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# Soil parent material delineation using MODIS and SRTM data

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## Abstract

A digital mapping procedure was developed and tested to support the SOTER (SOil and TERrain digital database) database development. The SOTER mapping unit delineation is based on terrain and parent material information. Terrain information can be derived from SRTM data, but parent material information is often difficult to obtain. Legacy data are scarce and they are not always easily accessible. A procedure is needed to derive parent material information with limited legacy data support. The aim of this study was to develop a robust, remote sensing (MODIS and SRTM) based procedure to delineate soil parent material (PM) classes for small scale soil mapping applications. This quantitative procedure aimed to maintain the original mapping concept and to develop an analogue database to the "manually" created, existing SOTER databases. A simplified soil parent material classification was developed and tested for remote sensing based application. Multitemporal, visible, near infrared and thermal channels were used to compile the RS dataset which was later complemented with SRTM data and terrain derivatives as well. The suggested method can produce the first level delineations of the major PM units which can be further subdivided into smaller and more specific units as more data become available. The detail produced for the unconsolidated PM part of the pilot area is quite promising it shows all the major soil and landscape units that are important for soil mapping at the targeted - 1:1M -scale of SOTER. The consolidated part has much less detail, those areas still need legacy data for more detailed PM unit delineation. That procedure can be used anywhere in the world, where PM data are limited.

**Keywords:** digital soil mapping, SOTER, small scale soil mapping, digital terrain modeling, global soil database

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## Introduction, rational and framework conditions for the soil parent material classification

*SOTER database development*

SOTER (Soil and TERrain Digital Database, ISRIC, 1993) is meant to replace the existing World Soil Map published by FAO. Its suggested scale is 1:1 M. The major limitation of the traditional SOTER products – as it has been identified so far - is the inconsistency between the national SOTER coverages. SOTER is designed to incorporate the existing data into a harmonized database. It is more like a correlation and a harmonization system than a mapping procedure. However, the spatial basis of correlation is the SOTER unit which should be consistent throughout the database, but this is not always the case. The delineations of the SOTER units vary from country to country. Therefore, the work to develop a more consistent mapping procedure – utilizing our state of the art in terrain modeling knowledge and the newly emerged SRTM data – to delineate the units started. Using SRTM as a common input data and a standardized digital elevation modeling toolset to define the terrain units guarantees the consistency between the databases of the different countries. A procedure to delineate SOTER terrain units was developed by Dobos, E. *et al.* (2005) and it was refined later by Dobos, E. *et al.* (2010a). Those physiographic units have to be further subdivided by the Parent Material (PM) information to define the final SOTER-units.

There are three potential situations which the SOTER database developers face when PM information has to be compiled:

– The first case assumes that there are existing and accessible legacy data for the whole area at an appropriate scale. It requires a harmonization effort of the input data sources as far as its thematic/attribute information is concerned, and a procedure to spatially incorporate, link the input PM polygons to the SOTER–units. That example was tested and a case study for incorporating the 1:1 M European Soil Database information into the SOTER database was demonstrated by Daroussin, J. *et al.* (2007). In that optimal case, a close to complete set of descriptive attributes can be loaded into the database.

– The second one is the limited data case when data are available for only a certain portion of the mapping area. It requires a harmonization effort, input data development efforts (digital mapping of PM info) and at the end a procedure to incorporate the info into the SOTER database. The latter one is the most typical case. The limited coverage PM info is used as training and calibration info for creating a full coverage for the whole area. That approach assumes that the areas with data represent the whole range of environmental, PM setups/variations. Hence, algorithms, rule systems can be developed to estimate the spatial distribution of the classes using environmental covariates like SRTM and MODIS data. Here, a limited set of PM information can be derived with varying accuracy depending on the environmental conditions and the quality and quantity of the training info.

– The third one is the no data situation when only general relationships and rules can be used to derive some delineations.

Parent material data are often limited or not accessible, which is already hindering the completion process of the SOTER database. PM classification – just like the soil one – varies from country to country as well. Therefore, a correlation system to harmonize the classes is needed. An international system has to have very general classes to be able to incorporate and correlate all national units. Both the thematic and the spatial correlations of the national PM data sets are difficult. Polygons coming from the national system inherit their own and often different way of delineations and interpretations of the PM classes. Importing those units introduces significant spatial inconsistency into the database. The only way to avoid that problem is to develop PM coverage in a controlled, quantitative way or at least increase the quantitative portion within the whole procedure. A quantitative procedure for PM delineations is needed to complete SOTER where no PM information is available and to increase the level of harmonization where legacy data can be incorporated into the database development.

## Methods

### *Development of a simplified parent material classification for Digital Soil Mapping application*

Information on the soil parent material is important to understand the current soil processes and properties better. One of the major limitations of the existing PM classification for soil scientist is the lack of expertise in geology. The majority of soil scientists have not got enough field knowledge to differentiate and classify certain rock types even if they occur in a pure stand. Classification of the rocks and parent materials is the responsibility of the geologists. There is a great diversity of PM definitions and interpretations in the national and international systems. Even the definition varies a lot.

There are general approaches like that of FAO, where the parent material is defined as the material from which the soil is presumably derived (FAO, 2006). Lawley (2009) defines the term as the geological deposits which immediately underlie the layers commonly known as 'topsoil' and 'subsoil' (Lawley, R. 2009). The most important source for a soil scientist is weathered, unconsolidated materials from which the soils are actually formed. That approach is shared by the Soil Science Society of America which defines the parent material as the unconsolidated and more or less chemically weathered mineral or organic matter from which a soil's solum is developed by pedogenic processes (SSSA, 2001; SSS & NRCS, 2007; Brady, N.C. and Weil, R.R. 1999). The US system and definition clearly defines that parent material is only an unconsolidated material in which soil horizons form and it is the only material which can be described in appropriate details by soil scientists.

Definitions are important, but the practice followed by the soil database developers is even more important. Many national systems provide information on the underlying consolidated rock rather than on the actual parent material, which are not necessarily the same. The most common example is a consolidated rock having a 2 meter thick loess cover on top. Soil is forming on the loess, but the identified PM is the consolidated rock type. That approach is misleading and it is also difficult to apply in the field. But most importantly, it does not provide appropriate information for the data users. Geological data are collected and kept by geologist. Soil science needs the description of the unconsolidated material from a soil formation point of view. A new, simplified system is suggested here to characterize the parent material, which can be applied for digital mapping procedures like digital terrain modeling and remote sensing.

The selected properties are important for the soil formation processes and can be easily described in the field with high level of reliability. The suggested system is shown in *Figures 1* and *2*. The first level of classification starts with the differentiation between the consolidated and unconsolidated parent materials.

### *Consolidated areas*

Consolidated material is defined here as solid rock with its shallow weathering residuum with the typical mountain soil associations like bare rock/Leptosol/Cambisol. By genetics, it can be further classified as eluvial, colluvial or bare rock areas. Eluvial material is defined as in situ weathered material, weathering residuum, while colluvium is a loose deposit moving on slopes due to gravitational forces (in some cases water may play a role in the initiation of the movement). Expanding the content with the weathering residuum is basically an unavoidable compromise, because the existing soil maps with parent material information describe only the underlying rocks and they give no information on the properties of weathered materials. Information in the available legacy datasets exist only about the underlying rock. There is no reliable digital mapping procedure to derive geology/lithology information in the detail required by the existing PM classification of the SOTER methodology (ISRIC, 1993), so it is not possible to derive them using remote sensing. They often occur as mountains in the target area with relatively dense vegetation (no way for RS applications) with higher relief and elevation and a very high and large-scale diversity.

The consolidated areas are further subdivided into bare and none-bare rock. The non-bare rock areas usually have two subunits, eluvial and colluvial. However, the spatial mixing of those two is often too complex to differentiate between them at the target scale of 1 : 1 M (the only option is to give proportions within the geometric units). This is the detail in case of which quantitative procedure has to stop (Level of Genetics, *Figure 1*).

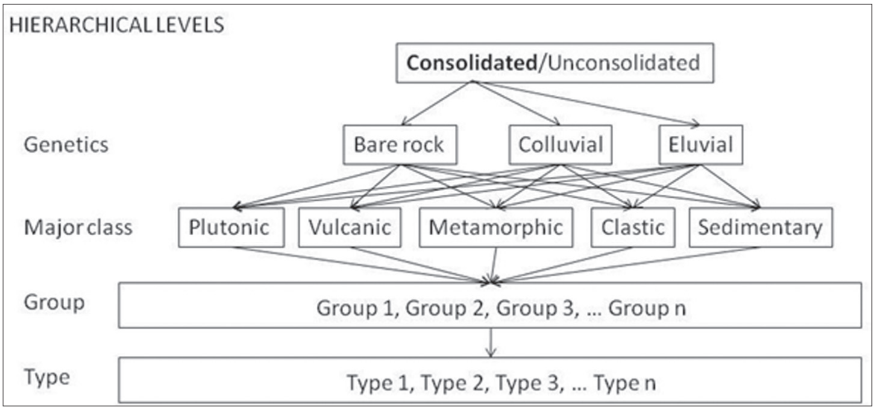


*Fig. 1.* Classification scheme for the Consolidated PM classes

*Unconsolidated areas*

An unconsolidated material is a loose inorganic/organic material which is – by nature – accumulated/deposited in a deeper stratum by wind, water or ice (aeolian, fluvial, estuarine, lacustrine, marine, glacial) or by mass movements (like the colluvial materials). The texture subclass of the unconsolidated areas can be delineated relatively easily with quantitative procedures using RS and DEM data with certain level of accuracy, but further separation of the lithology units is feasible only for areas having legacy data (*Figure 2*) when the classification can go further and the level of information defined by the revised lithology, classification can be filled into the database.

Based on the rationales described above, a new, revised classification system was developed (*Figures 1.* and *2.*). That system is designed to integrate the remote sensing techniques developed within the e-SOTER project where the consolidated/unconsolidated texture of unconsolidated materials, bare rock, alluvial, aeolian, marine and lacustrine material images were developed using RS and digital elevation modeling techniques. These layers can be used

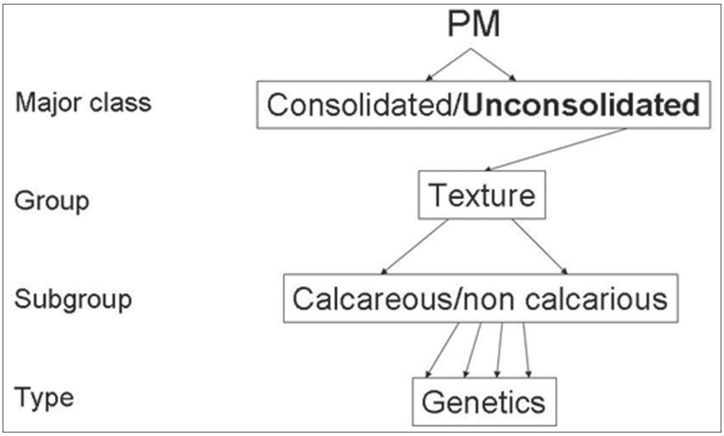


*Fig. 2.* Classification scheme for the Unconsolidated PM classes

as standalone information layers or they can be combined in any combinations depending on the data availability to refine the parent material information. That approach creates images with equivalent priorities, no hierarchy is kept in the system any more. The more input data and input layers, the better reliability and parent material map detail. At the end, the suggested system can provide the spatial detail needed for the SOTER database development.

The attribution of the units with legacy data happens with respect to the data availability. One of the major advantages of the system is the lack of hierarchy in the development process. In a hierarchical system, a classification tree is used to classify the phenomenon. The naming stops at the first level where data are missing. All pieces of information below which level are lost for the classification. Making the levels independent from each other helps to maintain each available information in the system and it fits a GIS database approach better. The system was tested using national databases and severe limitations were identified due to the hierarchy of the system.

