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A field experiment on the use of biogeotextiles for the conservation of sand-dunes of the Baltic coast in Lithuania

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Abstract

Extreme damage was caused by wave and wind erosion on sand dunes on the Baltic coast near Palanga in Lithuania. Waves breached a wide 'corridor' or 'blowout' through the coastal sand dune. A progressively widening breached blowout developed. There was a need to protect boundaries (walls) of the blowout from deflation and to encourage sand-dune accretion. The field experiment was performed to establish vegetation on the 'walls' and base of the blowout to stabilize the feature and stimulate sand-dune accretion. The hypothesis was tested that biogeotextiles could act as complementary measures for possible re-vegetation and temporary prevention of deflation.

The application of biogeotextile mats, constructed from the palm-leaves of *Borassus aethiopum* (Borassus) and *Mauritia flexuosa* (Buriti), has been investigated in field experiments on coastal sand dunes. Biogeotextiles effectively stored soil moisture during dry summer periods. Covering sand-dune slopes with biogeotextiles and planting local species of grasses, shrubs and trees enabled the stabilization of a breached 'corridor' through the sand-dune and a mean sand-dune accretion rate of 24.7 cm per year, over three years. The results of investigations show biogeotextile cover enabled stabilization and restoration of vulnerable ecosystems on the Baltic coastal sand-dune.

Geotextile cover prevented further deflation of the blowout; biogeotextile cover increased moisture storage and encouraged vegetation growth (planted shrubs and grasses); and biogeotextiles improved microclimatic and moisture conditions for the development of planted sprouts of plants communities. In turn, these changes encouraged rapid sand accretion and 'growth' of the basal sand dune. These processes contributed to the restoration of the breached sand-dune, sand accumulation and improved ecosystem functioning.

Keywords: biological geotextiles, coastal sand-dunes, landscape evolution, soil moisture, vegetation cover, wind erosion

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Introduction

Soil degradation by erosion is one of the world's most serious environmental problems, causing extensive loss of cultivated and potentially productive soil and crop yields (Fullen, M.A. and Catt, J.A. 2004; Morgan, R.P.C. 2006; Kertész, Á. 2009). It has been estimated that some 6,000 million tonnes of soil per year have been washed off the croplands of India (Fullen, M.A. and Catt, J.A. 2004). During the last 50 years, erosion has increased about 30-fold on some soils in Russia and crop production on these soils has decreased by 50–60% (Andronikov, S. 2000). The erosion-resisting capacity of the soil is disturbed by removing vegetation cover. About 17% of Lithuania's agricultural land is eroded, increasing to 43–58% in hilly regions. Water and wind erosion occurs mostly on arable soils and wind erosion occurs on the Baltic coast. There are many inexpensive potential soil conservation measures on arable soils in Lithuania (Jankauskas, B. *et al*. 2004, 2008a; Mazvila, J. *et al.* 2010). Vegetation cover is often undervalued in terms of its control over landscape incision (Howard, A. D. 1997; Poesen, J. *et al*., 2003). Conservation agriculture is a very successful method for retaining soil moisture and for decreasing the sediment load of surface waters. Adequate soil moisture can encourage both soil flora and fauna (Madarász, B. *et al*. 2011).

The drift sands of the Holocene are an important component of the European Sand Belt. They have been described by several authors (Högbom, I. 1923; Manikowska, B. 1995; Seppälä, M. 1995; Zeeberg, J.J. 1998; Göllnitz, D. 1999; Mangerud, J. *et al*. 1999; Bitinas, A. 2004; Koster, E.A. 2005, 2009; Satkunas, J. 2009). The youngest cover sands contain little silt and clay (Hoek, W. Z. 1997), which makes them susceptible to wind erosion.

The problem of coastal erosion is becoming increasingly evident on the south-east Baltic coast. Its fine-textured sandy beaches were heavy affected by storms in the late 20th century. Extreme damage, caused by wave and wind erosion on dunes, was exacerbated by anthropogenic activities. Waves breached a wide blowout through the coastal sand dune. Damage was even more serious after the stormy winter of 2001–2002: the coastal strip south of the town of Palanga was heavy eroded and the loss of sand exceeded 20,000 m^3 (12.5 m^3 m^{-1}) (Zilinskas, G. 2005). A ~30 m wide 'blowout' through the coastal sand-dune near Nemirseta was breached by pressure of natural (intense storm activity) and anthropogenic (footpath) activities and subsequently progressively widened. Therefore, there was a need to protect boundaries (walls) of this blowout from deflation and to encourage sand-dune accretion. The dynamics of the dunes preconditions the distribution of plant communities in aeolian systems (Morkunaite, R.–Cesnulevicius, A. 2005). However, we attempted to establish vegetation on the 'walls' and on the bottom of the blowout to stabilize the feature and stimulate sand-dune accretion. The hypothesis was tested that

biogeotextiles could act as complementary measures for possible re-vegetation and for temporary prevention of deflation.

Geotextiles are potentially excellent biodegradable and environmentally-friendly materials useful for soil conservation. The results obtained under UK rainfall intensities suggest that palm-mat application is highly effective for soil conservation. Water erosion rates equated to 0.45 Mg ha^{-1} from bare soil, 0.09 Mg ha^{-1} from grassed plots and 0.17 Mg ha^{-1} from both covered and buffer zone plots (Davies, K. *et al*. 2006). Geotextiles from leaves of the Lala palm (*Hyphaene coriacea*) reduced sediment yield from tailing dam slopes in South Africa by 55% (Bühmann, C. *et al*. 2010). The application of geotextile mats, constructed from the palm leaves of *Borassus aethiopum* (Borassus) and *Mauritia flexuosa* (Buriti), has been investigated at Kaltinenai Research Station of the Lithuanian Research Centre of Agriculture and Forestry. The geotextiles (Borassus and Buruti, respectively) decreased soil losses from bare fallow soil by 91% and 82% and from plots covered by perennial grasses by 88% and 79%, respectively. This illustrates that geotextiles have considerable potential as a biotechnical soil conservation method for slope stabilization and protection from water erosion on steep industrial slopes and may be integrated with the use of perennial grasses to optimize protection from water erosion (Jankauskas, B. *et al*. 2008b). Thus, we assessed the rehabilitation of degraded area on a breached sand-dune in the Pajurio Regional Park on the Baltic coast near Nemirseta (Lithuania) and the results of these investigations are presented.

It is postulated that biological geotextiles could act as a complementary measure for temporary prevention of deflation and to temporarily increase moisture storage, creating better conditions for re-vegetation. Of course, widespread adoption or dune stabilization measures are neither feasible nor desirable, considering the dynamic nature of the dune pedo-environment. However, carefully considered and targeted stabilization may make a balanced contribution to specific coastal sites.

Area descriptions, materials and methods

The European Commission funded the BORASSUS Project (Contract Number INCO-CT-2005-510745) for over three-years (2005–2009) to investigate 'The Environmental and Socio-economic Contribution of Palm Geotextiles to Sustainable Development and Soil Conservation.' Project objectives were deliverable to both 'developing' and 'industrialized' countries. The BORASSUS team was based in 10 countries (in Europe, Africa, South East Asia and South America) and scientifically tested four hypotheses, one of which is: palm-mat geotextiles efficiently conserve soil. To test this hypothesis, field experiments were conducted on the sand-dunes of the Baltic coast. The duration of the field experiment was three years.

Meteorological conditions during the three year project (2006–2008) are demonstrated in *Figure 1*. The mean monthly precipitation and temperatures present moisture and temperature conditions compared with the long-term mean. The highest monthly temperature was 20.1 °C in July 2006 and the lowest (-7.7 °C) in January 2006. Unusually high precipitation (170 mm) and mean air temperatures (1.9 °C) occurred in January 2007. Unusually high precipitation in July 2007 influenced lower temperatures compared with June and August. The winter of 2007–2008 was unusually warm, when average temperatures in December, January and February were ≥0 °C. Very dry periods in April and May occurred during each year of investigations. These conditions were unfavourable for the germination of seeds of perennial grasses sown in early spring.

Field experiments were conducted on the slope of a breached sand dune in Pajurio Regional Park on the Baltic coast, near Nemirseta (55°52'22''N; 21°03'25'' E). The soil is a Hapli-Calcaric Arenosol (ARc-ha) (Mazvila, J. *et al*. 2006). Particle size analysis shows that most material is sand (1.0–0.05 mm: 96.1%). The silt fraction is only 1.7 % and clay fraction 0.4% (*Table 1*). These data accord with general observations that young cover sands contain little silt and clay (e.g. Hoek, W.Z. 1997).

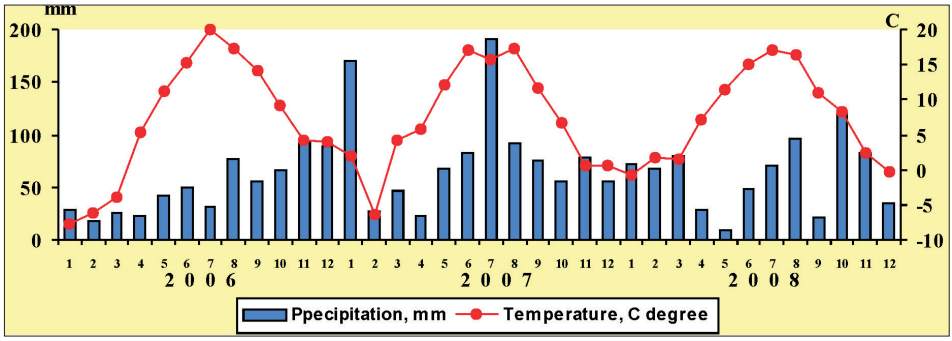

Fig. 1. Monthly precipitation and temperatures during the project (2006–2008)

Table 1. Particle size analysis of dune sands (fractions in % by weight)*

Soil depth, cm	Fractions, mm					
	1.0–0.25	0.25–0.05	0.05–0.01	0.01–0.005	0.005–0.001	<0.001
	Sand		Silt			Clay
0–20	8.8	88.1	0.4	0.4	0.9	0.4
	Mean sand = 96.1%		Mean silt = 1.7%			Mean clay = 0.4%

*Particle size analysis by the Kachinskiy method, n = 12 samples.

The dune sand had pH (KCl) 6.8, base saturation 92.4–92.5% and 0 available Al. The amount of organic matter (0.4 g kg^{-1}) and available K (15.8–24.1 mg kg^{-1}) accords with sandy soil properties. High concentrations of available P (168.2–185.3 mg kg^{-1}) can be attributed to periodic marine inundation.

For historical reasons, soil analytical techniques were mainly Russian procedures (Jankauskas, B. and Fullen, M.A. 2002). Soil textural classes were determined by the N. Kacinskij method (Michmanova, A.I. and Dolgov, S.I. 1966; Motuzas, A.J. *et al.* 1996), which is commonly used in Eastern Europe.

Soil reaction (pH_{KCl}) was determined in 1M KCl soil sample extracts using a calibrated digital pH meter. Hydrolytic acidity (H), which was used for calculation of base saturation, was determined in 1M CH_3COONa on soil sample extracts (ratio sample: extract, 1:25 for mineral soil) by titrating with 1M NaOH (Askinazi, D.L. 1975).

Exchangeable bases (*S*) and base saturation (*V*) were determined by the Kappen-Hilkovic method, which is based on hot titration of 0.1M HCl and soil sample filtrate (ratio sample:extract 1:5) with 0.1 M NaOH (Askinazi, D.L. 1975). Ca^{++}, Mg^{++}, K^{+}, Na^{+} and NH_4^{+} concentrations (meq kg^{-1}) were determined on filtrates and base saturation (*V*) calculated using the formula:

$$V = [S : (S + H)] \times 100,$$

where *V* = % base saturation, *S* = concentration of bases (meq kg^{-1}) and *H* = hydrolytic acidity (meq kg^{-1}).

Exchangeable Al was determined in the solution using the Sokolov method (Askinazi, D.L. 1975). Soil samples were mixed with 1M KCl (ratio 1:6.25), boiled to remove CO_2 and hot titrated using 0.01M NaOH. The amount of NaOH used for titrating corresponds to exchangeable acidity, which contains the total amount of H^{+} and Al^{+3} in the soil absorbing complex. The second analytical phase involves fixation and precipitation of Al^{+3} as a complex silt of kriolit (Na_3AlF_6), with NaF added to parallel solution samples and repeated titration with 0.01M NaOH. The difference represents exchangeable Al (cmol(+) kg^{-1}).

Exchangeable P_2O_5 and K_2O (mg kg^{-1}) were extracted with ammonium acetate-lactate (A-L solution, pH 3.7; ratio 1:20). Exchangeable P_2O_5 was determined by spectrophotometry and K_2O determined by flame photometry (Egner, H. *et al*. 1960; Vazenin, I.G. 1975; Ginzburg, K.E. 1975).

Soil humus (%) was determined by the Tiurin method (Bielchikova, N.P. 1975; Orlov, S.I. and Grisina, L.A. 1981), which is a wet combustion technique similar to the Walkley-Black method (USDA, 1995). Humified soil organic matter was oxidized by solution of potassium dichromate with sulphuric acid; ratio 1:50(25); and excess dichromate determined by titration with ferrous sulphate (Mohr solution). However, the protocol determines 'humus'

rather than soil organic matter or organic carbon, because only humified organic matter remains after thorough exclusion of un-decomposed plant and animal residues. Percentage humus was converted to % soil organic matter by multiplying by 1.724 (USDA, 1995).

The design of the field experiment on the sand-dune slope with a northerly aspect included the treatments: I. Perennial grasses (without geotextile mats, covered by shrub branches); II. Perennial grasses covered by Buriti mats; III. Perennial grasses covered by Borassus mats; and IV. Perennial grasses covered by coir carpet *(Photo 1).* Slope length was 5 m and the covered area 30 m^2.

The physical properties of the biogeotextiles show that the Borassus mats were somewhat thicker, had higher mass per unit area and smaller mesh sizes than Buriti mats (*Table 2*). The width of coir and straw-coir carpet was 2 m and thickness was only 1–3 mm.

The seeds from different wild plants, such us beach-grass (*Ammophila arenaria* L.), lyme-grass (*Elymus arenarius* L.), wood-reed (*Calamagrostis epigeios* L.), sedge (*Carex arenaria* L.), mugwort (*Artemisia campestris* L.), kidney vetch (*Anthyllis maritima* Schweigg) and baby's breath (*Gypsophila paniculata* L.) growing on the sand-dunes were collected in August and September 2006. Attempts to grow cultured seeds (orchard-grass (*Dactilis glomerata* L.), fescue red (*Festuca rubra* L.), Kentucky bluegrass (*Poa pratensis* L.), white clover (*Tripholium repens*

Photo 1. Field experiment on the sand-dune slope with a northerly aspect

Table 2. Selected physical properties of geotextile mats

Property	Borassus mats	Buriti mats
Material	Strips of Borassus palm *(Borassus aethiopum)* leaves	Fibres of Buriti palm (*Mauritia flexuosa)* leaves
Mean thickness (mm)	16	12
Size (m x m)	~0.60 x 0.60	~0.50 x 0.50
Mesh size (mm x mm)	30 x 30	40 x 40
Mass per unit area (g m^{-2})	950	520
Characteristics	Stiff, deformable	Flexible, deformable

L.) and alfalfa (*Medicago lupulina* L.)) in May 2006 proved unsuccessful. The cultured crops were unable to germinate due to the demanding edaphic conditions on the sand-dunes. The design of field experiment on the sand-dune slope with the southerly aspect contained the treatments:

I. Planting of cereal perennial grasses in May 2006, covered by shrub branches.

II. Planting of other perennials in May 2006, covered by shrub branches.

III. Planting of shrubs in November 2006, covered by shrub branches.

IV. Wild perennial grasses, sown in early spring 2007, covered by coir carpet.

V. Wild perennial grasses, sown in early spring 2007, covered by Borassus mats.

VI. Wild perennial grasses, sown in early spring 2007, covered by Buriti mats.

VII. Wild perennial grasses, sown in early spring 2007, covered by shrub branches.

VIII. Wild perennial grasses, sown in early spring 2007, covered by straw-coir carpet. Slope length was 7–10 m and the planted area was 48 m^2 (*Photo 2*).

The planted grasses were: beach-grass, kidney vetch and sedge, and planted shrubs or trees were: vilet willow (*Salix daphnoides* Vill.), currant (*Ribes alpinum* L.), rose (*Rosa dumalis* Bechst.), rowan (*Sorbus aucuparia* L.) and bird cherry (*Padus avium* Mill).

Two belts of palm-mats biogeotextiles were located on the front of the breached blowout, where the formation of an embryo sand-dune had commenced before spring 2006. The belts were designed as a checkerboard form from three rows of mats *(Figure 4).* One belt was located on the top of the highest newly formed sand-dune, while the other one was parallel with the first and 5 m inland. In total, 110 Borassus mats and 30 Buriti mats were used. The 72 sprouts of wood-reed, 80 sprouts of lyme-grass and 18 sprouts of beach-grass were planted on the squares of belts not covered by biogeotextile mats on

Photo 2. Field experiment on the sand-dune slope with the southerly aspect

31/06/06. Six graduated (every 10 cm) markers were inserted into sand-dunes at 5 m intervals in the middle of belts *(Figure 2)*. These markers were used for periodic (every 10 days) measurement of topographic changes.

The white squares were covered by biogeotextile mats; the sprout ⊕ of wood-reed, lyme-grass or beach-grass were planted on the checkerboard squares as well as on the space between the belts. The markers (1–6) were inserted into the centre of dark squares.

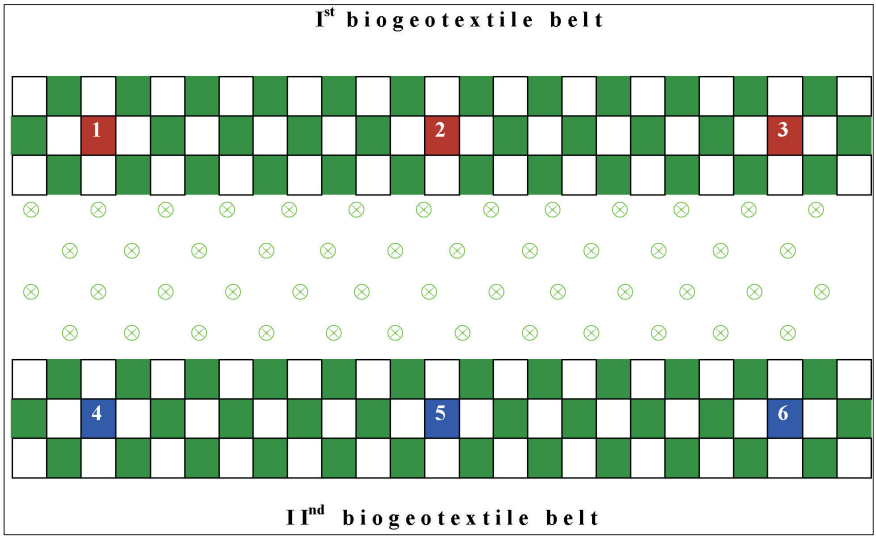

Fig. 2. The belts with biogeotextile mats located on the bottom of the breached 'corridor' and the slopes ('walls') of the breached sand-dune

Borassus mats, coir carpet and straw-coir carpet were used in the first set of field experiments in May 2006. A multi-species mixture of perennial grasses (Pg) consisted of 20% each of: orchard-grass, red fescue, Kentucky bluegrass, white clover and alfalfa. The mixture was sown into topsoil (0–5 cm). Soil sampling for soil moisture (% by volume) was determined using a Delta-T soil moisture meter type HH2. Measurements (6 individual measurements from each plot) were taken every 10 days on topsoil (0–6 cm) samples.

The data were analysed using the computer programs ANOVA, STAT and SPLIT-PLOT from the package SELKCIJA and IRRISTAT (Tarakanovas, P. and Raudonius, S. 2003).

Results

The dynamics of soil moisture were investigated every 10 days during the vegetation growth period on the sand-dunes each year, but is represented by the mean data for 2007. The highest mean soil moisture content during the vegetation growth period in 2007 was under cover of Borassus and Buriti mats (*Table 3*). However, there was some time (23/05/07–22/06/07) when topsoil (0–6 cm) moisture under the branches fell to 0.6–1.4%. Moisture content was a little greater on the slope with the northerly aspect. Linear correlation coefficients of soil moisture values among treatments were: r = 0.888–0.974 (P <0.001, n = 19) *(Table 3*).

Planting of grasses (treatments I and II) on the slope with the southerly aspect was performed on 31/05/06, and was followed by the planting of shrubs and trees (treatment III) on 23/10/06. The survival of planted species was high (*Table 4*), but growth rates were very low during the summers of 2007 and 2008. Very dry conditions in May and June impeded the development of young sprouts of sown plants, but most planted species survived this extremely dry period (*Figure 1*). Cover of the breached 'corridor' slopes on the sand-dune using biogeotextiles and established plants enabled the stabilization of the blowout and impeded further deflation.

A further objective was to nurture the accretion of the sand-dune basal 'floor' along the blowout. Planting sprouts of wood-reed, lime-grass and beach

Table 3. Soil moisture (% in 0–6 cm soil) on the sand-dune slope, southerly aspect, 2007

Treatments	Mean (n = 19*)	SE	Max.	Min.	SD
Pg (no cover)	2.46	0.38	7.40	0.60	1.62
Pg+Borassus	2.67	0.82	4.20	1.40	1.42
Pg+Buriti	2.52	0.38	7.60	0.30	1.60
Pg+straw-coir	2.16	0.41	7.80	0.10	1.75

*Soil moisture measurements taken every 10 days during the vegetation growth period.

Table 4. Survival of cultured plants and germination rates of sown perennial grasses

Treatments	Planted or sown species	Amount of the samplings (sprouts) on plot			
		planted	survived 2006	survived 2007	survived 2008
Planting grasses, May 2006 + shrubs' branches	Ammophila arenaria	60	43	58	37
Planting other perennials, May 2006 + shrubs' branches	Anthyllis maritima Carex arenaria	38 22	27 18	43 18	43 7
Planting shrubs and trees, October 2006 + shrub branches	Sorbus aucuparia Salix daphnoides Ribes alpinum Rosa dumalis Padus avium	15 12 15 2 1	– – – – –	14 12 15 1 1	12 12 15 1 1
Wildlife grasses, March 2007 + coir carpet	Artemisia campestris, Medicago lupulina and others	Sown	–	64	58
Wildlife grasses, March 2007 + Borassus	Artemisia campestris, Medicago lupulina and others	Sown	–	79	76
Wildlife grasses, March 2007 + Buriti	Artemisia campestris, Medicago lupulina and others	Sown	–	77	83
Wildlife grasses, March 2007 + shrubs' branches	Artemisia campestris, Medicago lupulina and others	Sown	–	69	77
Wildlife grasses, March 2007 + straw-coir carpet	Artemisia campestris, Medicago lupulina and others	Sown	–	66	78

grass was successful. The sprouts developed root systems and promoted herbaceous cover, both under geotextile belts and outside these belts. The cumulative curves (*Figure 3*) show evident changes in sand accumulation on belt I after winter 2006–2007 and much greater changes on belt II after winter 2007–2008. Most visible changes in sand-dune development were during warm periods (spring-summer-autumn) in 2006 and especially during 2008. Correlation among the mean data from three measurements every 10 days from biogeotextile belt I (x) and biogeotextile belt II (y) was $r = 0.90 \pm 0.058$, $P < 0.001$ (multiple regression $R = 0.96$ and regression coefficient $R^2y/x = 91.31\%$ ($n = 56 \cdot 3 = 168$). More rapid accretion occurred on biogeotextile belt I (mean 26.7 cm) compared with 22.8 cm on biogeotextile belt II, with a mean accretion of 24.7 cm yr^{-1} (*Table 5*). The most evident accretion phases were during winter and, in some cases, in June and August. Significantly more accretion occurred in 2008, when herbaceous cover became dense. There was a significant ($P < 0.001$) modified power regression ($R^2 = 89.96\%$; $t = 5.45$) among sand-dune accretion under biogeotextile belts I and II.

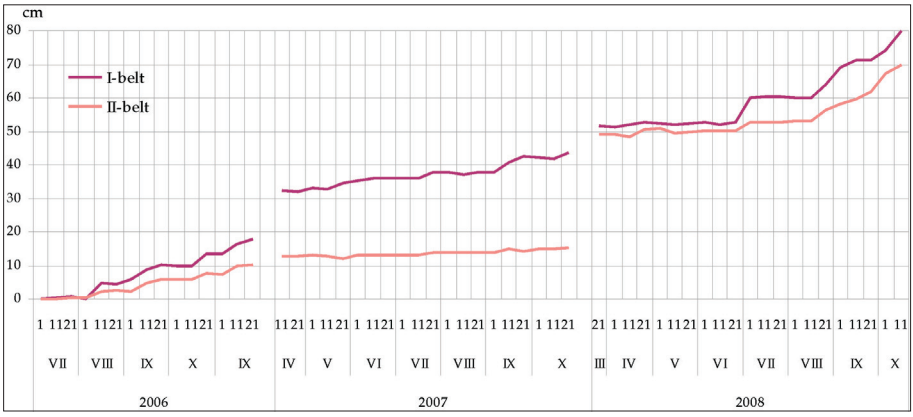

Fig. 3. Cumulative curves of sand-dune accretion on the areas of biogeotextile belts I and II. (Roman numerals represent months)

Table 5. Accretion (cm) of sand dunes on the breached blowout near Nemirseta

Year or index	Biogeotextile belt I, no. of markers				Biogeotextile belt II, no. of markers				Total mean
	1	2	3	Mean	4	5	6	Mean	
2006	38	26	17	27.0	14	11	11	12.0	19.5a
2007	15	26	20	20.3	18	20	21	19.7	20.0a
2008	23	35	40	32.7	62	26	22	36.7	34.7b
LSD_{05}	Among sand dune accretion in different years								7.80
Mean	–			26.7a	–			22.8a	24.7
LSD_{05}	Among sand dune accretion under biogeotextile belts I and II							7.85	–

Note: values with a different letter denote significant difference ($P < 0.05$).

