or recreation potential, as well as in the zone of the "special Chernobyl region";

– large (support) cities are attracting rural migrants during the whole period studied;

– the capital region is an active and potential area of demographic growth due to immigration as well as to the natural factors of fertility which is more important for improving the demographic situation in the country.

The change of this share of districts within the total rural population is calculated to study the spatial dynamics. The vector of the spatial shifts of demographic potential for the period 1970–2009 was identified with the qualitative characteristics of the dynamics (growth, stability, or decline). As a result, three types of districts have been identified by the nature of the dynamics of rural population: growing, stable, and shrinking (*Table 2*).

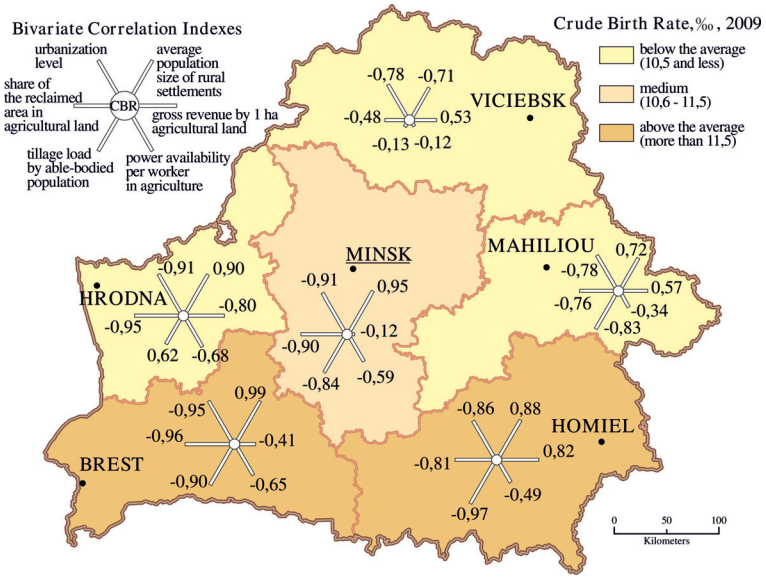

Fig. 4. Meso regional distribution of the factors of the geodemographic dynamics in the rural areas of Belarus

Table 2. Characteristics of districts types of Belarus by the nature of the dynamics of rural population

Type	Number of districts	Share within the total population, %		Share within the territory, %	Urbanization rate, %	
		1970	2009		1970	2009
Type 1	22	18.85	36.59	19.97	47.12	84.01
Type 2	60	49.62	42.44	48.72	47.95	62.2
Type 3	36	31.53	20.97	31.31	33.22	61.25

Source: Own compilation based on Population of Belarus: statistical digests 1970–2009.

Type 1. Growing. Southern agricultural districts of Polessye have an increasing share within the country's population. This region has a traditionally favourable demographic situation (Stolin, Gantsevichy, Luninets). These are districts with typically high agricultural potential, characterized by an increasing share within the population of the republic over the whole study period. Another large group of the growing districts does not have a compact area of distribution. This subtype is a mosaic of scattered districts located in the suburban zone of major cities and transport corridors. The share of this

subtype is steadily increasing. Mahiliou region is the only exception where the periods of growth have alternated with those of loss.

Type 2. Stable. This type is represented by agrarian districts with centres in medium and small urban settlements. Districts with conditional stability have not changed its share of the total rural population significantly. Geographical areas of this type relate to the zones of the average level of intensity dynamics of the basic demographic processes.

Type 3. Shrinking. This type is represented by peripheral districts of the country that are located in administrative regions of environmental and recreational profile, and the regions affected by man-made disaster. Homiel and Mahiliou regions have suffered the most sharp decrease in population over the study period. This territory was affected by the Chernobyl accident which had halved the share of this type within the total population.

These districts reduced the share of its population over the study period. The process has got the reverse vector at the present stage only, but the intensity and duration is still very low to cover the massive and prolonged thirty-year losses.

The peripheral districts of Mahiliou region and districts along the line of Mahiliou–Babruisk experienced the second largest decline in the share within the total population over the study period. Peripheral districts located north-west of Minsk region, west of Viciebsk and east of Hrodna belong to the shrinking type of dynamics, too.

The absolute decrease values are minor among the districts of this type. Thus, centre of gravity of the rural population has shifted in two directions: zonal – from north-east to south-west and azonal – to the suburbs of large cities. The second vector becomes increasingly significant with each passing year and the share of the population of suburban areas is growing faster and more intensive than that of the homogeneous agricultural areas.

Spatiotemporal patterns of demographic development of rural areas in Republic of Belarus

The mapping of the main demographic processes in the rural areas of Belarus in terms of their dynamics indices during the years 1989–2009 highlighted a substantial differentiation, resulting from the multi-directional evolutionary and transformational influence of socio-economic and spatial factors.

Rural population of Belarus has been reducing due to natural population decline mainly, which has exceeded migration outflow from the villages since 1992. Regressive demographic trends in Belarus appeared at the outset of the first "demographic transition" in rural areas by the mid-1960s.

These regressive demographic trends have taken place all over the republic, but the process of their expansion and development has been uneven in time and space. The differences in duration and indices of the increase in mortality and of decline in fertility are manifested on the meso level (i.e. of regions) and intensify on the micro level (of districts).

Natural rural population decline had grown to 3.8‰ both by reducing the birth rate to 12.3‰, and increasing mortality up to 16.1‰ by the end of 1980. Natural decrease had reached 13.8‰ in ten years by 1999. In 2009, births exceeded deaths by 13.0‰.

The natural decrease in rural population of Belarus began in the late 1970's as a whole. It was recorded in 1975 in Viciebsk, Hrodna and Mahiliou regions, in Minsk – in 1980, in Brest and Homiel regions – in 1985. Meso level differences in the completion of the first "demographic transition" are clearly seen from north-east to south-west i.e. from the agro-extensive areas to agro-intensive ones (Pirozhnik, I. 1986). Minsk region is an exception. It is the region with the highest social-economic potential, concentrating various functions of a large urban centre and demonstrating a relatively more stable demographic development (Fakeyeva, L. 2008b).

The direction of the population distribution axis is explained by the territorial differentiation of population losses in the Great Patriotic War. In the pre-war period the population on the territory of Belarus was located fairly evenly and significant meso level differences were not observed. Demographic potential shifted to the Minsk and Brest regions during the second half of the twentieth century (Antipova, E. 2007b).

The differentiation in development of demographic processes is greatly enhanced on the micro level. Spatial spread of the process of rural depopulation in the direction from north-east to south-west from the agro-extensive districts to agro-intensive districts is closely related to the settlement pattern which changes in the same direction from the prevalence of small-sized to that of large-sized settlements.

The first "demographic transition" has been completed in all rural areas of Belarus by the end of 1980. Five Polessye districts and typical suburban Minsk, Homiel and Brest had small natural growth only. The stimulating role of cities in the Homiel and Brest regions enhanced zonal features, which are expressed in a high fertility and low mortality in the southern part of Belarus.

Currently, all Belarus districts, except for those of Minsk and Brest, are characterized by a natural decrease of rural population. 3 types of dynamics of natural population movement were identified in accordance with spatial and temporal heterogeneity of the rural depopulation (*Table 3*).

Type 1. Developing. It includes suburban and urban, agrarian Polessye districts with a relatively favourable demographic dynamics (for the period of 1970–2009 CBR from 16.5 to 12.6‰, CDR from 8.5 to 19.4‰).

Table 3. Characteristics of district types by the dynamics of natural movement of rural population

Type	Number of districts	Territory, 1,000 km²	Share within total area, %	Population, 1,000 people		Share within total population, %	
				1970,	2009	1970	2009
Type 1	11	18.00	8.66	670.4	476.5	13.3	19.7
Subtype 1.1	8	12.67	6.09	422.2	232.4	8.4	9.6
Subtype 1.2	3	5.33	2.56	248.2	244.1	4.9	10.1
Type 2	60	109.67	52.76	2,615.5	1,238.8	52.1	51.3
Subtype 2.1	33	58.32	28.06	1,439.9	743.3	28.7	30.8
Subtype 2.2	22	42.20	20.30	836.9	301.3	16.7	12.4
Subtype 2.3	5	9.16	4.41	338.7	194.2	6.7	8.1
Type 3	47	80.20	38.58	1,737.7	698.1	34.6	29
Subtype 3.1	39	67.47	32.46	1,370.9	544.9	27.3	22.6
Subtype 3.2	8	12.72	6.12	366.8	153.2	7.3	6.4

Table 3. – continued

Type	CBR, ‰		Fertility dynamics index 2009/1970	CDR, ‰		Mortality dynamics index 2009/1970	CDI	
	1970	2009		1970	2009		1970	2009
Type 1	16.5	12.6	0.77	8.5	19.4	2.28	0.52	1.54
Subtype 1.1	16.4	11.8	0.72	8.4	21.3	2.53	0.51	1.80
Subtype 1.2	16.7	14.6	0.88	8.8	14.5	1.64	0.53	0.99
Type 2	15.8	10.9	0.69	9.6	24.7	2.57	0.61	2.26
Subtype 2.1	17.6	10.2	0.58	10.1	24.2	2.39	0.58	2.37
Subtype 2.2	13.9	12.1	0.87	8.8	26.1	2.95	0.64	2.15
Subtype 2.3	12.6	10.5	0.83	9.5	22.0	2.32	0.75	2.10
Type 3	12.5	9.3	0.74	10.4	28.2	2.72	0.83	3.03
Subtype 3.1	12.3	9.7	0.79	10.4	27.9	2.67	0.85	2.87
Subtype 3.2	13.6	7.3	0.54	9.9	29.8	3.01	0.73	4.07

Source: Own compilation based on Population of Belarus: statistical digests 1970–2009.

Type 2. Stable. It comprises transitional districts, the demographic development is close to the average (CBR from 15.8 to 10.9‰, CDR from 9.6 to 24.7‰).

Type 3. Depressive. It combines adverse peripheral districts (CBR from 12.5 to 9.3 ‰, CDR from 10.4 to 28.2‰), with low demographic and agricultural potential located in Poozerye, on the Neman lowland and Lida plain, with districts of high agricultural or tourist recreational potential in accordance with *Figure 2* (Fakeyeva, L. 2009).

Type 1. Developing type includes 11 districts, characterized by stable high fertility and low mortality, positive dynamics of natural movement. Currently, only these areas of Belarus are capable of self-development and demographic reproduction. Developing type includes two subtypes: southern and dispersed.

Subtype 1.1. Developing southern subtype comprises 8 Polessye agrarian districts that traditionally have an advantageous demographic situation. The combination of the confessional and ethnic structure, economic activities and settlement pattern in these extensive agrarian regions forms a stable area with the lowest level of rural depopulation in Belarus.

Subtype 1.2. Developing dispersed subtype includes three suburban, industrial districts Minsk, Homiel and Brest, where 10 percent of rural population live and the share of these areas within the rural population is on a constant increase.

Type 2. Stable type unites 60 districts, where 51 percent of the rural population of Belarus is concentrated residing in 53 percent of the area. The stability of these districts with regard to the average Belarus indicators determines the stagnation of the demographic development. Currently, most stable areas are not able to the natural population increase without migration inflow, except for the areas of suburban subtype:

Subtype 2.1. Stable central-western region embraces 33 districts of the Belarusian ridge and large-sized settlement districts of lowland areas of Pripyat river, the majority of which belongs to industrial and industrial-agrarian sections, 8 – to agro-extensive section and 7 – to agro-intensive section (Pirozhnik, I. 1986).

Subtype 2.2. Stable south-eastern region consists of 22 large- and middle-sized settlement districts of the Polessye within Homiel region, where ca 12,5 percent of the rural demographic potential is concentrated. In this subtype there are mainly agro-extensive districts, five of them relate to industrial and agricultural, Mozyr, Babruisk and Svetlogorsk belong to industrial ones.