## Determination of soil parent material within the landform units based on low-resolution satellite imagery (MODIS) and DEM (SRTM) in combination with legacy soil parent material data

### *The study area*

The pilot area is located in Central Europe and it covers the area of Austria, Hungary, Slovakia, Czech Republic, Southern Poland and a small part of Germany and Romania. The pilot window was chosen to cover the Central European pilot area of the e-SOTER project *(Figure 3).* The final area is much larger than the pilot area, it follows the tile borders of the SRTM (Farr, T.G. and Kolbrick, M. 2000) and MODIS images which include the whole e-SOTER pilot. Training data were available only for the pilot window and the territory of Hungary.

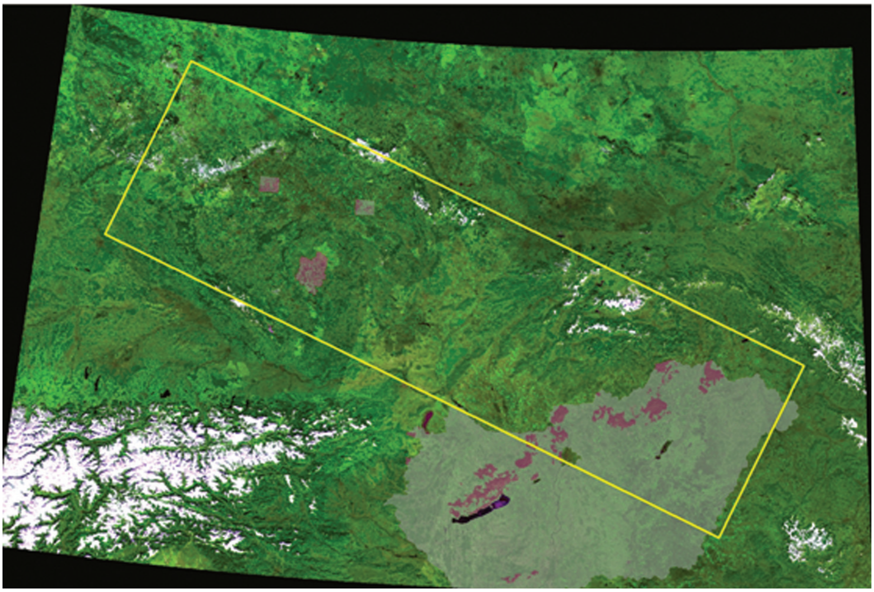

*Fig. 3.* The Central European window (yellow box) and the training areas for the consolidated PM image

The terrain and the soils of the area are quite variable. It includes some parts of the Alps, the Carpathian mountain range, the Czech–Moravian Mountains, the Pannonian Basin and the southern, hilly and flat region of Poland. The parent materials vary as well, all kinds of consolidated siliceous and carbonaceous rocks occur in the area together with Holocene alluvial and aeolian sediments and Pleistocene glacial and periglacial materials. The soils in the lowland are mainly Chernozems, Vertisols, Arenosols, Gleysols and Calcisols, while in the hilly and mountainous areas Luvisols, Cambisols, Stagnosols, Regosols and Leptosols are the dominant ones (FAO, IUSS Working Group WRB, 2007). Erdas Imagine 9.3 and ArcGIS 9.3.1 software were used for processing and classifying the data layers.

*Covariates used to derive the thematic layers*

In order to strengthen the performance of the classification, multi-temporal images of none-altered MODIS bands were compiled into an image of 55 layers representing the visible, NIR, MIR and thermal bands to capture the temporal environmental conditions and changes revealing to surface conditions. However, the 55 layers have a significant portion of overlapping information, redundant info in the images, hence a PCA was used to decrease the number of input images and decorrelate the information of the bands. The best 15 PCA components were maintained and incorporated into the final image.

MODIS-multi-temporal 8-day composites were used, 5 dates are evenly distributed over the vegetation period:

– MOD09A1: Band 1–7 (Layers 1–7), 500 m resolution,

– MOD11A2: Band 31–32 (Layers 9–10), LST (Land Surface Temperature) Day (Layer 1) and LST Night (Layer 5), 500 m resolution.

Surface temperature information like the thermal bands of the MODIS (Bands 31, 32) and the LST (Land Surface Temperature) products (night and day) having been derived from them were used as well. The daily temperate fluctuation is a function of the thermal capacity of the surface materials, actually a function of the parent material, texture, color and water content, basically the factors we are interested in. Therefore, a new normalized band combination was developed. The daily temperature differences were calculated with simply subtracting the LST night from the LST day and the values were multiplied with the ratio of the LST_(max for the whole area)/LST_(day) to reduce the effect of the climatic variation due to the differences in potential energy intake from the sun.

There were many attempts recorded in the literature to use band ratios to identify certain lithology classes or to highlight/enhance lithology differences in Landsat images (Knepper Jr., D.H. and Simpson, S.L. 1992; Vincent, R.K. 1997). Three band ratios, 6/1, 1/3, 7/6 were selected to represent lithological variations better. The band ratios were adopted to MODIS and they were derived for each of the 5 dates, resulting 15 new images added to the final image.

SRTM (Farr, T.G. and Kolbrick, M. 2000) data were used in combination with the MODIS derived layers as well. The basic parameters are the followings:

– Elevation (sinks are filled up to certain level),

– Slope percent,

– Relief Intensity,

– Potential Drainage Density (Dobos, E. *et al.* 2010a),

– Groundwater level (developed via the interpolation of the drainage network height and it is subtracted from the original elevation values),

– Topographic Wetness Index,

– Upland/Lowland,

– Convexity (not added to the basic image, used only for the colluvial image derivation).

The listed derivates have either been used in the SOTER methodology or they are believed to add significant information to make difference between the classified parameters. The SRTM images were spatially degraded to the level of MODIS resolution and an image of 43 layers containing 15 PCA layers, 8 SRTM derivatives, 5 normalized LST difference images and 15 band ratios.

Besides of the 43 layers described above, three further layers were added to the image to represent the climatic variability: the images of Easting and Northing to represent the geographic location. The distance from the sea was calculated as well. With the three further layers, an image of 46 layers was developed and used for the classification.

### *The PM classification procedure*

The procedure is developed for situations with a limited set of PM variables available when only basic properties can be estimated with a relatively high level of reliability/accuracy. Those properties are the consolidated status, the texture classes and the genetic classes of fluvial, marine/estuarine, aeolian, colluvial, eluvial and bare rocks. Large-scale studies can be done for further refinement and more attributes, but they are site specific. No generally adaptable procedure exists.

PM is considered as unconsolidated material characterized by its texture, carbonate status and genetic classes (*Figure 2*). The three (four with the consolidated/unconsolidated) parameters require to develop four separate layers. The first layer is the consolidated/unconsolidated one, also being the first step in the procedure. It stratifies the area into two classes. The two main areas require different approaches and different classification steps.

### *Pre-stratification of the area to consolidated/unconsolidated classes*

The first step in the process is the classification of the window into two classes (consolidated and unconsolidated). Maximum likelihood supervised classification algorithm using the combined, base image of 46 layers was applied to derive the image (Dobos, E. *et al.* 2010b). Several direct approaches were evaluated, but no one had an appropriate overall performance. There are only stochastic relationships between certain terrain parameters and the consolidatedness of the PM and the same is true for the RS images, especially in the temperate and tropical zones where the vegetation masks out the PM signal of the images. The stochastic relationships can be utilized in a supervised classification framework well.

Training data were limited to the window, as only 10 percent of the whole area was covered with legacy data. We used three small training areas for the Czech Republic and the Hungarian part of the window (*Figure 3*). The data sources had to be interpreted in the training areas for the classes defined.

Parent materials for the areas having consolidated rocks with shallow unconsolidated material /soil on the top are considered as consolidated and they are named according to the underlying materials such as granite, basalt, etc., regardless of the source of the materials, whether they are in situ materials or mixed ones with other aeolian or colluvial sediments. It is a traditional approach taken from the existing legacy databases. Anything having a bare rock, Leptosol/Cambisol soil association in a mountainous area is considered as a solid rock even if it does not appear directly on the surface. The training classes were merged that way, meaning that the in situ, weathered, relatively shallow eluvial or colluvial materials belong to the consolidated rock system and they are not considered to be independent unconsolidated strata.

### *Classification of the consolidated material areas*

The classified consolidated areas are divided into three further major classes: Bare rock, Colluvial and Eluvial. The units can be further described with legacy data, but that one is the final stage for areas where legacy data are not available.

#### Bare rock

The classification of the bare rock was done using an NDVI (Normalized Difference Vegetation Index) (Kriegler, F.J. *et al.* 1969; Tucker, C.J. 1979) image generated from the peak season (early summer) of the vegetative period when strong vegetation cover is expected. Only areas having no soil and thus vegetative cover are expected to have very low NDVI value. A threshold of 0,8 was set to select the low NDVI areas as part of the bare rock class. That value was set by comparing the images with Landsat and other high-resolution images where the existence of the bare rock surface was evident. The threshold value is date and climatic zone dependent.

#### Colluvial areas

The colluvial areas were delineated applying the assumption that the colluvial materials accumulate in the lower sections of the slopes often converting the shape of the slopes into concave. The assumptions were translated to the following SRTM based decision rules:

- Curvature < 0.00
- Slope percent > 2.00

*Classification of the unconsolidated materials*

Based on the revised lithology classification, there are three property groups within the unconsolidated material:

- Texture:
  gravel, sand, loam, clay, diamicton (organic material);
- Carbonate status:
  calcareous and non-calcareous;
- Genetic:
  fluvial, aeolian, lacustrine, marine, estuarine, glacial till, glaciofluvial.

Out of those properties, the texture and the selected subgroups of the genetic classes were targeted to define as a minimum set of PM descriptions, namely the fluvial/lacustrine, aeolian and marine genetic classes.

*Developing the texture class layer*

The texture classification was done the same way as the consolidated/unconsolidated layer using the 43 layer combined image and a texture class training data set as inputs for the Maximum likelihood supervised classification. That step of the procedure requires a thorough knowledge of the area (for validation purposes) and the application options of the classification tools to achieve the best optimal results. No automatic approach can be developed, an expert user is needed.

*Training data*

Training data are the most critical part of the procedure. In an optimal case relatively high resolution training data are available with well-defined, none-overlapping classes. 1 : 100 K to 1 : 250 K data sources are commonly available in the developed World.

The data sources contain aggregated but still concrete classes (not associations). These data sources can be used as direct inputs for the supervised classification.

*Development of the genetic layers*

The SOTER procedure identifies several genetic PM classes, namely the fluvial, alluvial, lacustrine, glaciofluvial, marine and estuarine, aeolian, older terraces and glacial till plain. Those materials often have major differences in their origin and composition, but some of them look very similar from a geomorphological point of view. Taken the case of limited knowledge and information about the origin of the material, the only available information to characterize the PM is geomorphology derived from digital elevation models, like SRTM. Having only the geomorphology as separating tool, several classes with similar morphology but different origin had to be merged.

Terrain modeling alone is not enough to explain the origin of the PM, but it is often enough to delineate the spatial units by highlighting the changes in the surface morphology. The allocation of descriptive variables to the spatial delineations – name of the genetic classes – can be done using expert knowledge for the certain area.

The following combined classes and genetic layers were developed:

– Fluvial/alluvial/lacustrine/glaciofluvial:

– Plain, low slope and low relief intensity areas close to the groundwater level;

– Marine and Estuarine (does not exist in the pilot window, not used in this study):

– Follows the seashore line and it is characterized by 0–5 m elevation along the seashore;- Aeolian/older terraces/glacial till plain:

– Higher relief, higher above the groundwater level, not influenced by the recent fluvial activities.

*Fluvial/alluvial/lacustrine/glaciofluvial class*

This combined class has a plain, smooth surface, low relief intensity and small depth to the ground water/surface water level. Those assumptions were translated to terrain modeling language. The final solution for the delineation has only one criterion, namely the depth to the surface/groundwater level system. Ground/surface water level grid was simply extracted from the SRTM DEM and the difference is the depth to the ground water (DGW). The layer of groundwater level was developed using a simple modeling exercise.