Discussion

Zaromskis, R. and Gulbinskas, S. (2010) identified three dynamically different shore segments of the Curonian Spit of Lithuania: relatively stable, transitional and accumulative. Our investigations were on the accumulative zone of the northern Curonian Spit on the slopes of a breached sand dune in Pajurio Regional Park on the Baltic coast near Nemirseta. Kask, A. *et al.* (2010) considered that "*waves and currents sort the abraded material so that coarser material accumulates closer to the outcrop of parent sediment and finer material is carried further. The sedimentation area is determined by hydrodynamic conditions and water depth. The depth and mean grain size correlation has confirmed that finer sediments accumulate in deeper and coarser ones in shallow areas. The glacial till in coastal areas and on shallow sills is subject to erosion by currents and waves which rework and redistribute the sand and silt components, while coarser particles (boulders and gravel) remain as lag sediments. Along the transport path to deeper areas, the sediment becomes progressively finer. Silt and clay particles settle in the deepest parts of the shelf. Sand forms deposits on the slopes of shallows where the equilibrium conditions for settling of sand particles exist*."

Similar characteristics of sand sorting were observed by Jarmalavicius, D. and Zilinskas, G. (2006). Particle size analysis reported in *Table 1* can be interpreted within this conceptual framework. The investigated sand dunes consisted of 96.1% sand, therefore soil moisture conditions were inimical for the growth of sown perennial grasses during dry summers (*Table 3*). Moisture conditions were better for the growth of planted local species on the bottom of breached sand-dunes. The planted species survived excellently and on the blowout slopes, but growth rates were very low during the summers of 2007 and 2008 (*Table 4*).

Biogeotextile cover enabled stabilization and restoration of vulnerable ecosystems on the Baltic coastal sand-dune. Firstly, geotextile cover prevented further deflation of the blowout. Biogeotextile cover increased moisture storage and encouraged vegetation growth (planted shrubs and grasses) (*Table 3*). Biogeotextiles also improved microclimatic and moisture conditions for the development of planted sprouts of wood-reed, lime-grass and beach grass communities.

In turn, this encouraged rapid sand accretion on the sand dune (*Figure 3, Table 5*). These processes contributed to the restoration of the breached sand-dune, sand accumulation and improved ecosystem functioning.

Time sequences of dune photographs are a useful means of studying dune dynamics (Fullen, M.A. and Moore, G.M. 1999). Further progressively rapid accretion of sand occurred on the 'basal floor' of the blowout some two years later after the completion of field measurements. *Photo 3* shows evidence of both sand accretion and the progressive thickening of plant cover.

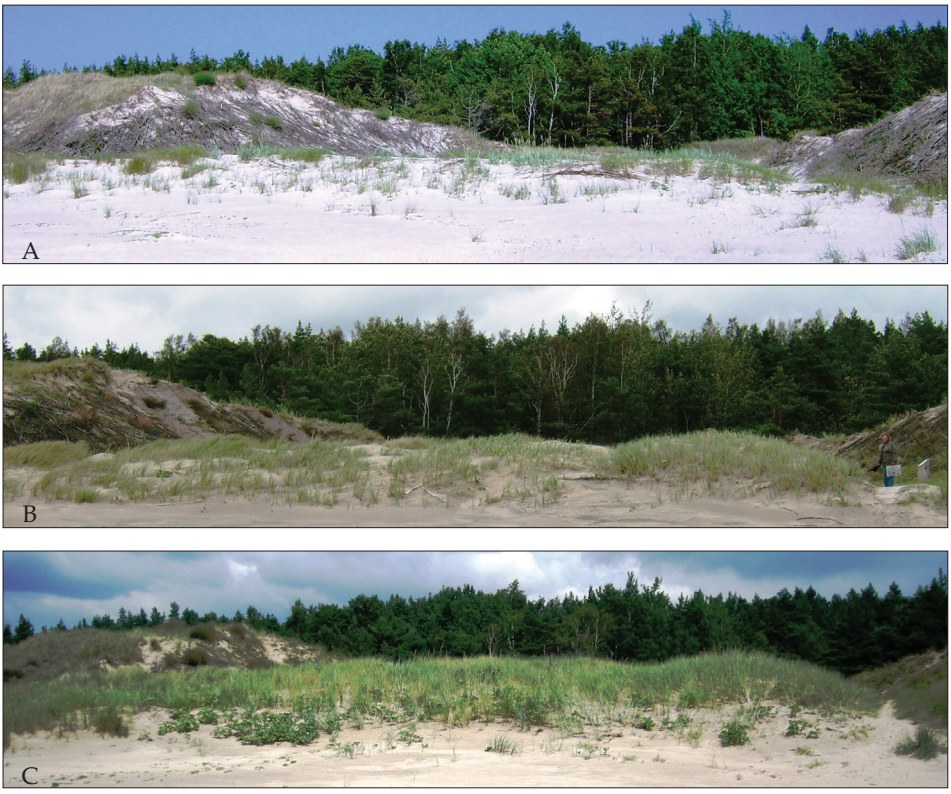

Photo 3. The breached blowout in the sand dune on the coast of Baltic Sea near Nemirseta. – A = 2006; B = 2008; C = 2011

Conclusions

Two important conclusions must be drawn:

1. Covering breached sand-dune slopes with Borassus and Buriti geotextile mats, straw-coir and coir carpets and with branches of shrubs as well as planting local species of grasses, shrubs and trees enabled the stabilization of a blowout within a coastal sand-dune.

2. Covering the blowout floor using Borassus and Buriti mats and planting local species of perennial grasses enabled sand dune accretion by a mean of 24.7 cm per year over three years. This accelerated the restoration of a breached coastal sand dune.

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REFERENCES

Andronikov, S. 2000. The present status of the soil environment in Russia. In *Soil quality, sustainable agriculture and environmental security in Central and Eastern Europe*. NATO Science Series, Environmental Security 69. 87–95.

Askinazi, D.L. 1975. The methods for determination of liming needs of soddy-podzolic soils. In *The agro-chemical methods of soil investigation*. Moscow, Nauka, 228–243. (In Russian)

Bielchikova, N.P. 1975. Determination of soil humus by method of I.V. Tiurin. In *The agro-chemical methods of soil investigation.* Moscow, Nauka, 56–62. (In Russian)

Bitinas, A. 2004. Lietuvos eolinių nuogulų amžius (The age of aeolian deposits of Lithuania). *Geologija* 45, 1–5. (In Lithuanian)

Bühmann, C., Paterson, D.G., Piennar, G.M.E., Nell, J.P., Mulibana, N.E., van Deventer, P.W., Fullen, M.A., Subedi, M. and Sarsby, R.W. 2010. Rainfall simulator study of the erosion control potential of palm geotextiles for mine dam slope stabilization. In *Construction for a sustainable environment* Eds. Sarsby, R.W. and Meggyes, T. CRC Press, Balkema, 443–451.

Davies, K., Fullen, M.A. and Booth, C.A. 2006. A pilot project on the potential contribution of palm-mat geotextiles to soil conservation. *Earth Surface Processes and Landforms* 31. 561–569.

Egner, H., Riehm, H. and Domingo, W.R. 1960. *Untersuchungen über die shemische bodenanalyse als grundlage für die beurteilung des nährstoffzustandes der böden.* II. Chemische extractionsmethoden zur phosphor- und kaliumbestimmung. Uppsala.

Fullen, M.A. and Moore, G.M. 1999. Photographing dune dynamics. *Geography Review* 13. (2): 14–17.

Fullen, M.A. and Catt, J.A. 2004. *Soil Management: Problems and Solutions*. London, Arnold Publishers.

Ginzburg, K.E. 1975. The methods for determination of phosphorus in soil. In *The agro-chemical methods of soil investigation.* Moscow, Nauka, 106–190. (In Russian)

Göllnitz, D. 1999. Das Dünenkataster des Landes Brandenburg. *Brandenburger Geowissenschaften Beiträge* 6. (2): 39–41.

Hoek, W.Z. 1997. Paleogeography of Lateglacial vegetation. Aspects of Lateglacial and Early Holocene vegetation, abiotic landscape and climate in The Netherlands. KNA/ICG/VUA. *Nederlandse Geografische Studies* 230, Utrecht/Amsterdam, The Netherlands, 160 p.

Högbom, I. 1923. Ancient inland dunes of northern and middle Europe. *Geografiska Annaler* 5. 113–243.

Howard, A.D. 1997. Simulation of gully erosion and bistable landforms. In *Proceedings of the Conference on Management of Landscapes Disturbed by Channel Incision*. Oxford MS, Center for Computational Hydroscience and Engineering, The University of Mississippi, 516–521.

Jankauskas, B., Jankauskiene, G. and Fullen, M.A. 2002. Erosion-preventive crop rotations and water erosion rates on undulating slopes of Lithuania. *Canadian Journal of Soil Science* 84. (2): 177–186.

Jankauskas, B., Jankauskiene, G., and Tiknius, A. 2008a. The contribution of quality assessment of eroded agricultural soil on hilly-undulating landscapes to sustainable community development. In *Use of landscape sciences for the assessment of environmental security.* Eds: Petrosilo, I., Müller, F., Jones, K.B., Zurlini, G., Krauze, K., Victorov, S., Bai-Lian, L. and Kepner, W.G., Dordrecht, Springer, 431–451.

Jankauskas, B., Jankauskiene, G., Fullen, M.A. and Booth, C.A. 2008b. Utilizing palm leaf geotextiles to control soil erosion on roadside slopes in Lithuania. *Zemės ukio mokslai (Agricultural Sciences)* 15. (3): 22–28.

Jarmalavičius, D. and Zilinskas, G. 2006. Peculiarities of sand sorting in the Lithuanian coast of the Baltic Sea. *Geologija* 56. 36–42.
Kask, A., Soomere, T., Suuroja, S. and Kask, J. 2010. Sand accumulation under varying lithohydrodynamic conditions in the coastal area. *Baltica* 23. (2): 157–164.
Kertész, Á. 2009. The global problem of land degradation and desertification. *Hungarian Geographical Bulletin* 58. (1): 19–31.
Koster, E.A. 2005. Aeolian environments. In *The Physical Geography of Western Europe. Oxford Regional Environments*. Ed. Koster, E.A. Oxford, Oxford University Press, 139–160.
Koster, E.A. 2009. The "European Aeolian Sand Belt": Geoconservation of drift sand landscapes. *Geoheritage* 1. 93–110.
Madarász, B., Bádonyi, K., Csepinszky, B., Mika, J. and Kertész, Á. 2011. Conservation tillage for rational water management and soil conservation. *Hungarian Geographical Bulletin* 60. (2): 117–133.
Mangerud, J., Svendsen, J.I. and Astakhov, V.I. 1999. Age and extent of the Barents and Kara ice sheets in Northern Russia. *Boreas* 28. 46–80.
Manikowska, B. 1995. Aeolian activity differentiation in the area of Poland during the period 20–8 ka BP. *Biuletyn Peryglacjalny* 34. 125–165.
Mazvila, J., Vaicys, M. and Buivydaite, V. 2006. *Lietuvos Dirvozemių Makromorfologine Diagnostika*. LZI, Akademija.
Mazvila, J., Staugaitis, G., Kutra, G.J. and Jankauskas, B. 2010. Empirinių modelių panaudojimas dirvožemių erozingumo įvertinimui Lietuvoje, *Zemės ūkio mokslai (Agricultural Sciences)*. 17. (3–4): 69–78.
Michmanova, A.I. and Dolgov, S.I. 1966. Methods for textural and microaggregate analysis of soil. In *Methods for agro-physical investigation of soil.* Moscow, Nauka, 5–41. (In Russian)
Morgan, R.P.C. 2006. *Soil Erosion and Conservation*. Third Ed. Oxford, Blackwell Publishing.
Morkunaite, R. and Cesnulevicius, A. 2005. Changes in blowout segments of the ridge in the Curonian Spit in 1999–2003. *Acta Zoologica Lithuanica* 15. (2): 145–150.
Motuzas, A.J., Buivydaite, V., Danilevicius, V. and Sleinys, R. 1996. *Pedology.* Vilnius, Mokslas, (In Lithuanian)
Orlov, D.S. and Grisina, L.A. 1981. *Guide in chemistry of humus.* MGU, Moscow. (In Russian)
Poesen, J., Nachtergaele, J., Verstraeten, G. and Valentin, C. 2003. Gully erosion and environmental change: importance and research needs. *Catena* 50. 91–133.
Satkunas, J. 2009. Pleistocene and Holocene palaeo-environments and recent processes across NE Europe. *Quaternary International* 207. 1–3.
Seppälä, M. 1995. Deflation and redeposition of sand dunes in Finnish Lapland. *Quaternary Science Reviews* 14. 799–809.
Tarakanovas, P. and Raudonius, S. 2003. *Agronominiu Tyrimu Duomenu Statistine Analize Taikant Kompiuterines Programas ANOVA, STAT, SPLIT-PLOT Is Paketo Selekcija Ir IRISTAT*. LZUU, Akademija.
USDA NRCS, 1995. *Soil survey laboratory information manual.* Lincoln, National Soil Survey Center, Soil Survey Laboratory. Nebraska.
Vazenin, I.G. 1975. The methods for determination of potassium in soil. In *The agro-chemical methods of soil investigation.* Moscow, Nauka, 191–218. (In Russian)
Zaromskis, R. and Gulbinskas, S. 2010. Main patterns of coastal zone development of the Curonian Spit, Lithuania. *Baltica* 23. (2): 149–156.
Zeeberg, J.J. 1998. The European sand belt in Eastern Europe and comparison of Late Glacial dune orientation with GCM simulation results. *Boreas* 27. 127–139.
Zilinskas, G. 2005. Trends in dynamic processes along the Lithuanian Baltic coast. *Acta Zoologica Lituanica* 15. (2): 204–207.

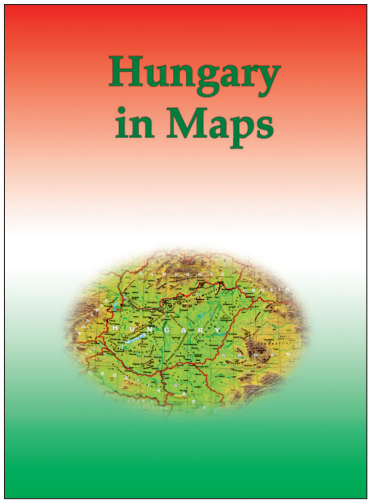
Hungary in Maps

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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Design of climate station network in mountain catchments

Josef KŘEČEK[1] and Petr PUNČOCHÁŘ[2]

Abstract

In the Jizera Mountains (Czech Republic) the density of climate station network was tested in relation to spatial data interpolation, and watershed management targets. Point weather data (precipitation, air temperature, humidity and wind velocity) were interpolated by the nearest neighbourhood (NN), inverse distance weighting (IDW), spline (SPL), hypsometric (HYP) and kriging (KRI) methods. The results were assessed by the root mean square error (RMSE). The interpolation effectiveness showed the following order: HYP, IDW, KRI, NN and SPL. The advantage of the hypsometric method was recognised, particularly, by providing reasonable outputs in marginal catchments of the region and outside of the main instrumented area. However, in case of a higher density of observation points (11 hectares per station), all interpolation methods manifested comparable and realistic outputs in the focused mountain watersheds.

Keywords: mountain watershed, climate station network, precipitation, potential evapotranspiration, spatial data interpolation

Introduction

Many tasks of watershed management (water resources recharge, water quality control or flood protection) require sets of authentic climate data from point-observation networks. For many years there has been an urgent call for the improvement of climatological inputs (atmospheric precipitation, solar radiation, air temperature, humidity and wind speed) used by catchment hydrological models (Becker, A. and Serban, P. 1990; Cooper, M.R. and Fernando, D.A.K. 2009).

WMO (1994) generally recommends the minimum aerial density of weather stations by 250 km^2 (eventually 25 km^2 on mountain islands). The

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quality of climate information in watershed scale depends on the method of aerial interpolation (and extrapolation) of the observed point data (Hay, L., Viger, R. and McCabe, G. 1998). In mountain regions, particularly, the spatial interpolation of point data is complicated by the effects of the mezo- and micro-climate. Geographic information systems are supposed to be powerful tools in the spatial application of interpolation techniques (Burroughs, P.A. and McDonnell, R.A. 1998; Hartkamp, A.D. *et al*. 1999).

The aim of this study is to compare and assess the most commonly used methods of aerial interpolation of point weather data observed in the central part of the Jizera Mountains. (Northern Bohemia, Czech Republic) (*Figure 1*).

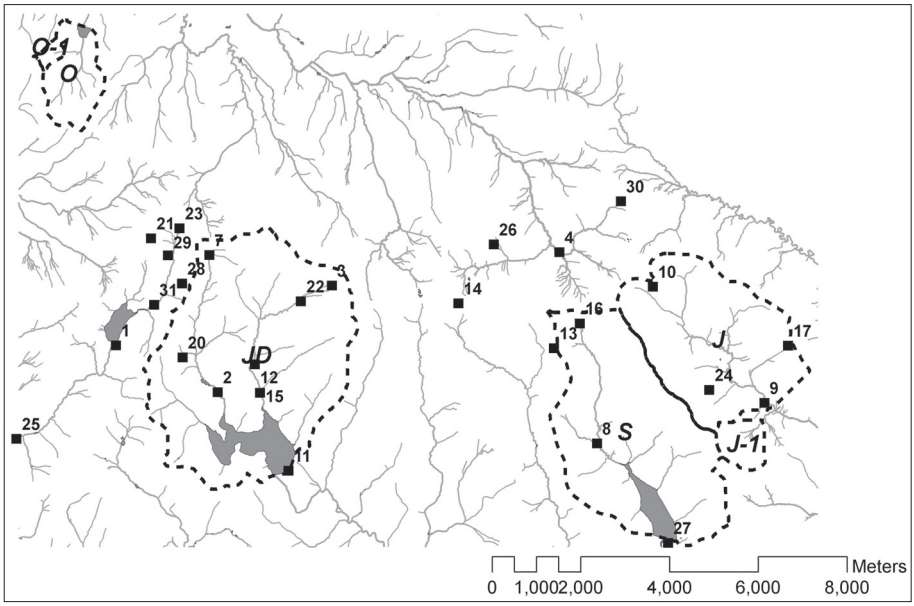

Fig. 1. Weather stations with numbers and focused basins in the Jizera Mountains. – J = Jizerka; J-1 = Jizerka-1; JD = Josefův Důl; O = Oldřichov; O-1 = Oldřichov-1; S = Sous

Material and methods

The Jizera Mountains are an important region for water resources recharge, therefore, the network of weather stations is relatively dense here. In total, 31 stations are located over an area of cca 200 km^2. The distance between the neighbouring stations varies from 0.6 to 2.8 km. All stations are instrumented by rain-gauges, 15 stations by thermometers, and 7 by anemometers.

The observation guidelines of the weather stations are provided by WMO (2009), and the spatial interpolation techniques by WMO (1994), Stein, M.L. (1999) or Sluiter, R. (2009). The following interpolation methods were used here to process the point climate data:

1. Nearest neighbourhood method (NN),
2. Inverse distance weighting (IDW),
3. Polynomial functions – splines (SPL),
4. Hypsometric method (HYP),
5. Kriging (KRI).

The *nearest neighbourhood method* (NN) assigns the value from the nearest observation to a certain grid cell (Sluiter, R. 2009). The Thiessen concept of polygon areas corresponding to observation points was applied here. Thus, the value of a climate parameter P, representative over a catchment area A, is given by (1):

$$P = \Sigma\ (P_i A_i)/A, \tag{1}$$

where P_i = value of the parameter P, observed at the station i; A_i = area of the polygon i.

The method of inverse distance weighting (IDW) is an advanced nearest neighbour approach. The value of a certain grid cell is obtained from a linear combination of the surrounding locations. This method is based on the assumption that the weight of each observation declines with distance. The value of a climate parameter P_j in a point j is given by (2):

$$P_j = \Sigma[P_i/(D_i + S)^p] \,/\, \Sigma[1/(D_i + S)^p], \tag{2}$$

where P_i = the value of the characteristic P, observed in a point i (i = 1, 2, … n); D_i = distance of the point j from the station i; p is parameter of the weight; S = parameter of smoothness; n = number of point observations. For the aim of this study, values of S = 0, and p = 2 were applied according to Shaw, E.M. (1991).

The method of splines (SPL) is based on polynomial functions that fit trends through the observation points by x-order polynomials. To ensure that results do not show strongly oscillating patterns between the observation points, algorithms are used to smooth the resulting surfaces. Broadly speaking, polynomial functions are regarded as a good method for the interpolation of monthly and yearly climate elements but they are less suitable at higher temporal resolutions (days or hours). That approach is not recommended when the neighbouring data show significant differences (see Sluiter, R. 2009).

The hypsometric method (HYP) is a composite approach which takes account of catchment topography (Shaw, E.M. 1991). It is recommended for small or medium sized catchments in hilly regions where the relationship between climate elements and elevation is statistically significant.

The probabilistic approach of kriging (KRI) incorporates the concepts of randomness, linear regression model, geo-statistics and optimum interpolation (Stein, M.L. 1999). That method is considered to be the best interpolation technique in case of relatively sparse point data. Kriging is also based on the recognition that the spatial variation of climate elements is often too irregular to be modelled by a simple function. Thus, the variation can be better described by a stochastic surface with an attribute known as a regionalized variable. The regionalized variable theory assumes that the value of a random variable P_j at point j is given by (3):

$$P_j = m_j + \varepsilon_j + \varepsilon'_j, \tag{3}$$

where m_j = deterministic function describing a structural component P at j; ε_j = a random spatially correlated component; ε'_j= a residual non-spatially correlated term (or noise).

When structural effects have been accounted for and the variation is homogenous, the semi-variance $\gamma\,(d)$ can be estimated by (4):

$$\gamma(d) = (1/2n) \sum (P_i - P_j)^2, \tag{4}$$

where P_i = value of climate element P, observed at the point i; P_j = value of element P at a point j (in a distance d from the point i); n = number of pairs of sample points of observations of the values of element P separated by distance d.

A plot of $\gamma\,(d)$ against d is called a semi-variogram and gives a quantitative description of the regionalised variation. An important factor of the variogram is the range which describes the distance in case of spatially independent data points. Several modifications of that approximation are mentioned by Sluiter (2009), however, in this study simple kriging applying a spherical model of the semi-variogram was used.

In this study daily precipitation amounts and daily values of mean air temperature, humidity and wind speed (data of the Czech Hydrometeorological Institute, and the Water Authority of the Elbe River collected in 1999–2007) were analysed. The raw data were filtered by the ADMS method ((Shaw, E.M. 1991) and ArcGIS/ArcInfo GIS software was applied for data processing. The success of spatial approximation was evaluated by statistical induction; the values of the root mean square error (RMSE) were calculated by (5):

$$RMSE = [(1/n) \sum (P_{mi} - P_i)^2]^{0,5}, \tag{5}$$

where P_i = parameter observed at a point i; P_{mi} = parameter modelled at a point i by the spatial interpolation from values of the parameter P in neighbouring points.

Considering the water budget in six selected watersheds (*Figure 1*), we tested the possibility to estimate realistic values of catchment precipitation (P) and evapotranspiration (ET). Potential evapotranspiration (ETP) was calculated from the daily values of climate parameters (air temperature, humidity and wind speed) by applying the FAO Penman-Monteith method (Allen, R.G. *et al.* 1998) corresponding to the reference crop of a height of 0.12 m, a surface resistance of 70 s/m and an albedo of 23%, adequately watered. The geomorphological characteristics of the selected basins are given in *Table 1*.

Table 1. Characteristics of the focused basins

Basin	Area (A), km^2	Mean elevation (E), m	Mean slope (S), %	Length (L), km	Shape index, A/L^2
J	10.41	913	9.7	4.32	0.56
J-1	1.03	927	12.0	1.14	0.79
JD	19.64	834	11.9	5.49	0.65
S	13.78	865	14.0	5.06	0.54
O	2.59	478	28.2	2.36	0.47
O-1	0.23	507	34.6	0.66	0.53

Results and discussion

Comparing the methods of interpolation, values of the root mean square error (RMSE) for modelled and observed mean annual data – precipitation (P_a), air temperature (T_a), humidity (H_a) and wind speed (W_a) – of a nine-year period (1999–2007) are presented in *Table 2*. The lower values of the root mean square error (RMSE) identify better space approximation for climate parameters.

Table 2. RMSE values for the modelled space distribution of climate parameters and methods of interpolation

Method	Precipitation (P_a) mm	Air temperature (T_a) °C	Humidity (H_a) %	Wind speed (W_a) m/s
NN	0.90	1.52	2.29	0.86
IDW	0.63	1.28	1.93	*0.52*
SPL	1.45	2.64	2.73	1.14
HYP	*0.56*	*1.13*	*1.47*	0.89
KRI	0.77	1.37	1.87	0.72

The hypsometric method (HYP) provided the best results concerning the values of precipitation, temperature and humidity; while for wind distribution, the method of inverse distance weighting (IDW) gave better outputs. That result corresponds to the significant correlation between precipitation (P_a), air temperature (T_a), humidity (H_a) and elevation (E). The estimated correlation coefficients are as follows: R = 0.757 (P_a, E), R = 0.869 (T_a, E), R = 0.728 (H_a, E), R

= 0.217 (W_a, E), by the critical value R_c = 0.254 (p = 0.01). The outputs of space interpolation (values of P_a, T_a, and H_a by hypsometric method and W_a by inverse distance weighting) for the years 1999–2007, are shown in *Figures 2*, *3*, *4* and *5*.

The interpolation by HYP, IDW and NN fits extreme values of the tested climate parameters by errors of ±10 %. The spline approach (SPL) tends to be a significant disfigurement of the observed extremes (up to 70%), similarly to the results of Richards, D. (1975) and Hay, L., Viger, R. and McCabe, G. (1998). Kriging (KRI) resulted in flattening the local extremes it corresponds to the findings of Stein, M.L. (1999) and Sluiter, R. (2009). The advantage of the hypsometric method (HYP) seems to be manifested mainly in a realistic extrapolation of the elevation-dependent parameters for the marginal areas of the investigated mountain region (outside of the observation network).

Concerning the interpolation of monthly data of elevation-dependent parameters, the hypsometric method was complicated by seasonal changes. Monthly precipitation showed the most significant relationship with elevation in May (R = 0.92); later it decreased to R = 0.65 (June-July), rised to R = 0.74 (September–November) and decreased to R = 0.33 (December-April).