Subtype 2.3. Stable suburban areas include 5 urban industrial districts, with more than 8 percent of resident rural population in the country and with a constantly increasing proportion of the demographic potential in these areas.

Type 3. Depressive type unites 47 districts, representing 39 percent of the territory, and concentrates about 28,9 percent of the rural demographic potential.

These districts could be characterized by low fertility and high mortality during the whole research period. In 1970 already Conditional Depopulation Index (CDI) was less than one in the regions of this type, indicating narrowed type of the population reproduction. Depopulation Index had risen up to 3.03 in 2009.

Subtype 3.1. Depressive north-eastern subtype unites 39 districts, which are home to 22,6 percent of the population and the proportion of the demographic potential is declining. Most of them are represented by northern part of Belarus – Poozerie, with a low demographic and agricultural potential. Districts of this subtype had reduced demographic potential throughout the study period. This process cannot be stopped in a natural way due to the abruptly disturbed age structure.

Subtype 3.2. Depressive western subtype includes 8 districts, which concentrate around 6.4 percent of the demographic potential, occupy 6 percent of rural areas in RB, and are located on the Neman lowland and Lida plain. They are districts with high agricultural, tourist and recreational potential, and are characterized by a delayed onset of depopulation, but fertility decline has occurred rapidly and more intensely, coupled with the average national growth rate of mortality.

The complex typology according to the type of demographic reproduction processes in rural areas of Belarus that was developed in this study was based on the preliminary, private typologies implemented on the base of the consistent spatial patterns of the main demographic processes. The latter were found by the type of the natural movement dynamics; features of the age structure; intensity of the decrease of the population number with provision for the effect of the economic and geographic factors that were identified using the multidimensional methods of mathematical analysis. The typologies thus developed provided the evidence of the geodemographic spatial polarisation of the central-peripheral quality.

As a result, 3 region types have been demarcated with clear geographical borders.

1. Comparatively stable type has the most favourable demographic characteristics and a potential for demographic self-development. The type comprises two subtypes:

1.1. Subtype of homogeneous comparatively stable regions with lower-than-the-average natural loss of population, the shortest duration of depopulation, the smallest disproportion in the age structure, the average or high rate of working population, a growing or stable overall rate of the rural population, and decreasing intensity of migration outflow.

1.2. Subtype of comparatively stable nodal regions with variably decreasing natural population, and regressive age structure; average, high or rising rate of working population, increasing population size, migration inflow or migration outflow with a trend of decreasing intensity.

2. Unstable type consists of the regions with average natural depopulation, average duration of depopulation, regressive age structure, low or average rate of the working population, changing rate within the total population size, and with migration outflow of an increasing intensity. Demographic development of these regions practically coincides with the trends that are characteristic to the rural population in Belarus in general (*Table 4, Figure 5*).

Table 4. Parameters of the region types in Belarus according to the type of demographic reproduction processes of rural population

Type	Number of districts	Share within total population, %		Share within total area, %	Natural population increase (+)/ decrease (-)		Migratory increase (+)/ decease (-)	
		1970	2008		1970–1979	1999–2008	1970–1979	1999–2008
Type 1	22	17.4	16.9	17.3	+	-	-	+
Subtype 1.1	7	5.2	4.1	5.2	+	-	-	-
Subtype 1.2	15	12.2	12.8	12.1	+	-	-	+
Type 2	46	38.0	36.6	39.8	+	-	-	-
Type 3	50	44.6	46.5	42.9	-	-	-	-

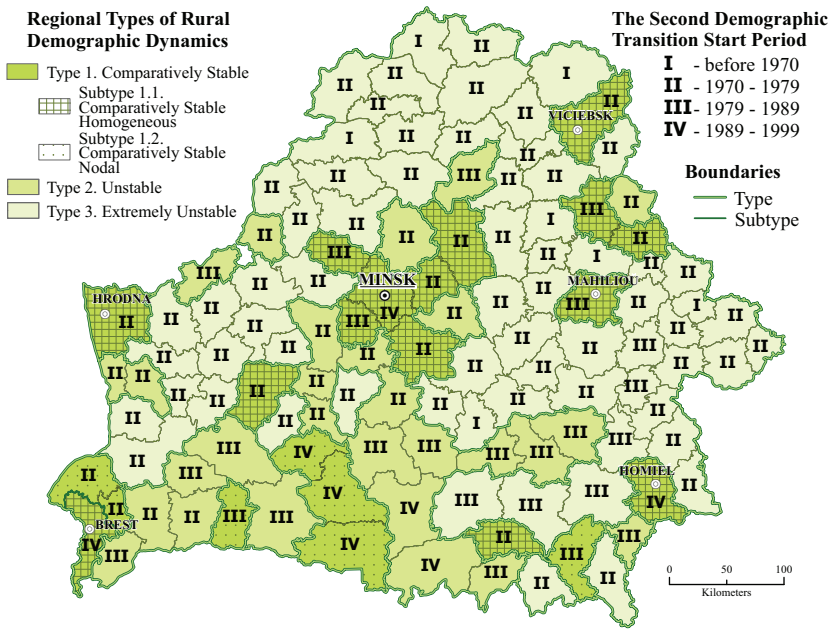

Fig. 5. Typology of the regions of Belarus according to the character of demographic reproduction processes within the rural areas, 1970–2009

3. Extremely unstable type includes areas with the natural decrease above the average, the longest duration of the depopulation process, sharply broken age structure, the low rate of able-bodied population, decreasing or stagnating population rate, migratory outflow. This type is the demographic periphery of rural Belarus.

Conclusions

Consequently, the research conducted shows that the geoinformational approach can be used not only to create the maps that follow the requirements of the socio-economical cartography, but also to construct GIS models that have massive opportunities for performing analytical operations. The "Rural population of Belarus" GIS developed can be used in government administration on the state, regional and local levels as a geographic and demographic interactive reference informational resource.

The spatial and temporal analysis of the rural population dynamics conducted for the period of 1970–2009 years allowed to formulate main conclusions:

– The dynamics of rural population of Belarus has an evolutionary character. The increasing reduction in the population size is the essential contemporary trend that leads to the decreasing role of the rural population in the formation of geodemographic space.

– Macro geographic trends illustrate the end of «urban transition», which is characterized by structural shift in rural areas from the dominant rural type of districts to suburban, and the "castling" of the urban and rural populations in the formation of geodemographic space.

– Spatial and temporal combination of factors shows the cyclic character of population dynamics on the one hand, and the centre-periphery polarization properties on micro geographic level on the other hand.

– Economic-geographical characteristics of the rural Belarus population dynamics testify to the geographically differentiated roles of districts in the formation of demographic space in Belarus, which is determined by a strong presence of suburban and suburban-ring districts, and by a weak presence of the peripheral districts.

The main spatial and temporal trends in the natural movement of rural population in the period of 1970–2009 are:

– an area of demographic depression is trending in the direction from north-east to south-west; south Polessye districts are characterized by the highest stability of the zonal demographic parameters;

– the demographic space has been fragmented under the influence of the development of urban settlement network and of the improvement of demographic parameters in suburban districts.

The spatiotemporal analysis of the main demographic parameters has shown that the rural areas of Belarus vary across the country significantly. These differences are intensified under the influence of the large urban settlements, and the region types identified have different potential of reaching the demographic optimum. This situation calls for an increasingly differentiated demographic policy to ensure the national demographic security.

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Contribution to regional division of Slovakia based on the application of the Reilly's model

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Abstract

The objective of the present article is an application of three versions of the Reilly's model in a regional division of Slovakia at two levels: from the point of view of potential natural gravity towards regional centres, and from the aspect of an alternative proposal of administrative division of Slovakia at the regional level. In this contribution the geometric version of the Reilly's model serves only as a complementary tool for an assessment of a regional organisation of Slovakia. A crucial part lies in the application of the topographic version; the oscillatory version possesses a correcting and refining role. Functional urban regions have been used as basic spatial zones in our analysis. The geometric version of the model is used for a preliminary assessment of possible influences of centres. Let alone several exceptions caused by physical geographical conditions (e.g. an overrated sphere of influence of Žilina) this version provides a relatively realistic image of the Slovak regional system.

Keywords: regional division, potential spatial interactions, Reilly's model, Slovakia

Introduction

Geographical space is not a homogeneous entity and individual geographical components are not distributed uniformly in the space, i.e. they are represented by different intensities in distinct regions. In most cases there is a natural tendency to balance these differences. As an example from physical geography the occurrence of horizontal flows of various types can be put forward. For instance in case of different values of atmospheric pressure the "polarity" is balanced by the flow of air masses. Such flows posses a character of vector or gradient.

An analogical situation can be witnessed also in case of human geographical partial components. Horizontal flows (of people, products, informa-

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tion etc.) occur in the social and economic environment as well. Geography mostly refers to them as the spatial interactions. They represent an aggregation of individual mobility and contacts. As for the flows of people they are conditioned by the activities of individuals. The spatial behaviour of individuals is affected by their needs and efforts to optimise spatial movements (or spatial location) in order to gain economic and social benefits. Socio-economic spatial interactions substantially affect the geographical organisation of the society and express the interdependence among the sections of geographical space (regions) of different hierarchical levels.

The primary information on spatial mobility of the population and spatial interactions is based on the migration data, particularly on the labour and school commuting. The labour commuting, which is the basic platform for regionalisation tasks, was recorded in the former Czechoslovakia for the first time in the 1961 census. Since then the data on main commuting flows have been available only in ten years intervals. Other data on the spatial interactions (for instance on passenger traffic volumes, attendance of shopping malls etc.) are very complicated to acquire and in some cases they are subject to business secret.

If such insufficiencies cannot be supplied by questionnaire surveys (these would be very demanding and practically not applicable on the whole state territory), geographers frequently resort to the use of potential spatial interactions when handling the regionalisation tasks. These approaches rely on the assumed non-homogeneity of geographical space and have been inspired by the laws of physics, for instance by the Newton law of universal gravitation.

The partial objective of the article is to apply basic geometric and topographic versions of the Reilly´s model on the territory of Slovakia. Spheres of influences of individual settlements reached by the geometric version will serve as a base for the selection of the centres and subsequent application of the topographic version of the Reilly´s model with a modified parameter. The primary objective of the article is, then, a delineation of regions in Slovakia aimed at putting forward an alternative proposal of an administrative division of Slovakia at the level of regions (i.e. NUTS 3), and their grouping into the NUTS 2 regions. This analysis will employ the potential spatial interactions. The proposal will attempt to take into account the rule of spatial justice and the size of the NUTS 2 regions recommended by the EU.

The delineation of the NUTS 3 regions in Slovakia is not correct and is subject to persistent harsh criticisms from the independent scientific public (for instance deliberate distribution of the Hungarian minority between the Bratislava, Trnava and Nitra regions, inadequate demarcation of the Spiš historical territory etc.). Our alternative proposal has made use of the Reilly´s model since the higher levels of the administrative system (NUTS 2 and NUTS

3 regions) cannot be delineated according to real commuting or migration flows (for instance the gravity zone of Bratislava reaches far eastern Slovakia). This claim is supported by the fact that such a task has not been undertaken by the Slovak geography so far. One of a few options of such a construction based on the quantitative data processing is presented in the article.

Theoretical background and methods

Geography (or spatial science) saw the first application of simple models inspired by the Newton law of gravitation in the 19th century (Ravenstein, E.G. 1885). The issue of spatial interaction modelling had further developed during the inter-war period when William J. Reilly (1929, 1931) defined the so called law of retail gravitation, which was based on the real interactions observed in Texas during the second half of the 1920s. However, the theoretical explanation of socio-economic spatial interactions based on the gravitation concept occurred after the Second World War, when Stewart, J.Q. (1948) formulated his concept of social physics and used the term demographic force as an analogy to gravitation force used in the natural sciences. Stewart´s work reflected the conclusions reached by Zipf, G.K. (1947) regarding the principle of minimum effort which is very important for the spatial interaction modelling since it is closely related to a "resistance" exerted by the geographical space towards the spatial interactions.