First, a surface drainage/channel network was created by selecting the pixels as drainage pixels which have more than 50 pixel contributing area. The pixels were selected and the corresponding elevation pixel values were copied from the SRTM to those pixels. The pixels were interpolated to create a continuous surface. That image was extracted from the actual elevation to create the DGW image. That difference image was thresholded using a value of 3 to create the final image. Areas having values lower than the threshold were classified as low lying areas being endangered by potential annual floods by both the rivers and lakes, basically all kind of surface waters, therefore they are smooth and plain. That is why the fluvial and lacustrine sediments are combined in this classification. The glaciofluvial areas have similar appearance to the fluvial ones, only the source of the deposited material is different.

*Aeolian/Older terraces/Glacial till moraines areas*

Aeolian areas are the ones which are free from flooding impact and also from significant ground water impact. Therefore, the unconsolidated, non-fluvial areas – which are often dry and therefore the object of wind erosion and deposition – are the potential Aeolian ones reworked by the wind or covered by wind-blown sediments. Those areas have slightly higher relief intensity due to the longer acting dissecting processes or to the dune nature of the wind carved/built surfaces.

The most problematic genetic class is the Glacial till. Tills can be till plains which are relatively plain (low relief intensity), but lying higher than the fluvial areas.

They can be identified with selecting areas with higher than 3 m elevation above the water level and have a plain/low relief intensity surface. Glacial till moraines have much higher relief, sometimes similar to the Aeolian areas and they lie above the fluvial areas as well. That is why the Glacial till class was merged with the Aeolian. However, no area with significant amount of glacial tills occurs in the pilot window.

*Finalizing the PM coverage*

Input data:

- from satellite image classification
- consolidated-unconsolidated image,
- texture (consolidated, gravel, sand, loam, clay, peat, sapropel, diamicton, water);
- from SRTM DEM derivation
- alluvial/Aeolian,
- bare rock,
- marine/estuarine.

At the final stage of the PM development procedure the previously developed layers were integrated into a combined PM image.

## Results and discussion

A novel approach of parent material delineation was developed and tested to support the SOTER completion process. SOTER is a polygon based database where the polygons are defined based on physiography/major landforms which are further subdivided by parent materials. One of the major limitations of the SOTER database development is the great variability of the input datasets having different systems of soil classification, mapping and delineations. The classes of different soil classification systems can likely to be correlated to reach a common platform, but the spatial units, namely, the polygons – are very difficult to change. Redrawing the units means a totally new polygon system, a new mapping campaign. That is why the existing international SOTER datasets have severe edge matching problems highlighting the thematic and spatial inconsistency of the datasets. It is an inherent property of the SOTER procedure, there is no way to avoid the use of the traditional SOTER mapping approach. That problem was identified and the need for a coherent developmental approach was expressed by the soil science community (Worstell, B. 2000).

Dobos, E. and Montanarella, L. (2004), Dobos, E. *et al.* (2005, 2010a,b) have developed a quantitative procedure to develop the terrain units of the SOTER database using GTOPO30 and later the SRTM database. That procedure was a feasible solution to solve the inconsistency problem, but the problem of lacking a coherent and consistent PM data layer to further subdivide the terrain units was still unsolved.

This study aimed to develop a quantitative method to develop the PM layer needed for the SOTER unit development using remote sensing and digital modeling tools. That system was designed to provide homogeneous spatial units of PM for areas lacking appropriate PM information. It does not require detailed, classified input data and the approach does not even aims to develop the classes. What it does is basically a stratification of the land surface based on very basic properties of the parent material and the surface landform types correlated strongly with the PM. The system is able to delineate the homogeneous PM units at a general level, but it cannot describe them at the level needed for the SOTER PM classification. It defines the PM polygons but it cannot fill up its record completely in the PM attribute table.

Besides of the remote sensing and digital terrain modeling approach, the major novelty of the system is its disaggregated nature. There is no hierarchy in the system, only property layers are created and combined to reach the appropriate level of delineation. The first layer is the consolidated/unconsolidated image (*Figure 4*).

The image was developed using a maximum likelihood classification of MODIS and SRTM data. Consolidated PM in the target area is mainly represented by the mountain. The mountains were lifted up and all uncon-

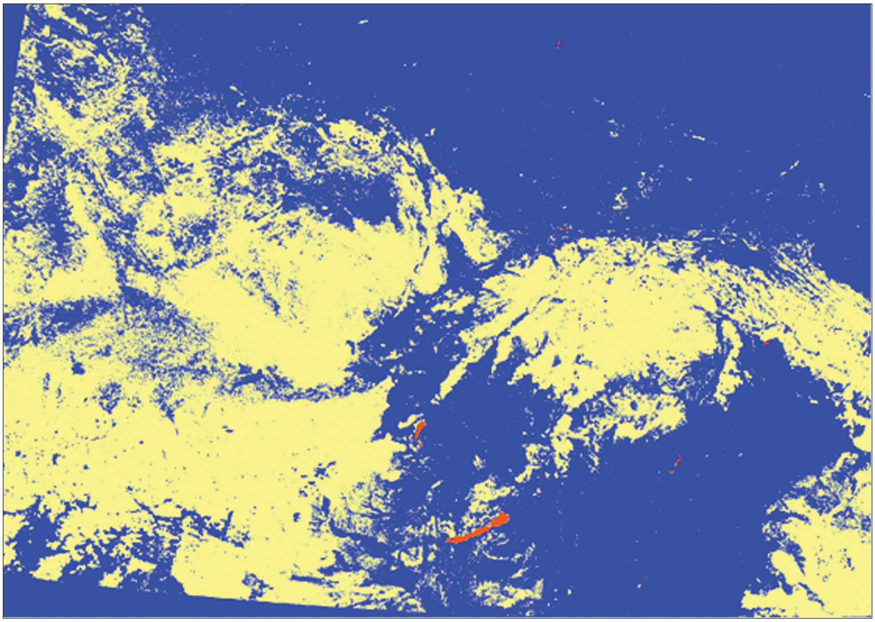

*Fig. 4.* The consolidated/unconsolidated image. Blue is the unconsolidated, while the yellow is the consolidated PM class. Orange color is surface water

solidated material were eroded away and resulted in the outcropping of the consolidated materials. The mountains are characterized by higher elevations, higher slope, higher relief intensity and they have mainly forest cover on them. Unconsolidated materials were accumulated in the basins and they filled them up to the current elevation. Accumulation happened mainly through fluvial and partly by aeolian processes resulted in a more or less flat surface for the alluvial areas or a little bit higher relief for the aeolian (reworked sand) sediments. The lower laying areas are under mainly agricultural use.

The two areas are so different from each other, both in the relief and in the land use that the combined image of MODIS and SRTM did a good job on the classification. The consolidated PM area is slightly over-classified, probably due to the forest cover. Areas having a dominant forest cover and higher relief were classified as consolidated materials. It leads to the over-representation of the consolidated class in the Southwestern part of Hungary. West from Lake Balaton and also in the hilly regions between the mountain ranges Pannonian sea sediments were accumulated and uplifted. However, in general, the consolidated-unconsolidated PM areas were classified with a relatively high performance and they can serve as a good basis for the further stratification steps.

### *Classification of the consolidated PM class*

There were two more additional steps in the procedure for the consolidated areas. The first step was to classify the bare rock areas with no soil cover and vegetation on it while the second step was to separate the colluvial and eluvial areas. Classifying the bare rock areas is important, because those areas are excluded from the further soil classification process. Due to the 500 m resolution, only larger, contagious areas of bare rock were identified, whereas smaller spots were not recognized in the process. Significantly large areas occurred only in the High and Low Tatras and in the Alps.

After the exclusion of the bare rock regions, the remaining area were classified into two classes, namely the eluvial areas developed by in situ weathering and the colluvial one where unconsolidated sediments were deposited at the lower part of the hill slopes. Based on our expert knowledge, the slopes were divided into two parts.

The upper one has convex or linear slopes and it is characterized by erosion or in situ weathering. The lower section of the slope is the depositional surface where the colluvic materials are the dominant ones and which has a concave shape. Having only those two classes, one class defines directly the other one as well – pixels not classified as colluvial would be automatically classified as eluvial.

The classification was done using the curvature command of ArcGIS and the pixels forming a concave surface were identified as colluvial area, while the rest of the pixels were assigned to the eluvial class *(Figure 5*). The SRTM image based classification has a relatively high resolution (90 m) with many slope scale patterns. The combination or aggregation of the 90 m pixels into the 500 m resolution of the overall system was totally meaningless. Resampling the pixels to 500 m resolution resulted in a mixed and often balanced composition between the two classes, simply averaging out the two properties for the whole area. Therefore, the colluvial-eluvial classification was concluded not to be relevant at that scale where only the major landforms are taken into consideration and no slope scale patterns are considered.

Significant and relevant information to further subdivide the consolidated PM area – other than the bare rock regions – could not be derived from RS and SRTM images when legacy data were not available.

### *Classification of the unconsolidated PM class*

The unconsolidated areas identified by the consolidated/unconsolidated image were further subdivided by the texture image in two steps. *Figure 6* shows the estimated texture classes of the pilot area.

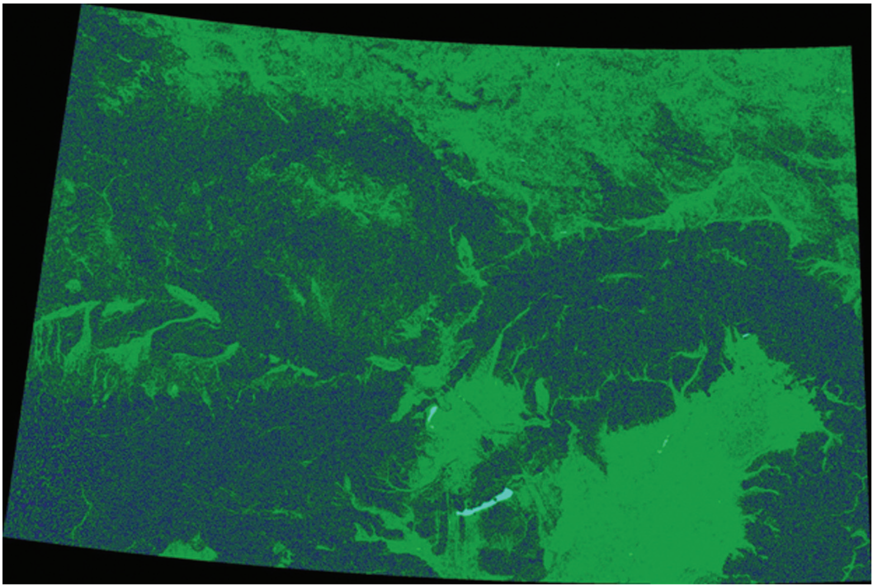

*Fig. 5.* Colluvial areas colored dark blue (curvature<0, slope%>2)

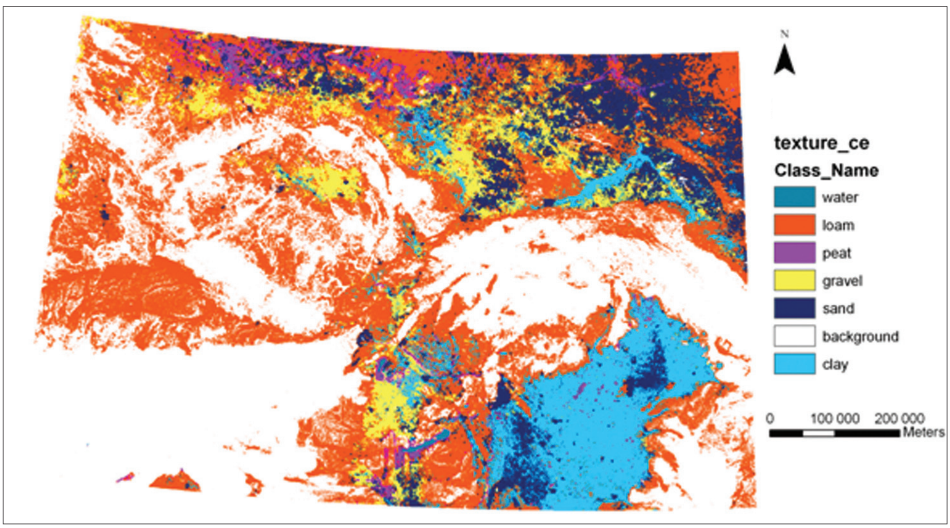


*Fig. 6.* The classified texture classes (background class means the consolidated areas where texture classes were not estimated)

The Hungarian part of the image was interpreted by a group of experts. That image corresponds well with the known picture of the soil class distribution of the area. The only problematic area was the Great Hungarian Plain where almost all of the clay-loam areas existing there disappeared from the image and were dissolved in the clay class. The silt-loam areas like the Transdanubian area with huge contiguous loess cover were classified correctly. There are two potential reasons for the regional misclassification. The first one is probably the limited capability of the covariates to distinguish between the clay-loam and clay classes. The two classes look very similar spectrally to each other and they occur on a very similar landscape.