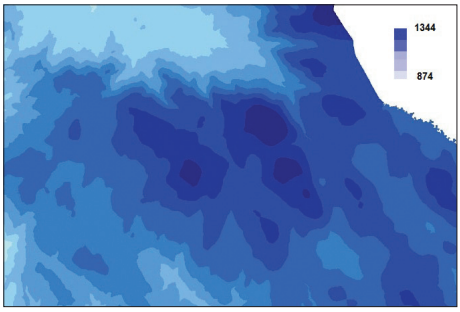

Fig. 2. Mean annual precipitation P_a (mm) interpolated by the hypsometric method

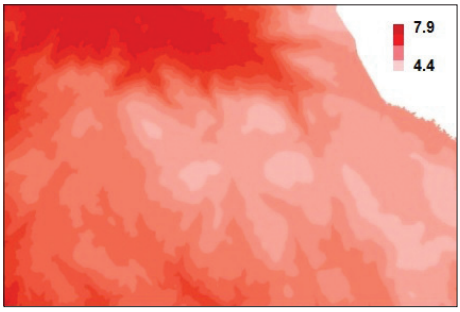

Fig. 3. Mean annual air temperature T_a (°C) interpolated by the hypsometric method

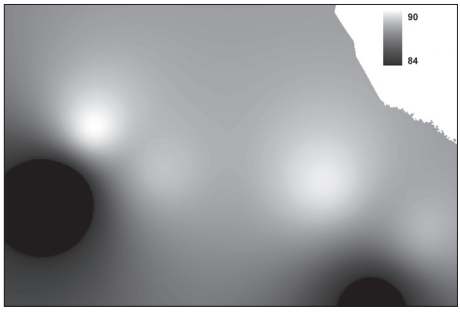

Fig. 4. Mean annual humidity H_a (%) interpolated by the hypsometric method

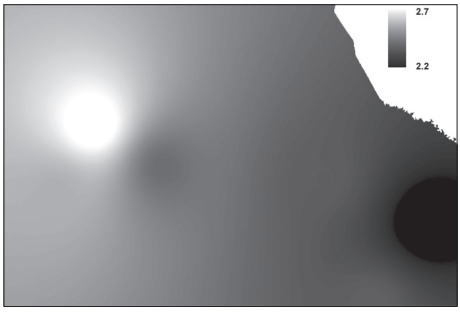

Fig. 5. Mean annual wind speed W_a (m/s) interpolated by inverse distance weighting

Potential evapotranspiration was calculated in daily steps from the interpolated daily data of temperature, humidity and wind speed. The distribution of mean annual values of potential evapotranspiration ETP_a over the Jizera Mountains region in 1999–2007 is presented in *Figure 6*.

Regarding the water budget in the six selected watersheds (*Figure 1, Table 1*), we suppose that aerial means of the parameters P, precipitation and potential evapotranspiration, (*P-HYP*) given by the hypsometric method are authentic. Then, differences Δ (mm) derived from the results given by alternative methods (NN, IDW, SPL, KRI) – see (6) – are shown in *Table 3*.

$$\Delta\text{-}NN = P\text{-}NN - P\text{-}HYP \quad (6)$$
$$\Delta\text{-}IDW = P\text{-}IDW - P\text{-}HYP$$
$$\Delta\text{-}SPL = P\text{-}SPL - P\text{-}HYP \quad (6)$$
$$\Delta\text{-}KRI = P\text{-}KRI - P\text{-}HYP$$

The percentage error ∂ (%) of aerial P-means, calculated by alternative methods (NN, IDW, SPL, KRI) versus the hypsometric method given by (7), is presented in *Table 4*.

$$\partial = 100\,\Delta / P\text{-}HYP \quad (7)$$

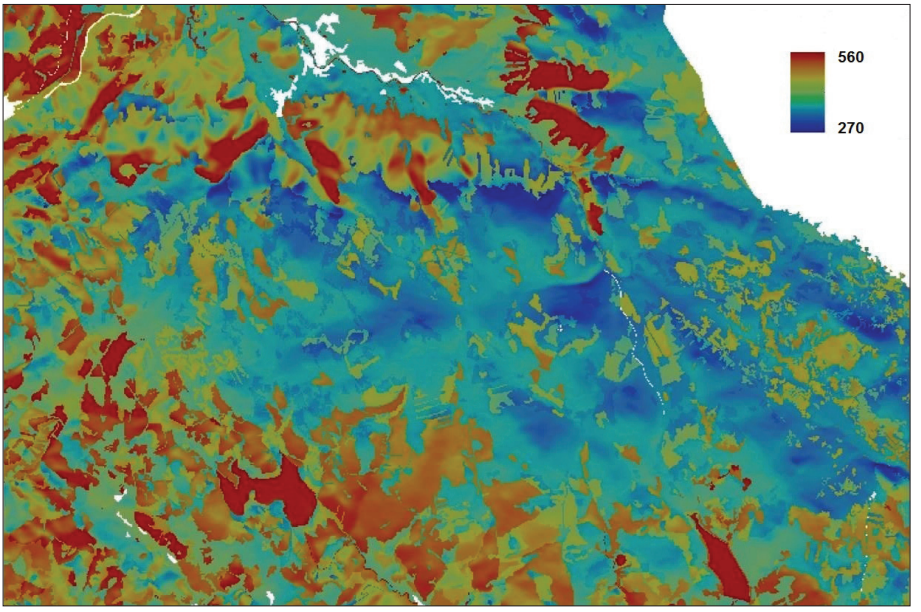

Fig. 6. Mean annual potential evapotranspiration ETP_a (mm)

Table 3. Differences Δ (mm) between areal annual precipitation given by the hypsometric method and the methods of IDW, KRI, NN and SPL in catchments

Catchment	Number of stations	P_a-HYP	Δ-IDW	Δ-KRI	Δ-NN	Δ-SPL
		mm				
J	4	1,217	-67	-69	-82	-59
J-1	–	1,227	-99	-88	-143	-178
JD	9	1,170	-1	-1	-1	-5
S	4	1,189	-25	-25	-32	-69
O	–	973	179	217	250	394
O-1	–	955	203	235	268	330

Table 4. Percentage errors ∂ (%) of mean annual precipitation in the focused catchments by using interpolation methods IDW, KRI, NN and SPL

Catchment	A/N* km^2	∂-IDW	∂-KRI	∂-NN	∂-SPL
		%			
J	0.25	-6	-6	-7	-5
J-1	–	-8	-7	-12	-15
JD	0.11	0	0	0	0
S	0.25	-2	-2	-3	-6
O	–	18	22	26	40
O-1	–	21	25	28	35

*A = catchment area, N = number of stations in catchments

It is evident that in catchments with a certain density of rain-gauges (11 hectares per gauge), all tested methods provide comparable and realistic outputs. On the contrary, in catchments where observations are absent, the percentage error in aerial estimates ∂ (%) significantly depends on interpolation techniques: ∂ (%) it varies from -8 to 21 (IDW), from -7 to 25 (KRI), from -12 to 28 (NN), and from -15 to 40 (SPL).

Similar errors ∂ (%) were found for mean annual values of potential evapotranspiration ETP_a in watersheds J (363 mm), J-1 (335 mm), JD (398 mm), S (386 mm), O (523 mm) and O-1 (514 mm) (*Table 5*). However, the accuracy of aerial evapotranspiration in catchments is limited particularly by the inadequate number of wind speed observations.

Concerning flood events, much higher errors in estimates of extreme climate events are reported by Srinivasan, G. and Sushma, N. (2005), Cooper, M.R. and Fernando, D.A.K. (2009) and Gallant, G. *et al.* (2010). Also here, for an extreme daily rainfall (observed on the 13th August 2002), rather high errors of aerial estimates were found by alternative interpolation methods: the percentage error ∂ (%) varies from -10 to 26 (IDW), from -13 to 26 (NN), from -16 to 34 (KRI), and from -18 to 173 (SPL) (*Tables 6* and *7*).

Table 5. Estimation errors ∂ (%) of mean annual potential evapotranspiration in the catchments calculated by interpolation methods IDW, KRI, NN and SPL

Catchment	A/N* km²	∂-IDW	∂-KRI	∂-NN	∂-SPL
		%			
J	5.20	5	8	10	7
J-1	–	7	6	9	12
JD	3.93	4	5	8	9
S	4.59	5	4	7	8
O	–	-12	-14	-21	-32
O-1	–	-10	-15	-24	-36

*A = catchment area, N = number of stations in catchments

Table 6. Differences Δ (mm) between the estimates of the areal daily rainfall (13th August 2002)

Catchment	Number of stations	P-HYP	Δ-IDW	Δ-KRI	Δ-NN	Δ-SPL
		mm				
J	4	207	0	0	4	16
J-1	–	209	-20	-34	-20	-28
JD	9	195	0	0	2	6
S	4	200	-10	-22	-26	-35
O	–	144	37	49	37	214
O-1	–	148	33	48	33	256

Table 7. Estimation errors ∂ (%) in aerial values of extreme daily precipitations (13th August 2002)

Catchment	A/N* km²	∂-IDW	∂-KRI	∂-NN	∂-SPL
		%			
J	0.25	0	0	2	8
J-1	–	-10	-16	-10	-13
JD	0.11	0	0	1	3
S	0.25	-5	-11	-13	-18
O	–	26	34	26	149
O-1	–	22	32	22	173

*A = catchment area, N = number of stations in catchments

Again, in the case of a watershed with relatively dense observation points (JD catchment) the results of all tested interpolation methods are realistic. However, with decreasing number of rain-gauges (J, S catchments with 25 hectares per gauge), the estimation error ∂ of aerial rainfall varies from -18 to 8%.

Conclusions

In the investigated mountain catchments the hypsometric method (HYP) proved to be the most effective interpolation technique for elevation-dependent climate parameters (precipitation, air temperature and humidity), see *Table 2*. The advantage of this approach is a realistic extrapolation of the data for marginal areas outside of the main observation network. For wind speed, the method of inverse distance weighting (IDW) provided the best spatial distribution because of its weak correlation with elevation. The methods of HYP, IDW and NN were able to fit extreme values of the tested climate parameters by errors of ±10% while SPL tends to be a significant disfigurement of the observed extremes (up to 70%).

For six investigated watersheds (*Figure 1*, *Table 1*), the error in estimated aerial precipitation and potential evapotranspiration depends on the density of weather stations.

With higher density of rain-gauges (11 hectares per gauge), all interpolation methods manifested comparable and realistic outputs. In catchments without observation data the output values gained by the hypsometric method were realistic and estimation errors given by alternative interpolation procedures reached almost 40% of mean annual values of precipitation and potential evapotranspiration (*Table 4.* and *5*).

In case of an extreme daily rainfall (*Table 7*) the error of aerial estimates provided by alternative interpolation techniques (NN, IDW, SPL, KRI) in marginal catchments of the studied region varies from -16 to 173%.

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REFERENCES

Allen, R.G., Pereira, L.S., Raes, D. and Smith, M. 1998. *Crop evapotranspiration, guidelines for computing crop water requirements.* Irrigation and Drainage Paper 56, Rome, FAO, 300 p.

Becker, A. and Serban, P. 1990. *Hydrological models for water – resources system design and operation.* Operational Hydrology Report 34, Geneva, WMO, 80 p.

Burroughs, P.A. Mc Donnell, R.A. 1998. *Principles of Geographical Information Systems*. Oxford, Oxford University Press, 327 p.

Cooper, M.R. and Fernando, D.A.K. 2009. The effect of the rain-gauge distribution on storm water models. In *Proceedings of the 18th World IMACS / MODSIM Congress*, Cairns, Australia, 13–17 July 2009, 3500–3506.

Gallant, G., Ailie J. E., David J. and Karoly, D.J. 2010. A Combined Climate Extreme Index for the Australian Region. *Journal of Climate* 23. 6153–6165.

Hay, L., Viger, R. and McCabe, G. 1998. Precipitation interpolation in mountainous regions using multiple linear regression. In *Hydrology, Water Resources and Ecology in Headwaters*. IAHS Publication 248, 33–38.

Hartkamp, A.D., De Beurs K., Stein, A. and White, J.W. 1999. *Interpolation Techniques for Climate Variables*. NRG-GIS Series 99-01, CIMMYT, Mexico, 25 p.

Richards, D. 1975. *The effect of reducing rain gauge network density on goodness of conceptual models fit and predictio*n. Institute of Hydrology, Report 28, Wallingford, UK, 25 p.

Shaw, E.M. 1991. *Hydrology in Practice*. Second edition, London, Chapman & Hall, 539 p.

Sluiter, R. 2009. *Interpolation Methods for Climate Data*. KNMI Report, De Bilt, The Netherlands, 24 p.

Srinivasan, G. and Sushma N. 2005. Daily rainfall characteristics from a high density rain gauge network. *Current Science: Special Section on Mountain Weather Forecasting* 88. 942–946.

Stein, M.L. 1999. *Statistical Interpolation of Spatial Data: Some Theory for Kriging.* Springer Series in Statistics, New York, Springer, 257 p.

WMO, 1994. *Guide to Hydrometeorological practices: Data aquisition and processing, analysis, forecasting and other applications.* Publication 168, Fifth edition, Geneva, 732 p.

WMO, 2008. *Guide to Meteorological Instruments and Methods of Observation*. Publication 8, Seventh edition, Geneva, 525 p.

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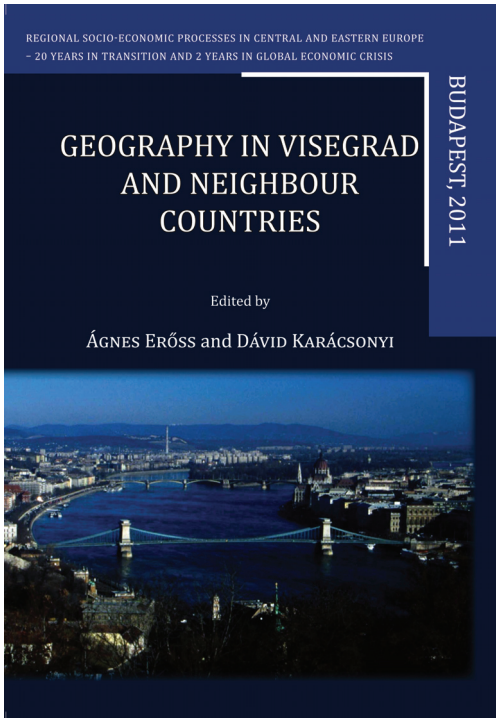

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Spatial differences in Hungarian medical tourism supply based on service providers' online presence

Gábor MICHALKÓ[1], Tamara RÁTZ[2] and Mátyás HINEK[3]

Abstract

Medical tourism is a relatively new field in Hungarian health tourism development, with significant growth potential. The paper presents the findings of an Internet-based research project that aims to explore the fundamental characteristics of medical tourism in Hungary. The key issues discussed in the framework of the analysis are the interrelationship of healthcare and tourism on the one hand, and the spatial distribution of medical services and treatments on the other hand. The research identified four main segments of the Hungarian medical tourism product: (1) the international tourism- and expatriate-oriented healthcare of Budapest, (2) the socio-geographically determined medical practices located near the Austrian border, (3) the combination of traditional spa culture and latest medical technology in the classical spa towns, and (4) the fast developing regional centres of the periphery.

Keywords: medical tourism, health tourism, medical services, online communication, Hungary

Introduction

Following the 1919 Trianon Peace Treaty ending World War I, in a referendum held in December 1921, the citizens of Sopron expressed their wish to belong to Hungary instead of Austria after the borderlines would be drawn (L. Nagy, Zs. 1991). Despite this honourable gesture of the "most faithful town", Sopron has been and still is strongly tied to the neighbouring Austrian region, Burgenland, long after the dictated war settlement was set (Jankó, F. 2009; Győri,

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R. and Jankó, F. 2009). As a result, nowadays tourism is an outstanding and thriving element of the Schengen cross-border area, with shopping and dental tourism being the most stable components (Bertalan, L. *et al.* 2010). This story goes back to that period of the socialist era when the iron curtain started to unravel, and the one-party state turned a blind eye on the "capitalistisation" of Sopron in order to increase Hungary's revenues in Austrian Schilling (i.e. in convertible currency) (Michalkó, G. 2004). Thanks to this, the retail and catering businesses of the historic town flourished already in the decade preceding the political transformation, beauty shops opened and a new phenomenon appeared: the introduction of private dental surgeries (Bünten, K. 2006). The development of supply was influenced mostly by Austrian demand: the tourist milieu of Sopron, together with the great-value-for-money services, strongly attracted the citizens of Burgenland *(Photo 1)*. The Sopron model has been imitated, with varying degrees of change, by other West Hungarian towns among which Mosonmagyaróvár – situated by the Budapest–Vienna motorway built in the meantime – seems to be the most successful rival.

In the Hungarian cities that benefit from the synergies of the symbiosis of shopping and dental tourism, medical services are to be developed

Photo 1. An advertisement of dental tourism along the primary road from Budapest to Sopron. Photo by Michalkó, G.

together with retail trade, both in quantity and quality. While in the creation of retail spaces (e.g. shopping centres, markets, pedestrian precincts) local governments have also been involved, medical services beyond general public healthcare (e.g. private surgeries or clinics) could rarely count on regional or state support (Nagy, L. 1999). The involvement of Hungarian health services in tourism development, especially before 1990, progressed spontaneously, without any central initiative or planning; only after the change of government in 2010 did the opportunity of worthwhile state support arise. According to the New Széchenyi Plan announced in 2011, the government emphasizes the significance of drawing non-public or non-municipal medical services into tourism more efficiently than before, in addition to the qualitative development of health tourism that has already been considered state priority[4]. This way the national tourism policy aims to adapt to the current international market trends (Michalkó, G. *et al.* 2009). Hungarian decision-makers have realised that within health tourism, medical tourism is the fastest developing sector, reaching a 60 billion USD annual turnover worldwide (Heung, V. *et al.* 2010). An increasing number of developing and moderately developed countries are striving to benefit from the market niche created by the relationship of healthcare and tourism, often supported by their respective governments (Lautier, M. 2008; Whittaker, A. 2008; Helmy, E. and Travers, R. 2009; Lee, C. 2010; Warf, B. 2010; Ormond, M. 2011; Yu, J.Y. and Ko, T.G. 2011).

Little is known about the operations of the Hungarian health tourism market, since official data collection or comprehensive research has not been done on this topic. In order to better understand the subject, we explored the supply side by investigating online advertisements of medical services. Our starting point was that foreigners, who want to use medical services in our country, are most likely to search on the Internet, which is the most often used information source (together with word-of-mouth recommendations from relatives and friends). Consequently, it is in the interest of each medical supplier to advertise itself in the language of the target market on the Internet. This study uses a database compiled of 638 Hungarian suppliers' homepages to analyse the spatial and professional features of medical tourism, with special emphasis on the relationship of medical and tourist services.

Theoretical background

In the last few years, significant progress has been witnessed in the field of medical tourism research. On the one hand, the number of publications written on the topic has been multiplied and, on the other hand, the range of journals

[4] http://www.ujszechenyiterv.hu/

discussing the latest results of medical tourism research has widened. This reflects the fact that the investigated phenomenon has opened new, unfamiliar dimensions in the sciences studying healthcare and tourism, and these dimensions have a high social and economic relevance.

Medical tourism is a relatively clear theoretical term: most authors agree that those travels belong to this category where the participants' primary motivation is to use treatments provided by physicians in another country (Sobo, E. 2009; Kangas, B. 2010; Whittaker, A. *et al.* 2010). Although the range of medical treatments used within the framework of medical tourism is wide, most trips are typically connected to dental surgery (Leggat, P. and Kedjarune, U. 2009), plastic surgery (Connell, J. 2006; Aizura, A. 2009; Ackerman, S. 2010) and gynaecological treatments (Ye, B. *et al.* 2011). The development of medical tourism is not location-specific, and the level of general socio-economic development is not an obvious advantage or disadvantage regarding its increase. This is explained by the relatively mobile nature of the core attraction component of the tourist product, i.e. the physicians and their professional knowledge. In comparison with other health tourism products, for example thermal water tourism, which is tied to hydro-geological resources, medical tourism is less dependent on location. Medical knowledge is universal, and mobility – both in the periods of studies and employment – is facilitated both by the Latin language used in medicine and by English being a tool of international communication among physicians. Developed countries usually have high quality but expensive healthcare systems; in developing countries the quality of basic healthcare is generally rather low, however, certain clinics that provide luxurious facilities are able to compete with the services of developed countries in terms of quality as well, but at more favourable price level. All these lead us to reinforce the former statement: within health tourism, medical tourism is one of the most global sectors, and by now research has progressed beyond the initial narrative approaches exploring the characteristics of supply and demand flows, and focuses on the complex problems of the phenomenon.

Since the developing and the moderately developed countries have also realised the opportunities in medical tourism, the growing tourist demand has raised questions that attracted less attention previously. One of these issues is health insurance, introducing the dilemma of financing medical treatments abroad for citizens of developed and moderately developed countries (Sheaff, R. 1997; Cohen, G. 2010; Kincses, Gy. 2010). Further significant issues are quality assurance and consumer protection, especially responsibility related to after-care, as well as complaints generated by medical malpractice, and the international legal regulation of guarantee systems (Bezruchka, S. 2000; Svantesson, D. 2008; Birch, D. *et al.* 2010; Jeevan, R. *et al.* 2011). Ethical questions are equally important, focusing, among others, on donors or recipients

of organ transplants, embryo implantations, stem and sperm banks (Rhodes, R. and Schiano, T. 2010; Whittaker, A. and Speier, A. 2010). Partly arising as an ethical question and partly concerning socio-economic effects is the issue of state financial support given to local citizens' healthcare in medical tourist destinations in comparison with the amount spent to promote medical treatments for foreign citizens (Bies, W. and Zacharia, L. 2007; Bauer, I. 2008; Johnston, R. *et al.* 2010). A special aspect of medical tourism is the cultural, linguistic, ethnic and religious embeddedness of treatments, and the exploration of related conflicts (Chambers, D. and McIntosh, B. 2008; Horton, S. and Cole, S. 2011; Moghimehfar, F. and Nasr-Esfahani, M. 2011).

One actor behind the fast development of medical tourism is marketing communication presenting medical treatments, tourist services, and destinations features and attractions. Despite the fact that health generally plays an important role in consumer marketing (especially due to advertisements by the pharmaceutical industry and to societal marketing promoting healthy lifestyles), tourism is less actively present in this field (Granzin, K. *et al*. 1998; Stremersch, S. 2008). While the advertisements of health and wellness hotels can be seen on television and on billboards, marketing communication messages promoting medical treatments are only moderately present in the traditional media channels (Crooks, V. *et al.* 2011). The most efficient platform for cross-border messages of medical practices, clinics and hospitals is provided by the Internet. Some specific features of certain diseases and the confidential nature of preliminary contact with potential tourists (i.e. patients) require the operation of relatively closed channels. Consequently, it has been recognized that the wide range of information available on websites can be used as a database for surveys on medical tourism (Lunt, N. *et al.* 2010; Cormany, D. and Baloglu, S. 2011).

Research methods

Despite the fact that health tourism is one of the leading tourism products in Hungary, the availability of relevant statistical data is rather limited. The Central Statistical Office has been publishing data on the demand and supply of health and wellness hotels since 2004, but data collection on the demand of spas started only in 2009, and up to this day there is no comprehensive information available, due to the service providers' passive resistance. Concerning Hungarian medical tourism, it is such a new area of the market that practically no statistical data are available. Only healthcare data can be used as a starting point, however, in the registry of the NPHMOS[5] only the number of clinics

[5] National Public Health and Medical Officer Service (ÁNTSZ)

(not the number of practising physicians) can be found, while the Ministry of National Resources responsible for healthcare does not follow physicians' mobility within the country, thus it does not have a current database on how many physicians practise in the private clinics specialised in certain medical fields in certain settlements.

Though existing databases make some speculative approach on medical tourism possible, we cannot use them to determine the actual demand or patients' primary motivations. A good example may be the analysis of the number of inhabitants per dentist in a settlement, since it may point out the potential presence of medical tourism: if the indicator is significantly under the national average, we may conclude that besides local inhabitants, visitors are also attracted by the given health service, otherwise the business would not be profitable.

Analysing the number of inhabitants per dentist, we can see in *Table 1* that certain settlements of the Western Transdanubia region have the most favourable indicators. Besides Hévíz and Bük, the strongholds of Hungarian medical tourism, several towns and villages located along the Hungarian–Austrian border are extremely well provided with dentists. This data does not reflect on the local inhabitants' bad teeth, rather is related to satisfying the needs of Austrian visitors. In the list of 154 settlements based on the quantitative indicators of dental services, Budapest and Szeged are ranked among the top ten; the excellent positions of both cities are due to their international urban functions, the former is the capital of Hungary, while the latter is a regional centre by the Hungarian–Serbian border. Nevertheless, all these assertions are, of course, speculation only, and the data in *Table 1* only serve to illustrate the methodology of the evaluation of spatial differences in Hungarian medical tourism.

Table 1. Assumed locations of dental tourism in Hungary, 2007

Name of settlement	Number of dentists	Number of inhabitants	Number of inhabitants per dentist
Hévíz	18	4,464	248
Bük	12	3,305	275
Mosonmagyaróvár	73	31,071	426
Sopron	128	56,869	444
Sé	3	1,388	463
Fertőd	7	3,402	486
Szentgotthárd	13	9,082	699
Szeged	196	163,259	833
Budapest	1,972	1,705,309	865
Jánosháza	3	2,696	899
Hungary total	*4,918*	*10,076,581*	*2,049*

Source: Ministry of Health, Hungary, 2008

Since there is no data available on Hungarian medical tourism demand that would be suitable for a comparative analysis of spatial and temporal processes, we need to investigate the supply side. Our database was created using the assumption that medical services can most effectively address their potential costumers through websites accessible on the Internet. Information available online, the content and graphical design of websites help customers compare services, estimate value-for-money and book in advance. Hungarian medical providers use several solutions to create an online presence: some operate their own multi lingual websites, others are included in various international databases (professional, intermediary etc.), and some take advantage of both opportunities *(Photo 2)*.