The law of retail gravitation has been further modified on the basis of the above mentioned works by Converse, P.D. (1949) and Huff, D.L. (1964). Converse mathematically expressed the breaking point between the spheres of influences of neighbouring centres, whereas Huff was the first to express the theoretical probability of choice of shopping centre by customers (not applied on the concrete territory). Derivation of the interaction models has not been limited to a mere analogy to the Newtonian physics. Wilson´s derivation is based on the entropy maximising method inspired by the second law of thermodynamics (Wilson, A.G. 1970) and it shows that the Reilly´s model and equation identifying the breaking point is only a special case of the so called unconstrained interaction model.

Originally the Reilly´s model was constructed as a tool identifying the retail attraction and was based on purely formal relations. It was applied mainly to determine the tendencies of the population to travel to selected centres in order to reach different types of services and to identify the borders of influence between centres within simple graphical schemes of the settlement system (e.g. Fotheringham, A.S. and O´Kelly, M.E. 1989). A different type of task was and mainly currently is a delineation of tributary areas of shopping centres, i.e. points carrying the masses are not conceived as settlements (e.g.

Lee, M.L. and Pace, R.K. 2005; Baray, J. and Cliquet, G. 2007). A note should be made here that not all mentioned works are products of geography but of spatial economy as well. Lee and Pace (2005) deal with a spatial distribution of retail sales between the shopping centres in relation to their mutual location in Houston, Baray and Cliquet (2007) besides the application of the gravity models discuss the possibility of mathematical morphological analysis for delineation of shopping centres' tributary areas.

In Slovakia the Reilly´s model was used by Očovský, Š. (1973) to delineate the tributary areas of shopping centres in Slovakia, in the Czech literature the topic was discussed by e.g. Maryáš, J. (1983), Hlavička, V. (1992) or Řehák, S. (2004). Although originally the Reilly´s model was intended to identify the retail attraction, currently it can also be used – despite some objections made by Berry, B.J.L. (1967), regarding however rather its original use – for the assessment of geographical organisation of a territory, suitability of its administrative division, of its historical or future development, and for general regionalisation tasks (Hubáčková, V. and Krejčí, T. 2007; Halás, M. and Klapka, P. 2010; Klapka, P. and Niedźwiedźová, K. 2010).

The law of retail gravitation formulated by Reilly, W.J. (1929) states that the portion of realised shopping visits in two competing centres (settlements) depends on the size of these centres (increasing size of a centre brings increasing portion of visits in it) and on the distance between these centres (increasing distance from a centre brings decreasing portion of visits in it). Mathematical expression of this relation is:

$$B_A / B_B = \left(M_A / M_B\right)^N \left(d_B / d_A\right)^n ,$$

where B_A, B_B are number of visits in centres *A, B* from the place (settlement) examined; M_A, M_B are masses (weights) of the centres *A, B* given by their population; d_A, d_B are distances from centres *A, B*. Parameter *N* was set by Reilly to 1 and parameter *n* to 2, which is of course the full analogy to the gravitation law.

Border of the influence spheres of two competing centres *A, B* is made by a set of points possessing the equal number of visits to the centres, i.e. $B_A/B_B = 1$. If we keep N = 1 we get by adjustments the equation

$$k = \sqrt[n]{\frac{M_A}{M_B}} = \frac{d_{AB} - d_B}{d_B}$$

valid in case that $M_A \geq M_B$ where d_{AB} is a distance of centres *A, B*; d_B is a distance of smaller of the two centres from the influence breaking point of these centres along their shortest link. In practice it means that the border between

influences of two centres is a set of points whose distance from the centre A is a k-multiple of the distance from the centre B. In case that $M_A \neq M_B$ we get a circle as a dividing set of points. Its construction is described in detail by Řehák, S., Halás, M. and Klapka, P. (2009).

Weights of centres M_A, M_B can be defined in various ways according to the character of phenomena to be modelled. In original works the weights were given either by the populations of centres or by the financial expression of the retail sales. In case of a delineation of the economic influence the econometric indices can be used, such as the size of shopping area, number of occupied job positions or the number of entrepreneurial subjects (used e.g. by Hubáčková and Krejčí, 2007). The results are basically analogous to those reached by the use of the population as the weight of a centre (see conclusions of several reports cited by Maryáš, 1983).

Löffler, G. (1998) in his complex outline states that generally the population, number of firms in the service sector, number of job opportunities and the so called "commuting balance" can be used as weights. However, it is the population that is the simplest and most universal factor expressing the weight of a centre. It is most suitable for general tasks of approximation of complex human geographical regionalisation of a territory and for proposals of administrative division of a territory as well (other indices can be distorted by a functional specialisation of some centres). In the present applications a potential (theoretical) attraction to a centre at a general level will be applied, therefore the most complex and universal factor, which is the population of the centres as of January 1, 2009, will be used. According to the way of areal delineation three basic versions of the Reilly´s model have been defined: geometric, topographic and oscillatory (Řehák, S., Halás, M. and Klapka, P. 2009), each of them having its reason in a particular orientation and phase of the research.

The simplest *geometric version* of the Reilly´s model works in isomorphic space, i.e. with distances in air kilometres, without the communication network being taken into account. The border of the influence spheres of two centres is always a circle, in the case of centres of equal weight this border is straight line. The advantage of the geometric version is seen particularly in cases of preliminary assessment of possible influences of centres when surveying larger territories, with a well designed communication network and without distinct natural barriers. This version can also be very well used for the identification of the influence spheres crossing the national border and in historically conceived tasks for generalised retrospective analyses of the settlement system.

The *topographic version* of the model does not work with an isotropic plain but with some more or less tangible geographical characteristics of a territory, for instance with communication network, which also reflects the

physical geographical conditions of a surveyed territory to a certain extent. This version already employs the spatial zones (e.g. municipalities) and with distances separating the centres of these spatial zones along the elements of the communication network, such as roads or railways. The border between the influence spheres is confined to the borders of the spatial zones, when each zone can be unequivocally assigned. The topographic version can be used for classic regionalisation tasks and for testing the suitability of the spatial division of a territory.

The *oscillatory version* of the Reilly´s model is not inherently aimed at the regionalisation but at the identification of transitory belts. The construction of these areas has its reason particularly when employing the spatial zones as in the preceding version. It identifies those zones that are located near the border of the influence spheres of the centres. Delineation of this transitory belt can be achieved by setting the span of the belt, for instance in a form $(0.9 \cdot k; 1/0.9 \cdot k)$. The oscillatory version of the model can be applied at the beginning of detailed study of attraction, but also at the final stages of research as a correction of the resulting regionalisation.

A special attention should be paid to the n parameter choice in the basic equation of the Reilly´s model. Maryáš (1983) reminds a long time discussion about the values of this parameter (e.g. also Schwartz, G. 1962) and claims that for centres of lower orders the needed tributary area had been reached by application of the distance parameter with the value at least three. The construction of the model shows that it can be calibrated by the n parameter estimation, while the classic version of the Reilly´s model had worked with the value $n = 2$. Reilly had chosen two having said that the mode of his sample had belonged to the interval from 1,51 to 2,50. If we strive to work exactly and take into account the attraction/gravity as the analogy to the laws of physics we have to use the value two. However, the parameter choice has to reflect the character of a phenomenon to be approximated or the nature of the application task (if we focus on the practical use).

The selection of centres is an important part of the Reilly´s model application. It can follow several criteria. The simplest is selection according to the size criterion where the population number of the centre or potential population of its influence sphere can be taken into account. The selection of the centres can use existing versions of regionalization based on the real interactions when it is possible (at a given hierarchical level) to adopt these centres.

In this article the geometric version of the model will serve only as a supplementary tool of the assessment of the regional division of the Slovak territory. Observed influence spheres of individual centres will be taken into account when selecting later the centres for individual variants of the possible territorial divisions. The application of the topographic version will bear the

major significance (see below), the oscillatory version will serve a practical purpose as a correcting and refining tool for the results of the topographic version. Since the Reilly´s model will be used for regionalisation with several different objectives, details of the method will be provided in the ensuing text in the places where it is applied.

Existing regionalisations of Slovakia, basic spatial units

The literature presents several regionalisations of Slovakia. One of the most important of them is the delineation of the so called daily urban systems, generally known as the functional urban regions (FUR further on). Bezák, A. (2000) has delineated two versions of functional urban regions (FUR 91-A and FUR 91-B) on the basis of 1991 labour commuting data having employed a relatively sophisticated method. The second system (marked as FUR 91-A), except for the inner coherence and outer separation, has met the criterion of minimal population size of the region (35,000 inhabitants) as well.

In this article (precisely when applying the topographic version of the Reilly´s model) Bezák´s FURs 91-B have been used as basic spatial units. They had been delineated only on the basis of a scientific data processing without inclusion of a minimum size of a region, and at the same time considered to present the primary regionalisation of the Slovak territory convenient for the analyses of the spatial data or for further geographical processing. Slovak districts cannot be used as basic regions, since their delineation was purposefully and strongly political and the criterion of spatial justice was not obeyed. In the north of Slovakia the status of a district capital was assigned even to the small centres (such as Bytča, Kysucké Nové Mesto, Turčanské Teplice) and these districts do not match their counterparts in the southern Slovakia in terms of their size (for instance Nové Zámky, Levice, Rimavská Sobota, Trebišov).

In geographical scientific literature no regionalisations of Slovakia have been found at a hierarchical level higher than the system of FUR, that would aim directly at the proposals of the territorial administrative division. It can be considered as a relatively serious deficiency, since particularly this level (NUTS 3) acts as regional self-governments that are delineated in a very poor and biased way in Slovakia (their delineation in 1995–1996 was strongly influenced by the political intentions of the government coalition of the time). Hierarchically higher regional system delineates NUTS 2 regions, i.e. basic territorial units of the EU countries serving (among others) for the distribution of main financial flows into the regional policy of the EU. We register only several scientific proposals of the division to the regions, i.e. NUTS 3 level (e.g. Bačík, V. and Sloboda, D. 2005; Sloboda, D. 2006), which are all already better than current territorial administrative division, but are not supported

by the exact quantitative processing of the data on real or potential population flows. Moreover, these proposals employ the districts delineated in 1996 as basic spatial units, which had not been constructed very transparently either (see the preceding paragraph).

Application of the geometric version of the Reilly´s model on the Slovak territory

The geometric version of the model serves in the article only illustrative purposes and presents a preliminary view of the possible application of the Reilly´s model. As the parameter we have set the most frequently used value $n = 2$ and the selection of centres followed a simple population criterion. The original intention for the centre selection has been the level of 25,000 inhabitants, which has been later lowered to 24,000. The reason for this has been an inclusion of Rimavská Sobota (its population was 24,446 as of January 1, 2009), which could be in further applications, regarding its location in less exposed areas in terms of the population, seen as a potential regional capital.

In this chapter we turn our attention to a brief commentary of the geometric version results of the model *(Figure 1)* in relation to major geomorphologic barriers or to the comparison of the results of the topographic version of the Reilly´s model.