The difference between the two classes is only 10 percent of clay increase, 30 to 40 percent clay required for the clay-loam class and over 40 percent clay is needed for the clay class. The majority of the low lying areas of the Hungarian plain are clay-loam. There are only smaller regions, like Taktaköz or a part of the Bodrogköz area where the clay content is high enough for the clay texture class.

The second reason for the low separability between the loam and clay classes is probably caused by the preprocessing steps of the training dataset. The training sites were point observations with known texture class or having only diagnostic horizons corresponding to certain texture classes, like Arenosols to sand or Vertisols to clay. There were 951 points in the whole pilot area where a decision on the existence or non-existence of the Vertisols could be made and 140 out of them were classified as Vertisols, all of them located on the Great Hungarian Plain. By definition, Vertisols need to have at least 30 percent clay. There is no Vertisol soil type in the Hungarian classification system, so the classification or the allocation of the profile of the Vertisol reference soil group of the WRB was done based on only the texture using a simplified rule. Soils having more than 30 percent clay and a thickness of 25 cm or more were classified automatically to the Vertisol reference group and all of them were used as training samples for the clay classes. However, it was a mistake, because the majority of them had less than 40 percent clay, not meeting the clay texture class requirement, but matching with the one for the Vertisols. Using th 140 sites as clay areas widened and distorted the clay class histogram, which later caused a significant over-classification of the class.

The texture of the unconsolidated sediments on the plains has a strong correlation with the origin of the parent material in Central Europe. The classes make a real and significant difference between the soil forming processes of the plain areas and they separate the different soil associations. Therefore, the texture was used to refine the stratification of the plain areas and divide them into two subclasses of fine and coarse textured parent materials. The soils developing on the sand and gravelly-sand (called gravel in the image of *Figure 6*) areas are totally different from the ones forming on loamy or clayey materials. Further differentiation within the fine texture class to loam and clay classes would have been advantageous, but the input texture image did not make a good separation between the classes. Areas having clay-loam texture – very common in the alluvial area of the Pannonian plain – were classified as clay. Therefore clayey soils are artificially overrepresented in the image of the target area. Luckily, the separation between the fine and coarse textured areas is much more reliable and it makes a good input for further classification.

### *Genetic classes, the delineation of the Fluvial/Alluvial areas*

As the last step in the procedure, the basic geomorphological characteristics were used to classify the origin of the surface material. Two SRTM derivatives were used for that purpose, the relief intensity and the depth to groundwater (DGW). The relief intensity is the elevation range within a unit size area. Low relief means level surface, alluvial areas, while higher relief intensity alludes to Aeolian sedimentation or older, uplifted and more dissected areas.

The second terrain property, the depth to groundwater referred to the elevation of the area over the current surface drainage network. Small DGW values highlighted that the low lying areas, namely the recent alluvial areas had a higher chance of annual flooding. As it was concluded, the latter one – the DGW – alone was able to separate the alluvial areas, further differentiation using the relief intensity did not added significantly more spatial details. Therefore, the relief intensity factor was not even integrated into the final procedure. *Figure 7* shows the image of the alluvial areas.

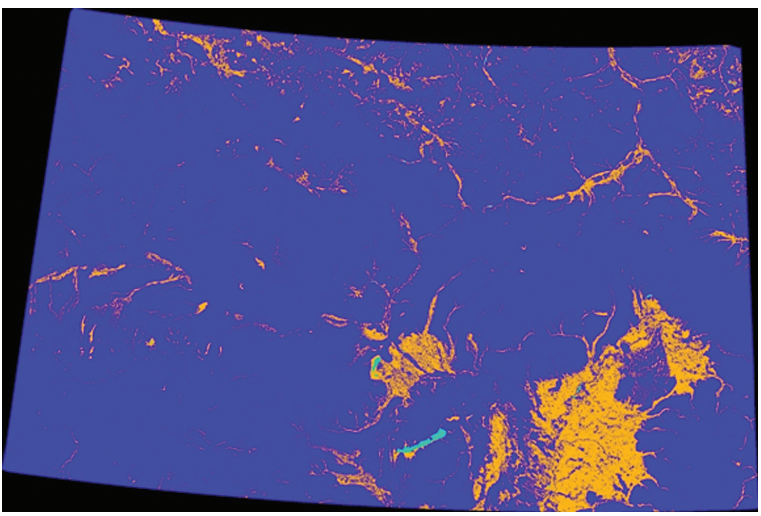

*Fig. 7.* Fluvial/Alluvial sediments (yellow) of the pilot area

All the current and recent floodplains are classified correctly. Unconsolidated areas not classified as alluvial refer to older terraces or Aeolian sediments. At the end the two major genetic-class groups of the unconsolidated areas, namely the Fluvial/alluvial/lacustrine/glaciofluvial and the Aeolian/Older_terrace/Glacial_till/Moraines areas could be separated by using the simple terrain derivative.

*Developing the final parent material image*

The final, combined image of the parent material is shown on *Figure 8*. It shows tremendous amount of spatial details representing information on consolidated- unconsolidated materials, bare rock areas, colluvial areas, texture classes and genetic classes of the unconsolidated areas. They are very basic properties of the surface material, relatively easy to map using digital mapping tools. Each of the layers represents important properties for the soil formation, but the real added value of the procedure is the combination of them into one combined image. The classes of the parent material image represent uniform areas where the geologic processes resulting in the current parent material for the soil formation were uniform as well. The procedure recognizes the differences and it defines

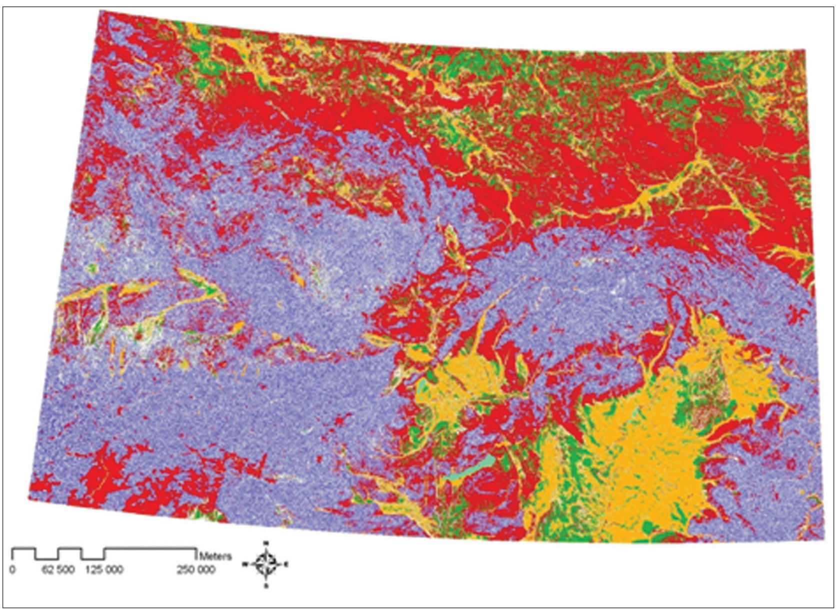


*Fig. 8.* The combined parent material image. No legend was allocated to the units, only the spatial patterns are used

the spatial units helping the delineation, but it does not explain the geologic origin in detail, only small segments of the whole information are given.

The traditional procedure needed to have PM input layer for the SOTER-unit delineation (ISRIC, 1993). The layers are always country specific and they follow the local traditions and local PM and soil classification systems. Therefore, all of the national layers are different with given, differently defined and not necessarily correlatable spatial units. The procedure follows the original SOTER idea of having broad melting pot classes which are capable of integrating the different national inputs. The procedure takes only the attributes of the input data by allocating, correlating, reclassifying them to the common property classes without importing their spatial definition, delineation. The geometry is defined by the remote sensing and terrain modeling based approach presented here. The resulting image has a consistent spatial delineation throughout the entire area.

The final image used only a simplified texture classification having only coarse and fine texture classes. The lowest class separability happened between the gravelly sand and sand and between the clay-loam and clay classes – as it was described earlier. Merging the overlapping and problematic classes together solved the majority of the misclassification problems while still kept the important information for soil formation. Separating the coarse textured areas – with huge amount of none or slowly weathering minerals and low buffer and CEC capacity – from the fine textured areas – with very different weathering processes and colloid characteristics – is important for any further soil characterization.

However, by merging the related classes, some important features are lost as well, especially in the fine texture class where the clay-loam areas – mainly the lower lying alluvial areas – and the silt-loam ones – representing the loess plateaus – are really different from each other. The first class is mainly covered by Fluvisols, Gleysols and salt effected soils, while the second one is Chernozem and Phaeozem dominated one. The differences are not always evident in *Figure 6*, but they are highlighted in the final image (*Figure 8*). The loess plateaus – like Hajdúság – and the sandy regions have higher elevation over the surface drainage network and therefore their areas are excluded from the alluvial-fluvial genetic class (*Figure 7).* After the combination of all of the input layers, the "missing classes" were reintroduced. The fine textured areas not classified as alluvial felt to the other class of Aeolian and appear in the final image solving the problem of texture image.

Please note that the image has no legend. The primary goal is to assist the SOTER unit delineation by providing the spatial delineations of the PM units. Of course, there are existing attributes allocated to each pixel, but their thematic accuracy – as it was described in the case of the texture class map – may have high uncertainty. The procedure separates the spatial units with relatively high certainty and the attribution of those units with descriptive data should be case dependent. Areas with high number of reliable training data can be described with the same input data layers, while in case of limited number or quality training data, only the spatial units should be used for further processing.

## Conclusions

One of the major restricting factors for the SOTER database development is the lack of harmonized parent material information that could be used for the SOTER unit delineation. SOTER units are based on terrain and parent material information. Terrain information can be extracted from DEM using quantitative procedure. The terrain units have to be further subdivided by PM information which is often difficult to obtain. A procedure to produce that layer is crucially needed. The aim of this study was to develop a simplified procedure for PM unit delineation using easy to access RS and SRTM data and a limited set of PM information.

The original SOTER requires quite a complex and detailed information on lithology which is often difficult to acquire. Therefore, a simplified – property based and hierarchy free classification system focusing only on the most basic PM information – was developed to characterize the PM. There is only one hierarchical segment, the consolidated/unconsolidated material layer which is used as a first level stratification layer. After that, the consolidated and unconsolidated areas were treated differently throughout the process and were rejoined only at the end of the process. The segmentation of the consolidated PM area is difficult, only the bare rock areas can be identified with high reliability. No further division could be made without reliable legacy data. The most important factor, the lithology, is hidden under the forest cover and cannot be identified using neither RS nor digital terrain modeling tools. The unconsolidated material was further stratified by texture classes and by alluvial-aeolian processes. The two layers were combined to achieve the final PM units.