In order to obtain a complete picture of the online presence and the possible tourist role of Hungarian medical services that may be used for spatial comparison, we have categorised the selected websites by medical field, and analysed their contents. Data collection was carried out by students of the Tourism Department of Kodolányi János University of Applied Sciences. The students' task was to use optional searching methods to find as many websites as possible of dentists, dental technicians, surgeons, plastic surgeons, dermatologists, otolaryngologists, ophthalmologists, urologists, gynaecolo-

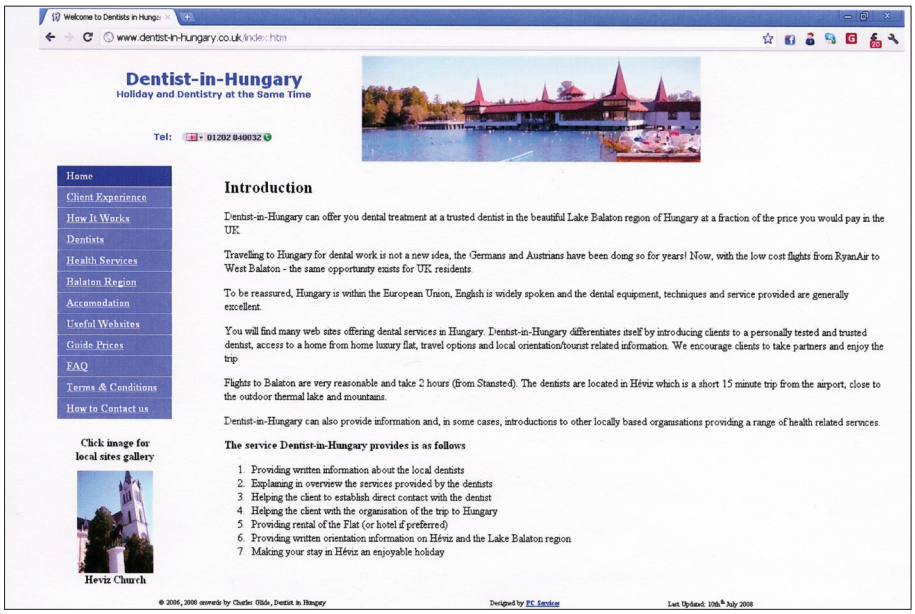

Photo 2. One of the websites advertising Hungarian dental tourism that builds upon the synergies of medical tourist supply in Hévíz. (*Source:* http://www.dentist-in-hungary.co.uk/index.htm)

gists, cardiologists, oncologists, osteopaths, rheumathologists, homeopaths and naturopaths, with the condition that they practise in Hungary and, based on the multilingual contents of their websites, provide or potentially could provide services to foreigners as well. In parallel with data on medical services, students also had to collect information on tourist services (e.g. accommodation, airport transfer, travel arrangements for patients etc.) offered on the websites. Data collectors had to fill in an Excel sheet with the content of the analysed websites. Data collection took place from March to May in 2010. Since there was no contact among the students, the resulting databases significantly overlapped. Duplicates were screened and removed during post-data cleaning using partly manual, partly electronic methods. Data cleaning was complicated since certain providers (e.g. clinics, private hospitals) may offer several services simultaneously, thus several students found the same providers and recorded their data in different medical field categories. The original database consisting of more than 1,300 items was reduced, through multiple rounds of screening, to 638 clinics, practices, physicians and other medical providers offering altogether 1,028 services[6].

Evaluating the data collection method, it shall be noted that it was not possible to obtain a complete inventory of the Hungarian medical tourism supply, and the analysed service providers do not represent the total Hungarian market. Not all service providers with multilingual websites are necessarily actors of international medical tourism, the foreign language content may also be explained by an attempt to follow global trends, may be linked to the criteria of certain tenders or may be an operational precondition in the expatriate market (especially in the case of clinics providing a wide range of services in the capital). However, despite the methodological limitations, the authors believe that the collected data give an adequately detailed insight into the services offered in Hungarian medical tourism.

Research results

Spatial differences of supply

In 2010, medical providers that offer foreign language content on their website, i.e. those who might be considered potential actors in tourism, represent only 76 settlements in Hungary, a fragment of the total number of 3,150 settlements *(Figure 1).* Since 57% of the treatments are concentrated in Budapest, the sup-

[6] In the case of service providers operating at several geographical locations, either their largest or their primary practice was selected as the basis of their spatial classification (the selection was made by the researchers on the basis of the information conveyed by the companies on their own websites).

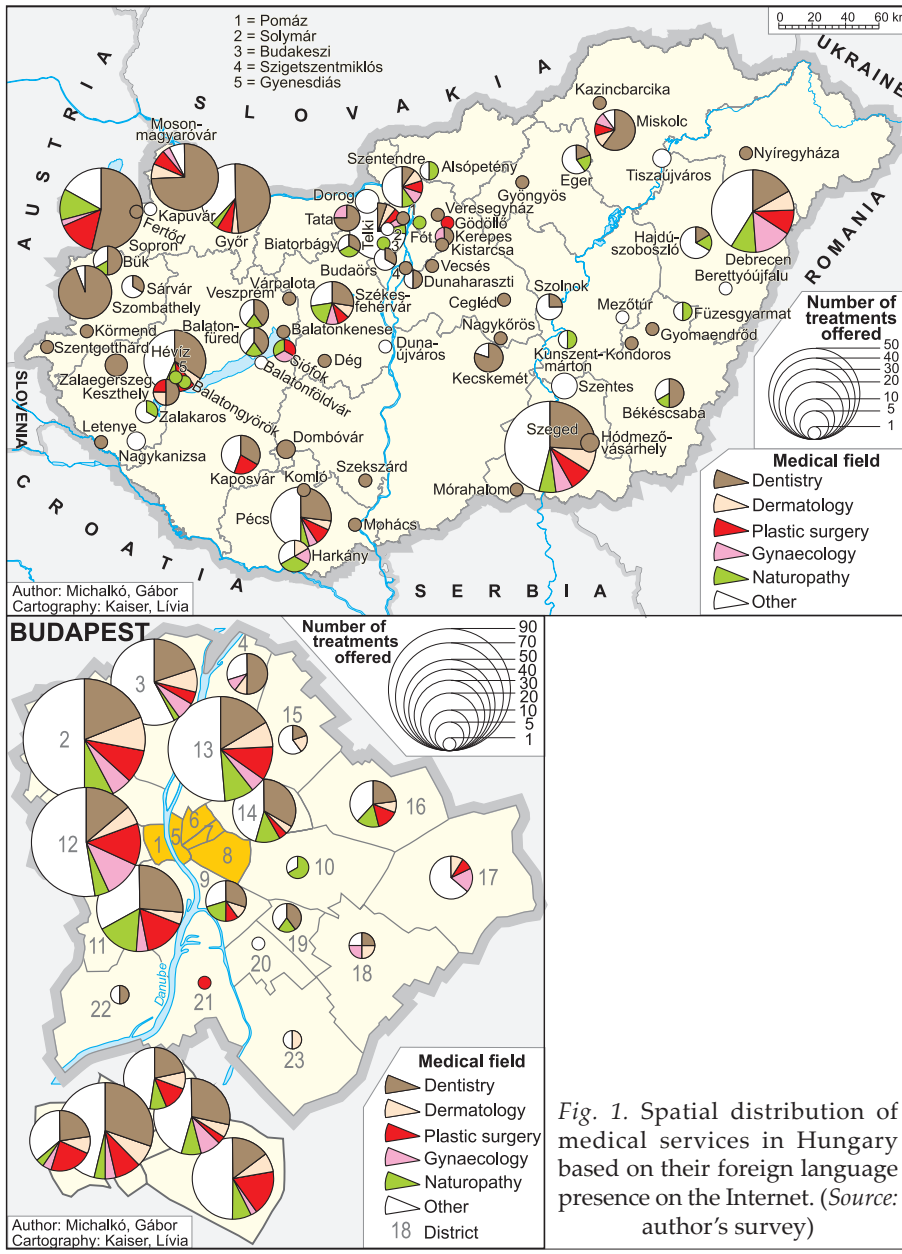

Fig. 1. Spatial distribution of medical services in Hungary based on their foreign language presence on the Internet. (*Source:* author's survey)

ply of the Hungarian capital was analysed by districts. Regarding the spatial ranking of healthcare services potentially involved in medical tourism, the first place is taken by District 2 of Budapest (90 treatments offered), followed by District 12 (72 treatments) and District 13 (66) treatments).

In the list of settlements based on the number of medical treatments offered, further top ten positions are occupied by other districts of Budapest (District 5: 56 treatments, Districts 3 and 11: 45–45 treatments, District 8: 40 treatments). Outside of Budapest, the widest range of supply was discovered in Szeged, the centre of the Southern Great Plain region situated by the Hungarian–Serbian border as well as a university city with a medical faculty (50 treatments); in Debrecen, the seat of the Northern Great Plain region, an other outstanding centre of medical education (41 treatments); and in Sopron, a town situated by the Hungarian–Austrian border (41 treatments).

In addition, the following settlements represent at least 1% of the overall supply, the threshold value set in the analysis: Győr, the centre of the Western Transdanubia region located by the Budapest–Vienna motorway (29 treatments); Mosonmagyaróvár, a town accessible by the same motorway, but situated closer to the Austrian border (27 treatments); Hévíz, the leading spa centre of the Transdanubia region in the immediate vicinity of Lake Balaton (23 treatments); Pécs, the seat of the Southern Transdanubia region, a university town with high level medical education, and the European Capital of Culture in 2010 (22 treatments); Telki, a small town in the suburban belt of Budapest with the best-known Hungarian private hospital (19 treatments); Szombathely, a county seat near the Austrian border (17 treatments); Székesfehérvár, the seat of the Central Transdanubia region (11 treatments); and, last but not least, Szentendre, the most popular day-trip destination near Budapest (10 treatments), and Miskolc, the regional centre of Northern Hungary (10 treatments).

Considering all treatments, dentistry (29.7%), plastic surgery (8.8%), naturopathy (8.3%), dermatology (6.0%) and gynaecology (5.1%) accounted for at least 5% of the supply. Consequently, in the spatial analysis of the data, these medical fields were assessed individually, while all other fields were regarded as one single group[7]. The city of Budapest is ranked first in terms of dental treatments (127 treatments), while two of its individual districts came third on the same list. Sopron (22 treatments) and Mosonmagyaróvár (20 treatments), two towns situated practically on the Austrian–Hungarian

[7] Initially, data collection focused on those key medical fields that were identified by the researchers as predominantly relevant in international medical tourism. However, the online contents of medical providers' websites and the information collected by the students represented a much greater variety of treatments and services than anticipated. The raw data consisted of more than 200 medical treatments, therapies, cures and other health- and/or wellness-related services. In order to create a standardised data set, every single procedure in the database was categorised, using either the pre-determined categories or creating new ones based on the frequency of certain procedures. Information loss was the most significant in the "other" category that includes procedures with either very low frequency or with unspecified content; however, the key findings of the research are not affected.

border, were ranked first and second, and Districts 2 and 5 shared the third place (17–17 treatments). This fact illustrates the high level of spatial concentration in Hungarian medical tourism supply: although in dental treatments Budapest, despite being the market leader, does not account for majority share (41.6%), in other fields such as dermatology (69.0%), plastic surgery (66.0%), gynaecology (62.0%) and naturopathy (54.0%) the capital alone represents a greater proportion than all the other settlements of the country combined.

Almost nine tenths (85.9%) of the websites of service providers included in our survey may be accessed in English as well as in Hungarian. Almost 60% of the websites contain information in German, followed by far lower representation of Italian (14.9%), French (11.0%), Russian (9.4%), and Romanian (8.2%). In addition, 11.3% of the websites may be accessed in other languages. No significant correlation could be detected between the websites' languages and the regional locations of the service providers.

Spatial features of medical supply with a tourism component

As mentioned above, the services included in our survey may be regarded as the potential supply of Hungarian medical tourism. However, the assessment of the websites with foreign language content indicates that only a percentage of these medical services offer any kind of supplementary tourist service as well: merely one fifth (20.2%) of all investigated treatments are connected to tourist services (accommodation, food and beverage services, package tour organisation, airport transfer, tourist attractions etc.). 40% of the offers including both medical and tourism components appear on websites of service providers in Budapest, almost one third (30.5%) are situated near the Austrian border (e.g. in Mosonmagyaróvár, Sopron, Szombathely, Győr or Zalaegerszeg), and close to 15% are available in spa destinations (e.g. in Hévíz, Harkány, Hajdúszoboszló, Bük or Sárvár). Comparing this data with the geographical distribution of medical providers with foreign language websites, we can say that those districts of Budapest (2 and 12) and cities (Szeged, Debrecen) that have top positions in terms of foreign language online content are considerably less prominent when supplementary tourist services are taken into account *(Figure 2).*

The investigation of the spatial distribution of the supply of supplementary tourist services suggests that physicians and clinics practising in popular spa destinations or in settlements close to the Austrian–Hungarian border provide a much wider range of tourist services than the national average. In Bük, Sárvár and Zalakaros every single medical service that provides online information in foreign languages (i.e. that aims to target international customers) offers tourist services as well. In other spa destinations the indicator shows a lower, but still relatively high level of involvement in tourism: 83%

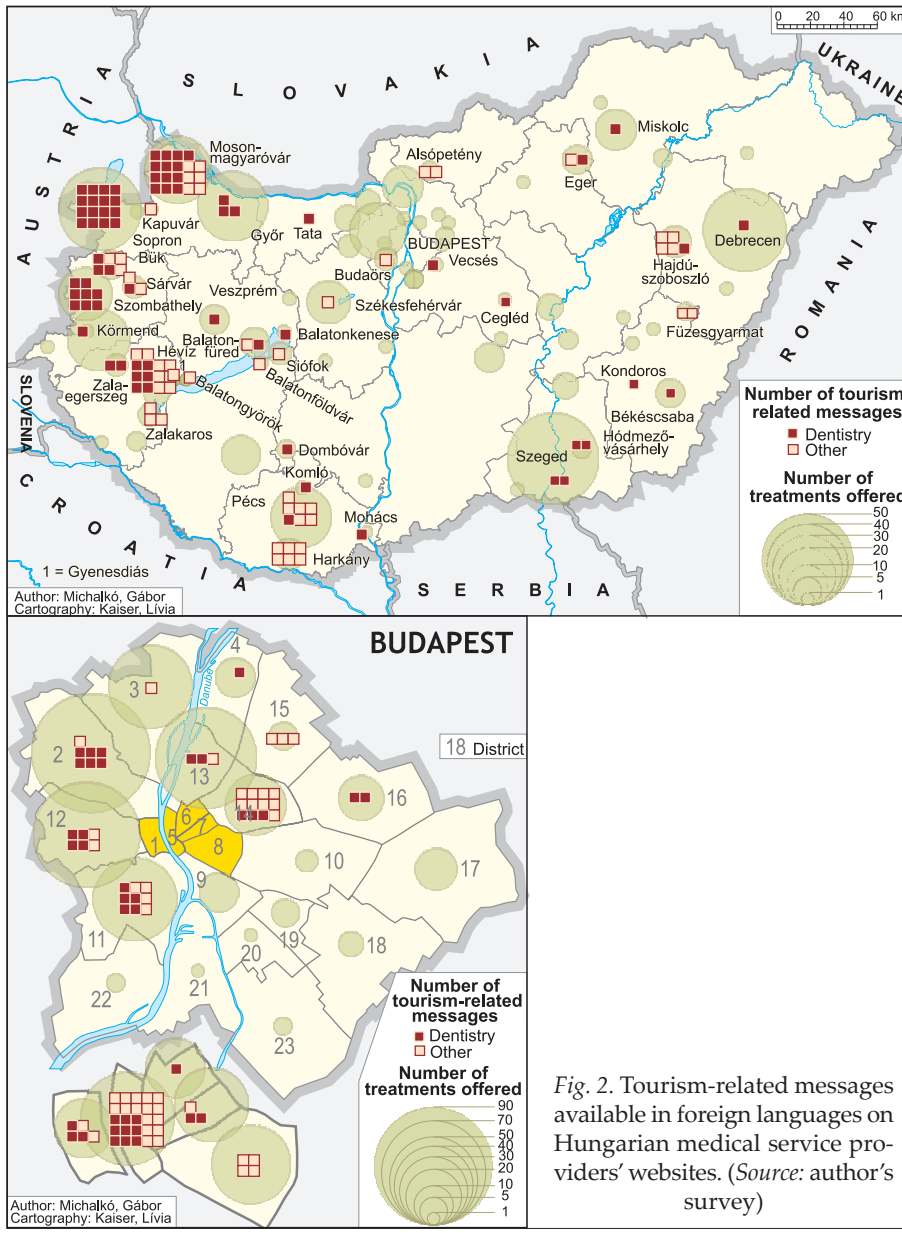

Fig. 2. Tourism-related messages available in foreign languages on Hungarian medical service providers' websites. (*Source:* author's survey)

in Hajdúszoboszló, 70% in Mosonmagyaróvár, 67% in Zalaegerszeg, 61% in Hévíz, 47% in Szombathely, and 39% in Sopron. At the same time, in Budapest only 14% of the investigated enterprises offered tourist services in addition to medical treatments, and the indicator only reached 8–8% in the case of Districts

2 and 12, the leading areas of the capital with respect to medical services accessible in foreign languages. This paradox may be explained by the fact that these wealthy districts are particularly popular residential areas among the expatriate community of Budapest, thus the medical services available in these areas aim to target the international residents. In contrast, Districts 16 and 5 of Budapest performed well over the national average, with indicators of 50% and 45%, respectively: while District 5 is the traditional tourist centre of the capital with a high concentration of commercial accommodation and other hospitality services, District 16 is a more affordable, but attractive suburban area with good access to the city centre and the airport.

In order to achieve a comprehensive picture of the investigated issues, we looked at the frequency of tourism services supplementing health treatments in various medical fields. The results suggest that more than one third (35.4%) of all dental treatments are linked with hospitality services. Since dental services represent the greatest proportion in our database, this figure implies that dental tourism is the most important medical tourist product in Hungary (this is supported by the fact that 52% of all tourist services supplementing some kind of medical treatment are related to dental treatments). In Szombathely, 100% of the medical treatments supplemented by tourist services are offered by dental surgeries, the same indicator is 75% in Sopron, 68% in Mosonmagyaróvár, 46% in Budapest, and 43% in Hévíz. Even in District 2 of Budapest, where the tourism dimension of the medical industry is relatively insignificant, 86% of the available medical tourist services are related to dental treatments.

Conclusions

The Hungarian medical tourism supply is highly concentrated both in space and in terms of treatments. 90% of services may be divided into the following four main segments.

The *first* one is Budapest. The capital plays the key role concerning the volume and the diversity of the product. 40% of the Hungarian medical tourism supply can be found in the capital city. Most dermatologists, plastic surgeons, gynaecologists and dentists who treat foreigners are concentrated in Budapest. The website analysis indicates that medical tourism supply in Budapest is predominantly based on cheap and quick air transportation (i.e. on accessibility ensured by budget airlines), and several surgeries and clinics have representative agencies in other European capitals (e.g. in Dublin or in London), which is a significant confidence factor for customers. With small private practices being in minority, the supply of Budapest mostly consists of modern clinics with first-rate facilities employing highly qualified staff with

good foreign language skills; in some cases, these clinics are established solely to satisfy the needs of foreign patients, i.e. medical tourists. Within the capital city, spatial differences can be outlined: whilst in District 5, the centre of international tourism in Budapest, medical services generally include a tourism component, in Districts 2 and 12, located in the greenbelt of Buda, the most popular area among foreigners living in Budapest, hardly any tourism services are offered by the otherwise abundant supply of clinics and medical practices.

A *second* significant segment of the supply is composed of towns in the western borderland of Hungary – primarily Sopron and Mosonmagyaróvár, but the relatively smaller Szombathely may also be mentioned here –, which mainly, but not exclusively, offer dental treatments to customers from Austria. These settlements have become medical tourism spaces due to their good accessibility near the border, and their good socio-economic relationship with Austria that has developed during the last decades, rooted partly in history. The development of the medical tourism product has been influenced by the utilization of synergies of shopping tourism in the given settlements.

The *third* segment of the supply consists of traditional Hungarian thermal spa destinations receiving significant international demand such as Hévíz, Bük, Sárvár, Harkány and Hajdúszoboszló. The special feature of the supply of these settlements is the availability of medical – e.g. dental, dermatological, surgical – services together with traditional thermal cures based on medicinal water (e.g. balneotherapy, rheumatology, physiotherapy). In the case of the spa towns, it is difficult to determine whether the primary motivation of travel is a medical procedure or a curative treatment or simply the enjoyment of thermal waters.

The *fourth* segment is represented by regional centres located along the national border (Pécs, Debrecen, Szeged), which are strongholds of higher education in general and also of medical training, thus foreign students outside of Budapest are concentrated in these cities. Due to their urban functions, these settlements represent potential receiving areas of global investment, and, as the locations of various subsidiaries of international companies, play hosts to a relatively significant number of expatriates and temporary foreign residents. Medical services in these regional centres are used not only by foreigners participating in international student and labour mobility, but there is also a cross-border demand from neighbouring countries' citizens of Hungarian origin.

It is generally accepted that the main appeal of Hungarian medical services for foreigners is the relatively low price level (Földvári, Zs. 2000; Vértessy, P. 2006; Szűts, L. 2010). However, according to the evidence of the analysed websites, the quality level of these services has recently improved dramatically as well. In the last few years, both in Budapest and in certain Western Hungarian towns, state-of-the-art private clinics were established offering high

quality dental and plastic surgical treatments as well as a wide range of supplementary tourist services. The information obtained from websites indicate that Hungarian medical tourism has an opportunity for significant further growth as long as the companies are able to preserve a favourable price-value ratio, the current key competitive advantage. At the moment, Hungary is market leader in Europe in the field of dental tourism, but further development is also expected in the segments of plastic surgery and beauty treatments, as a result of high quality procedures, affordable prices, qualified staff as well as improving marketing communication. However, competition from the neighbouring countries has also increased in the last decade, both in terms of quantity and quality. Consequently, Hungary needs to move beyond the more or less spontaneous development path of dental tourism: although it has proved to be successful, and the international trends of medical tourism imply further opportunities for growth in the future, in an increasingly competitive environment Hungary can only realise its full potential if its favourable natural resources are developed in a consensus-based national policy framework.

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REFERENCES

Ackerman, S. 2010. Plastic Paradise: Transforming Bodies and Selves in Costa Rica's Cosmetic Surgery Tourism Industry. *Medical Anthropology* 29. (4): 403–423.

Aizura, A. 2009. Where Health and Beauty Meet: Femininity and Racialization in Thai Cosmetic Surgery Clinics. *Asian Studies Review* 33. (3): 303–317.

Bauer, I. 2008. The Health Impact of Tourism on Local and Indigenous Populations in Resource-poor Countries. *Travel Medicine and Infectious Disease*. 6. (5): 276–291.

Bertalan, L., Jankó, F., Nagy, M. and Presits, A. 2010. A kiskereskedelem területhasználatának változása Győrben és Sopronban: a bevásárlóközpontok hatása a belvárosi kereskedelemre. (Changes in space use of retail in Győr and Sopron: how shopping centres influence downtown trade). In *Párbeszéd és együttműködés: Területfejlesztési Szabadegyetem 2006–2010.* Eds. Fábián, A. and Lukács, A. Sopron, Nyugat-Magyarországi Egyetemi Kiadó, 389–404.

Bezruchka, S. 2000. Medical Tourism as Medical Harm to the Third World: Why? For Whom? *Wilderness and Environmental Medicine* 11. (2): 77–78.

Bies, W. and Zacharia, L. 2007. Medical Tourism: Outsourcing Surgery. *Mathematical and Computer Modelling* 46. (7–8): 1144–1159.

Birch, D., Vu, L., Karmali, S., Stoklossa, C. and Sharma, A. 2010. Medical Tourism in Bariatric Surgery. *The American Journal of Surgery* 199. (5): 604–608.

Bünten, K. 2006. Dentaltourismus in Ungarn – Bestandsaufnahme und Perspektiven einer neuen Form des Gesundheitstourismus. *Europa Regional* 14. (3): 132–142.

Chambers, D. and McIntosh, B. 2008. Using Authenticity to Achieve Competitive Advantage in Medical Tourism in the English-speaking Caribbean. *Third World Quarterly* 29. (5): 919–937.

Cohen, G. 2010. Protecting Patients with Passports: Medical Tourism and the Patient-Protective Argument. *Iowa Law Review* 95. (5): 1467–1567

Connell, J. 2006. Medical tourism: Sea, Sun, Sand and … Surgery. *Tourism Management* 27. (6): 1093–1100.

Cormany, D. and Baloglu, S. 2011. Medical Travel Facilitator Websites: An Exploratory Study of Web Page Contents and Services Offered to the Prospective Medical Tourist. *Tourism Management* 32. (4): 709–716.

Crooks, V., Turner, L., Snyder, J., Johnston, R. and Kingsbury, P. 2011. Promoting Medical Tourism to India: Messages, Images, and the Marketing of International Patient Travel. *Social Science and Medicine* 72. (5): 726–732.

Földvári, Zs. 2000. Osztrák fogturizmus: hídpénzszedők (Austrian dental tourism: Costs of crossing a bridge). *Heti Világgazdaság* 22. (19): 47–51.

Granzin, K., Olsen, J. and Painter, J. 1998. Marketing to Consumer Segments Using Health-promoting Lifestyles. *Journal of Retailing and Consumer Services* 5. (3): 131–141.

Győri, R. and Jankó, F. 2009. Nyugat-Dunántúl és Burgenland regionális fejlettségi különbségeinek alakulása 1910 és 2001 között (Changes in regional development differences of West Transdanubia and Burgenland from 1910 to 2011). *Soproni Szemle* 63. (2): 218–238.

Helmy, E. and Travers, R. 2009. Towards the Development of Egyptian Medical Tourism Sector. *Anatolia: An International Journal of Tourism and Hospitality Research* 20. (2): 419–439.

Heung, V., Kucukusta, D. and Song, H. 2010. Medical Tourism Development in Hong Kong: An Assessment of the Barriers. *Tourism Management* 32. (5): 995–1005.

Horton, S. and Cole, S. 2011. Medical Returns: Seeking Health Care in Mexico. *Social Science and Medicine* 72. (11): 1846l–1852.