Despite the fact that the geometric version of the Reilly´s model cannot be completely ideally applied on the dissected territory in terms of landforms, it is generally able to approximate the settlement pattern and regional structure of Slovakia. Even when using the direct geometric distance it is possible

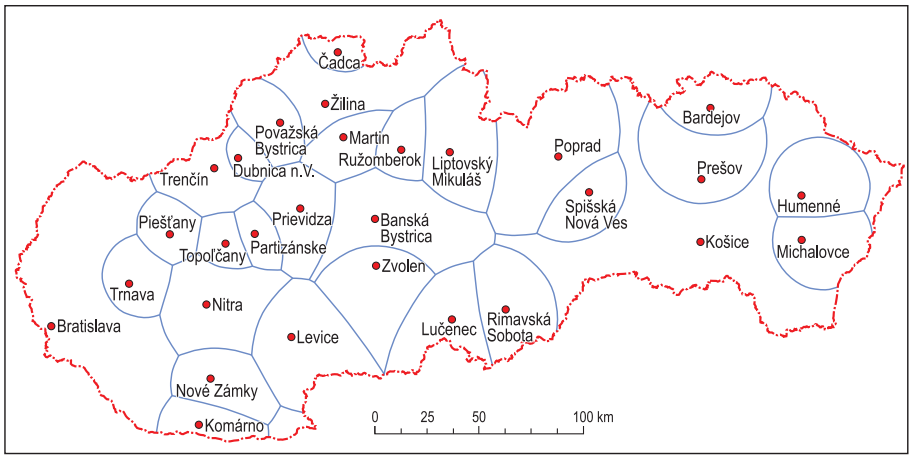

Fig. 1. Potential influence of centres of settlement system in Slovakia , 2009

to identify the main direction of the so-called central Slovak communication barrier (more in Lukniš, M. 1985) mainly along the borders of influence spheres of Banská Bystrica or Prievidza (in the north-eastern part), Martin, Ružomberok and Liptovský Mikuláš. In comparison to the real situation the Prievidza influence sphere is actually reaching southwards (the influence of Žiar nad Hronom and Žarnovica, both having less than 24,000 inhabitants, has not been taken into account). The same situation holds true for the Poprad and Spišská Nová Ves influence spheres, when the influences of Rožňava and Revúca have not been considered.

The Bratislava influence sphere is relatively compact according to the geometric version, forming circa 50 km wide crescent reaching approximately 80 km to the north and 80 km to the southeast. On the contrary the Košice influence sphere forms several lobes or projections towards Rožňava, Stará Lubovňa, Medzilaborce, and Trebišov (all towns below 24,000 inhabitants). The spheres of influence of Bratislava and Košice have the so called exclaves, i.e. they do not obey the contiguity principle. The influence of Bratislava, intersected by the sphere of influence of Komárno, reaches the region of Štúrovo; the influence of Košice, intersected by the spheres of influence of Humenné and Michalovce, reaches the north-easternmost part of the country.

The geometric version overrates the influence sphere of Žilina and pushes it significantly to the north-east, where it comprises a large part of the Orava region. This territory would actually belong to Martin or Ružomberok (unless the influence of Dolný Kubín is taken into account), particularly as a result of very poor transport connection of the Kysuce region (and thus Žilina) to the Orava region.

In other instances the geometric version of the Reilly´s model relatively aptly approximates the basic features of the Slovak regional system (e.g. central Považie region etc.) and in general offers a relatively relevant information.

Application of the topographic version of the Reilly´s model on the Slovak territory: potential natural interactions

Attempting to approximate the potential natural interactions by the topographic version of the Reilly´s model, it is necessary to use the variant directly following the Newton´s law of gravitation, i.e. the variant with the value of the parameter $n = 2$. This fact has been tested on the territory of the Czech Republic (Halás, M. and Klapka, P. 2010), when the areas of the municipalities with extended authority (further on referred to as MEA areas) have been used as basic spatial units. The comparison of potential natural interactions reached by the topographic version of the Reilly´s model (using the parameter $n = 2$) to the real commuting interregional flows (i.e regionalisation by Hampl, M. 2004)

has provided a high degree of correlation. The majority of the MEA areas has been a part of the same mezzo-region; 94.8% of the population belonged to the same mezzo-region according to both methods. Moreover, out of remaining 5.2% of the population that has been assigned to different mezzo-regions, almost one half (exactly 2.5% of the population) is concerned with the trade-offs between the Hradec Králové and Pardubice mezzo-regions. It is caused by the advantageous location of the city of Pardubice on the major railway line, while this study takes into account the road distances only.

As it has been already mentioned, the basic spatial units (zones) that have been tested in terms of their affinity towards centres are FURs 91-B, when the road distances among their centres have entered the model as a distance variable between the zones. The model thus has used the road distances between our centres and FUR 91-B centres. The distances have been set by the Škoda Auto route planner (www.skoda-auto.com/cz) and they have had a character of the fastest connection in terms of the time needed. Each FUR 91-B has been assigned in the way described in the method above to the so-called mezzo-region (approximately the level of the NUTS 3 region). During the first phase 8 regional capitals have been defined as the mezzo-regional centres *(Figure 2)*, later four others have been supplemented *(Figure 3)*.

The main results are generally comparable to the geometric version of the model. The dominance of larger centres documents a regular co-existence of Bratislava with such centres as Trenčín, Trnava and Nitra in the west of Slovakia and similar situation occurs in the case of Košice and its co-existence with other centres in the east. Bratislava forms the influence sphere reaching along the borders with the Czech Republic, Austria and Hungary (from the town of Myjava to the town of Šahy). This sphere is significantly conditioned by the eccentric position of Bratislava within the state territory of Slovakia. The influence sphere of Košice comprises almost the whole eastern Slovakia with the exception of small tributary area of Prešov that is made up by five FURs only. The pattern in the central Slovakia (cities of Žilina, Banská Bystrica and partly also Trenčín and Nitra) approximates the regional administrative division quite well, since this territory lacks a significantly dominant centre *(Figure 2).*

The cities of Trenčín and particularly of Trnava form reduced influence spheres in comparison to other regional capitals. Therefore other centres capable of forming the influence spheres comparable to those of Trnava and Trenčín have entered the second phase of the topographic version of the Reilly´s model (aimed at potential natural interactions). The cities of Martin, Poprad and Michalovce have not been doubted as regional centres in this respect. In the south of Slovakia a decision has had to be made whether insert the city of Lučenec or Rimavská Sobota in the set of the regional centres, since their spheres of influence have considerably overlapped. The final decision has favoured Lučenec, since it has been able to attract more population in this version.

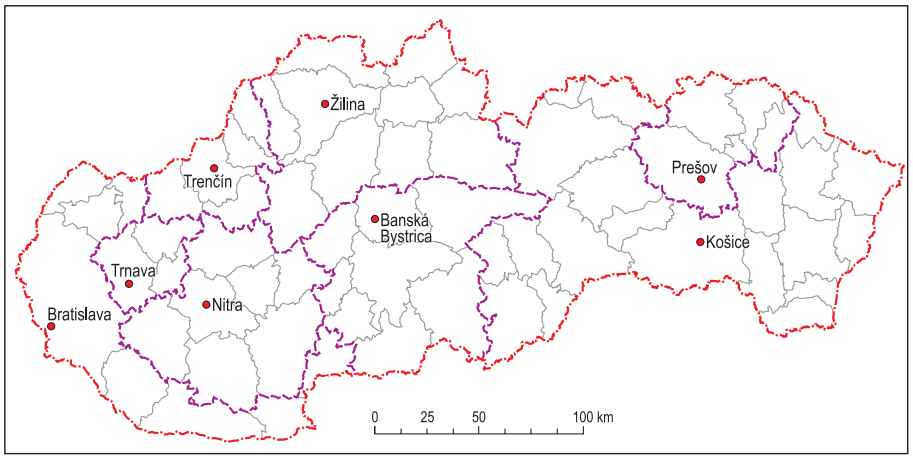

Fig. 2. Regional division of Slovakia based on potential natural interactions (8 centres)

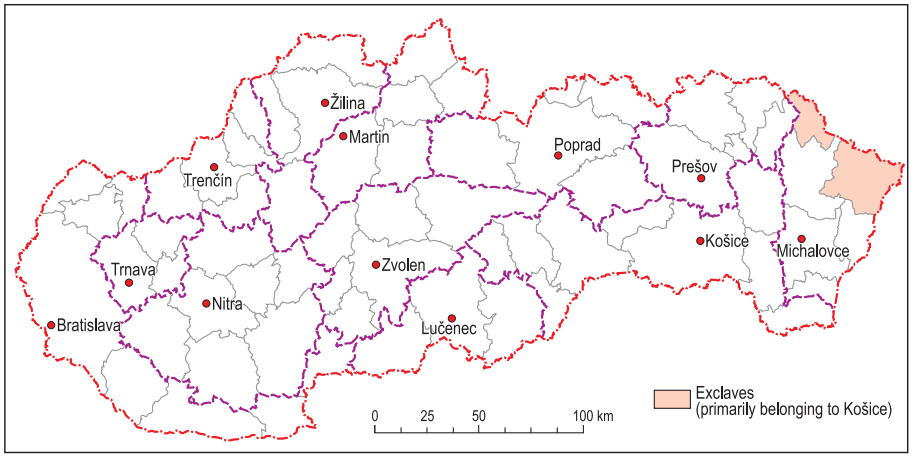

Fig. 3. Regional division of Slovakia based on potential natural interactions (12 centres)

When compared to the preceding situation the regional pattern in the west of Slovakia has not been adjusted and the central Slovak communication barrier has remained in its extent and position as well. The larger part of the influence sphere of Žilina has been attracted by the city of Martin (including the whole Orava region and the west of the Liptov region) and the FUR Liptovský Mikuláš has joined the regional centre of Poprad. The south of the influence sphere of Banská Bystrica has been taken over by the city of Lučenec, which has also attracted the FUR of Rimavská Sobota originally being a part

of the Košice region. In the eastern Slovakia the sphere of influence of Prešov has retained its extent. The part of the Spiš region, originally belonging to the regional centre of Košice, has been transferred to the regional centre of Poprad. Finally the Zemplín region has joined the sphere of influence of Michalovce.

Should the contiguity constraint of the delineated region be obeyed, the results in the north east of the state territory had to be corrected (the FURs Medzilaborce and Snina). These two exclaves are primarily attracted to the influence sphere of Košice according to the potential natural interactions (this fact is witnessed in the geometric version of the model as well – *fig. 1*). Their final regional affiliation has been determined by their secondary affinity, then. The population characteristics of the delineated regions are presented in *Table 1*.

Table 1. Population characteristics of regions of Slovakia (potential natural interactions)

Regional capital	Population in 1,000			Share of capital in population, %
	Total	Capital	Hinterland	
Bratislava	1,026.4	428.8	597.6	41.8
Nitra	738.5	84.1	654.4	11.4
Košice	667.9	233.7	434.2	35.0
Žilina	528.7	85.3	443.3	16.1
Poprad	408.6	54.6	354.0	13.4
Banská Bystrica	361.8	80.1	281.7	22.1
Prešov	344.2	91.3	253.0	26.5
Trenčín	333.3	56.8	276.5	17.0
Martin	298.0	58.4	239.6	19.6
Michalovce	256.3	39.5	216.7	15.4
Trnava	241.7	67.7	173.9	28.0
Lučenec	208.2	27.5	180.6	13.2
Total	*5,413.5*	*1,307.9*	*4,105.6*	*24.2*

Application of the topographic version of the Reilly´s model on the Slovak territory: proposals of territorial division

The attempt to propose the alternatives to the territorial administrative division (further on only territorial) of Slovakia by the application of the topographic version of the Reilly´s model has employed a higher value of the parameter *n*. The application of the higher parameter is necessary because when constructing a possible territorial administrative division, the rule of spatial justice has to be obeyed. It ensures that the extreme most locations of municipalities in individual regions have the comparable distance from their regional capitals. The value of the parameter has been set on the basis of extensive statistical testing.

In the preceding study on the Czech Republic (Halás, M. and Klapka, P. 2010), the F-test (with the level of significance 0,05 used for the comparison of the current territorial division and regionalisation according to the topographic version of the Reilly´s model and increasing the values of n gradually by 0,1) has produced the optimal value of the parameter n for the purpose of territorial administrative division (n = 5). Statistical sets in both compared divisions have been acquired as the maximum distances of the MEA area capital from the selected regional centres. The level of significance 0.05 has been reached also at the parameter with the value 5.0 (test criterion F has counted for 3.04 and for the last time it has been lower than the critical value of F-distribution for m x m degrees of freedom F = 3.28; the number of regional centres has been m + 1.