The resulting database is just a first approximation of the major PM units. However, the detail produced for the unconsolidated PM part of the pilot area is quite promising, it shows all the major soil and landscape units being important for soil mapping at the targeted – 1 : 1 M – scale of SOTER. The consolidated part has much less details, those areas still need legacy data for more detailed PM unit delineation.

The procedure can be used anywhere in the world where PM data are limited. It creates the first level delineationwhich can be further subdivided into smaller and more specific units as more data become available. Due to its quantitative approach of spatial unit definition, the resulting dataset is consistent and free of any artifacts and edge matching problems.

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# Groundwater flooding hazard in river valleys of hill regions: example of the Kapos River, Southwest-Hungary

Dénes LÓCZY[1] and József DEZSŐ[1]

## Abstract

In the riverine floodplains of hill regions built of sand and loess, interactions between river channels and groundwater reservoirs result from the high permeability of the riverbed and the spatial heterogeneity of floodplain deposits and soils. Although in dry periods, groundwater sustains the river in the form of baseflow, and the relationship is the opposite during wet spells, the predictability of inundations from rising groundwater levels is rather low. Also the spatial and temporal development of inundation in narrow floodplains of hill regions (like the Kapos River floodplain) takes a course in several respects different from that in broad lowlands. In the study areas of the Kapos floodplain topographic, remote sensing and soil distribution surveys are jointly applied to assess the true extent of frequent inundation hazard.

**Keywords**: floodplain, groundwater monitoring, Histosols, "perirheic zone", waterlogging, hill region

## Introduction

The evaluation of flood hazard calls for answering a range of questions:

- where are inundations expected (i.e. the potential floodplain has to be delimited);
- how often do inundations happen;
- what duration do they have and
- in which part of the year are they expected with the highest probability?

In addition to geomorphological factors, *local flood inundation* also depends on the ecological conditions in the floodplain: the density of vegetation, tillage and other cultivation methods applied in land utilization and soil moisture state prior to the flood (Lastra, J. *et al.* 2007). Waterlogging precludes

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certain types of land use, while ephemeral wetlands are maintained by regular temporal waterlogging. Elements of infrastructure (road and railway embankments, flood-control dykes, irrigation and drainage canals) modify the passage of floods. Large-scale farming has also substantially transformed the natural pattern of inundation. The frequency and *duration of inundation* depends on flood discharge and slope of the river as well on the climate of the catchment. The floodplains of major rivers can be inundated for months, significantly reducing their agroecological value.

Since the abiotic environments of floodplains are generated at critical discharges above geomorphological thresholds, the *spatial patterns* of floodplains are also governed by the spatial and temporal pattern of floods. In order to properly appreciate the impacts of *flood*s, first of all, their *recurrence intervals* has to be compared to the duration of natural floodplain succession. If both intervals are of similar length, it is probable that a more 'mature' vegetation type, a floodplain forest of limited spatial diversity, is formed (Whited, D.C. *et al*. 2007). If floods recur within shorter intervals, such as along rivers of braided channel, their disturbance character is more pronounced, and an earlier stage of succession with a more complex pattern becomes prevalent in the floodplain (Arscott, D.B. *et al*. 2002). A medium-long recurrence interval or a more complicated history of disturbance (on a decadal scale) may create maximum spatial complexity (Ward, J.V. *et al.* 1999).

Earlier the zones of flood hazard have been delimited on hydraulic, hydrological basis. More recently *ecological considerations*, e.g. land suitability are also included in the delimitation, in the sense of the slogan 'living with floods'. Land use restrictions vary with the zones.

It is necessary to mention that from the aspect of flood and inundation hazards *small watercourses* also deserve attention. The riparian zones of headwaters may be in natural conditions and, therefore, may be more efficient in flood control than the zones along larger rivers, completely transformed by human activities (for instance, along the Rhine – Dister, E. *et al.* 1990). The restoration/rehabilitation of floodplain habitats – where it is still possible – is the most economical tool of flood control (McCartney, M.P. and Naden, P.S. 1995).

## Inundation hazard from excess water in the lowlands of Hungary

*Excess water* (waterlogging) had been long associated with river flooding. Recently, the definitions of excess water (Pálfai, I. 2001) have been extended also to include upbursting groundwater even in total absence of any watercourse. In addition to groundwater levels raised on the floodplains of major rivers during flood stages, any waterlogging in lowland areas is included in this broad category. The presently used definition of excess water originating from rainfall or snowmelt which covers any extensive but temporary inundation of lowland areas and fully saturates the soil. Whether soil saturation necessarily leads to seasonally waterlogged surfaces, remains to be an open question (Rakonczai, J. *et al*. 2003). Recurrence intervals of extreme waterlogging have been calculated for Hungary recently (Pálfai, I. 2009 – *Table 1)* and found to be rather irregular for the mid- and late 20th century. In recent decades, excess water hazard has been observed to increase dramatically.

*Table 1. Recurrence intervals of major excess water inundations in Hungary **

| Probability of occurrence, per cent | Average return period, years | Approximate minimum inundated area, hectares | Example years |
|---|---|---|---|
| 50 | 2 | 60,000 | 1960, 1997 |
| 20 | 5 | 170,000 | 1963, 2010 |
| 10 | 10 | 270,000 | 1956, 1967 |
| 5 | 20 | 360,000 | 1966, 2000 |
| 2 | 50 | 480,000 | 1940, 1941, 1942, 1999 |

* Modified after Pálfai, I. 2009.

*Inundation hazard* from excess water is more difficult to delimit both temporally and spatially than river flood hazard. Rapid snowmelt in spring, early summer cyclonal rains as well as occasional summer cloudbursts are held to be responsible for it. Although the average depth and duration of snow cover is on the decline, extreme values of such parameters often occur. The excess water hazard map of Hungary (Pálfai, I. 2009) identifies four classes:

1 – no hazard areas, where highly permeable surface deposits (sands) prevent enduring inundation;

2 – moderate hazard, where natural levees in floodplains and lower sections of alluvial fans are occasionally affected;

3 – medium hazard, where one-time floodways and backswamps and swamps enclosed between alluvial fans are exposed to rising groundwater and

4 – serious hazard, where inundations regularly recur in wet years.

The first three categories make up more than two million hectares in Hungary, i.e. one-third of the agricultural area. In wet years excess water is a source of great damage to Hungarian agriculture, public transport (washing away railway embankments) and tourism (the proliferation of mosquitoes).

## Waterlogging in river valleys of hill regions

The spatial and temporal development of inundation in narrow floodplains of hill regions (like the Kapos River floodplain under study) takes a course different from that in broad lowlands (for instance, of the Tisza River and its tributaries). In the former case concentrated cloudbursts create inundations which affect the floodplain all along the river, particularly in broader sections (embayments), while in the Great Plain extensive partial areas are flooded with rapid and hardly predictable dynamics.

The *'flood pulse' concept* (Junk, W.J. *et al*. 1989) portrays a simple time sequence of *floodplain flooding* (*Figure 1*, I. A–C). However, during floods the incursion of river water across the surface of a 'convex' floodplain may be strongly affected by floodplain 'wetness' (groundwater, hyporheic water, run-off from the hillslopes surrounding the floodplain, direct precipitation and antecedent water from earlier floods) (Mertes, L.A.K. 1997).

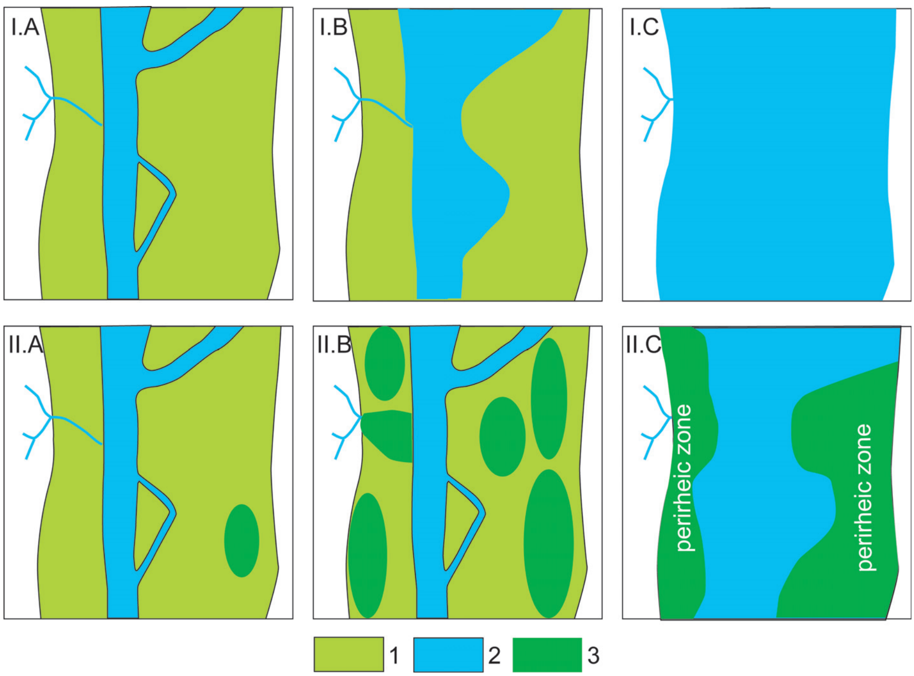


*Fig. 1* Comparison of flood development according to the flood pulse concept (I.A–C, after Junk, W.J. and Wantzen, K.M. 2004) and according to the perirheic zone concept of floodplain inundation (II.A–C, after Mertes, L.A.K. 1997). I.A = dry floodplain before flood; I.B = flood inundation extending from river channel; I.C = complete inundation of the floodplain; II.A = floodplain with high groundwater table and local wetlands before flood; II.B = extending excess groundwater patches during rising river stage; II.C = inundated floodplain with streamwater/groundwater mixing ("perirheic zone"). 1 = floodplain; 2 = river channel and streamwater-inundated areas; 3 = excess groundwater-inundated areas and the perirheic zone

Consequently, somewhat different temporal and spatial patterns of flooding result: along with the hyporheic zone, a mixing zone of stream and (excess) groundwater, the *'perirheic zone'*, is created (*Figure 1*, II.A–C, after Mertes, L.A.K. 1997).

## Study area: the Kapos River catchment

The medium-sized catchment of the *Kapos River* covers 3,295.4 km$^2$ in the Outer Somogy Hills region (*Figure 2*). The trunk river is 112.7 km long, a 5$^{th}$-order stream at confluence with the Sió Canal (the outflow of Lake Balaton to the Danube). The topographical floodplain (without that of the tributaries) extends over 104.2 km$^2$, which makes up 3.3 per cent of the total catchment area.