Jankó, F. (Hrsg.) 2009. *Geographisches Jahrbuch Burgenland 2009*. Band 33. Neutal, Vereinigung Burgenländischer Geographen, 436 p.

Jeevan, R., Birch, J. and Armstrong, A. 2011. Travelling Abroad for Aesthetic Surgery: Informing Healthcare Practitioners and Providers while Improving Patient Safety. *Journal of Plastic, Reconstructive and Aesthetic Surgery* 64. (2): 143–147.

Johnston, R., Crooks, V., Snyder, J. and Kingsbury, P. 2010. What is Known About the Effects of Medical Tourism in Destination and Departure Countries? A Scoping Review. *International Journal for Equity in Health* 9. (24): 1–13.

Kangas, B. 2010. Traveling for Medical Care in a Global World. *Medical Anthropology* 29. (4): 344–362.

Kincses, Gy. 2010. A határon átnyúló egészségügyi ellátás perspektívái (Prospects of trans-border health care). *Turizmus Bulletin* 14. (4): 69–72.

L. Nagy, Zs. 1991. *Magyarország története 1919–1945*. (History of Hungary 1919–1945) Történelmi Figyelő Könyvek 1. Debrecen, Kossuth Lajos Tudományegyetem, 186 p.

Lautier, M. 2008. Export of Health Services from Developing Countries: The Case of Tunisia. *Social Science and Medicine* 67. (1): 101–110.

Lee, C. 2010. Health Care and Tourism: Evidence from Singapore. *Tourism Management* 31. (4): 486–488.

Leggat, P. and Kedjarune, U. 2009. Dental Health, 'Dental Tourism' and Travellers. *Travel Medicine and Infectious Disease* 7. (3): 123–124.

Lunt, N., Hardey, M. and Mannion, R. 2010. Nip, Tuck and Click: Medical Tourism and the Emergence of Web-Based Health Information. *The Open Medical Informatics Journal* 4. 1–11.

Michalkó, G. 2004. *Bevásárlóturizmus* (Shopping Tourism). Székesfehérvár, Kodolányi János Főiskola, 108 p.
Michalkó, G., Kiss, K., Kovács, B. and Sulyok, J. 2009. The impact of tourism on subjective quality of life among Hungarian population. *Hungarian Geographical Bulletin* 58. (2): 121–136.
Moghimehfar, F. and Nasr-Esfahani, M. 2011. Decisive Factors in Medical Tourism Destination Choice: A Case Study of Isfahan, Iran and Fertility Treatments. *Tourism Management.* 32. (6): 1431–1434.
Nagy, E. 1999. A kereskedelmi ingatlan-fejlesztések néhány sajátossága és térszerkezetformáló szerepe a kelet-közép-európai városokban (Some Specialities and Configuration Forming Functions of Commercial Property-Developments in Eastern-Central-European Cities). *Alföldi Tanulmányok* 17. 13–28.
Ormond, M. 2011. Shifting Subjects of Healthcare: Placing 'Medical Tourism' in the Context of Malaysian Domestic Healthcare Reform. *Asia Pacific Viewpoint* 52. (3): 247–259.
Rhodes, R. and Schiano, T. 2010. Transplant Tourism in China: A Tale of Two Transplants. *The American Journal of Bioethics* 10. (2): 3–11.
Sheaff, R. 1997. Healthcare Access and Mobility between the UK and Other European Union States: an 'Implementation Surplus'. *Health Policy* 42. (3): 239–253.
Sobo, E. 2009. Medical Travel: What it Means, Why it Matters. *Medical Anthropology* 28. (4): 326–335.
Stremersch, S. 2008. Health and Marketing: The Emergence of a New Field of Research. *International Journal of Research in Marketing* 25. (4): 229–233.
Svantesson, D. 2008. From the Airport to the Surgery to the Courtroom – Private International Law and Medical Tourism. *Commonwealth Law Bulletin* 34. (2): 265–276.
Szűts, L. 2010. Fogturizmus, az új hungarikum (Dental tourism: a new hungaricum is showing up). *Nővér* 23. (5): 32–39.
Vértessy, P. 2006. Fontért koronát – Brit fogturizmus Magyarországon (Pounds for caps – British dental tourism in Hungary). *Figyelő* 50. (32): 44-47.
Warf, B. 2010. Do You Know the Way to San José? Medical Tourism in Costa Rica. *Journal of Latin American Geography* 9. (1): 51–66.
Whittaker, A., Manderson, L. and Cartwright, E. 2010. Patients without Borders: Understanding Medical Travel. *Medical Anthropology* 29. (4): 336–343.
Whittaker, A. and Speier, A. 2010. "Cycling Overseas": Care, Commodification, and Stratification in Cross-Border Reproductive Travel. *Medical Anthropology* 29. (4): 363–383.
Whittaker, A. 2008. Pleasure and Pain: Medical Travel in Asia. *Global Public Health* 3. (3): 271–290.
Ye, B., Qiu, H. and Yuen, P. 2011. Motivations and Experiences of Mainland Chinese Medical Tourists in Hong Kong. *Tourism Management* 32. (5): 1125–1127.
Yu, J.Y. and Ko, T.G. 2011. A Cross-cultural Study of Perceptions of Medical Tourism Among Chinese, Japanese and Korean Tourists in Korea. *Tourism Management* doi: 10.1016/J.tourman.2011.02.002.

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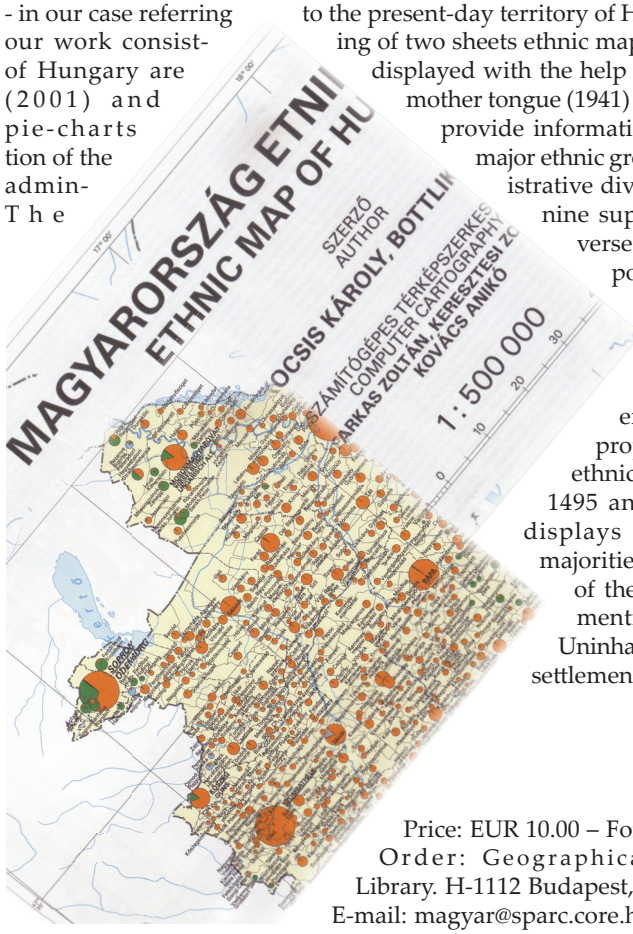

The nine supplementary maps on the reverse show the lingual-ethnic composition of the present-day territory of Hungary in 1495, 1715, 1784, 1880, 1910, 1930, 1941, 1990 and 2001 respectively. The chart here explores the quantitative and proportional changes of the main ethnic groups' population between 1495 and 2001. The series of maps displays absolute or relative ethnic majorities only in the inhabited areas of the settlements which had been mentioned in the source referred. Uninhabited areas with no permanent settlements are shown as blank spots.

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Rural population in Ukraine: assessing reality, looking for revitalization

Yelizaveta SKRYZHEVSKA[1] and Dávid KARÁCSONYI[2]

Abstract

The rural population in Ukraine has declined dramatically since 1989. Today, Ukraine's rural areas suffer from depopulation and out-migration as well as from the low fertility, high mortality, and declining life expectancy of residents, which are the obvious indications of a demographic crisis. To reverse these negative demographic trends, governmental policies should be directed at improving economic and social well-being in rural areas. This study attempts to describe and analyze the major trends and regional variations in Ukraine's rural population decline, to bring into focus the problems of rural areas that are affected by the demographic crisis, and to provide recommendations for the rural development policy-makers that would help revitalize rural areas.

Keywords: Ukraine, demographic crisis, rural population, rural development policy, rural life

Introduction

Throughout history, urbanization has been a powerful force drawing people to the cities in search of a better life and economic opportunities. As a result, rural populations in many developed countries have declined. Ukraine is no exception to this phenomenon. According to historical data from the State Committee of Statistics of Ukraine, Ukraine's rural population started its decline as early as 1913, whereas its urban population was growing steadily until 1993 (Derzhavniy Komitet Statistyky Ukrayini, 2001). What makes Ukraine different from other countries with shrinking rural populations is its deteriorating population quality. The quality of a population is defined by the health, life expectancy, education level and mortality of the economically active

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population (15–59 years old). The decrease in the rural population has become a continuous phenomenon (*Figure 1*) and, in the mid 1990s, resulted in a deep demographic crisis in Ukraine's rural areas (Libanova, E. *et al*. 2007).

The signs of demographic crisis are depopulation, aging, and decreasing life expectancy as well as the low fertility and rate of marriage, worsening health conditions, and deteriorating quality of education of rural dwellers accompanied by a net out-migration of the young and physically active population. The demographic crisis in rural areas has been a crucial component of the profound socio-economic crisis in Ukraine that occurred after the collapse of the Soviet Union in 1991.

This study attempts to describe and analyze the major trends and regional variations in Ukraine's rural population decline, to bring into focus the problems of rural areas that are affected by the demographic crisis, and to provide recommendations for the rural development policy-makers that would help revitalize rural areas. The data used in this analysis come from Ukraine's State Committee of Statistics yearbooks. The yearbooks provide demographic data at the country level and at the level of the administrative region (oblast) based on the population censuses of 1979, 1989 and 2001.

The data at the rayon (administrative entities within oblasts) level were obtained from the regional (oblast) yearbooks from 2003 to 2010 and Ukrainian Population Census website (http://www.ukrcensus.gov.ua). The

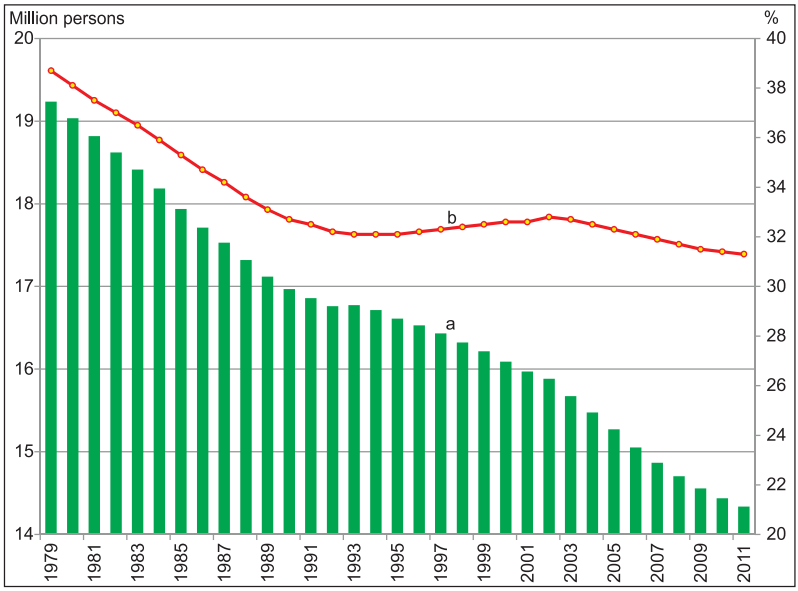

Fig. 1. Decline of the rural population in Ukraine. – a = total rural population; b = proportion of rural population, %

rayon level data allow for the analysis of spatial variations of rural population trends within the regions (oblasts) of Ukraine. For the comparison with the European region, the data provided by Eurostat, World Health Organization, and United Nations Population Division were used.

To understand the structural changes occurring and the spatial variation within Ukraine, it should be examined total population decline over time and the role of rural populations played in this trend.

Demographic crisis and its facets

Total population decline

Ukraine's population has been declining dramatically since the country began the transition from a centrally planned to a market economy. The total population loss between 1989 (the last pre-transition population census) and 2011 constitutes 5.9 million people or 11.5 per cent of the total population (Derzhavniy Komitet Statistyky Ukrayini, 2011). This considerable decrease was caused by declining fertility, increasing mortality, and significant net out-migration, and it was exacerbated by the socio-economic crisis that occurred in Ukraine following the collapse of the Soviet Union in 1991. In 1992, Ukraine's population reached its peak of 52.2 million and its steady decline started. The term "demographic crisis" was first used in Ukraine in 1985 by the Ukrainian demographer Steshenko, V. (Demographic Dictionary, 1985). Since the 1990s, this term has been widely used to characterize the demographic situation in Ukraine.

Ukraine's population is predominantly urban (over 68 per cent) and thus the decrease of total population is largely attributed to the decrease in urban dwellers. However, the rural population decline started long before the transition of the 1990s and demonstrated a slightly higher rate of decline than the urban population. According to Ukraine's State Committee of Statistics (2011), the first signs of depopulation in rural areas were observed as early as 1979, which is thirteen years earlier than in urban areas *(Figure 2).*

The situation had worsened by the beginning of the 1990s, when rural populations suffered from unemployment, critical aging, worsening health conditions, and a deteriorated social infrastructure brought on by the economic crisis associated with the transition to a market economy.

Ukraine versus Europe

In Europe, decreasing population is not a unique phenomenon. Most Central and Eastern European countries have experienced depopulation and negative

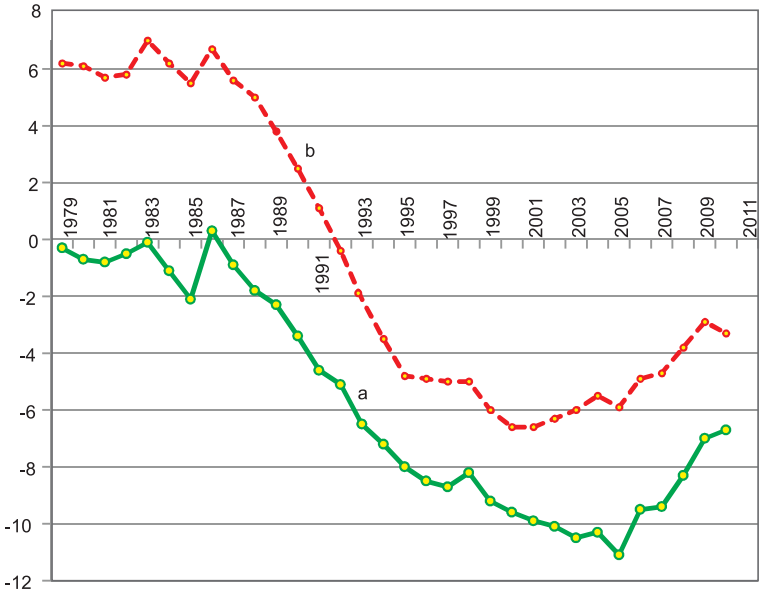

Fig. 2. Natural increase of population in rural (a) and urban (b) areas of Ukraine (per 1,000)

total population change. Some countries in Western and Southern Europe are also experiencing negative demographic trends *(Table 1)*. However, even in a European context, Ukraine demonstrates an unprecedented negative natural increase and total population change, producing a population loss of 5.4 million in the last twenty years and one of the world's highest annual rates of population decline, reaching -0.65 per cent in 2008.

The recent population loss is larger than the total populations of some European countries such as Ireland (4.7 million), Latvia (2.2 million), Lithuania (3.5 million), Norway (4.7 million), and Moldova (3.6 million). Another demographic indicator that makes Ukraine different from the majority of European countries is life expectancy. While in some European countries population is decreasing, life expectancy of Europeans on the whole is increasing, indicating improvements in quality of life. Ukraine's total life expectancy is the second lowest in Europe (68.1 years in 2007) after the Russian Federation (67.7 in 2007). Life expectancy of rural dwellers is even lower (67.2 in 2007). The economic crisis of the 1990s revealed weaknesses of the centrally planned economic system dominant during the Soviet era and showed the necessity of a transition to a market economy. The transition period was painful for both the economy and the population, producing unemployment, increasing mortality among the economically active population, and worsening social problems that had been hidden during the Soviet era. Life expectancy has become an indicator of instability and uncertainty in Ukraine.

By the end of the 1990s, the negative demographic trends in rural areas were revealed by researchers studying Central and Eastern European countries during their transition to a market economy. It has been shown that, under socialism, rural-urban migration was caused by the prospect of an improved

Table 1 Selected demographic indicators of European countries, 2007

Country	Natural change	Net migration	Total change	Life expectancy at birth*, year	Total fertility rate**
	per 1000 inhabitants				
EU member states					
Belgium	1.9	5.9	7.7	79.7	1.81
Bulgaria	-4.9	-0.2	-5.1	73.0	1.42
Czech Republic	1.0	8.1	9.1	77.2	1.44
Denmark	1.6	3.7	5.3	78.7	1.85
Germany	-1.7	0.6	-1.1	80.2	1.39
Estonia	-1.2	0.1	-1.1	74.2	1.64
Ireland	9.8	14.7	24.5	77.6	1.91
Greece	0.2	3.7	3.9	80.1	1.38
Spain	2.4	15.6	18.0	81.0	1.38
France	4.6	1.1	5.7	81.3	1.98
Italy	-0.1	8.3	8.2	81.0	1.34
Cyprus	4.0	16.3	20.2	80.0	1.39
Latvia	-4.3	-0.3	-4.6	71.4	1.42
Lithuania	-3.9	-1.6	-5.5	72.0	1.35
Luxemburg	3.4	12.5	15.9	80.2	1.61
Hungary	-3.5	1.4	-2.1	73.9	1.32
Malta	1.9	4.9	6.8	80.0	1.30
The Netherlands	2.9	-0.1	2.8	80.4	1.71
Austria	0.2	3.8	4.0	80.4	1.38
Poland	0.3	-0.5	-0.3	75.5	1.27
Portugal	-0.1	1.8	1.7	79.2	1.30
Romania	-1.7	0.0	-1.7	73.3	1.29
Slovenia	0.7	7.0	7.7	79.0	1.37
Slovakia	0.1	1.3	1.4	74.8	1.25
Finland	1.8	2.6	4.4	79.8	1.83
Sweden	1.7	5.9	7.6	81.2	1.85
United Kingdom	3.2	2.9	6.1	79.7	1.85
EU candidate countries					
Croatia	-2.6	1.3	-1.3	76.0	1.38
TFYR of Macedonia	1.5	0.1	1.6	73.8	1.41
Turkey	12.8	..	12.8	74.3	2.17
EFTA countries					
Iceland	8.4	13.0	21.4	81.8	2.07
Norway	3.5	8.4	11.9	80.7	1.90
Switzerland	1.8	9.2	11.0	82.1	1.45

Table 1 Continued

Country	Natural change	Net migration	Total change	Life expectancy at birth*, year	Total fertility rate**
	per 1000 inhabitants				
Other European countries					
Albania	5.9	-0.4	5.5	72.6	1.33
Andorra	7.3	16.1	23.3	81.7	1.17
Armenia	4.1	-1.9	2.2	69.9	1.30
Azerbaijan	11.5	-0.1	11.4	67.9	2.30
Belarus	-3.0	0.5	-2.5	70.0	1.29
Bosnia and Herzegovina	-0.2	..	-0.1	75.4	1.18
Georgia	1.8	-4.7	-2.9	71.6	1.45
Moldova	-1.4	-0.9	-2.4	68.4	1.22
Montenegro	3.0	1.2	4.1	74.1	1.65
Russian Federation	-3.3	1.8	-1.5	67.8	1.41
San Marino	2.2	11.7	13.9	82.9	1.24
Serbia	-4.7	1.5	-3.2	73.7	1.43
Ukraine	*-6.2*	*0.4*	*-5.8*	*67.6*	*1.3*

* In 2008. ** Children per woman. .. = no data

Source: Eurostat, 2007; World Health Organization (Life tables, 2008)

standard of living available in urban areas compared to the lack of incentives under collectivization in rural settlements (Dragona, V. and Turnock, D. 2000; Gorz, B. and Kurek, W. 2000). The transition to a market economy caused rural de-industrialization and diminishing of rural services that increased migration from rural to urban areas throughout Central and Eastern Europe during 1990–1995. In order to cope with unemployment resulting from de-industrialization and land privatization, an increasing number of rural dwellers were confined to farming, which made rural areas mono-functional and left the population without employment prospects in non-agricultural sectors (Rey, V. and Bachvarov, M. 1998).

Borowicz, R. (1996) noted that there has been a negative effect of depopulation and out-migration on rural communities in Central and Eastern Europe. Bulgaria, for instance, experienced rapid urbanization between 1946 and 1993, when the share of urban population increased from 25 per cent to 63 per cent. This urbanization resulted in severe depopulation in rural areas, where the population age structure was irreversibly shifted by the decreasing number of women of reproductive age, producing a decreasing birth rate (Rey, V. and Bachvarov, M. 1998). These findings indicate that, in terms of declining rural population, Ukraine shares similar features with other European countries. What makes Ukraine unique is the scale of this decline and the deteriorating quality of life in rural areas that can be considered both a cause and a consequence of this trend.

There is a significant gap in publications, especially in English-speaking world, devoted to population decline in rural areas of Ukraine. In 1989 Khomra, A.U. published the first paper in English devoted to Ukraine's rural depopulation. He introduced rayon level analysis of demographic situation in rural areas.

Since then only few publications in English devoted to rural depopulation in Ukraine appeared. However, majority of authors use oblast' as a unit of demographic analysis (Rowland, R.H. 2004; Pantyley, I.V. 2009), which does not reveal spatial variations on a local level. The last decade demonstrates an increasing interest to the phenomenon of rural population change in Ukraine.

Two publications came out in 2008. An atlas about Ukraine in English issued by Geographical Research Institute of HAS (Kocsis, K. *et al*. 2008), and the article by Karácsonyi, D. (2009) was published in German. As to the research conducted by Ukrainian scholars, a work of Baranovsky, M.O. (2009) on depressed territories in Ukraine is a significant contribution to the study of rural population change.

Table 2 presents data from the United Nations Demographic Yearbooks that emphasize the change in size of rural population in selected Eastern European countries between 1989 and 2006. Among the ten countries presented in *Table 2*, six countries lost rural population between 1989 and 2006. Ukraine's loss constitutes 2.2 million people, which is a significant reduction compared to the other countries.

Table 2. Change in rural population in selected European countries, 1989–2006

Country	1989		2006		Change in rural population, 1989–2006	
	Rural population, 1,000 persons	Rural rate, % of total	Rural population 1,000 persons	Rural rate, % of total	1,000 persons	%
Albania	2,052	64.5	1,622	51.5	-431	-21.0
Bulgaria	2,938	32.7	2,271	29.5	-668	-22.7
Czech Rep.	2,189[1]	21.1[1]	2,713	26.4	524	23.9
Hungary	3,934	37.1	3,322	33.0	-612	-15.6
Moldova	2,129[2]	58.3[2]	2,104	58.7	-25	-1.2
Poland	14,594	38.6	14,732	38.6	138	0.9
Romania	10,840	44.8	9,670	44.8	-1,169	-10.8
Slovakia	2,188[1]	41.3	2,401	44.5	214	9.8
Slovenia	987[1]	49.4[1]	1,046	52.1	58.3	5.9
Ukraine	*17,113*	*33.1*	*14,900*	*31.8*	*-2,213*	*-12.9*

[1]1990; [2]1997. *Source:* United Nations Demographic Yearbooks (1989, 2006).

Demographic trends in rural areas of Ukraine

Rural areas in Ukraine have traditionally been associated with backwardness and underdevelopment. However, the problems of rural areas have been neglected by the government since World War Two. Most of the governmental policies were focused on urban areas that were transformed into economically and socially attractive places to live. The post-war period became an era of rural-urban migration, resulting in rapid urban growth that started during the 1950s and has continued into the present. A typical rural migrant of the 1950s and 1960s was a young high-school graduate who used any means to get to a city and become established there.

Many young people who grew up in rural areas were attracted to cities by the prospect of obtaining higher education or to work at factories and plants and benefit from the amenities of urban life that were not available in their home towns and villages. Only few of them returned to the rural areas after getting their degrees.

It was considered less prestigious to develop a career in non-urban settlements. Migration to the cities became popular and was encouraged by the mass media. The most popular movies, for instance, were about young, motivated people who became successful after they left their homes in rural areas and moved to the cities.

According to Ukraine's State Committee of Statistics, the proportion of rural inhabitants in the total population decreased by 15.6 per cent between 1939 and 1959 and by 34.8 per cent between 1959 and 2007. The total number of rural residents declined by 4.67 million between 1979 and 2009, including 2.3 million since the collapse of the Soviet Union (Derzhavniy Komitet Statistyky Ukrayini, 2009) *(Table 3).*

The period of decline between 1979 and 2009 can be divided into two sub-periods. These sub-periods differ in the importance of the *components* of population decline: *migration* and *depopulation* (natural decrease). The first sub-period is the time between 1979 and 1990, when net out-migration was the biggest contributor to the rural population decline (*Figure 3, Table 3*).