While F-test demands for a comparison with other (preferably existing) pattern, its application on the Slovak territory would not be correct. The current territorial administrative division of Slovakia, including the selection of eight regional capitals, can be considered as insufficient from the scientific point of view and thus cannot be used for statistical testing. Therefore, the value n = 5, statistically tested in the Czech Republic, has been applied in case of Slovakia as well. This approach appears to provide an optimal compromise between the elimination of increased influence of the largest centres (Bratislava and Košice) and the partial fulfilment of the principles of spatial justice. The argument for the use of the same parameter lies in the fact that both countries (Czech Republic and Slovakia) have a similar disproportion in hierarchy of their largest centres in terms of their order (seen for instance also in the Zipf curve etc.). These centres serve as potential capitals of NUTS 2 and NUTS 3 regions, then.

The selection of regional capitals (centres) is an important question. During the first phase the current regional capital, except for Trnava and Trenčín, have been employed. The two exceptions mentioned are not capable, due to their relative location to Žilina and particularly Bratislava, of forming the influence spheres comparable to the remaining six regional capitals. This variant has also substituted the city of Zvolen for Banská Bystrica. The reason for this step has been twofold: 1) Zvolen is capable of generation of larger tributary area, in comparison to the city of Banská Bystrica it attracts the FUR Rimavská Sobota in addition; 2) the variant with six resulting regions asks that Zvolen/Banská Bystrica should comprise the FURs in the Jihoslovenská kotlina basin and the city of Zvolen possesses a more advantageous central location within the resulting region, i.e. the sum of distances (simple and weighted by the population) from all centres of FURs to Zvolen is lower than to Banská Bystrica and thus the city of Zvolen appears to be a better option for the regional capital in terms of the principle of spatial efficiency.

The result *(Figure 4)* can be considered as optimal: six selected centres (regional capitals) manage to form comparable natural tributary areas and generally this variant of the possible territorial administrative divisions seems

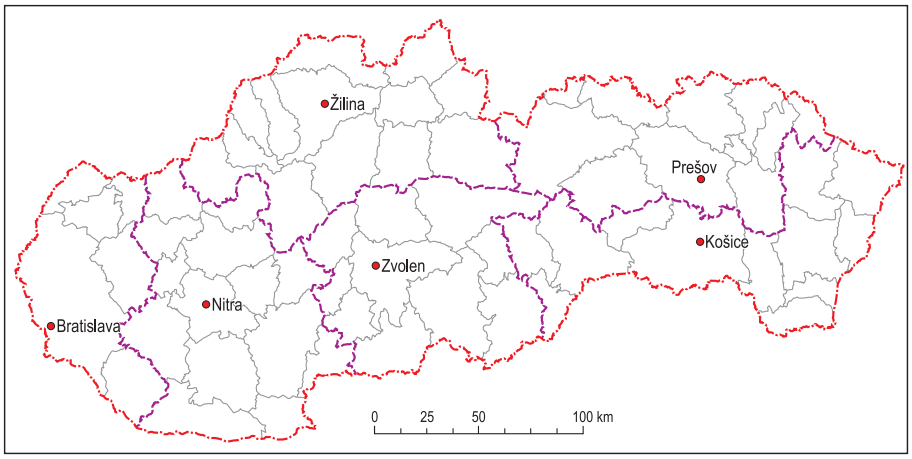

Fig. 4. Proposal of possible administrative division of Slovakia (regional level, 6 centres)

Table 2. Population characteristics of proposed regions of Slovakia (potential modified interactions, 6 centres)

Regional capital	Population in 1,000			Share of capital in population, %
	Total	Capital	Hinterland	
Žilina	1,129.0	85.3	1,043.7	7.6
Nitra	1,118.9	84.1	1,034.8	7.5
Bratislava	994.1	428.8	565.3	43.1
Košice	824.8	233.7	591.1	28.3
Prešov	763.4	91.3	672.1	12.0
Zvolen	583.3	42.5	540.8	7.3
Total	*5,413.5*	*965.7*	*4,447.8*	*17.8*

to be balanced. The population characteristics of the delineated regions are presented in *Table 2*.

Even though the territorial division of Slovakia with six regions can be seen as appropriate, it unfortunately does not match the EU criteria of the recommended population size of the NUTS 3 regions. It should vary according to the rules between 150,000–800,000 inhabitants. The optimal number of regions in Slovakia following the EU normatives is somewhere between 12 and 16. Therefore, the Reilly´s model for such a pattern of regional division has been applied once more. The possibility of merging the NUTS 3 regions into the NUTS 2 regions has been taken into account in the examination as well. The NUTS 2 regions should have the population between 800,000 and 3,000,000 according to the EU recommendations.

The first important step is a selection of centres, again. Eight regional capitals entered the model, the city of Banská Bystrica has not been substituted for by the city of Zvolen this time, since neither of the two arguments used in the variant with six regions has remained valid. Without any doubt the cities of Martin, Poprad, Michalovce and one of the pair Lučenec and Rimavská Sobota has had to be included in the set of the regional capitals. Using $n = 5$ the model has produced such a regional pattern that has had to be refined in several cases. First, the tributary area of Nitra has appeared to be too large and it exceeds together with the city of Nitra itself the level of 800,000 inhabitants. It seems to be necessary to form a region with a centre in Komárno or Nové Zámky, then. This adjustment makes the region of Nitra to fulfil the demanded size level and proves that the cities of Komárno/Nové Zámky are capable of forming the area comparable to other potential regions (i.e. exceeding the level of 250,000 inhabitants) as the only other centres in Slovakia. Finally the city of Nové Zámky seems to act as a more advantageous centre of the region due to its central location in the formed region and due to the fact that it meets better the demands of the spatial efficiency (the sum of distances weighted by the population from all municipalities is lower in case of Nové Zámky than in case of Komárno). No other city or town is able to form a tributary area comparable to the above-mentioned examples, therefore 13 regional capitals appear to be an optimal number taking into account the recommended size criteria.

All other transfers of the FURs from one region into another have been based on the application of the oscillatory version of the Reilly´s model only, which means in cases when the tested FUR has been located at the boundary of the influence spheres of two regional capitals within the span $(0.9 \cdot k; 1/0.9 \cdot k)$ (see methodology). Thus the region of Trnava has been joined by the FUR Skalica (otherwise the region of Trnava would have been too small and the region of Bratislava too large) and by the FUR Myjava. The FUR Liptovský Mikuláš has been transferred from the region of Poprad to the region of Martin, while preserving the historical border between the Liptov and Spiš regions, and, moreover, this transfer has enabled a simpler division to the hierarchical higher NUTS 2 regions. The choice of the regional centre between the cities of Lučenec and Rimavská Sobota has remained question that has not been easy to answer. The city of Lučenec manages to form a little larger area though (the difference is in the FUR Veľký Krtíš - the variant of the centre in Lučenec, and in the FUR Revúca – the variant of the centre in Rimavská Sobota), but the FUR Veľký Krtíš oscillates between Banská Bystrica and Rimavská Sobota, and the FUR Revúca has a poor accessibility to the proposed regional centre in Lučenec and never can be assigned to its region. There is just the only way to solve these problems satisfactory. If the city of Rimavská Sobota is made a regional capital than both questioned FURs Rimavská Sobota and Veľký Krtíš remain in the region. Other variants only raise other and more even problematic questions to cope with.

The resulting alternative proposal of the territorial administrative division with 13 regions is presented in *Figure 5.* It also shows an alternative division to the NUTS 2 regions: the current names West, Central and East can be preserved. All three proposed regions manage to follow the demanded population span, individual treatment of the city Bratislava is considered as irrelevant. Bratislava is not a metropolis with a million of inhabitants and in this phase it is not necessary to approach to the division of the NUTS 2 regions in an expedient manner in order to maximise the financial inflow from the EU funds. The population characteristics of the delineated regions are presented in the *Table 3.*

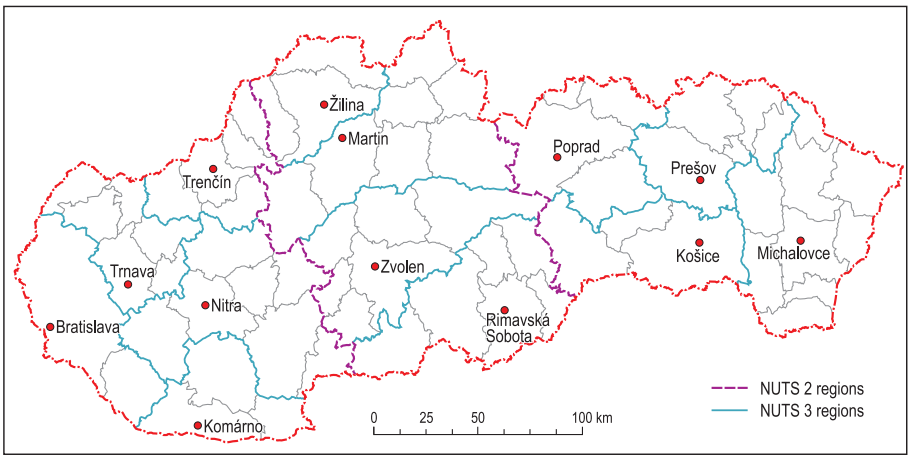

Fig. 5. Proposal of possible administrative division of Slovakia (regional level, 13 centres)

Tab. 3. Population characteristics of proposed regions Slovakia (potential modified interactions, 13 centres)

Regional capital	Population in 1,000			Share of capital in population, %
	Total	Capital	Hinterland	
Bratislava	735.6	428.8	306.8	58.3
Nitra	630.8	84.1	546.8	13.3
Martin	515.3	58.4	456.8	11.3
Michalovce	436.5	39.5	397.0	9.1
Košice	430.0	233.7	196.3	54.3
Žilina	386.8	85.3	301.5	22.1
Trnava	372.6	67.7	304.9	18.2
Banská Bystrica	361.8	80.1	281.7	22.1
Prešov	344.2	91.3	253.0	26.5
Trenčín	333.3	56.8	276.5	17.0
Poprad	333.2	54.6	278.6	16.4
Nové Zámky	267.5	40.5	227.0	15.1
Rimavská Sobota	265.8	24.2	241.5	9.1
Total	*5,413.5*	*1,340.5*	*4,073.0*	*24.8*

Conclusion

From the standpoint of natural conditions and prerequisites and from the standpoint of socio-economic regional disparities Slovakia is a considerably diversified country, therefore its regionalisation at any hierarchical level is a very demanding challenge. The results reached can be influenced to a considerable extent by the choice of regionalisation criteria, therefore these tasks cannot be taken as completed and could become a subject of further discussions.

The regionalisation employing the potential spatial interactions and the comparison of the results to the current territorial division of Slovakia (or to its proposals) has shown according to our opinion the viability of the Reilly´s model and its versions also in the solution of current regionalisation tasks. The results can be used also for the assessment of the characteristics of the settlement system in Slovakia and regional influence of its centres. The application of the Reilly´s model can vary according to the nature of the solved task.

The resulting regionalisations have confirmed several well-known facts. The specific position of the cities of Bratislava and Košice in the regional and settlement systems of Slovakia remains unchallenged. The capital city of Bratislava, despite its eccentric location, can be seen as a natural centre of the country, while the city of Košice is able to supply some functions of the country´s capital for the territory of the eastern Slovakia. Lukniš´ macro-regionalisation into two central and two corridor regions has been confirmed as well, while the central Slovak communication barrier can be identified in all results of the regionalisation tasks.