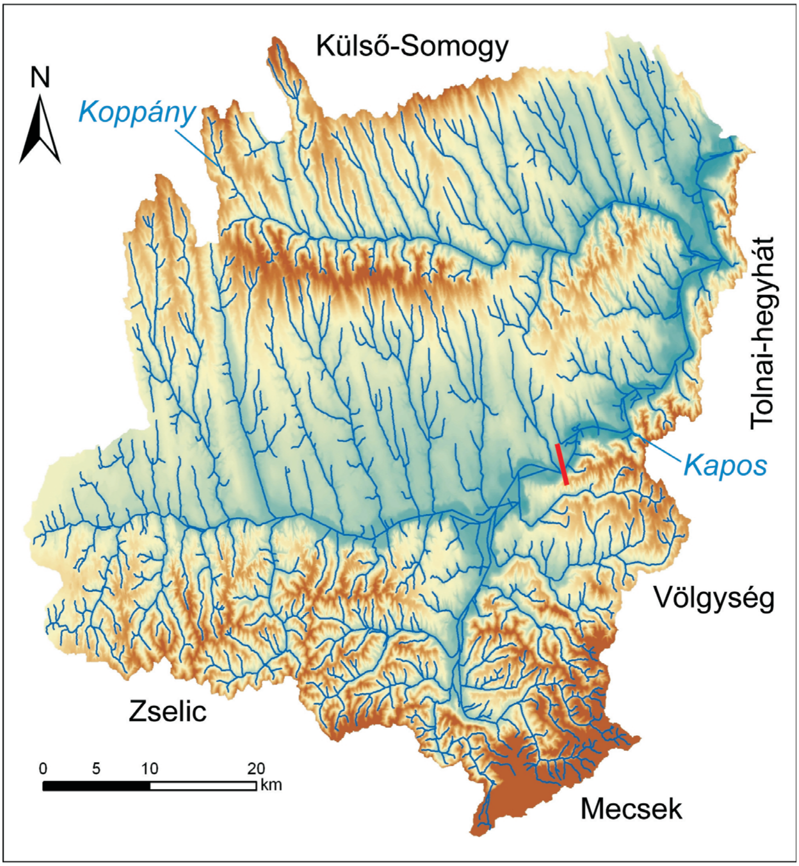


*Fig. 2.* DEM representation of the Kapos River catchment

High-water flow regulation in the early 19th and mid-20th century (Ihrig, D. 1973) did not fully eliminate flood and inundation hazards in the Kapos Valley. Even today all streams of the catchment show *high flood hazards* since global climate change increases the probability of non-predictable rainfall events and flash floods (Czigány, Sz. *et al.* 2010). Water regime shows low-water stages in August–early September and high water most often in March (caused by snowmelt in the hills). Most of the other extremes are due to summer showers. In the embayments downstream of the town of Dombóvár rainy weather can raise groundwater levels rapidly and create extensive temporary *waterlogging*. Water seepage beneath dykes and impoundments at the confluences of tributary streams may further aggravate the situation.

The events of May and June 2010 called attention to inundations in the perirheic zone and increased vulnerability to flooding also along smaller tributaries (Lóczy, D. *et al.* 2012). For the mapping of the spatial extension of waterlogging and estimating inundation hazard, alternative methods have been tried. Although it cannot be confirmed yet by groundwater table monitoring, the 2010 flooding in the Döbrököz embayment clearly shows a waterlogged perirheic zone also significantly contributed to the inundation of the floodplain.

## Inundation hazard evaluation from topographic and drainage analyses

Through the detailed survey and mapping of landforms and DEM representation of topography, most (and earliest) flood endangered tracts on the floodplain can be relatively easily identified (see e.g. Lastra, J. *et al.* 2007). Among the GIS methods the *MrVBF index* (Gallant, J.C. and Dowling, T.I. 2003) is of outstanding significance. In order to be able to use the MrVBF approach for inundation hazard assessment in Hungary, a table to assess *sensitivity to inundation* was prepared *(Table 2).* It is based on inundation frequency, soil drainage and position in relief. When applied for the Kapos floodplain, it was supplemented with reference sites field-checked after the 2010 rainfall events.

## Inundation hazard evaluation by remote sensing

The interpretation of remote sensing images taken during floods (particularly high-resolution Ikonos and SPOT images and aerial photographs) can also be of help in the identification of areas with inundation hazard (Rakonczai, J. *et al*. 2003). Unfortunately, few images are suitable for this purpose. They have to be taken shortly after flooding, and the percentage of cloud cover has to remain below 10 per cent. For the floodplain embayments the *map of possible inun-*

*dation (Figure 3)* was based on the first available image after the flooding and was constructed from band 6 of the Landsat-7 (ETM+) image for 24 September 2010. It shows the actual distribution of pixels where reflectance was predominantly controlled by water surface. (Reflectance was calibrated for fish-ponds in the study area.

The drainage network was superimposed on the image from the Hungarian Water Management Database. (The allocation error of drainage lines may amount to ca 100 m.) The *smoothed envelope curve* embraces all 'water' pixels and provides at least and approximation of areas potentially affected by waterlogging *(Figure 3)*. (On the basis of field observations, it is assumed that the patches of early summer inundations survived to a large extent well into the autumn.)

Studying the figure, the following observations can be made. The contiguous inundated areas are closely associated with the elements of the drainage network (the Kapos canal, the also channelized tributary streams and the drainage canals). At the same time, minor water surfaces in the marginal zone of the

*Table 2. Inundation sensitivity classes of the floodplain* *

| Rank score | Sensitivity class | Description | Example from the Kapos Valley |
|---|---|---|---|
| 0 | not sensible (inundation not probable) | soils with medium to good water budget in higher position | natural levee (south of Regöly) |
| 1 | low | soils with medium water budget occasionally inundated in winter and spring on hill summits and slopes | footslopes on the right bank (Tolna Hills) (e.g. at Keszőhidegkút, Belecska) |
| 2 | low to medium | soils with medium water budget potentially inundated in winter and spring, limited cultivability, on hill midslopes and footslopes | footslope zone of terrace levels (e.g. Döbrököz, Kurd – back gardens) |
| 3 | medium | soils with poor water budget and reduced cultivability because of saturation or inundation, on footslopes, flat surfaces, depressions | margins of backswamps in the Dombóvár–Döbrököz embayment |
| 4 | medium to high | uncultivable soils with poor water budget, seasonally inundated, on footslopes, flat surfaces and depressions | bottom of backswamp in the Szakály embayment |
| 5 | high | soils with poor water budget under enduring inundation, cultivation is limited throughout the year, found on valley floors, in depressions | old meanders, infilled oxbows (e.g. southeast of Regöly) |

* Compiled by Lóczy, D. from various sources.

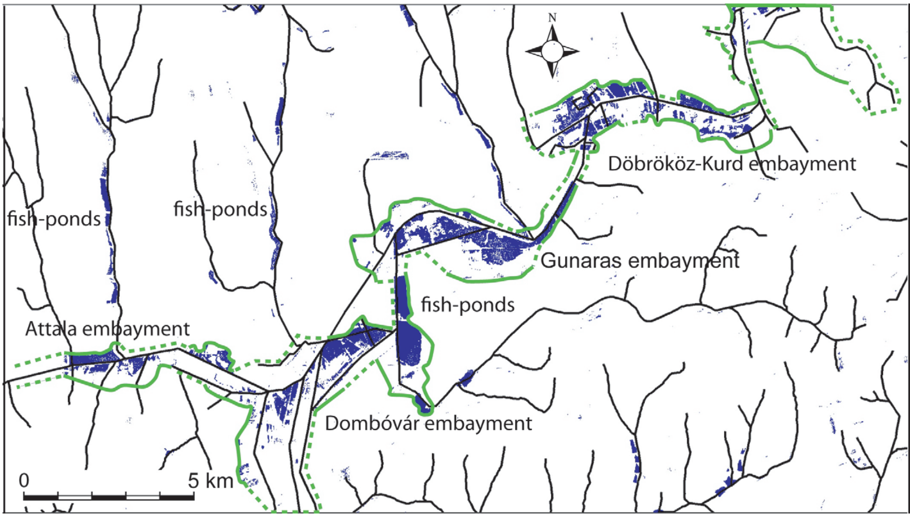


*Fig. 3* Excess water inundation in the Kapos floodplain between Nagyberki and Kurd on 24 September 2010 (based on Landsat-7 ETM+ image). The dashed line indicates sections where only approximate width of the inundated zone can be established

floodplain, which derive from rainwater runoff and throughflow generated on the neighbouring hillslopes. Some manmade features of the floodplain impound both kinds of flow.

This kind of reconstruction, however, cannot show a complete picture since, for various reasons, along some sections no water surface can be observed at all. Here the approximate boundary of maximum possible inundation is shown by a dashed envelope line. Also areas with groundwater table immediately (less than 20 cm) below the surface could have been rightfully included among those stricken by excess water (Rakonczai, J. *et al.* 2003). The authors of the mentioned paper on mapping excess water inundations in the Great Hungarian Plain cite several sources of incorrect identification.

## Inundation hazard evaluation from soil distribution

*Land drainage* measures, as corollaries to river regulation, modify or even reverse the soil formation sequences in the former floodplains. As a consequence of the hydromorphic effect, on higher grounds of the floodplain meadow *soil dynamics* had been prevalent before river regulation. With land drainage groundwater levels dropped and chernozem dynamics became predominant.

In lower-lying spots of the floodplain (in the infilling oxbows and backswamps) bog formation had been the typical pedological process, but after water management interventions the peat bogs (Fibric Histosol) began to transform into muck (Hemic Histosol) and 'earthy' or humified peat (Sapric Histosol), where the groundwater lies at 1.5–2 m deep below the surface (Dömsödi, J. 1988). In the Kapos floodplain this process is of particularly great significance (Lóczy, D. 2013). Bog degradation in the Kapos Valley is a process with unfavourable impact on temporal waterlogging.

In the Kapos floodplain *bog soils (Histosols)* are related to the former bogs of the valley floor drained during the water regulations in the early 19th century *(Figure 4)*. Peat occurs in the most extensive areas and thickest (up to 6 m thick) beds (with silt interbeddings) along the uppermost course of the Kapos River and in the valleys of tributary streams there (Gergely, E. *et al*. 2000).

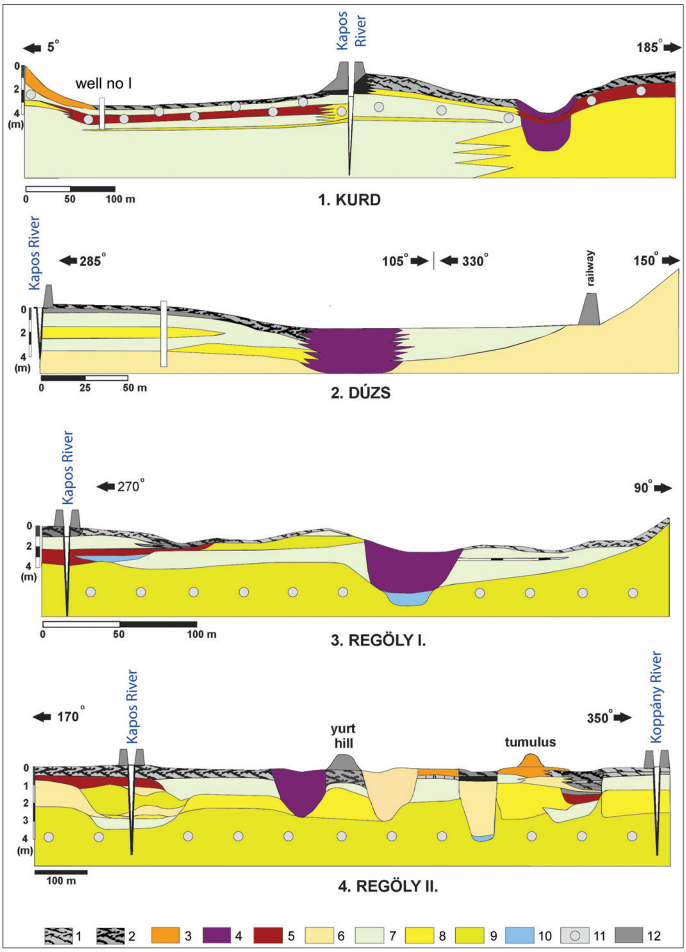


*Fig. 4.* Soil catenas across the Kapos Valley (edited by Dezső, J. 2012). Main soil types: 1 = Haplic Gleysol; 2 = Histic Gleysol; 3 = Cambisols; 4 = Histosols. Parent materials: 5 = clay; 6 = loess; 7 = silt; 8 = fine sand; 9 = coarse sand; 10 = layer with mollusc shells; 11 = gleyic horizon

Along the Upper Kapos the peat beds are typically underlain by unconsolidated silts, peat-bearing silt and calcareous silt deposited upon clay, sandy clay and fine sand layers. In the major floodplain embayments downstream, thinner humified peat and muck beds alternate with meadow clays. In the Upper Kapos Valley most of beds are composed of fibrous *Sphagnum* peat of fine fabric *(Table 3)*. The most extensive peat area is ca 12 km long, 400–500 m wide and the peat beds are 2 m deep.