Table 3. Components of rural population decline

Time period	Total change in rural population	Natural increase	Net migration
	in 1,000 persons		
1979–1990	-2,411	-243	-1,962
1991–2009	-2,303	-2,191[1]	157[1]
1979–2009	-4,678	-2,434[2]	-1,805[2]

[1]1991–2006; [2]1979–2006. *Source:* State Committee of Statistics of Ukraine, 2009

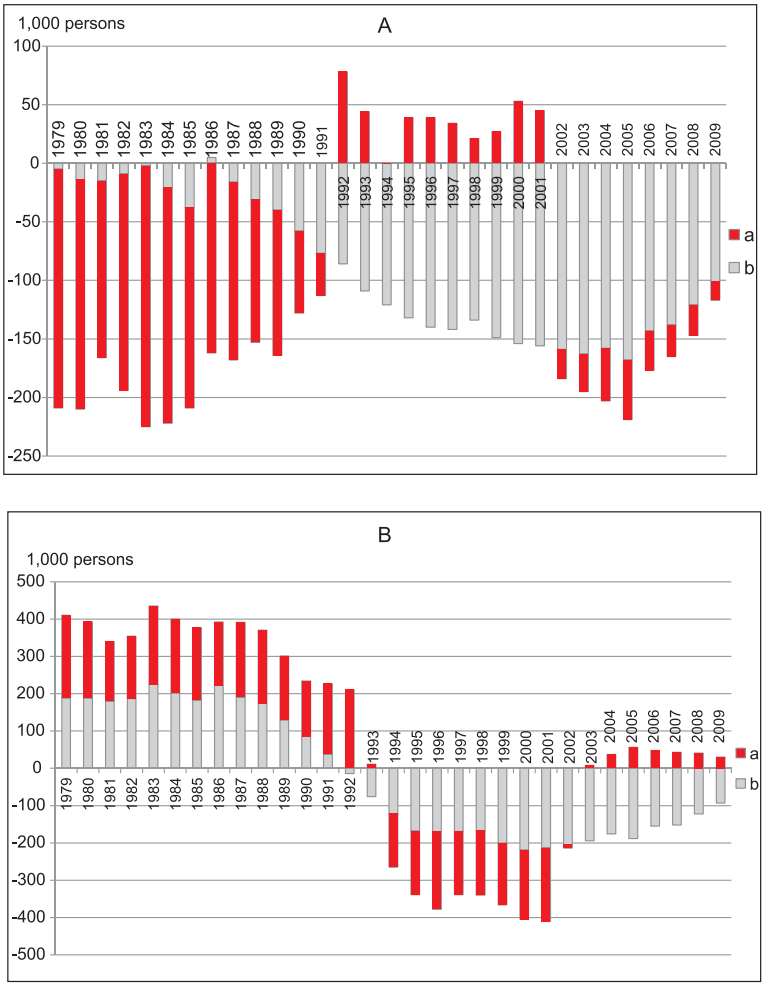

Fig 3. Components of rural (A) and urban (B) population change in Ukraine between 1979 and 2009. – a = net migration; b = natural increase

This time is called "the great escape" because the majority of the young and economically active population moved out of rural settlements. The second sub-period (1991–2009) was characterized by a high degree of depopulation that became the major component of the total rural population decline during these years. The process of depopulation in rural areas became visible in 1979, when deaths exceeded births and produced a negative natural increase of -0.3 per 1,000 persons. Since 1979, the natural increase of rural population reached a positive value of 0.3 per 1,000 only once (in 1986) and has never been positive again (*figures 2* and *4).*

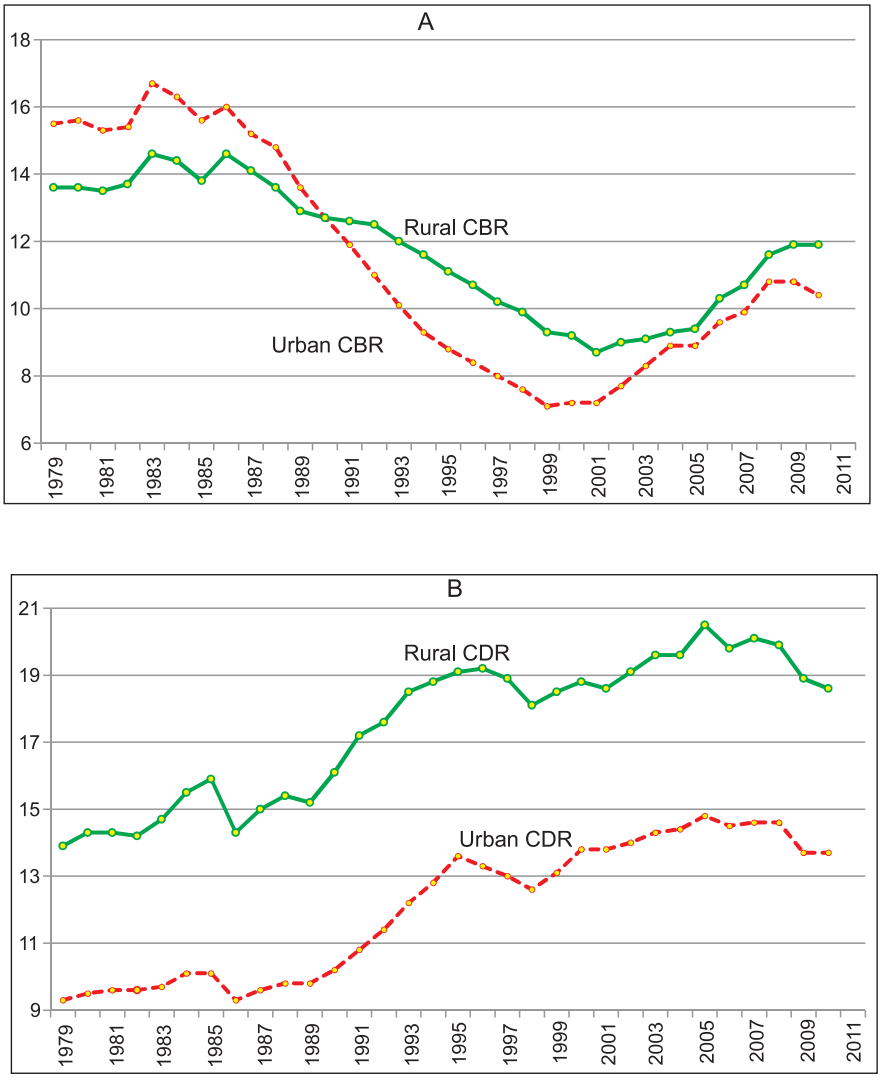

Fig 4. Changes in rural and urban crude birth rates (CBR) (A), and crude death rates (CDR) (B) in Ukraine between 1979 and 2009 (per 1,000)

The direction of migration flow reversed during this period. Beginning in 1992, in-migration outnumbered out-migration. The net in-migration in rural areas was primarily caused by the return of those rural residents who migrated to the cities prior to the economic crisis of the 1990s, but were forced to come back to the rural areas due to limited employment opportunities in urban settlements. Another category of in-migrants was ethnic Ukrainians

that returned from nearby regions following the collapse of the Soviet Union. However, this process did not last long. In 2002, there was a shift from in- to out-migration and an increase in rural depopulation (*Figure 3* A). Although the process of depopulation in urban areas started much later than in rural settlements *(figures 2* and *3* B*),* it follows the same trend of growth and contributes the most to the decline in urban population.

Fertility, mortality, and life expectancy

In the early 1990s, Eastern European countries shifted toward very low fertility (Caldwell, J. and Schindlmayr, T. 2003; Frejka, T. *et al*. 2008). This shift was determined by the collapse of state socialism and associated with societal transformations. Although the value of family as a societal institution remains high, other forms of partnership relationships are becoming common among young people (Libanova, E. *et al*. 2007). These new forms of partnership often assume new patterns of childbearing, such as the postponement of first and second births and childlessness. The economic crisis of the 1990s is arguably another cause of declining fertility. In this case, fear of losing a job prevents women from childbearing. However, Kohler, H. and Kohler, I. (2002) demonstrated in Russia that economic crisis and uncertainty in the labour market were correlated with increased fertility. One theory for this shift is that, within a limited and uncertain job market, unemployed women are more likely to bear a child, judging that it would take long until employment opportunities reappear.

Ukraine's fertility declined substantially in the 20th century. The total fertility rate fell from 5.2 in the 1920s to 1.9 in 1988–1989. Since 1991, the total fertility rate in Ukraine has been declining dramatically and reached 1.1 in 2000 (Steshenko, V. 2000). Along with Armenia and the Czech Republic, Ukraine's total fertility rate is the lowest in the world (Caldwell, J. and Schindlmayr, T. 2003). Steshenko stated that the major factors that caused the decline in fertility are worsening living standards, an ecological situation exacerbated by the Chernobyl disaster, and social discomfort brought on by worries and insecure feelings about the future. Although the last decades of 20th century demonstrated a significant decline in birth rates in rural areas of Ukraine, this decline has not been as dramatic as in urban areas (*Figure 4*). Initially higher than the rural birth rate, the urban birth rate started its rapid decline during the 1990s, and reached its lowest values of 7.1 – 7.2 per 1,000 people in 1999–2000. In 1979, 2,603 children were born in rural areas. In 1998, less than twenty years later, the number of births dropped to 1,605 (Libanova, E. *et al*. 2007).

There are two peaks of increased births in both urban and rural areas during the 1980s. These peaks seem to have been short-term responses to a

governmental policy directed at increased fertility that was adopted in 1982. At that time, mothers were granted a paid three-year maternity leave with the guarantee that their jobs would be available upon return. The positive effect of this demographic policy was offset by the economic crisis of the 1990s. 2001 became the year with the lowest fertility in Ukraine's rural areas. The number of births in that year dropped to 1,393, which was a 5.3 per cent decline from the previous year. The period of 1989–2001 is characterized by a loss of 36.7 per cent of the rural population compared to a 49.6 per cent loss in urban areas. The lower rates of decline in rural areas can be explained by causes such as traditional values and lifestyle, mentality and cultural roots of rural dwellers compared to their urban counterparts and by the socio-economic factors that affect urban and rural childbearing decisions differently. Such factors include educational level, income, and housing conditions that vary between urban and rural areas (Libanova, E. *et al*. 2007). When the economic crisis of the 1990s hit Ukraine, the urban dwellers became more vulnerable, facing severe crisis conditions. Unemployment was higher in the cities than in rural areas. Many people were desperate to find a job and affordable housing, whereas in rural areas it was easier to survive relying on private subsistence economies.

Mortality of rural and urban populations has been following the same trend of increase since the 1970s (*Figure 4*, B). However, the crude death rate (CDR) has always been higher in rural areas owing to the intense aging of the population and generally lower quality of life. Rural out-migration is a typical behavior of young people. This process shifts the rural population age structure toward older population groups. In 2006, the rural population CDR was 19.8, while in urban settlements it was only 14.5 (*Figure 4*, B).

Although rural depopulation is typical for many European countries, Ukraine's depopulation is much higher compared to the European region. It is characterized by the higher mortality rates in the elderly cohorts. While it is possible to compare crude death rates for Ukraine and the European region, it is more informative to analyze the data that are adjusted for differences in age structure of the populations of these regions (Weeks, J. 2008). To demonstrate the fact that Ukraine's rural population mortality is higher than in the population of the European region, the age-specific mortality rates[3] by sex were calculated for three cohorts: 40–44, 50–54 and 65–69 years old. Then the age-specific mortality rates were applied to a standard European population (as estimated by the World Health Organization). As a result, the age-standardized mortality rates[4] by sex were obtained for the European region, Ukraine as a whole, and Ukraine's rural population (*Table 4).*

[3] Number of deaths in a year of people of a particular age group divided by the average number of people of that age in the population.

[4] Age-specific mortality rates adjusted to a standard European population.

Table 4. Age-specific and age-standardized mortality rates by sex for selected cohorts in Europe and in Ukraine, 2008

Region	Age-specific mortality rates (deaths per 1,000 persons)						Age-standardized mortality rates (deaths per 1,000 of standard population)					
	40–44 years		50–54 years		65–69 years		40–44 years		50–54 years		65–69 years	
	male	female	male	female	male	female	male	female	male	female	male	female
Europe (total)	4.45	1.73	10.56	4.29	27.83	13.95	5.23	1.89	10.28	4.37	30.71	19.37
Ukraine (whole)	12.05	3.49	22.05	7.02	48.54	20.45	11.35	3.40	21.88	6.5	41.23	17.7
Ukraine (rural)	12.51	3.5	24.7	7.6	50.34	21.68	13.10	3.11	23.7	6.7	63.5	39.8

Source: Author's calculations based on the data provided by the UN Population Division, 2008; World Population prospects, 2008; and the State Committee of Statistics of Ukraine, 2008.

The results in *Table 4* show that in Ukraine mortality rates are higher than the European average for both men and women, and rural mortality rates in Ukraine are highest of all. In fact, mortality rates among Ukraine's men are much higher than among women. Considering the importance of the health care system responsible for sanitary conditions, it is worth mentioning that many people who live in rural areas have limited access to health care facilities. Only 2 per cent of rural settlements have local hospitals. In order to see a doctor, people sometimes have to travel to a distant facility, which is often impossible because of limited transportation. It is typical for rural dwellers to avoid visits to the doctor until a serious condition occurs. Low income is another factor that postpones doctor's appointments for rural residents. Often, people cannot afford to see a specialist because of the high price of a medical examination. Such situations make preventive medicine unaffordable for many people and may in part explain high mortality rates in rural settlements.

Steshenko pointed out that the public health system declined during the economic crisis, worsening population health conditions. Since 1970, deaths from respiratory troubles, digestive and infectious diseases decreased, but sharp increases occurred in cardiovascular, cancer, accidents and poisoning, and other causes of death (*Table 5*).

Life expectancy is one of the indicators that determine quality of life. In Ukraine, increased mortality is reflected in declining life expectancy. In 2006, the difference between female and male life expectancy was 11.6 years. The lower life

Table 5. Causes of death and life expectancy at birth in rural areas of Ukraine, 1970-2001

Indicators	1970	1980	1990	2001
Life expectancy at birth (in years)	70.34	69.24[1]	70.21[2]	67.33
Mortality by causes of death (per 10,000 person):				
Cardiovascular disease	564.4	907.6	834.7	1,088.3
Cancer	114.8	139.7	207.4	197.6
Accidents and poisoning	84.2	121.7	126.4	157.4
Respiratory disease	184.0	163.5	127.4	109.2
Digestive system disease	22.6	28.0	32.7	39.0
Infectious disease	29.8	18.6	14.4	24.2
Other causes	41.5	38.9	267.3	247.2

[1]1979; [2]1989. *Source:* Compiled by authors using data from the State Committee of Statistics of Ukraine and Center of Medical Statistics of the Ministry of Health of Ukraine.

expectancy for males may be the result of the entrenched habits that dominate the lifestyle of rural Ukrainian men, such as excessive alcohol consumption (Levchuk, N. 2009) and heavy smoking. Ukraine's indicators of life expectancy, along with the crude birth and death rates, are remarkably negative in comparison with some Central European countries (*Table 6*).

Table 6. Crude birth rate, crude death rate, and life expectancy indicators: Ukraine versus selected European countries

Country	Crude birth rate		Crude death rate		Life expectancy in years			
	1989	2006	1989	2006	1989		2006	
					male	female	male	female
Albania	26.8	14.0[1]	5.9	6.7	69.6	73.5	72.5	77.3
Bulgaria	11.4	8.3	18.2	20.7	68.3	74.7	69.1	76.3
Czech Rep.	13.6[2]	10.1	14.3[2]	10.5	67.7[2]	75.2[2]	73.4	79.7
Hungary	13.9[3]	9.9	16.3[3]	13.9	65.4	73.7	69.0	77.4
Moldova	..	11.4	..	14.0	..	..	64.6	72.2
Poland	18.0[3]	10.6	10.6[4]	10.0	67.1	75.6	70.4	79.0
Romania	17.8	10.3	13.7	14.7	66.5	72.4	68.7	75.8
Slovakia	..	10.6	..	11.3	66.7	75.5	70.4	78.2
Slovenia	..	9.8	..	9.7	69.9	77.9	74.8	81.9
Ukraine	*12.7*	*10.2*	*16.1*[4]	*19.8*	*68.6*	*74.4*	*61.7*	*73.3*

[1]2004; [2]Czechoslovakia, [3]1988, [4]1987, .. no data. *Source:* Eurostat, World Health Organization

Population aging

In all Central and Eastern European countries, the rural population is getting older (Rey, V. and Bachvarov, M. 1998), and Ukraine is no exception. Among the various measures of population aging (Sanderson, W. and Schebrov, S.

2005), Edward Rosset's (1964) method is used in Ukraine. According to this method, if 18 per cent or more of the population is 60 years or older, the society is considered to have a very high level of population aging. In rural areas of Ukraine, the level of population aging is very high and is significantly higher than in urban areas. According to the State Committee of Statistics, the proportion of population in the oldest age group (60 years old and above) was 20.3 per cent in 1979, 24.2 per cent in 1989, and 24.1 per cent in 2007. In urban areas this proportion was 12.7 per cent, 14.9 per cent, and 18.5 per cent in the corresponding years (Derzhavniy Komitet Statistyky Ukrayini, 2009).

The major issue emerging from the population aging is the increasing dependency ratio[5]. In rural areas, the aged dependency ratio has been higher than the youth dependency ratio since 1979, whereas in urban settlements this pattern first occurred only in 2000 *(Figure 5)*.

In Ukraine and other post-Soviet countries, it is typical to consider population in post-productive age as a burden for the working-age population. However, in countries with well-developed market relationships, people of

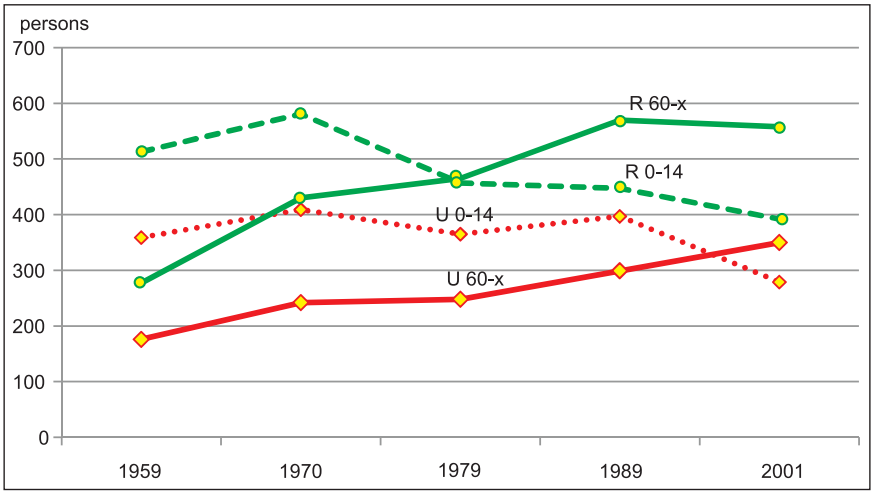

Fig. 5. Rural and urban youth and aged dependency ratios between 1959 and 2001. – U_{0-14} = number of urban residents aged 0–14 per 1,000 urban residents aged 15–59; U_{60-x} = number of urban residents aged 60 and older per 1,000 urban residents aged 15–59; R_{0-14} = number of rural residents aged 0–14 per 1,000 rural residents aged 15–59; R_{60-x} = number of rural residents aged 60 and older per 1,000 rural residents aged 15–59

[5] Dependency ratio is a ratio of those not in the labor force and those in the labour force. Dependency ratio can be decomposed into youth dependency ratio: a ratio of population aged 0–14 years old and population aged 15–59 years old, and aged dependency ratio: a ratio of population aged 60 years old and above and population aged 15–59 years old.

post-productive age live on retirement savings earned during their productive age and do not become a burden for younger cohorts.

It is a sign of societal maturity when elderly people live long and active lives with a high level of material well-being. In rural Ukraine, the population aging is primarily the result of intensive out-migration of the economically active population to the cities. The failed reforms of transition affected the so called "state retirement fund" in Ukraine and produced a shortage of pension money in the state budget. This negative process echoes even now, in the post-transition period, and brings financial tension into the lives of Ukrainian pensioners. If, instead, people in older cohorts were considered human resource or human capital, then the whole society could work toward improving the material and social conditions of the elderly population. However, this transition to the new societal values requires changes in governmental social policies and a significant budgetary influx.

Spatial differences in rural demographic trends

The east-west socio-economic dichotomy in Ukraine is a well-known phenomenon (Skryzhevska, Y. 2008). The line Uman'–Kharkiv *(Figure 6*) is not only a divide between eastern and western Ukraine, but also between urban and rural Ukraine (Karácsonyi, D. 2009).

As *Figure 6* suggests, the rural population distribution is uneven, displaying high concentrations of rural residents in western and central regions and lower concentrations in eastern regions. Western Ukraine is dominated by agriculture and forestry, and the eastern part is known for its industrial specialization (mining, heavy industries). During the economic crisis of the 1990s, Eastern Ukraine experienced the most dramatic decline in population and quality of life compared to other regions. A similar pattern has been observed in terms of rural population decline. The analysis in this paper involves 669 administrative units (*rayons*) aggregated into 501 rayon-level units.[6] During the period from 2004 to 2010, there were only 33 administrative units (out of 501) with increasing rural population, and most of them were located in western Ukraine (*Figure 7*). Further analysis suggests that the increase in population was achieved as a result of a positive natural increase of the rural population in only 5 of these 33 units. All of them are located in western Ukraine (*Figure 8*).

Throughout history, western Ukraine was an area of diverse ethnic composition, which affected the traditional lifestyle of the population. Family as a social institution has a greater value in western areas compared to the

[6] 501 rayon-level units were created by aggregation of selected cities of oblast' subordination with surrounding rayons.

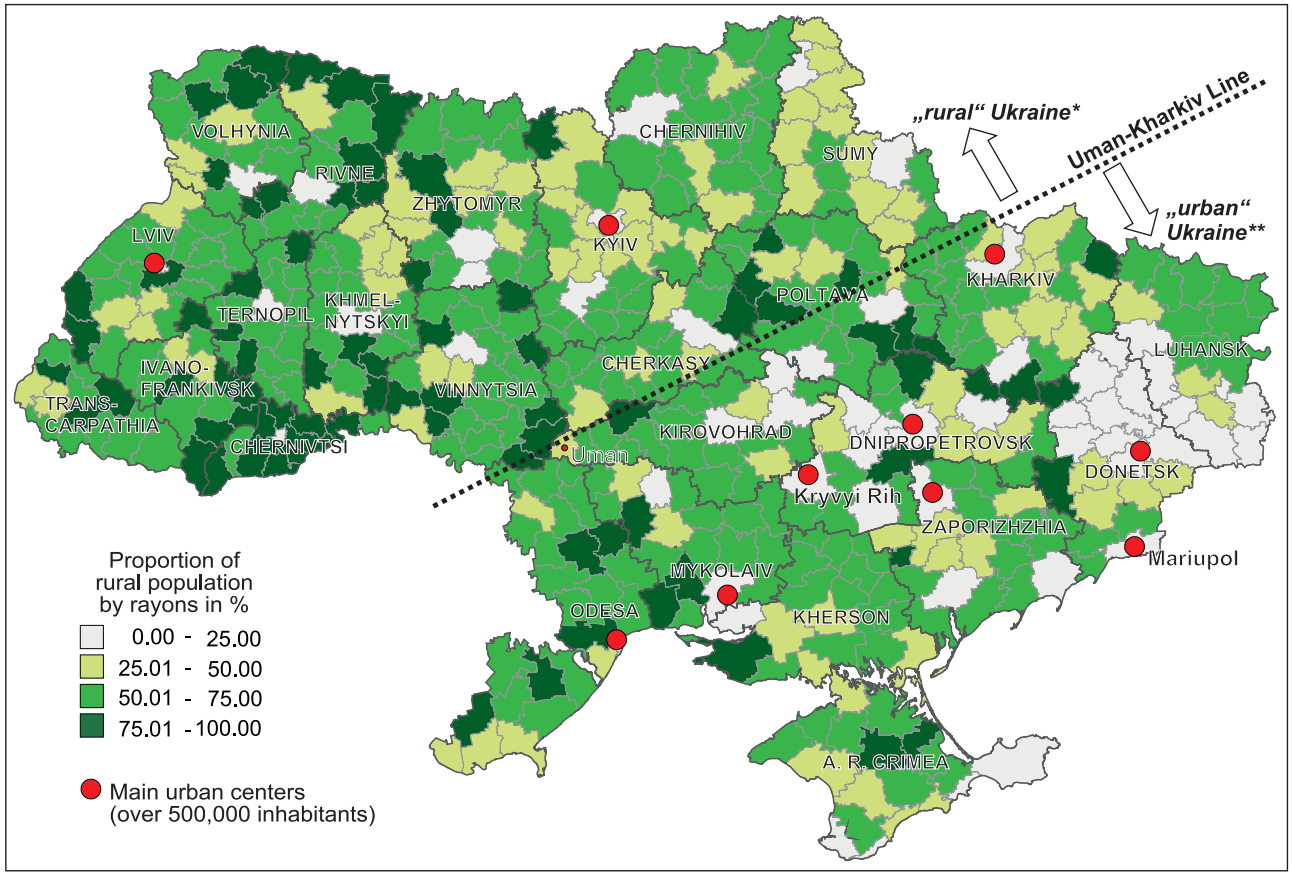

Fig. 6. Spatial distribution of rural and urban population in Ukraine, 2010. *Rate of rural population is 44% (65% of total rural population of Ukraine). **Rate of rural population is 22% (35% of total rural population of Ukraine)