Other centres, excluding Bratislava and Košice, are classified at the minimum as one or two hierarchical levels lower. None of them significantly dominates since their development is limited either by natural barriers or the location within the vicinity of two largest centres. The absence of one dominating centre and significant geomorphologic barriers causes that the regionalisation of the central Slovakia is less problematic. Therefore the smallest number of the differences between individual proposals of this article and between current and past territorial divisions is witnessed in this territory.

The resulting regionalisations are significantly dependent on the selection of centres, while this issue is considered as a key question in the regionalisation tasks. The variant choices of centres can considerably affect the potential territorial divisions (e.g. Poprad, Michalovce etc.). In this place 12–13 years old discussion of the potential "Komárno region" can be mentioned when the main argument raised has been homogeneity instead of nodality. The alternative proposal of 13 regions put forward in this article comprises this independent region in the south of Slovakia (with the centre in the city of Nové Zámky). However, a note should be made here that the method presented in

this article is a mere theoretical expression of spatial interactions and is not able to reveal a possible influence of national differentiation of the territory on the existing nodal relations.

The results that have been reached in the article are in our opinion interesting in any case. They confirm the insufficient and problematic territorial delineation of current regional self-governments including the selection of their centres. A comparison of the results reached by the use of potential spatial interactions with the regionalisations constructed on the basis of real commuting or migration relations would be a very interesting research task for the future, then.

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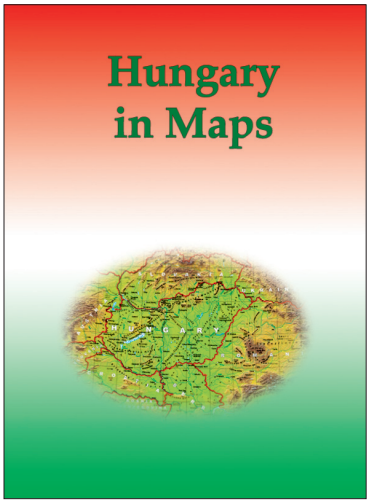
Hungary in Maps

Edited by
Károly Kocsis and Ferenc Schweitzer

Geographical Research Institute Hungarian Academy of Sciences
Budapest, 2009. 212 p.

'Hungary in Maps' is the latest volume in a series of atlases published by the Geographical Research Institute of the Hungarian Academy of Sciences. A unique publication, it combines the best features of the books and atlases that have been published in Hungary during the last decades. This work provides a clear, masterly and comprehensive overview of present-day Hungary by a distinguished team of contributors, presenting the results of research in the fields of geography, demography, economics, history, geophysics, geology, hydrology, meteorology, pedology and other earth sciences. The 172 lavish, full-colour maps and diagrams, along with 52 tables are complemented by clear, authoritative explanatory notes, revealing a fresh perspective on the anatomy of modern day Hungary. Although the emphasis is largely placed on contemporary Hungary, important sections are devoted to the historical development of the natural and human environment as well.

In its concentration and focus, this atlas was intended to act as Hungary's 'business card', as the country's résumé, to serve as an information resource for the sophisticated general reader and to inform the international scientific community about the foremost challenges facing Hungary today, both in a European context and on a global scale. Examples of such intriguing topics are: stability and change in the ethnic and state territory, natural hazards, earthquakes, urgent flood control and water management tasks, land degradation, the state of nature conservation, international environmental conflicts, the general population decline, ageing, the increase in unemployment, the Roma population at home and the situation of Hungarian minorities abroad, new trends in urban development, controversial economic and social consequences as a result of the transition to a market economy, privatisation, the massive influx of foreign direct investment, perspectives on the exploitation of mineral resources, problems in the energy supply and electricity generation, increasing spatial concentration focused on Budapest in the field of services (e.g. in banking, retail, transport and telecommunications networks), and finally the shaping of an internationally competitive tourism industry, thus making Hungary more attractive to visit.



This project serves as a preliminary study for the new, 3rd edition of the National Atlas of Hungary, that is to be co-ordinated by the Geographical Research Institute of the Hungarian Academy of Sciences.

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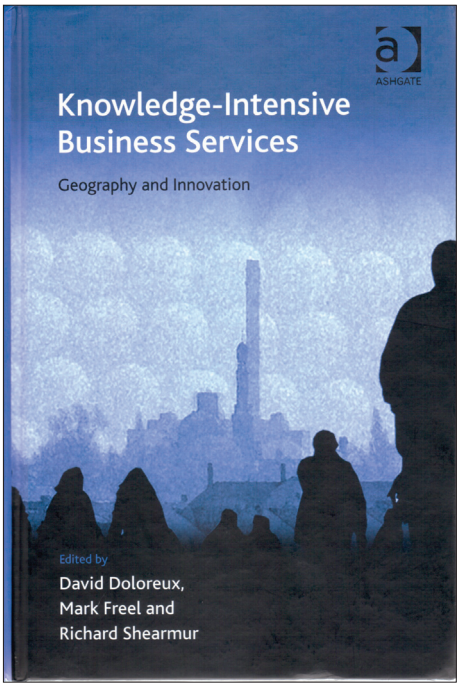
Hungarian Geographical Bulletin 61 (3) (2012) pp. 257–262.

Doloreux, D., Freel, M. and Shearmur, R. eds: Knowledge-Intensive Business Services. Geography and Innovation. Ashgate, Alderhsot, 2010, 246 p.

Studies focused on knowledge-intensive business services (KIBS) have been embedded into and stimulated by academic discourses over theorization of 'knowledge' and 'learning' in the contemporary (global) capitalism (see e.g. Lyotard, J.F. 1984; Harvey, D. 1989; Bryson, J. *et al*. 2004) and also by practical (policy) debates over competitiveness of firms and national economies for the last three decades. As various fields and disciplines got involved in conceptualizing the production and circulation of knowledge, research approaches towards KIBS grew increasingly transdisciplinary, and concerned with space – analysing intra-firm and inter-firm relations across geographical scales, and revealing their socio-cultural embeddedness (Amin, A. and Cohendet, P. 2004). Although, such studies are focused dominantly on "advanced" economies of the traditional core regions, they provided and increasingly sophisticated view of knowledge-production as an engine of economic restructuring.

This book contributes to understanding the role of knowledge intensive business services as drivers of innovation – how KIBS support innovation and how KIBS innovate themselves –, and also to explaining uneven development in the context of production, management and exchange of knowledge. The studies published in the book are "resolutely empirical" (p. 8), discussing KIBS activities in different institutional and cultural (basically, in European and North American) contexts.



The nine case-studies provide a deep insight into the drivers and mechanisms of knowledge production, discussing the types of knowledge are produced and exchanged and how people and organisations interact in this process. Although, the analyses are focused on different geographical scales, discussing the globalization of KIBS, their role in regional differentiation of a national economy, the knowledge flows in regional innovation systems, and also within KIBS firms, the majority of studies suggest that knowledge production and exchange take place across geographical scales – and yet, they are shaped by particular local and regional contexts largely.

In lack of space for a detailed review of results, I do not follow the logic of book that is organised around geographical scales. Instead, the authors' findings shall be discussed in relation to key issues well-

known in service studies, such as the conceptualisation of KIBS, the production of knowledge and innovation within the KIBS firms, moreover, the interfirm relations through which KIBS stimulate innovation in other organisations – all interpreted as processes producing space.

The authors share the widely discussed and accepted *conception of KIBS* as producers and mediators of knowledge. This role rests on a highly complex and diverse process of information and knowledge sourcing (see *Trippl* and *Tödtling* in Chapter 8) and on a creative manipulation of those in particular organisational and spatial contexts – the constant reproduction of the core asset (expertise) of KIBS firms (see *Warf* in Chapter 2 and *Muller, Zenker* and *Héraud* in Chapter 10). In geographical terms, KIBS are conceptualized as highly networked *and* locally (regionally) embedded activities that act across geographical scales while sourcing and mediating knowledge.

Nevertheless, putting knowledge in the focus drove some authors to conceptualize KIBS in the wider context of social reproduction (e.g. considering medical services and higher education as knowledge intensive business services; see *Warf* in Chapter 2), that might stimulate further debate over the definition, and over KIBS-related policies. Moreover, the discussion of KIBS'role in different macroeconomic and socio-cultural contexts (cultural milieu and social practices) highlighted how diverse knowledge production and exchange are in core economies, and thus, how conceptualisation of KIBS is shaped by local/regional processes and conditions (see *Shearmur; Aslesen* and *Isaksen; Kautonen* and *Hyypiä; Doloreux, Defazio* and *Rangdrol* in Chapter 3, 5, 6 and 9).

To understand the role of KIBS providers as "innovators in their own right" (*Freel*, p. 75), knowledge sourcing, development of new ideas and expertise, and the management of such processes within firms are key issues discussed by most of the authors. Studies focused on *knowledge sourcing* argue against simplified approaches that rest on local buzz-global pipelines dichotomy. The authors' empirical results suggest a highly diverse process in which, a number of agents (clients/users, competitors, suppliers, R&D institutions, universities, development agencies, networked professional communities) are acting as sources and/or co-producers of knowledge at different geographical scales through various (formal and informal) channels of information flow (see Chapter 4, 5, 6 and 8 by *Freel; Aslesen* and *Isaksen; Kautonen* and *Hyypiä; Trippl* and *Tödtling*).

The book suggests that knowledge sourcing is a diverse process that depends on the nature of services provided (professional expertise-based vs. technology-related activities/P-KIBS vs. T-KIBS), on the size KIBS firms, and on the business (innovation) strategy adopted by a particular organisation. Moreover, as KIBS innovations rely highly on localized formal and informal relations (advantages of agglomeration economies and network externalities), knowledge sourcing should be discussed as a locally/regionally embedded process. Studies focused local context of knowledge sourcing (see *Kautonen* and *Hyypiä; Trippl* and *Tödtling; Doloreux, Defazio* and *Rangdro* in Chapter 6, 8 and 9*)* highlight, how uneven development in metropolitan/non-metropolitan, core/peripheral, and in high-tech-based/public sector-oriented regions are driven by having (or not having) access to information and expertise.

Knowledge production is also discussed as a networked process (co-produced with other agents, primarily, with clients) that is ranging from customization of well-known recipes to innovative solutions to the clients' problems (see Chapter 2, 3, 4, 7 and 8 by *Warf; Shearmur; Freel; Landry, Amara* and *Doloreux; Trippl* and *Tödtling*). The studies suggest that, project-based work that grew dominant in the KIBS sector is a source of new expertise and diverse knowledge management practices (codification, developing tacit knowledge and the combination of those). Nevertheless, it is also stressed that knowledge production rests on capacities of KIBS firms, primarily on the skills of KIBS staff and the

use of advanced technologies (see *Landry, Amara* and *Doloreux; Trippl* and *Tödtling* in Capter 7 and 8). An in-depth analysis of this process is provided by *Muller, Zenker* and *Héraud* (Chapter 10), who identified the key agents of knowledge production ("knowledge angels"), searched their skills and qualities – that are over-arching disciplinary and organisational boundaries, and rest on professional expertise as well as on creative capacities –, and defined their strategic functions within intra-firm and wider networks.

The widely discussed role of *KIBS as mediators of knowledge*, and as such, stimulators and supporters of innovation (technological and organisational change, problem solving, crisis management, knowledge transfer etc.) in other organisations is also put in the focus of the book. Types of knowledge produced and mediated, channels and methods of exchange, and the geography of those was researched empirically in different regional and national contexts.

A key issue discussed by most of the authors is the problem of tacit and codified knowledge. As the results of *Landry et al.*, as well as of *Trippl* and *Tödtling* (Chapter 7 and 8) suggest, we should shift from this dichotomy: both types of knowledge are (re)produced and exchanged at once in client-KIBS provider relationships. For this, we should understand the complexity of knowledge exchange in various organisational and spatial contexts. This problem was discussed in a particular spatial context by the authors who adopted regional innovation system (RIS) approach as a conceptual framework. *Aslesen* and *Isaksen* (Chapter 5) analysed the role of KIBS as mediators between agents (business/institutional) of RIS that have different knowledge basis; *Trippl* and *Tödtling* (Chapter 8) focused on distinct types of KIBS as mediators by their innovative activities in the Vienna software cluster, while *Doloreux et al.* highlighted (Chapter 9), how knowledge mediation is culturally embedded and how this function works within more distant relationships in Canada.