The soil profile shows evidence of *organic matter accumulation* and *decomposition* as well as biotic action and hydromorphic influence. If exposed, the decomposed muck of porous structure and low bulk density is highly susceptible to *wind erosion*, particularly in spring when the surface is still barren.

*Meadow soils* are the widest spread soil type of the floodplain, typical of the waterlogged bottom surfaces of *backswamps* and *oxbows*. The uppermost, ploughed horizon is of crumbly structure, but often degraded to porous. It is underlain by a ferric horizon of marked red colour *(Table 4).* Hydromorphic effect (mottled fabric) is observed at 0.5 to 1 m depth.

Located in depressions, such soils receive surplus water from the surrounding, somewhat higher, surfaces and, therefore, are usually waterlogged.

In addition to the reconstruction of former channels and wetlands, which are important elements of the landscape structure, another benefit of collecting *soil survey information* is the help they provide for the delimitation of areas of excess water hazard.

The *water budget classes* of the genetic soil types occurring on the floodplain are identified using a table *(Table 5)* compiled from various literary sources and also drawing information from the interpretation of the Landsat image. When detailed soil data are available, the *wetness classes* of the Soil Survey of England and Wales can also be applied (McRae, S.G. and Burnham, C.P. 1981 – *Table 6)*.

Classification is based on depth to groundwater table and the duration of soil water saturation. The subtypes and varieties of meadow soils (Histosols and Gleysols) which are liable to be waterlogged in rainy periods can be identified on the soil map: boggy meadow soil, mucky meadow soil, 'earthy peat' and peaty meadow soil.

Since all the typologies presented in the three tables define six classes, comparisons between them are relatively easy. Having completed the assessments, the embayments of the Lower Kapos floodplain are mostly found to belong to the inundation sensitivity classes 2–3 (low to medium sensitivity); show rank scores 2–3 (medium susceptibility to inundation; poor to medium infiltration capacity and permeability; high water storage) and fall into the British wetness classes II or (less typically) III (moderately well drained or imperfectly drained).

*Table 3. Field description of a widespread Histosol variety from the Kapos floodplain (by* Dezső, *J. and* Lóczy, *D.)*

<table>
<tr><td>Locality</td><td colspan="4">Locality description</td><td colspan="2" rowspan="2">Genetic soil type</td><td colspan="3" rowspan="2">WRB soil type</td></tr>
<tr><td>Code:</td><td>Regöly<br>R7F</td><td colspan="3">Land use: meadow/grazing land (ancient root traces indicate one-time floodplain softwood forest)<br>Landform: bottom of oxbow</td></tr>
<tr><td rowspan="2">Date of survey</td><td rowspan="2">21.08.2011</td><td colspan="3">GPS coordinates</td><td colspan="2">Pseudogleyic meadow soil</td><td colspan="3">Gleyic Histosol</td></tr>
<tr><td>x</td><td>y</td><td>z</td><td colspan="2" rowspan="2">Parent material: silt</td><td colspan="3" rowspan="2">Groundwater table:<br>-280 cm</td></tr>
<tr><td>Soil pit</td><td>0–150 cm</td><td>137711N</td><td>601580E</td><td>101 m</td></tr>
<tr><td>Horizons, cm</td><td colspan="4">Profile description</td><td>Colour</td><td>Physical type</td><td>Effer-vescence/ carbonate, %</td><td>$K_A$*</td><td>Salts, per cent</td></tr>
<tr><td>0–15</td><td colspan="4">crumbly in the root zone, muck, not ploughed</td><td>dark yellow to light brown, 10YR 3/4</td><td>clayey silt</td><td>strong/>10</td><td>66</td><td>0.11</td></tr>
<tr><td>15–25</td><td colspan="4">decomposed peat of porous structure, red ferric precipitations</td><td>yellowish red, 5YR 6/8</td><td>–</td><td>very slight/<2</td><td>66</td><td>0.11</td></tr>
<tr><td>25–45</td><td colspan="4">compact, disintegrating into slabs, pitch black, shiny clay films on skeletal particles</td><td>black, 10 YR 2/1</td><td>clay loam</td><td>non-effer-ves-cent/0</td><td>47</td><td>0.08</td></tr>
<tr><td>45–50</td><td colspan="4">bioturbated (?), transitional towards gleyed heavy clay</td><td>mixed</td><td>clayey silt</td><td>strong/ 10–25</td><td>47</td><td>–</td></tr>
<tr><td>50–90</td><td colspan="4">pseudogleyic horizon with rusty precipitations along root traces, root and bioturbation chan-nels</td><td>grey</td><td>compacted silt</td><td>violent/ >25</td><td>47</td><td>0.09</td></tr>
<tr><td>90–120</td><td colspan="4">layer rich in rusty precipitations along root channels</td><td>mixed with olive grey ma-trix, 5Y 6/2</td><td>fine silt</td><td>violent/ >25</td><td>32</td><td>0.09</td></tr>
<tr><td>120–150</td><td colspan="4">rusty ferric and soft calcareous precipitations along root channels</td><td>mixed</td><td>fine silt</td><td>violent/ >25</td><td>–</td><td>–</td></tr>
</table>

*Table 3. folytatása*

| Locality | Locality description | | | | Genetic soil type | | WRB soil type | | |
|---|---|---|---|---|---|---|---|---|---|
| Code: | Regöly R7F | Land use: meadow/grazing land (ancient root traces indicate one-time floodplain softwood forest) Landform: bottom of oxbow | | | | | | | |
| Date of survey | 21.08.2011 | GPS coordinates | | | *Pseudogleyic meadow soil* | | *Gleyic Histosol* | | |
| | | x | y | z | Parent material: silt | | Groundwater table: -280 cm | | |
| Soil pit | 0–150 cm | 137711N | 601580E | 101 m | | | | | |
| Horizons, cm | Profile description | | | | Colour | Physical type | Effer-vescence/ carbonate, per cent | $K_A$* | Salts, per cent |
| 150–210 | fluvially reworked loess? | | | | light grey, 5Y 7/2 | silt | violent/ >25 | – | – |
| 210–270 | homogeneous fluvial deposit | | | | light grey, 5Y 7/2 | silt | strong/ 10–25 | – | – |
| 270–310 | redeposited loess, groundwater table at 280 cm | | | | light grey, 5Y 7/2 | silt | strong/ 10–25 | – | – |
| 310–340 | homogeneous fluvial deposit | | | | light grey, 5Y 7/1 | fine sand | strong/ 10–25 | – | – |
| >340 | homogeneous fluvial deposit | | | | light grey, 5Y 7/1 | silt | strong/ 10–25 | – | – |

* Arany's Plasticity Index (for explanation see the text)

*Table 4. Field description of a typical Gleysol (meadow soil) from the Kapos floodplain (by* D*ezső, J. and* L*óczy, D.)*

<table>
<tr><td>Locality</td><td colspan="4">Locality description</td><td colspan="2">Genetic soil type</td><td>WRB soil type</td></tr>
<tr><td>Code:</td><td>Regöly R3F</td><td colspan="3">Land use: arable field with horse raddish Landform: bottom of backswamp</td><td colspan="2">Meadow soil under cultivation</td><td>Mollic Gleysol</td></tr>
<tr><td>Date of survey</td><td>20.08. 2011</td><td colspan="3">GPS coordinates</td><td colspan="2" rowspan="3">Parent material: fine sand</td><td rowspan="3">Groundwater table: >150 cm</td></tr>
<tr><td rowspan="2">Soil pit</td><td rowspan="2">0–150 cm</td><td>x</td><td>y</td><td>z</td></tr>
<tr><td>134644N</td><td>598925</td><td>95 m</td></tr>
<tr><td>Horizons, cm</td><td colspan="4">Profile description</td><td>Colour</td><td>Physical type</td><td>Effer-vescence/ carbonate, per cent</td></tr>
<tr><td>0–25</td><td colspan="4">reddish brown matrix with dark grey bioturbated elements</td><td>yellowish red; 5YR 5/6</td><td>silt</td><td>strong/ 10–25</td></tr>
<tr><td>25–45</td><td colspan="4">compacted, homogeneous, slab structure, dark grey shiny clay films</td><td>black, 10YR 2/1</td><td>clay</td><td>non-effer-ves-cent/0</td></tr>
<tr><td>45–55</td><td colspan="4">crumbly with rusty precipitations, gleyic matrix with black clay in channels</td><td>mottled</td><td>fine sand, clay</td><td>strong/ 10–25</td></tr>
<tr><td>55–120</td><td colspan="4">gleyed sand with pale ferric precipitations</td><td>light yellowish brown, 2.5Y 6/4</td><td>medium sand</td><td>strong/ 10–25</td></tr>
<tr><td>>120</td><td colspan="4">indistinct structure</td><td>light grey, 5Y 7/2</td><td>medium sand</td><td>slight/ 2–10</td></tr>
</table>

*Table 5. Evaluation of genetic soil types occurring on the Kapos floodplain according to their susceptibility to inundation **

| Rank score | Predictable saturation | | Genetic soil (sub)types | Drainage properties | | |
|---|---|---|---|---|---|---|
| | Frequency, years | Duration, weeks | | Infiltration capacity, mm $d^{-1}$ | Transmission capacity, mm $d^{-1}$ | Storage capacity, mm $m^{-1}$ |
| 0 | 50–100 | less than one | meadow chernozem, chernozem meadow soil | good: 300–1000 | good: 150–500 | good: 100–150 |
| 1 | 20–50 | 1–2 | meadow soil, calcareous alluvial meadow soil | high: >1,000 | high: 500–1,000 | medium: 50–100 |
| 2 | 10–20 | 3–4 | boggy meadow soil | medium: 100–300 | medium: 50–150 | high: 150–200 |
| 3 | 5–10 | 4–8 | earthy peat ('black earth') | poor: 50–100 | poor: 10–50 | high: 150–200 |
| 4 | 2–5 | several months | bog soil with muck | poor: 10–100 | very poor: <10 | high: 150–200 |
| 5 | 1 | several months | bog soil with peat | poor: 10–100 | very poor: <10 | very high: >200 |

* Compiled by Lóczy, D.

*Table 6. Wetness classes of soils according to the depth of the soil horizon saturated to water capacity*

| Wetness class | Water saturation | | Drainage class (approximate) |
|---|---|---|---|
| | Depth, cm | Duration, day per year | |
| I | >70 | <30 | well drained |
| II | <70 | 30–90 | moderately well drained |
| III | <70 | 90–180 | imperfectly drained |
| IV | <40 | >180 | poorly drained |
| V | <40 or <70 | >180 or >335 | very poorly drained (waterlogged) |
| VI | <40 | >335 | very poorly drained (regularly inundated) |

*Source*: Soil Survey of England and Wales.

## Groundwater table monitoring

At high (flood) stages the unconsolidated floodplain deposits and soils are assumed to temporarily store water before it is conveyed downstream. The overall effect of this water storage is the delay and attenuation of the flood peak in downstream areas. *Flow pathways* are often deflected from the alignment of the main channel and often run diagonal towards the channel in a downstream direction (Kelly, B.P. 2001). Over a narrow floodplain (such as that of the Kapos River) another major element of subsurface flow is the spatial continuation of *throughflow* from the neighbouring hillslopes, which is close to perpendicular to the channel. It often causes waterlogging during high river stages (perirheic zone). The major controls on the alignment of groundwater flow ('underflow') paths are the hydraulic properties of floodplain deposits, regional slope and sinuosity (Larkin, R.G. and Sharp, J.M. Jr. 1992).