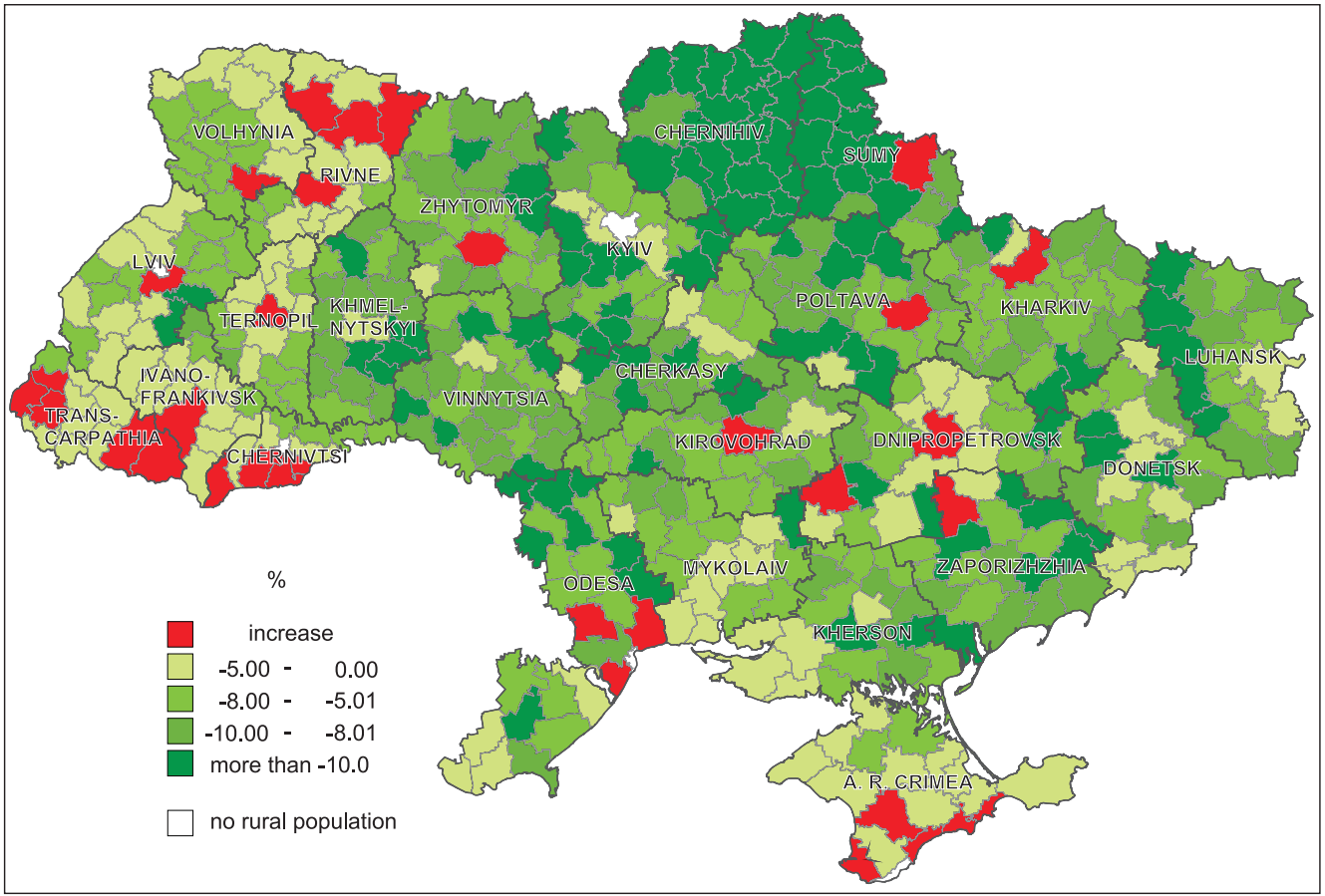

Fig. 7. Rural population change by rayons between 2004 and 2010, %

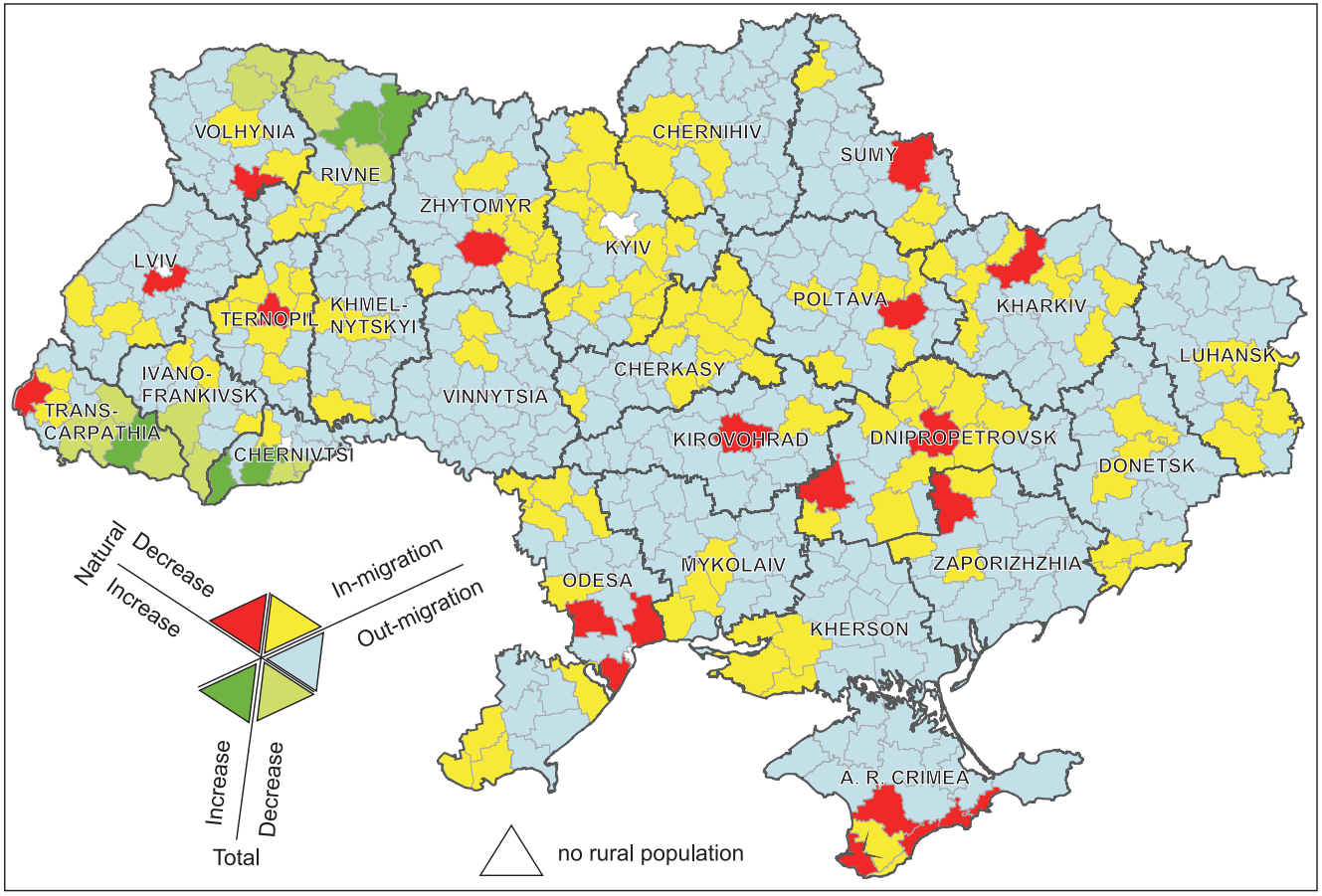

Fig. 8. Types of rural population change by rayons between 2003 and 2009

eastern areas of Ukraine. It is traditional for western Ukrainians to have large families. The rate of divorce in western Ukraine is lower than the average in Ukraine and the rate of marriage is higher (Libanova, E. *et al*. 2007). These facts explain the higher-than-average (11.9 in 2009) birth rates in rural western regions (*Figure 9*). As *Figure 8* suggests, rural population also increased around major urban centers. Although these rayons demonstrated negative natural increase, they experienced in-migration triggered by the pull factors of the major urban settlements (Nefedova, T.G. 2006).

The higher-than-average birth rates are also observed in Crimea. The high birth rate may be related to the traditional lifestyle of the Crimean Tatars, the ethnic group that was exiled from Crimea after World War II and were only allowed to return by the Gorbachev administration in the 1980s (Shamshur, O. 1998 p. 31). Another area where the rural population birth rate is higher than average is southern Ukraine, particularly the Odesa region. This area is another ethnically diverse region, where the traditional lifestyle of the residents is responsible for childbearing patterns. The rest of the rural areas of Ukraine experienced lower-than-average birth rates.

After 2001, the birth rates in majority of rural areas have increased (*Figure 10*). This increase can be attributed in part to the demographic policy change that occurred in the early 2000s. According to the new policy, families with children were provided monetary benefits in the form of governmental payments following the births of first, second, and third child. In spatial aspect, the highest increase of crude birth rates occurred in western Ukraine and some suburban regions of central and eastern Ukraine, where it has been already higher compared to other regions.

Mortality in rural areas is especially high in northern and central regions, where the crude death rate reached 35 in 2009 when the average for rural Ukraine was 18.9 (*Figure 11*). In a majority of industrial eastern regions, the crude death rate indicators also exceed the average level. Some authors (Marples, D. 1996; Vargo, G.J. 2000) ascribe the high level of mortality in northern Ukraine to the disastrous consequences of the Chernobyl nuclear accident. However, it is worth mentioning that the rural population of these areas is dominated by elderly cohorts (60 and older). For Ukraine's rural population, the average proportion of residents over 60 is 26.8 per cent. In the northern and central regions of Ukraine, this indicator reaches 29.4 per cent in the Zhytomyr region, 30.8 per cent in the Kyiv region (excluding the City of Kyiv), and 38.1 per cent in the Chernihiv region, which produces higher-than-average crude death rates.

It is obvious that demographic component is an important part of the east-west dichotomy in Ukraine. The population change processes are driven by the differences in the traditional lifestyles and economic backgrounds of the population in these regions. The existence of such dichotomy suggests

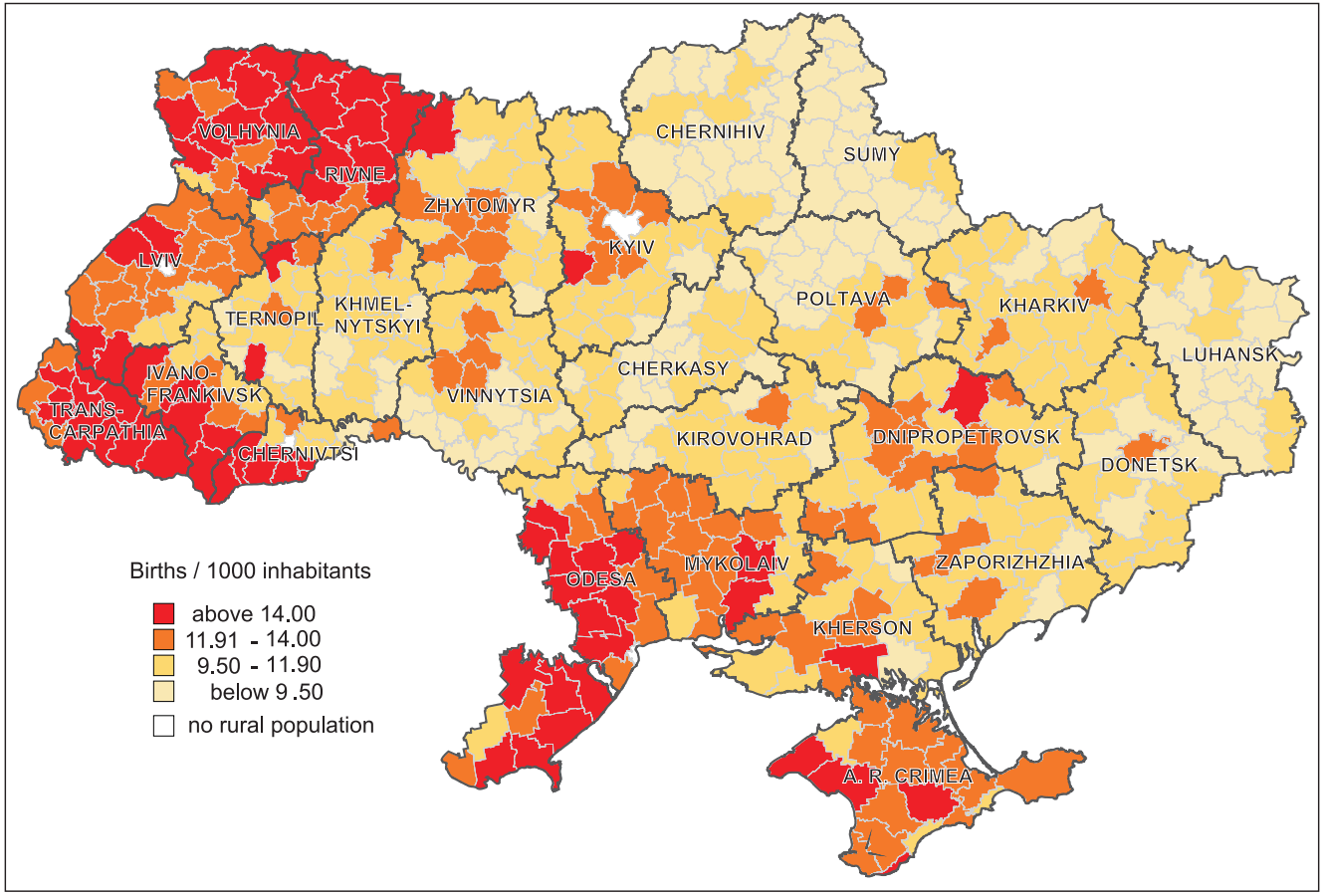

Fig. 9. Crude birth rate of the rural population by rayons, 2009

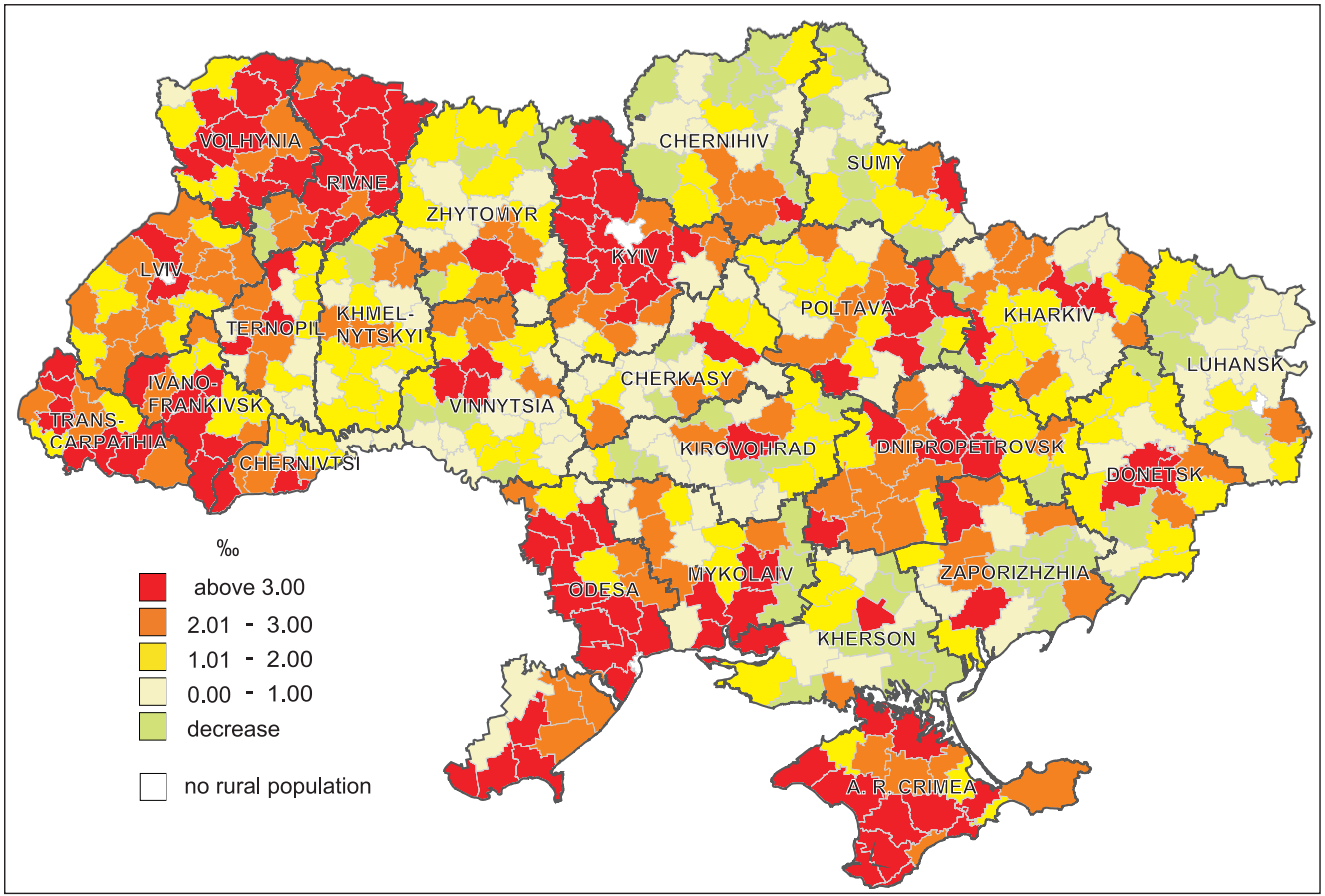

Fig. 10. Change of crude birth rate of the rural population between 2003 and 2009

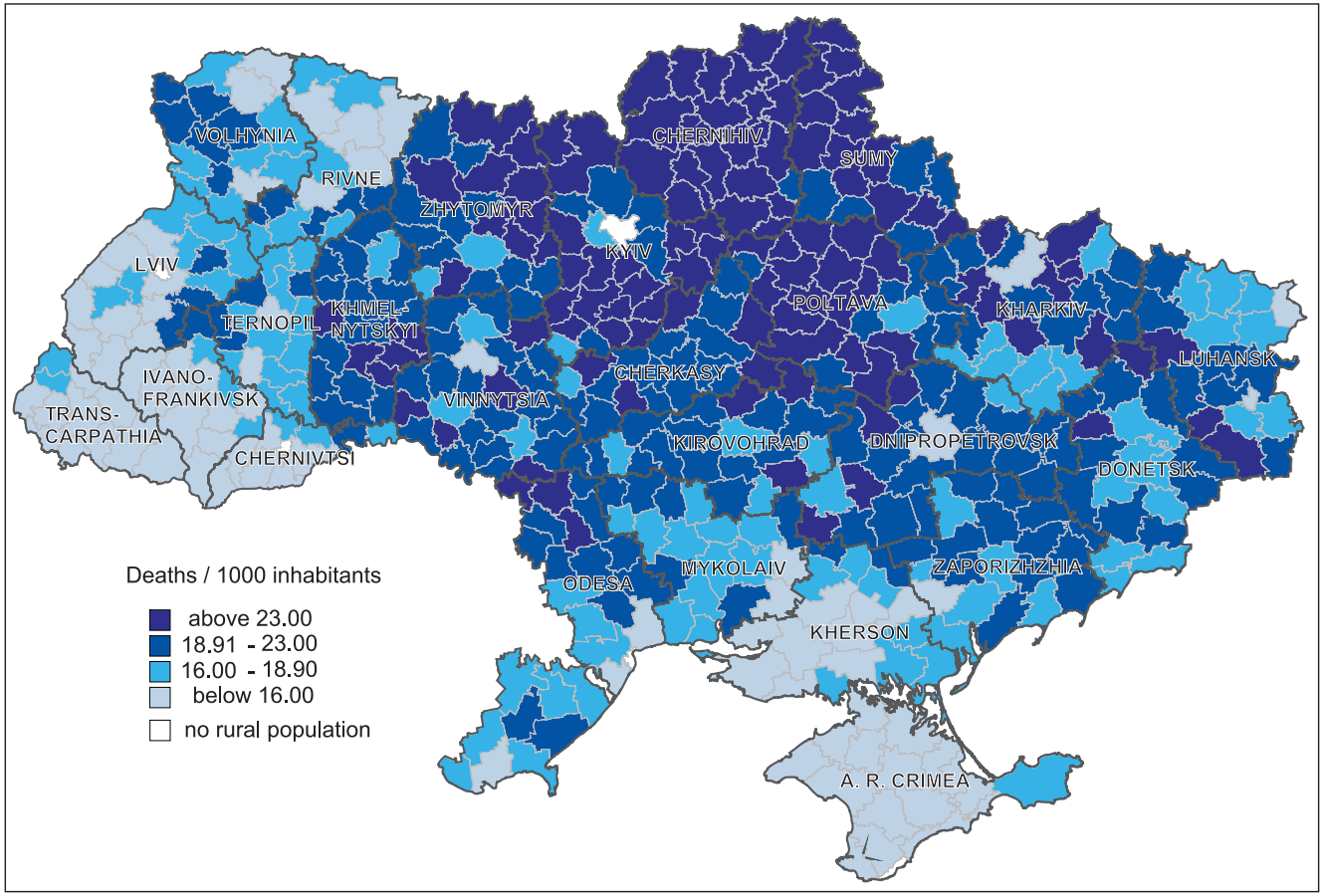

Fig. 11. Crude death rate of the rural population by rayons, 2009

that, when targeting demographic improvements on the country level, policy-makers should take into account local differences and cultural specificities in Ukraine's regions.

The results of demographic analysis presented in the first two sections of this article reveal clear indications of a deep demographic crisis in rural areas of Ukraine. The negative demographic trends are homogeneous across the country with some exceptions in the regions with diverse ethnic composition that demonstrate slightly positive demographic tendencies. It is hard to say whether this demographic situation caused economic and social decline, or vice versa. The reality is that the problems of rural areas in Ukraine exist and they have been neglected by the government for more than half of a century. The array of these problems goes far beyond just the demographic decline. Rural economies have been declining as well. Transition to market economy has brought restructuring and the land privatization reform into the rural economies led to economic uncertainties, unemployment, and out-migration of young population and deterioration of social institutions in rural areas. Despite the weak attempts of the policy-makers to initiate programs directed at improvements of rural areas, most of these programs had only a short-term effect and did not produce significant positive change. The next two sections reveal the realities and challenges of every-day life in rural areas in Ukraine and provide suggestions for revitalization of rural economies and societies as a whole.

Realities of rural life

The first and foremost problem of rural areas in Ukraine is the mono-functional nature of rural economies resulting from its socialist past and the economic restructuring of the 1990s. During the Soviet era, rural employment was provided almost entirely by the collective and state farms. Although the majority of rural residents were employed on these farms, there was a small proportion of rural industrial and service workers who worked at small plants and factories, branches of big enterprises located in the nearby cities. This pattern was typical for not only Central and Eastern European countries (Rey, V. and Bachvarov, M. 1998), but also the countries of the former Soviet Union such as Ukraine. When the restructuring of the 1990s started, many of the city-based enterprises shut down their rural branches, producing growing unemployment in rural areas.

Another element of economic restructuring was land privatization. Collective land ownership was eliminated and turned into private land ownership. This element of a market economy was new and unknown to the rural people and produced a high degree of uncertainty among former employees

of the collective farms. Due to their lack of experience and material resources, many rural residents leased their land parcels to the newly emerged farmers, usually managers of the former collective farms. This type of relationship is still widely practiced in rural Ukraine. The renter pays the landowner a share of crop that is used by the landowner in his household or sold at the market. Usually, these relationships do not generate sufficient income for leasers, who have to search for salaried jobs or survive by subsistence living. According to the data provided by the State Committee of Statistics in the Odesa region, between 2000 and 2008 the number of workers employed in agriculture in Ukraine decreased by 72 per cent (Derzhavniy Komitet Statistyky Ukrayini, 2007, 2009). The highest reduction of agricultural workers was in western and southern regions. One might assume that the eliminated agricultural jobs were replaced by industrial and service jobs, diversifying rural mono-functionality. But unfortunately, in the case of Ukraine, this reduction did not spur an increase in non-agricultural activities. Instead, those people who were dismissed from agricultural jobs as a result of economic restructuring and land privatization found sources of income either in the cities or in other countries or, sometimes, just remained unemployed.

Growing unemployment, in turn, generated a new flow of job seeking out-migrants from the rural areas to the cities. In 2005, one million rural residents worked in urban areas, which is 28.5 per cent of the employed rural population. Currently, the most common income-generating activity in rural areas is private agriculture, which accounts for 43 per cent of the employed rural population (Libanova, E. *et al*. 2007). The majority of employed rural residents (55 per cent) belong to professions that do not require special knowledge or professional qualification. Unsurprisingly, agriculture wages are about half as much as the average in Ukraine's manufacturing sector. This system produces low incentive for young people to return to rural areas after completing their education. There is a significant difference between the sources of household income in rural and urban areas. On average, one third of rural household income is generated by salary. The rest is comprised of pensions that come from the state budget and income from selling agricultural goods produced by small private economies. For urban households, the share of salary in household income constitutes 50 per cent. Taking into account the significant aging of the rural population, pensions as a major income source will remain important in the future. Supporting these pensions will require additional governmental funds and thoughtful governmental policies.

Deep economic crisis, along with the long-running ineffective process of restructuring in the agricultural sector, ruined social infrastructure in rural areas. According to research by the Institute for Rural Development (Ostashko, T. 2006), 71 per cent of rural settlements do not have preschools, 41 per cent do not have places for cultural and leisure activities, and 98 per cent do not

have hospitals. This situation is not favorable for demographic improvements. Governmental policies should be directed at identifying internal and external investments to support rural social infrastructure. Special attention should be given to creating a network of socio-cultural establishments in rural areas that would become the foundation for the recruitment and retention of youth in the agricultural sector and rural businesses.

Another problem of rural areas is poor housing conditions. Although the majority of rural dwellers own homes, the quality of these homes is unsatisfactory. Often, rural houses lack running water or sewer and are in need of repair. The majority of low-income families live in houses without adequate heating and water supply. Only a few rural settlements are connected to the sewer lines.

The system of social security inherited by Ukraine from its socialist past became inadequate under the pressures of the 1990s. Pensions paid from the state budget are the major sources of income for the majority of rural residents because of the aging nature of the rural population. The low social standards adopted by the government make pension payments small and inadequate to face the growing prices of consumer goods. These decreasing pension payments put the buying potential of rural elderly people at the lowest level and increases poverty in rural areas. Although the number of people who lived in poverty in Ukraine decreased during 1999–2006, the rural poverty level did not decrease during that time and still remains higher than in urban areas.

The problems of Ukraine's rural areas described in this section require the immediate attention of governmental bodies and policy-makers. If development policies are directed at the improvement of economic and social dimensions in rural areas, the demographic crisis could be overcome and economic and social climate improved.

Suggestions for revitalization

Ukraine's countryside suffered severely during the economic crisis of the 1990s and is currently in need of a consistent demographic and economic development policy that would help to revitalize population and economy of rural Ukraine. It is important that governmental authorities recognize that rural development requires serious consideration and a new approach that combines traditional focus on agriculture with non-agricultural components of rural life. The depressed rural territories should be perceived as complex systems where all components such as population, economy and infrastructure are mutually connected and play important roles in the system functionality rather than exist independently.