The authors were considered also with the *geography of knowledge mediation*. Although, knowledge production in KIBS firms is stimulated by locally (regionally) embedded relations that produce hierarchical and centralised spatial structures, knowledge mediation does not follow such patters necessarily. It occurs across geographical scales, linking users and providers, connecting different regional innovation systems, and local businesses to global flows, as it is suggested by *Shearmur; Freel; Kautonen* and *Hyypia* (Chapter 3, 4 and 6).

Although, there are no strikingly new concepts introduced in the book, it helps the reader to understand knowledge production and exchange as a highly complex, multiscalar process, that is shaped by intrafirm processes, different socio-cultural contexts (spaces and places interlinked by various networks), by macro-economic processes of national markets, as well as by local "buzz" of interpersonal/inter-organisational relations. Moreover, the authors' empirical results make the reader uneasy enough to re-think "settled" definitions and categories, and open further discussion on knowledge-related issues in social sciences. Finally, the authors highlight, how uneven development is driven through knowledge production, and how inequalities are being (re)produced by being involved or excluded from flows of information and expertise.

Erika Nagy

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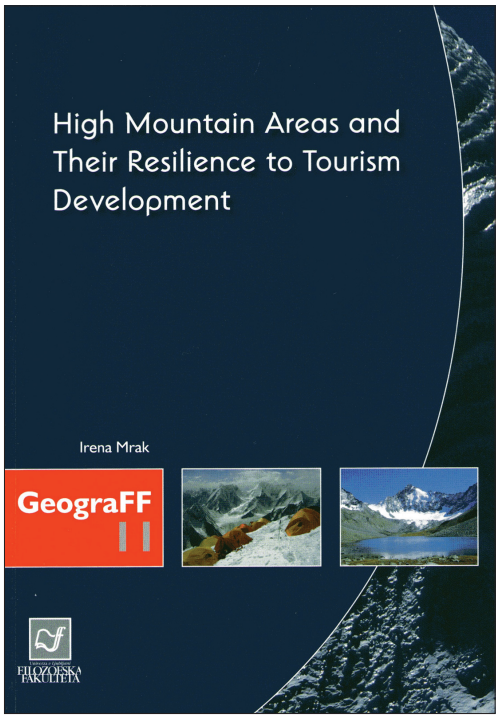
Mrak, I.: High Mountain Areas and Their Resilience to Tourism Development. GeograFF, Ljubljana University Press, 2011, Ljubljana, 168 p.

This is a monograph from the GeograFF series which present primary research achievements of the scientific work of staff at the Department of Geography, Faculty of Arts, University of Ljubljana. In the GeograFF monographs, which are published at the University of Ljubljana (Slovenia), professional explanations of current spatial processes are revealed thoroughly and systematically by experts. The topic of this volume is substantial and up-to-date directing attention on the physical and human geographical conditions and tourism in high-mountain areas. The book outlines the characteristics and impacts of adventure tourism and recreation in mountain, especially high-mountain regions.

The author is an assistant professor at the Department of Geography, Faculty of Arts, University of Ljubljana, Slovenia. In Irena Mrak's research projects geographical field works are favourably combined with pastime activities (mountaineering). By her own admission, her greatest passions are mountains and geography, accordingly promoting sustainable mountaineering practices is extremely significant for her. She started to climb in 1995 and since then she has already reached several noteworthy summits of the Alps, the Andes and the Karakoram and become a renowned mountaineer. Her research projects mainly focus on human impacts on the vulnerable high-mountain areas and the resilience of mountain regions to the phenomenon of mountaineering.

Although, the role of mountains in the human societies has changed more than once in history, these geographical features have always been of great significance. Nowadays, about 12% of the world's population live in these regions. Mountains are the second most popular tourism destinations (following coasts and islands) generating 15–20% of annual global tourism. More and more visitors are attracted to mountain areas, the number of travels is increasing rapidly therefore, extensive researches on human impacts in these vulnerable environments are much required.



The monograph is well-proportioned and consists of five main chapters. Special international literature is adequately treated in the writing and the author is unambiguously aware of the last scientific achievements. In the preface she gives a short but thoughtful geographical definition of mountain and high-mountain areas on the basis of references.

In the first main chapter, an especially important statement is accentuated namely mountain tourism is mass tourism. What is more, mass ski and mountaineering tourism have reached

up to high-mountain areas. In spite of the fact that in the last decades travels to mountains has became more common in all seasons, seasonality is still a characteristic of these regions outside Europe. In the chapter it is laid down that in several vulnerable mountainous areas tourism is the most important – often the only – source of income for inhabitants accordingly, priority must be given to those forms of tourism (sustainable ecotourism) which have the least damaging impacts on the natural environment and the local communities. Then high mountain areas of the Alps, Africa, the Americas and the Himalayas are briefly characterised together with the development of mountaineering and trekking.

Forms of tourism and recreation in high mountain areas are described in the second chapter. Although there have been several approaches of this topic, the author tried to give a thorough overview of definitions, forms and characteristics in connection with 'mountain tourism and recreation', 'mountain adventure tourism and recreation' and 'mountaineering' on the score of special international literature. These categories are frequently intertwined since the boundaries between them have become blurred in the last few years. Notwithstanding that, motives of visitors who travel to mountains is diverse, the author focuses on active pastime and adventure since mainly these appear in high mountain areas. One of her important and steady statements is that a mountain tourist is not definitely a "true mountaineer", but may become that. Another essential finding is that tourism trends originating from lifestyle changes have also a remarkable effect on high mountain areas adapting to the needs of modern tourists. Finally, questions of ethics connected to environment, adventure tourism and recreation and mountaineering is laid down in this chapter.

In the third chapter the environmental, social, cultural and economic impacts of tourism and recreation are shortly summarized with special respect on the high mountain areas. Positive and negative impacts are supported by the own experiences and photos of the author. The fourth chapter is an exceedingly important part of the monograph introducing a noteworthy model for the sustainable development of tourism and recreation in high mountain areas. Agreeing with the writer's opinion, the primary goal of the sustainable development of tourism and recreation in high mountain areas should be to maintain the dynamic equilibrium between physical geographic conditions and human pressures. The author gives an adequately detailed description of each step of the model, namely: identification of landscape ecological units (LEU); functional valuation of environmental components and assessment of the carrying capacity of LEUs; analysis of anthropogenic influences and impacts on the high mountain landscape; assessment of vulnerability of the high mountain landscape; perception; planning and implementing the sustainable development of tourism and recreation in mountain areas. The appropriate management of protected territories has a very significant role in this process.

The last chapter brings forward a case study in which the above mentioned model was tested on a certain research spot. The author characterises high mountain areas and their resilience to tourism development on the example of Baltoro Glacier in the region of Gilgit-Baltistan (the Karakoram). The reader can take pleasure in a number of the writer's photos about the splendid landscape of the analysed mountain range. After a brief description of the geographical endowments of central Karakoram the primary research achievements of studying the Baltoro Glacier area (one of the highest regions in the world) with the help of the above mentioned model are introduced. The most important results are based on a severe field work consisting of numerous measures, observations and interviews with inhabitants who participate in tourism and data analysing with special respect on the impacts of tourism. Although more and more experts and residents have been working on to release the negative impacts of tourism, a lot of problems have not been

solved yet. The ecological footprint of expeditions and trekking groups is still considerably large in the surroundings. Since along with agriculture tourism represents a main source of income there, inhabitants wish to welcome as many tourists as possible. Better tourism infrastructure, better educated employees and more marketing are all needed to achieve this goal. Furthermore, it is a protected area (Central Karakoram National Park) without a management that could guide the sustainable development of the area.

The monograph is especially rich in illustrations among of which the numerous photos of the author are really fascinating. Figures are of high value. With this publication she has established a complex and comprehensive ground for determining the main directions of sustainable tourism development in the Baltoro Glacier area. The author's extensive knowledge and responsible thoughts about high mountain areas are unambiguously proven in the writing.

Katalin Szalai

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International Geographical Conference in Berehove (Ukraine)

It had become a tradition to hold "Rákóczi days" during the last week of March at II. Rákóczi Ferenc Kárpátaljai Magyar Főiskola (Francis II. Rákóczi Transcarpathian Hungarian Institute) in the town of Berehove (Hung. *Beregszász*). On 29–30 March 2012 the Geographical Department of the Institute organized an international geographical conference entitled „Social-geographical challenges in the 21st century East and Central Europe". 150 researchers coming from 7 countries (Ukraine, Hungary, Russia, Slovakia, Romania, Serbia and Bulgaria) and representing 45 educational and scientific establishments held scientific discussions in Hungarian, Ukrainian and English languages which were the official working languages at the conference.

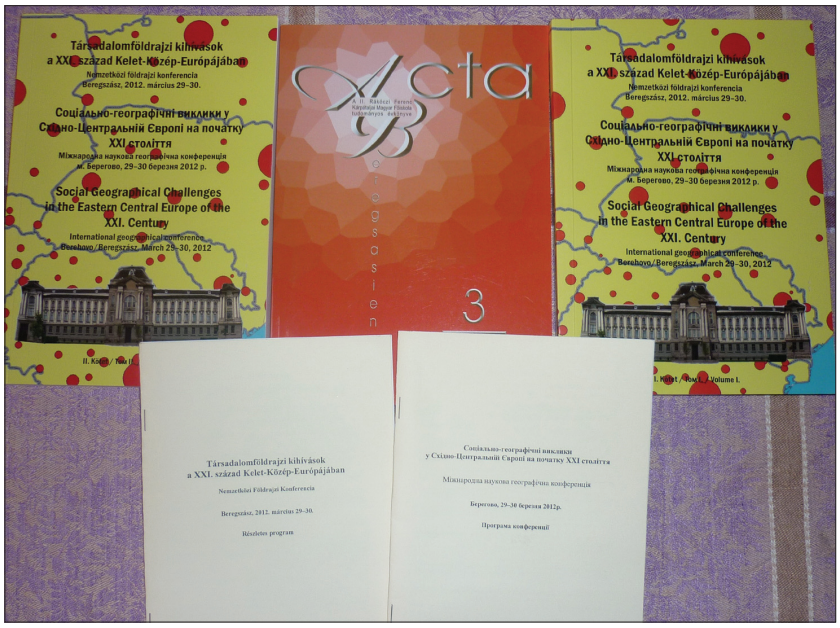
The materials of the lectures (776 pages) that had been sent by the participants to the organizing committee were published in two volumes and handed in to the lecturers during the registration process together with the Berehove Institute's scientific herald "Acta Beregsasiensis".

The conference was opened in the Esztergom auditorium by Ildikó Orosz, who is the president of the Institute, then István Tóth, Hungary's consul general at Berehove Consulate, greeted the participants. They were followed by plenary sessions where Prof.

Opening of the conference

Participants of the plenary session

Participants of the professional excursion to Uzhhorod



Publications for the conference

Miroslav Dnistransky, the Head of the Department, dwelt on the language assimilation trends of ethnic Russians and Ukrainians in Ukraine's regions; Prof. József Nemes Nagy outlined the changes in Hungary's territorial researches; Prof. István Süli-Zakar conducted a lecture on the demographic explosion and migration of the Romas in East and Central Europe as one of the biggest challenges in 21st century Europe. The plenary session was closed by Sándor Fegyir who elucidated the problems of Transcarpathia's tourism before the 2012 European Football Championship.

In the afternoon section meetings were held. Due to the great interest shown by the participants, four sections (population- and social geography, economic geography, regions and borders, tourism) were organized where the researchers presented the results of their investigations on 21st century social geography in Europe. The speeches were delivered in several languages – each speaker's presentation was supplemented with the summary of his speech in another language. The summaries were translated into Hungarian, Ukrainian and English by the members of the organizing committee of the Institute.

Next day a professional excursion was scheduled. The participants were taken to Mukacheve (Hung. *Munkács*) Castle and Dobó Cellar in the village of Serednie (Hung: *Szerednye*), as well as Uzhhorod (Hung. *Ungvár*) which is a regional centre. The excursion was organised by the staff of the Geographical Department, a professional tourist guide who presented Transcarpathia's sights.

The conference and the publication were sponsored by Gábor Bethlen Foundation and the Berehove Institute. We thank the sponsors for the support and the participants for their contribution to the conference's success and its high scientific level.

Tibor Izsák

Report on the 32nd International Geographical Congress

Cologne, 26–30 August 2012

More than hundred years after the IGU's (International Geographical Union) 7th Congress held in Berlin in 1899, its quadrennial meeting took place again in Germany in August 2012. On that occasion geographers from all over the world gathered in Cologne, where science and research have been the organic part of the city since the foundation of the University of Cologne in 1388. The central building of the university offered an excellent venue for the congress. Under the motto "Down to Earth" wide ranges of topics and research results were presented demonstrating the versatile contribution of geography to many acute problems affecting our planet. The congress was on the one hand a platform where geographers could share their views, their research results and opinions, and on the other hand, it gave place to the traditional meetings of the IGC Commissions as well.

Scientifically, the five-day-long congress covered wide range of topics, which were grouped into four main themes, such as: *Global change and globalisation*, *Society and environment*, *Risks and conflicts*, and *Urbanisation and demographic change*. The congress attracted more than 2,400 participants from all over the world. The 400 sessions with great number of presentations and the 180 posters provided the opportunity to everybody to find new pieces of information about comprehensive topics of geography.

The orientation between the parallel sessions held in four neighbouring university buildings was easy due to the very well edited, nearly 300-page, programme book and due to the kind instructions of the organising staff. In addition, a flash-drive with the abstracts of all the papers provided facilitated the participants to make the right choice which sessions or lectures to visit.

For every day of the congress a keynote lecture was scheduled just before the lunch break. In these plenary sessions a prominent person (mostly politicians) and a geographer held presentations in one of the IGC's four key themes in the conference hall of the main building. As the capacity of the lecture room was limited, these presentations were both broadcasted online and projected in the neighbouring rooms of the conference venue.

The scope and depth of presentations varied greatly, as is the case in such large congresses. While in sessions, like the "Managing changes is cultural heritage cities in South-East Asia" one could meet rather specific examples from Myanmar, Indonesia and Burma, in the session of "Facets of Contested Geographies: negotiating *lieux de mémorie* in Transnational Context" more general and more theoretical presentations were given. In the session of "Demographic divide 3: Population decline in post-socialist city" nice examples illustrated the wide possibilities in using quantitative research methods (and the difficulties made by the lack of data in some countries). While lectures in the double session of "Multilocality: symbolic and material constructions of space in societies of mobile individuals" revealed how qualitative research methods can be used efficiently and creatively. In the morning session of "Tourism Sustainability with GIS and zoning systems" one could meet exemplary attempts of using GIS systems in exploring social phenomena of geography.

Geographers from Hungary represented themselves in great number at the congress. The researchers of four universities and of the Hungarian Academy of Sciences gave presentations in a wide spectrum of topics. Just to mention a couple of these presentations, Éva Kiss talked about the Hungarian industry and its crises, Mónika Váradi, Ágnes Erőss and Patrik Tátrai in cooperation with Doris Wastl-Walter (University of Bern) provided some of the results of an international research project focusing on cross-border educational migration.

No less than 195 well-prepared volunteers (most of them students of geography) were giving information and helped at the registration

Looking around at one of the exhibition halls during the minutes of coffee-breaks

Loads of information about the reinvention of Bonn after the loss of capital function. A one-day tour with the leadership of Prof. Hans Dieter Laux

The best view over the most debated building of Cologne, the large mosque Zentralmoschee. The first station of the fieldtrip "Cologne – a cultural meltingpot"

From the University of Szeged numerous colleagues gave presentations. Ilona Bárány-Kevei, besides giving a short overview on "The significance of landscape ecological research in the 21st century", also chaired the session on "Human impacts and environmental changes in karst". The results of the research she carried out together with her colleagues on land cover patterns in Hungarian karst areas (with Eszter Tanács) and on freshwater tufa sites and karst springs (with Gabriella Koltai and Sándor Kele) were also presented. Gábor Mezősi and Péter Csorba in cooperation with Burghard Meyer (University of Leipzig) introduced their results on "Climate change impact assessment in Hungarian landscapes". Zoltán Kovács, Viktor Pál and Péter Bajmócy presented papers on various social and economic geographical aspects of Hungary like the garry-mendering phenomenon of the new Hungarian electoral system, the spatial justice in the Hungarian healthcare policy and the recent urbanisation trends in Hungary, respectively. Researchers of the Institute of Geography, University of Pécs, Gábor Pirisi, Tamás Németh, András Trócsányi and Tímea Vercse, presented their paper on the reactions of Hungarian small towns when facing shrinking-based challenges.

A lot of new information could be acquired also in the coffee breaks held between the sessions when participants were offered sandwiches, coffee and/or tea to regenerate. Both newly established and long-term professional relationships could be further strengthened not only during these short coffee breaks but also during the Congress Dinner and the Reception Party held in the town hall. The Young Researcher's Party was another forum where young geographers could meet each other and in some friendly conversations they could share their experiences, doubts and questions regarding their research topics.

The rich and concentrated scientific program of the congress could be diluted by the numerous one-day and half-day excursions provided by the organisers before, during and after the congress. In the framework of one-day trips participants could experience geography "live" by witnessing for example the waterfront revitalisation in Duisburg or the advantages and risks the national park "Eifel" has to face due to tourism flows. By participating in half-day trips one could get insight into the colourful issues strongly determining the life of Cologne: the changing face of its port, its car-production, the revitalisation of its building after World War II, its multicultural society and its most monumental building: the word-famous Cologne cathedral.

Those who did not enrol to any of the field trips also had the opportunity to take a short break in the city of Cologne and enjoy its fascinating cathedral, its riverfront little parks, the numerous restaurants and bars. These were all ideal places to have a rest for some time and let the new seeds of ideas and impressions gained during the inspiring discussions of the geographical congress become deeply rooted.

Until the next International Geographical Congress to be held in Beijing we have to wait four more years, but in the meantime the IGU will organise regional conferences in Kyoto (2013), Cracow (2014) and Moscow (2015). We sincerely hope that these forthcoming IGU conferences will be attended by an increasing number of Hungarian participants giving insights about the most important results of Hungarian geography.

Ágnes Pap

In memoriam György Enyedi (1930–2012)

Professor György Enyedi, aged 82, member and former vice-president of the Hungarian Academy of Sciences, distinguished scholar of the community of geographers passed away on 10 September 2012. György Enyedi was one of the most influential Hungarian geographers of the last half a century. He has been the voice and the face of Hungarian geography in the worldwide community of geographers for many decades due to the quality of his own work, but also on his untiring efforts at maintaining wide-range of international academic contacts.

Born in Budapest on 28th of August 1930, he graduated from the Budapest University of Economics in 1953. He was one of those few students in economics who could specialise in economic geography and regional development. After graduating he got a lecturer position at his university which was followed by a post at the University of Agriculture in Gödöllő where he was assistant professor until 1960. In the first part of his academic career his scientific interest focused mostly on regional problems of Hungarian and world agriculture. In 1960 he became researcher of the Geographical Research Institute, Hungarian Academy of Sciences, where he was appointed Deputy Director in 1962. With the change his research gained a new dimension in that socio-economic issues of the development of rural areas became the centre of his interest. His studies revealed many of the negative consequences of state-socialist modernisation in the Hungarian settlement system and more specifically in rural areas.

He was always an 'integral' geographer who followed and integrated the results of other social sciences. This helped him to become the 'father' of Hungarian regional science in the 1980s. In this capacity he founded an interdisciplinary research institute specialised in regional science, the Centre for Regional Studies, Hungarian Academy of Sciences in 1984. He was the director of the institute until 1991. Working together with economists, sociologists, geographers, lawyers and representatives of other disciplines he proved again his extraordinary capacities and skills in team building. During the last two decades his scientific interest turned towards the socio-spatial aspects of urbanisation and urban development at the global and local scale.

Enyedi's intellectual legacy extends well beyond geography also through his writings. During his academic career he was the author of nearly 700 scientific publications, authored and edited 45 books, among them *Hungary – an economic geography.* Boulder,

Westview (1976); *The effect of modern agriculture on rural development*. New York, Pergamon (1982); *Environmental policies in East and West*. London, Taylor Graham (1987); *Budapest – a Central European Capital*. London, Belhaven, (1992, with Viktória Szirmai); *Social changes and urban restructuring in Central Europe*. Budapest, Akadémiai Kiadó (1998). He was editor-in-chief of the Series Geography of World Agriculture (9 Volumes between 1972 and1984). He founded the journal Tér és Társadalom (Space and Society) in 1987 and he has been the chairman of its editorial board ever since. He acted as editor in chief of the journal Magyar Tudomány (Hungarian Science) and he was honorary editor-in-chief of our journal, the Hungarian Geographical Bulletin. He left his imprint on the academic literature of human geography and regional science forever.

György Enyedi played an outstanding role in connecting Hungarian geography with the international mainstream of our discipline. In 1966 he spent a year in Berkeley (US) with the scholarship of the Ford Foundation. Between 1972 and 1984 he was chairman of the Commission of Rural Development of the International Geographical Union (IGU). He organised and attended several international conferences and published great number of papers in top quality scientific journals. This was the period when his work became internationally known and renowned. In 1984 the Union's General Assembly elected him – against the candidate nominated by the Hungarian National Committee – Vice President of the IGU and he served two terms until 1992. In August 2008 at the 31st Congress of the International Geographical Union in Tunis he received the highest recognition by the IGU the *Laureat d'Honneur*. During his creative and successful career he built wide range of scientific contacts in geography and beyond all around the world, and he helped and encouraged his younger colleagues for international collaborations. Both as a colleague and as a mentor he has touched the professional lives of many geographers across the world. He was always able to see the forest even when engaged in among the trees, in this respect he became the ideal for many of us.

Enyedi's wide-ranging scientific work and accomplishment received a lot of recognitions and awards at home and abroad. He became corresponding member of the Hungarian Academy of Sciences in 1982 and full member in 1990. He was Vice-President of the Hungarian Academy of Sciences between 1999 and 2002. He became member of the Academia Europaea in London in 1990. Enyedi was elected Honorary Member of the Finnish Geographical Society (1978), the Polish Geographical Society (1981), the French Geographical Society (1982), the Royal Geographical Society, London (1983), the Hungarian Geographical Society (1985), and the Croatian Geographical Society (1995).

Professor Enyedi lived most of his life throughout the exciting but otherwise troublesome 20th century, with world war, revolutions, oppression and systemic changes. What helped him to cope with all the difficulties in his professional and personal life was his extraordinary sense of humour. He was always able to cheer up his surrounding, even in the middle of the most boring committee meetings. Despite his influential positions he never behaved pompous and self-important manner. Typical of him, we were never allowed to address him Professor, or even György, but simply Gyurka, what was his well-known nickname among Hungarian geographers and social scientist independently from age or position.

The Hungarian human geography lost its outstanding representative who gained worldwide acknowledgements and who formed the view of generations of Hungarian geographers. With his work Professor Enyedi made an indelible contribution to the development of Hungarian human geography and the international recognition of our discipline. We geographers lost an extraordinary colleague and a great friend.

Zoltán Kovács