It has been observed lately that governmental actions often target only one specific component of rural territories. For instance, in the recent years, government has been increasing pensions for selected groups of elderly population claiming that these actions will improve quality of life of these people. What is happening in reality is that in the economic crisis of transition and restructuring, rural societies are hit the most, and these small infusions of money do not solve the problem of backwardness and underdevelopment. The problems still persist in health care, education, financial institutions, and job markets in rural areas. This demographic analysis provides evidence that policy changes could help overcome negative tendencies in rural territories and bring improvements in the economic and social climate of rural areas.

Policy suggestions for rural areas in Ukraine

In order to create economically attractive rural areas in Ukraine, it is important to diversify the economy by creating opportunities for industrial and service jobs in rural settlements. This can be achieved by encouraging *entrepreneurship*, especially in small and medium- size business. Many rural residents complain that they would like to start their own businesses in rural area, but the bureaucratic procedure they have to go through is too complicated and time consuming. Additionally, many rural dwellers lack knowledge in tax and financial legislation, which also keeps them away from becoming entrepreneurs.

The following measures would be beneficial in supporting small and medium entrepreneurship in the non-agricultural sector: (a) elimination of bureaucracy in the process of business registration; (b) creation of educational opportunities for those rural residents who would like to start their own business; (c) improvements in tax legislation and provision of tax incentives for small and medium-size business owners in rural areas; and (d) availability of micro loans for rural entrepreneurs. There is a significant demand for consumer services such as retail, transportation and private early childhood educational establishments that can be satisfied by increasing number of rural entrepreneurs. In the industrial sector and construction, new jobs may become available as a result of private investment in the non-agricultural rural sector. So far, private investors have been cautious in their investment decisions in rural areas.

There are many uncertainties and instabilities in the legislation that control the investment process, which reduce volume of private investment in rural Ukraine. To overcome this barrier, investment attractiveness of rural areas should be improved. Such improvement cannot be achieved in a short time. It involves improvements in *rural infrastructure* such as construction of new highways, gas pipelines, improved water supply, as well as promotion

of information technologies and innovations. For those who would like to improve their business in the agricultural sector, creation of agricultural co-operatives that would serve agro-business would be beneficial.

There is a need for locally tailored rural development policies that would take into account local diversity of individual rural areas. Many Ukrainian villages, especially in the western part of the country, possess valuable natural and agro resources such as intact forests, rivers, and fertile soils of the river valleys. In these areas, rural tourism should be considered as another element of rural development. Tourism as an economic sector creates jobs and positively contributes to rural communities. It stimulates renewal of villages and makes them better places to live and visit as well as encourages preservation of cultural heritage. With the development of rural tourism, the other associated businesses such as hospitality and sustainable agricultural practices come to life and produce benefits to local communities.

In order to create and implement rural development programs based on a new approach, a new generation of rural leaders should be raised. These leaders should come from the rural areas and be well aware of the challenges of every-day rural life. They have to be well-educated in the field of rural development and capable in adjusting their policies according to the changing nature of local conditions. Ability to use innovative approaches in rural development policy, establish partnership with state agencies and NGOs and govern transparently is essential qualities of new generation of rural leaders.

Such changes could help counter the negative stereotype of rural life and could result in gradual improvements in rural areas. Until new policies are implemented, the rural areas are likely to remain unattractive to young people, which will deepen the demographic crisis.

Conclusion

Demographic data for Ukraine clearly demonstrate a serious decline in both the quantity and quality of rural population. The combined effects of negative natural increase, negative migration rates, high and increasing mortality rates, reduced life expectancy, and aging population have put Ukraine's rural areas in a difficult situation that will need attention soon to avoid further decline. The current demographic, social, and economic situation in rural Ukraine suggests that depopulation will continue as a result of further out-migration and high mortality. This could result in a shrinking of rural settlements and populations that are increasingly elderly and therefore more dependent. The trend toward subsistence agriculture and unemployment will continue to reduce tax revenue for rural municipalities, and cause further decline in supports for infrastructure and social programs. To break this vicious cycle, Ukraine needs

to direct policy toward improving the economic attractiveness of rural areas for entrepreneurs in both agricultural and non-agricultural enterprises. This could include formation of agricultural cooperatives, educational training for rural leaders, identification and development of rural tourism opportunities, and adaptation of rural policies to the regional differences within the country.

A new economic program for rural Ukraine would benefit from including both agricultural and non-agricultural activities to create employment opportunities that might help retain younger people and could reverse the flow of migrants. Such a revitalized rural economy would improve living standards and market support for rural business development and could help reverse the steady demographic decline that Ukraine has experienced since the outset of the transition to market economy.

REFERENCES

Baranovsky, M.O. 2009. *Naukovi zasadi suspilno-geografičnovo vivčennja silskih depressivnih teritoriy Ukrayini.* (Scientific principles of human geographical development of depressive rural spaces in Ukraine). Kyiv, National Taras Shevčenko University, 394 p.

Borowicz, R. 1996. Rural unemployment: Specific traits. *Eastern European Countryside* 2. 17–27.

Caldwell, J. and Schindlmayr, T. 2003. Explanations of the fertility crisis in modern societies: A search of commonalities. *Population Studies* 57. (3): 241–263.

Demographicheskiy Slovar. (Demographic Dictionary), 1985. Moscow. (in Russian).

Derzhavniy Komitet Statistyky Ukrayini. (State Committee of Statistics of Ukraine), 2001. Statystychniy schorichnyk Ukrayini za 2000 rik (Statistical yearbook of Ukraine for 2000), Kyiv, Ukraine, Tekhnika.

Derzhavniy Komitet Statistyky Ukrayini.(State Committee of Statistics of Ukraine), 2007. Statystychniy schorichnyk Ukrayini za 2006 rik (Statistical yearbook of Ukraine for 2006), Kyiv, Ukraine, Tekhnika.

Derzhavniy Komitet Statistyky Ukrayini.(State Committee of Statistics of Ukraine), 2009. Statystychniy schorichnyk Ukrayini za 2008 rik (Statistical yearbook of Ukraine for 2008), Kyiv, Ukraine, Tekhnika.

Dragona, V. and Turnock, D. 2000. Policies for rural Eastern Europe in transition: The case of Slovakia. *GeoJournal* 50. 235–247.

Frejka, T., Sobotka, T., Hoem, J.M. and Toulemont, L. 2008. Summary and general conclusions: Childbearing trends and policies in Europe. *Demographic Research* 19. (2): 5–14.

Gorz, B. and Kurek, W. 2000. The population of the Polish countryside: Demography and living conditions. *GeoJournal* 50. 101–104.

Karácsonyi, D. 2009. Ein Versuch der Typologie der ländlichen Räume in der Ukraine (Experiment for Typology of Rural Spaces in Ukraine). *Europa Regional* 1. 34–50.

Khomra, A.U. 1989. Rural depopulation trends in the Ukrainian SSR: The delimitation and spatial differentiation. In *The process of depopulation of rural areas in Central and Eastern Europe*. Eds. Stasiak, A. and Mirówski, W. Warsaw, Polish Academy of Sciences, Institute of Geography and Spatial Organization, 173–182.

Kocsis, K., Rudenko, L. and Schweitzer, F. (eds.) 2008. *Ukraine in Maps*. Budapest, Geographical Research Institute, Hungarian Academy of Sciences, 000 p.
Kohler, H. and Kohler, I. 2002. Fertility decline in Russia in the early and mid 1990s: The role of economic uncertainty and labor market crisis. *European Journal of Population* 18. 233–262..
Levchuk, N. 2009. *Alcohol and mortality in Ukraine*. Max Planck Institute for Demographic Research. Working paper. (available at http://www.demogr.mpg.de/) (accessed on April 28, 2010).
Libanova, E., Kurylo, O., Makarova, O., Steshenko, V. and Cherenko, L. 2007. *Naselennia Ukraini: Socialno-demographichni problem Ukrainskogo sela* (Population of Ukraine: Social and Demographic Problems of Rural Areas). Kyiv, Institute for Demography and Social Studies at the NAS of Ukraine. (in Ukrainian).
Marples, D. 1996. The Chernobyl disaster: its effect on Belarus and Ukraine. In *Long road to recovery: community responses to industrial disaster.* Ed. Mitchel, J. Tokyo–New York–Paris, The United Nations University Press.
Nefedova, T. G. 2006. Goroda kak organizatori selskoy mesnosty. (Cities as organizers of rural spaces) *Nauka v Rossii* 4. 9–34.
Ostashko, T. 2006. *Stan i perspektyvi ukrainskogo sela (Present and future of Ukrainian rural areas*). Kyiv, Institute for Rural Development. (in Ukrainian).
Pantyley, V. 2009. Demographic situation of rural population in Ukraine in the period of intensive socio-economic transformation. *European Countryside* 1. 34–52.
Rey, V. and Bachvarov, M. 1998. Rural settlements in transition – agricultural and countryside crisis in Central-Eastern Europe. *GeoJournal* 44. 345 – 353.
Rosset, E. 1964. *Aging process of population*. Oxford, Pergamon Press.
Rowland, R. H. 2004. National and regional population trends in Ukraine: Results from the most recent census. *Eurasian Geography and Economics* 45. (7): 491–514.
Sanderson, W. and Scherbov, S. 2005. Average remaining lifetimes can increase as human populations age. *Nature* 435. (7043): 811–813.
Shamshur, O. 1998. *Migration Situation in Ukraine: International Cooperation Related Aspects.* Migration, 29-30-31. The Former Soviet Union. Berlin, Berliner Institut für Vergleichende Sozialforschung, 29–44.
Skryzhevska, Y. 2008. *Regional inequalities in Ukraine: Causes, consequences, policy implications,* VDM.
Steshenko, V. 2000. Demographic situation in Ukraine in the transition period. In *New Demographic Faces of Europe.* Eds. Kučera, T., Kucerová, O., Opara, O. and Schaich, E. Berlin, Springer Verlag, 347–369.
Steshenko, V. 2001. *Demographichna kriza v Ukraini. (Demographic crisis in Ukraine*). Kyiv: Institute for Demography and Social Studies at the NAS of Ukraine. (in Ukrainian).
Vargo, G.J. 2000. *The Chernobyl Accident: A comprehensive Risk Assessment*. Columbus and Richland, Battelle Press.
Weeks, J. 2008. *Population: An Introduction to Concepts and Issues*. 10th Edition. Belmont, Wadsworth Publishing Co. CA.
European Commission. Eurostat. Accessed September 28, 2011.
<http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/>.
World Health Organization. Accessed September 28, 2011. < http://www.who.int/research/en/ >

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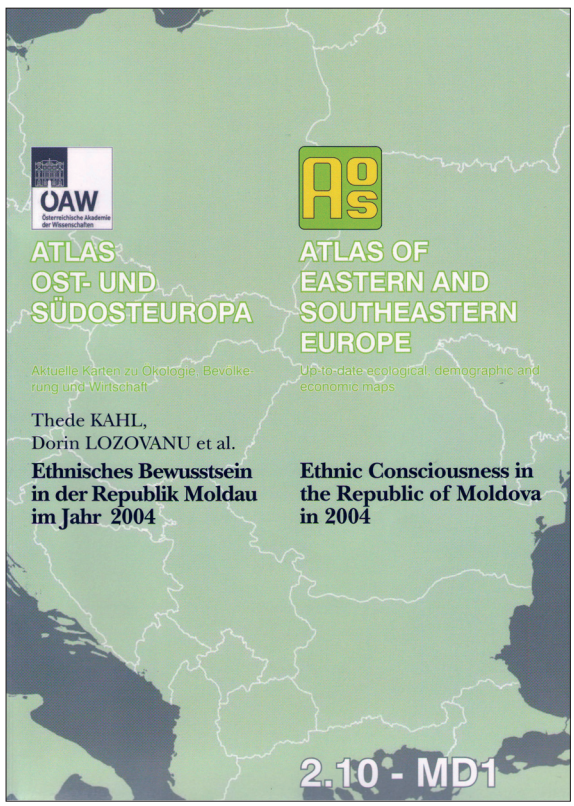
Kahl, T., Lozovanu, D., Heuberger, V., Jordan, P., Ethnisches Bewusstsein in der Republik Moldau im Jahr 2004 / Ethnic Consciousness in the Republic of Moldova in 2004. Institut für Stadt- und Regionalforschung der Österreichischen Akademie der Wissenschaften, 2010, Wien, 78 p. (Series: Atlas Ost- und Südosteuropa / Atlas of Eastern and Southeastern Europe. 2.10 – MD1)

The volume titled 'Ethnic Consciousness in the Republic of Moldova in 2004' corresponds with the traditional topics of the series 'Atlas of Eastern and Southeastern Europe'. Similarly to the previous volumes 'Ethnic structure of Eastern Europe and Caucasia around 1990', 'Ethnic structure of Southeastern Europe around 1992' and 'Ethnic consciousness in Central and Southeast Europe around 2000', this publication also deals with the ethnic structure of a post-soviet region hardly known in the west. The volume consists of two parts: a map and the accompanying text (32 pages in German, 33 pages in English and a 10 pages long bibliography).



The map depicts an extract of Moldova and the surrounding territories. According to the title, the content of the map is based on 2004 data, but the title refers only to the date of the last census in the Republic of Moldova. The Ukrainian and the Romanian censuses were held earlier (in 2001 and 2002). The map focuses on the ethnic structure of the above mentioned territories using the ethnic data of the censuses.

The publication has several new, scientific outcomes. Maybe the most important one is the representation of the diverse ethnic structure of Moldova (including Transnistria and Gagauzia) and Southwest Ukraine (e.g. the Budzhak), which has been almost impossible due to the lack of accessible ethnic data so far.

Knowing the difficulties of getting detailed census data in these countries, it was a great challenge to collect all the needed data.

The authors applied the diagram method (using circle diagrams) which provides precise information on the ethnic division of the basic units. The latter ones are the basic administration units in each country. As for the colours, the map follows the tradition of the earlier ethnic maps of the Atlas; the ethnic groups and nations are classified on linguistic basis (e.g. the tones of the green colour belong to the Russian and the Ukrainian). The names are written in the official language of the specific country, but in case of Transnistria and Gagauzia, the minority names are also represented.

Although the main information of the map refers to the ethnic consciousness, the administrative subdivision – borders are delineated as of 2004 – plays an important role as well. Here the authors could not avoid the problems regarding the status of Transnistria (also called 'Dniester Republic'), namely, the map represents only the official status. Transnistria is part of the Republic of Moldova and its boundary is signed on the map, but in the legend this border is explained only as "Administrative unit, upper regional level (RO: județ; UA: oblast')" without any references to Transnistria.

The accompanying text consists of four parts. In the first one Peter Jordan gives an overview on the methodologycal background of the ethnic maps. He analyzes the ethnic data of the censuses (e.g. their subjectivity, the method of their collection and the political influences on them), the possible cartographic methods applicable for ethnic maps and the connection between the person (the subjective) and the data represented on the map.

The publication focuses not only on the ethnic structure of Moldova, but it also presents general information on the country. The geographical outline of the Republic of Moldova written by Thede Kahl reports on location, nature, population and economy. This chapter gives useful supplementary information, but only the location and the population issues are in closer connection with the main topic. As the publication focuses primarily on the human peculiarities of Moldova, it is surprising that 'nature' (fauna and flora) are described in this volume as well.

The third chapter deals with the history of Moldova written by Valeria Heuberger. It gives a comprehensive historical overview (sometimes exaggerating the Romanian point of view) from Antiquity to the collapse of the Soviet Union.

The final part of the accompanying text written by Peter Jordan and Dorin Lozovanu presents the ethnic structure of Moldova and the neighbouring territories of Romania and Ukraine. It offers a short overview on the ethno-demographic history of the region by countries. The historic ethnic data presented at regional or national level are followed by a more detailed description of the present ethnic situation (by countries as well). Unfortunately, it describes only the state visible on the map so one can find only little analysis and a few attempts to reveal the connections. Nevertheless, being only an accompanying text, detailed analysis is probably not an aim of this work. This part is illustrated with 19 tables so that the readers can understand all the numbers and proportions regarding the different ethnic groups.

The attempt to draw the ethnic map of Moldova and the surrounding territories was a difficult task, but it was realised successfully. This atlas is a very useful database for everybody who is interested in the ethnic (and administrative) issues of this region.

Patrik Tátrai

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Report on the EUGEO 2011 Congress and the RGS-IBG Annual Conference

London, August 30 – September 2, 2011

The turn of August and September of 2011 offered a unique opportunity for European geographers: the conferences of EUGEO and the British Royal Geographical Society were held together in London. This meant that more than 1400 professionals gathered together to discuss their ideas and most recent researches. The conferences took place at two nearby locations: the RGS-IBG building and Imperial College.

EUGEO is the society of European geographical societies with members from 21 countries. This year's congress was the third – following the ones in Amsterdam and Bratislava. The scientific program of the Congress started on Tuesday, August 30 but the day before a study tour was organized in London. As a part of the scientific program more

Registration desk at the RGS-IBG building

than 20 sessions, 6 plenary lectures and a poster session took place on August 30 and 31. The overall number of presenters was nearly 200. This year's conference had three key topics: sustainability and environment; people, politics and place; and new world, new Europe. Within these topics the climate change and its consequences and the related risks got special attention.

The plenary lectures covered wide ranges of geographical knowledge. For example Merje Kuus from the University of British Columbia analyzed the role of symbolic capital in the everyday work of the European Union showing that there is still an East-West divide among experts and decision makers. Peter Mehlbye, on behalf of ESPON presented the new trends and problems of European territorial dynamics. He stressed that the competitiveness depends greatly on global cities and metropolitan regions but because of the importance of connectivity rural areas can integrate into the global economy as well. Boleslaw Domanski from Jagiellonian University, Poland introduced the mechanisms and patterns of local and regional development in the post-socialist European countries using an evolutionary perspective. A very stimulating roundtable discussion dealt with "open" geographic information.

Hungarian geography was represented by nearly 20 researchers with eight presentations showing the versatility of Hungarian research topics. For example Károly Kocsis (University of Miskolc and HAS Geographical Research Institute) discussed the questions related to ethnic identity and territorial autonomy in Carpatho-Pannonian region. Viktória Blanka (University of Szeged) analyzed the consequences of the extremely humid year of 2010 in Hungary. Lajos Boros (University of Szeged) showed what kinds of consequences the extreme weather conditions might have on most deprived social groups. Gábor Hegedűs (University of Szeged) introduced the socio-spatial effects of gated communities in Hungary, while Gábor Dudás and Péter Pernyész (University of Szeged) analyzed the spatial characteristics of the changing airline industry and its effects on the hierarchy of world cities. Zoltán Kovács (University of Szeged) chaired the session on "Governance and geo-economics".

The RGS-IBG Conference had 318 sessions with more than 1200 presentations in them. These impressive numbers demonstrate that the meeting is one of the most important geographical conferences in Europe. When the event started on August 31 there was a one day overlap with EUGEO Congress. The key theme of the meeting was the "Geographical imagination" which meant that a lot of presentations analyzed how we see and understand the world around us – and how we represent it. Peter Hulme from the University of Essex explored how artists, writers and geographers have imagined Cuba and its relations with the United States. Some sessions focused on changing urban and rural landscapes emphasizing the role of geographical imagination. But several sessions and lectures dealt with the forms of imagination in physical geography or cartography. Steven Wainwright (Brunel University) analyzed scientific writings to show the role of geographical imagination in relation to hydrography.

Out-migration and returning migration were also discussed extensively, focusing not on only the socio-spatial characteristics of these processes but their narratives as well. Thilo Lang and Robert Nadler (Leibnitz Institute for Regional Studies, Leipzig) presented the theoretical and methodological framework of an extensive research about returning migration into the post-socialist countries. A few presentations analyzed the narratives of refugee (re-)migration and the imaginations of migration as well.

Maybe the most anticipated lecture was Jamie Peck's one, entitled "Beyond the neoliberal zombieland" in which he presented the nature of neoliberalism claiming that despite the recent crisis its logic and functioning haven't really changed. According to Peck,

Jamie Peck during his presentation

Book exhibition at the RGS-IBG building

neoliberalism acts and looks just like zombies: it does not react to communication and is very tenacious, wants the brain (mind) of the living and its appearance is disheveled. He also analyzed the emergent, Latin American notion of "post-neoliberalism" and the possible politics related to it.

As usual, a book and journal exhibition with the presence of the most influential publishing companies enriched the two events, too. The exhibitors offered their latest textbooks and journals which also helped to get familiar with the latest research trends and results.

The two meetings were both extremely inspiring and thematically rich. The joint organization gave an exceptional opportunity for networking and gathering new impulses. The next EUGEO Congress will be held in Rome in 2013 while the RGS-IBG Annual Meeting will be in Edinburgh in early July of 2012.

Lajos Boros

Report on the 100th anniversary of the establishment of the Economic and Social Geography Section of the Hungarian Geographical Society

The Economic and Social Geography Section of the Hungarian Geographical Society (HGS) celebrated the 100th anniversary of its foundation on 12 January 2012. The oldest section of the 140-year-old Association (HGA) was founded on 11 January 1912 under the name 'economic geography section'. 27 persons participated the inaugural meeting including the élite of the Hungarian geography such as Lajos Lóczy and count Pál Teleki. Hundred years later as a result of the efforts of HGA, the section and the Department of Social and Economic Geography of ELTE University, a program of high standard was organized to celebrate the anniversary. About 80 persons from different parts of the country came together on Lágymányos Campus of ELTE.

The commemoration was opened by József Szabó, the president of HGS and was followed by Mária Szabó, the head of Institute for Earth Sciences and Geography of Eötvös Loránd University who greeted the audience. The program continued with scientific presentations consisted of two parts (according to the purpose of the organizers). First, presentations on the history and the establishment of the section were held, then the representatives of the contemporary Hungarian geography presented shortly the past, the present and the significance of the main disciplines of the Hungarian human geography.

The first part started with Patrik Tátrai's presentation on the history of the section from its foundation up to the present. After that Zoltán Dövényi delineated the details (e.g. participants, background information) of the inaugural meeting.

The second part began with Róbert Győri's presentation (read by Márton Czirfusz as the author could not participate) on the history and the main schools of the Hungarian economic geography. The following presenter was József Tóth who tried to systematize and group the various research fields of population geography mainly through presenting scientific books and publications.

The rich history of the Hungarian urban geography was overviewed by Pál Beluszky. Later István Berényi outlined the history of the Hungarian and the German social

The audience of the commemoration event

geography emphasising the common points of the two systems. Besides the "traditional" disciplines of the human geography, new trends were also presented by academician Rezső Mészáros who summarized the human geographical approaches of new technologies. The last guest was Zoltán Hajdú who reviewed some issues of the Hungarian political geography.

The task of the presenters to overview their special fields was quite difficult: all of them emphasised their difficulties in summarising the history, the great variety and the scientific results of each discipline, which resulted in different approaches of the task. All in all the audience had the opportunity to listen to exciting presentations covering most of the research fields of the Hungarian human geography.

After the scientific part of the program, Gábor Michalkó, the chairman and the secretary general of HGS gave the floor to academician Károly Kocsis, the president of the section, who closed the presentations and initiated that the name of the section should be changed to Human Geography Section. His proposal was accepted. The event was closed with a simple and modest reception where the participants celebrated the anniversary with some champagne and a "birthday cake".

Patrik Tátrai

In memoriam Prof Hanna Bremer (1928–2012)

The community of scientists associated with the International Association of Geomorphologists (IAG/AIG) has lost another of its founding figures. Hanna Bremer, one of the closed circle of IAG Honorary Senior Fellows, had been an ardent supporter of the idea of collaboration among the workers in this discipline from the very beginning, from the first International Geomorphological Conference held in Manchester in 1985.

At the time of the second conference, which took place in Frankfurt in 1989, she could look back to a highly successful academic career. It started with studies in Geography, Geology and Physics in Göttingen, where she first worked in fluvial geomorphology, the topic of her doctor's thesis also defended there. Then she moved to Heidelberg and accomplished habilitation on the geomorphology of the Australian Outback and finally settled in Cologne, where she chaired Physical Geography for two decades (from 1972 to 1993) and became an authority on tropical geomorphology. In her books on morphogenesis in the tropics she exploited the experience accumulated during long years of field work on four continents: Australia, Africa (Nigeria, Mali and Kenya), Asia (India and Sri Lanka) and South-America (Amazonia). Communication in English or French was no problem for her.

After her retirement (in 1993) she travelled less frequently, but in 1996 she felt it to be her duty to participate at the Regional Geomorphological Conference at venues of Budapest and Veszprém. Unfortunately, the acting President of the IAG, Prof Dietrich

Olaf Slaymaker, Dénes Lóczy and Hanna Bremer in Sümeg, at an excursion during the IAG Regional Geomorphological Conference in 1996

Barsch suffered a stroke just some months before the Conference started. On hearing the sad news, Hanna Bremer immediately presented herself as an obvious substitute (a German professor of equal international esteem) and enthusiastically filled the gap created by the absence of the President. She was particularly delighted when she was decorated with the Medal of Veszprém, the Town of Hungarian Queens. She and Prof Olav Slaymaker (University of British Columbia, Vancouver) also took part at the excursions accompanying the meeting – as it is attested by the photo taken in Sümeg, where we stopped to have a rest. Hanna also co-edited the proceedings volume of the conference, which was published as the rather thick "Supplement-Band 110" to the high-ranking international professional journal she founded in 1973, the *Zeitschrift für Geomorphologie.* (She filled the position of Chief Editor at the journal until 1992.) After the meeting in Veszprém she made some friendly gestures towards the Hungarian hosts: invited a Hungarian geomorphologist among the editors of her favourite journal and offered part of her rich collection of books to the library of the Geographical Research Institute of the Academy in Budapest.

In the last decades of her life she was seldom seen at big conferences, but preferred to spend most of her time at home in Wilhelmsfeld, reading or sorting her collection of slides, books and maps, regularly socializing and daytripping in female circles. For the very last years the Soroptimist Club in Weinheim, in the pleasant environs of the Bergstrasse of Hesse, became her residence. She kept contact with geomorphologist friends through circular letters sent out before Christmas.

She passed away on 20 January, 2012. Hanna Bremer will be remembered not only for her publications, the well-written textbooks and handbooks on the tropics *(Die Tropen),* weathering and soil formation in tropical environments *(Zur Morphogenese in den Feuchten Tropen, Relief und Boden)*, the origin of inselbergs and other exotic topics, but even more for her personal traits, her boundless helpfulness and enthusiasm and the warmth of her original personality.

Dénes Lóczy

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