Unfortunately, to realistically depict groundwater flow a dense network of observation wells with long time series would be necessary. The national *monitoring* system of *groundwater levels* only very sparsely covers the Kapos floodplain and the embayments of the lower segments are not monitored at all. In order to receive information on the position of groundwater in the floodplain for the period November 2011–October 2012, we installed measuring instruments (Dataqua DA-S-LRB 122 SMART rigid sound water level gauges, precision: ±0.1 per cent; measurement range: 0–200 cm; manufactured by Dataqua Electronic Co., Balatonalmádi, Hungary) into two observations wells (at Kurd, at a short distance from the river gauge, and downstream of the constriction, at Dúzs). The first year when an uninterrupted record of groundwater table fluctuations could be obtained was 2012 *(Figure 5)*. Naturally, the laws of groundwater flow could only be revealed after a much longer period of monitoring.

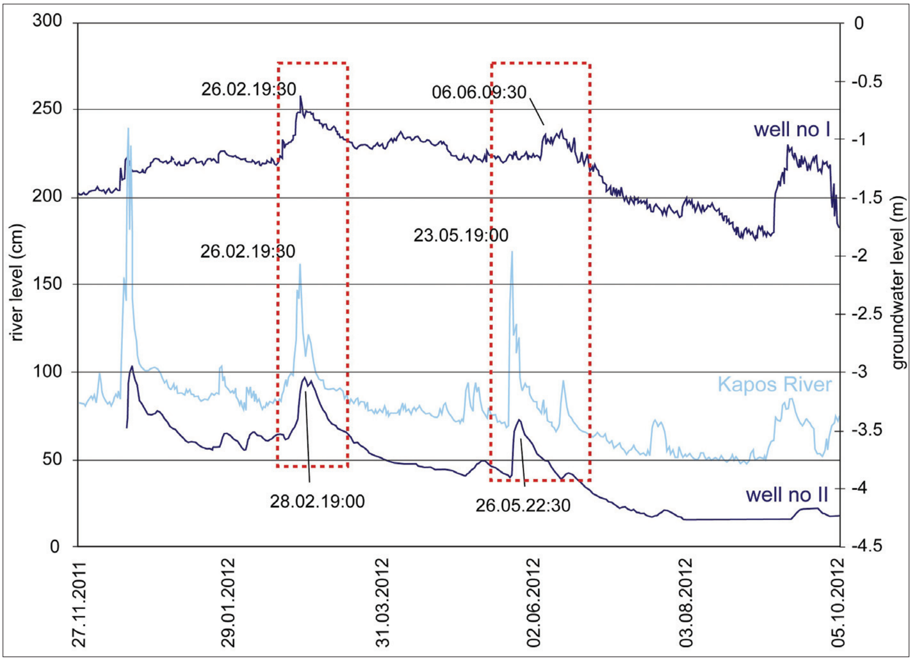


*Fig. 5.* River stages of the Kapos River at the Kurd gauge and groundwater levels recorded in observation wells I (Kurd) and II (Dúzs) between November 2011 and October 2012 (by Dezső, J. 2012)

Assessing the intensity of mutual stream/groundwater interactions in the Kapos floodplain, Considerable recharge is observed from infiltration (snowmelt) and early spring floods, when evaporation losses are not yet remarkable, and in the saturated floodplain deposits *perirheic flow* (Mertes, L.A.K. 1997) is regularly observed. The river stages and water levels of observation well I were raised by rapid snowmelt in late February. The much lower groundwater table in well II responded with a remarkable *delay.* The groundwater reserves, however, are heavily depleted by evaporation caused by rising temperature in the first third of the growing season. Although the highly variable amounts of (early) summer precipitation are of great ecological significance, high temperatures considerably reduce their contribution to groundwater recharge. The rainfall event in July did not influence water level in well I, while its impact with a three-day delay (similar to that in February) was observed for well no II.

Since infiltration does not reach the groundwater table, summer showers are mostly inefficient in groundwater recharge. In lack of by-channels and oxbows and backswamps in the perirheic zone drained, higher river water stages are unable to saturate floodplain soils. Where high-porosity layers are uninterrupted between the channel and more remote areas of the floodplain, groundwater recharge also occurs in drought periods.

## Conclusions

Different approaches have been tried to present inundation hazard in the narrow floodplain of a medium-sized river in a hill region of Hungary. Supplemented with long-term groundwater level monitoring, the joint application of the presented methods can lead to realistic identification of areas with high-probability groundwater flooding.

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# Religious tourism in Hungary – an integrative framework

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## Abstract

Tourism to religious sites, shrines, temples, churches and religious festivities is significantly growing worldwide. Central and Southeastern Europe is historically a region where different ethnic and religious groups live. In the last century, during the 40 years of Communist rule over the social and political system in the Carpathian Basin, religion was banished and spiritual life could be practised mainly within the domestic environment. Since 1990, former socialist countries like Hungary (as also for example Poland, Slovakia, Romania etc.) have turned to capitalism, but without being prepared for the social, economical and psychological changes, with which that process would affect individuals and families. Faith and pilgrimages seem to have regained their roles in people's lives. This paper outlines an integrative framework on Christian religious tourism and discusses its cultural aspects. The framework emphasises the identification of geographical aspects of the phenomenon in terms of scale (local, regional, national and international) as well as in terms of the research theme (cultural, political and health-related aspects). In the first part, the history of religious tourism and its integrative framework are presented based on relevant international literature. In the second part of the paper, the focus is on the development and interpretation of the Via Maria pilgrimage route (especially at its most important station, Mátraverebély-Szentkút), the first established within the Central and Southeastern European area, and the primary results of our field research are presented.

**Keywords**: tourism, spiritual experience, pilgrimage route, Hungary

## Introduction

Religious tourism has recently emerged as a significant field of study despite the fact that the phenomenon is contemporary to the birth of major world religions: Buddhism, Hinduism, Islam, Judaism and Christianity (Collins-Kreiner, N. 2010a). Pilgrimage is one of the symbols of Christian life deeply

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rooted in the Bible. The ecclesiastical view of a human being, of a Christian as *homo viator*, is a person on journey, a pilgrim on earth on the way to the heavenly life. Pilgrimage, moreover, reflects a human desire for fulfilment. Throughout history, pilgrimage has been a religious phenomenon that set people on a physical journey yielding spiritual results (Timothy, J.D. and Olsen, H.D. 2006). In general, related academic works deal with the complicated economic, political, social, psychological, and emotional relationship between pilgrimage and tourism (Nolan, M.L. and Nolan, S. 1992).

As Collins-Kreiner, N. (2010a) assumes in her article on pilgrimages, the key issues and the arguments related to that research field also reflect the boundary between tourism and pilgrimage. Tourists and pilgrims visiting the same shrine might have different motivations for travelling, but similar needs are satisfied on the spot.

The research focused on the definitions of "religious tourism" as the individual's quest for sacred places where the historical and cultural layer of meaning of the place might reinforce their spiritual experience (Mazumdar, S. and Mazumdar, S. 2004; Nolan, M.L. and Nolan, S. 1992). In addition, the search for something miraculous, better and purer, alleviating the perception of personal problems and offering a different perspective to the evaluation of life are key characteristics of modern secular pilgrimages (Ward-Thompson, C. 2011). In *The Canterbury Tales* by Geoffrey Chaucer, group cohesion among pilgrims on route is not only a question of security during the journey, but it is a means for elaboration of the pilgrimage experience. Travelling with other fellows, the construction of groups and enhancing group cohesion are highly relevant aspects of religious tourism.

Going on a pilgrimage or participating in religiously motivated travels, however, might have several other reasons (Olsen, H.D. 2010). In Europe, believers attribute healing effects to numerous shrines and the alleviation of physical suffering is one of the motivations to visit pilgrimage centres (Lourdes, for example). Moreover, Gesler, W. (1996) affirmed that medical geographers were attempting to show how people influenced by their material circumstances give meaning to their experiences related to health in places and how places, in turn, change their perceptions and experiences regarding health. Rátz, T. and Michalkó, G. (2011) demonstrated that tourism has a beneficial effect on individuals' perception of well-being and contributes to the positive valuation of quality of life. The importance of the natural environment is highly relevant and landscape is considered to be therapeutic (Gesler, W. 1996; Pohner, T. *et al.* 2009). The environment close to sacred places might relieve depression or stress (Foley, R. 2011) enhancing the wish to visit sacred and healing places.

Religiously motivated tourism, nowadays, is connected to cultural and heritage tourism as well. As it has been demonstrated, religious and secular pilgrims as well as cultural tourists often go on a journey for the same reason: searching a spiritual experience (Digance, J. 2003; Murray, M. and Graham, B. 1997; Nolan, M.L. and Nolan, S. 1992). In Rome, the Holy See represents the core of the 'Eternal City' and it is embedded within the urban tissue of the city. It is worth noting that religious sites in Rome are at the same time important cultural sites as well. The overlap of cultural tourism seeking Christian traditions, heritage buildings, religious festivities and religious tourism represented by Christian believers is highly pronounced in the Vatican City. Following Pope Benedict XVI's resignation proclaimed on 11 February 2012, the Vatican has experienced an increased number of tourists' and pilgrims' arrivals. The last mass celebration of Pope Ratzinger was followed by thousands of pious believers giving a new sense of pilgrimage to a Pope who is still alive but despite that fact, celebrates his last mass.

Furthermore, religious tourism assumes the role of a niche tourism product in international tourism. Pilgrimage involves not only a journey from one place to another, but it is a spiritual and cultural experience changing or significantly influencing the pilgrims' lives (Pohner, T. *et al.* 2009). Those journeys, usually completed with fellow pilgrims, hardly ever in solitude, are about self transformation, gaining knowledge and spiritual experience (Collins-Kreiner, N. 2010b; Murray, M. and Graham, B. 1997; Nolan, M.L. and Nolan, S. 1992). In the 21st century, questing for spiritual experience and relief includes not only traditional sacred sites worshiped by Christians (the Vatican, Santiago de Compostela etc.) but also contemporary pilgrimage sites (Shackley, M. 2001).

The geographical scale of religious sites is determined by a possible place development. Current industry trends show that religious tourism has great economic potential and in some cases it contributes significantly to regional and local development. However, internationally relevant pilgrimage centres constructed around hidden sacred fountains in a forest or in remote alpine villages have impact on the natural environment and they pose questions on sustainability (Petrillo, C.S. 2003; Rinschede, G. 1992). Difficult-to-access monasteries and abbeys have recently become tourism attractions, therefore infrastructural development as well as the construction of service facilities appear to be unavoidable. However, such development and commercialization of the places has strongly influenced the function, the work and the lives of monasteries involved.

In this paper the aforementioned framework for religious tourism is discussed. Pilgrimage is a common phenomenon to all major world religions, however, in this paper only tourism to European Christian sites and religiously motivated Catholic travels are analysed. In our approach aspects of authenticity, place identity and interpretation are highly relevant. We focus on the Via Maria pilgrimage route and present the results of the empirical research and fieldwork conducted at Szentkút.

### Theoretical framework for religious tourism

Thinking about historical pilgrimage routes, the Holy Land and Jerusalem are the primary destinations coming to mind. The sacred city has been a holy place for Jews and Muslims, as well as for Christians for a long time. (However, in 2012 Israel hosted less than 4 million tourists (www1.cbs.gov.il). Over the centuries, the places of birth, life events and the crucifixion of Jesus Christ have become sites of pilgrimages for pious believers and secular tourists as well. In 2012, the birthplace of Jesus with the Church of the Nativity and the pilgrimage route to Bethlehem were included on the UNESCO World Heritage site list. In 1453 the conquest of Constantinople by the Ottoman Empire redrew the pilgrimage map of Europe. The Holy Land with Jerusalem was not accessible for Christian pilgrims during the Ottoman period and in its place numerous sacred sites appeared in Europe to fulfil the need of devotees for mercy through peregrination. Rome became the main destination for pilgrims, however, in the 12th century Santiago de Compostela, with its patron Saint James, became one of the most visited pilgrimage sites in medieval Europe (Rinschede, G. 1992).

The Bible is full of references to travel: leaving oneself behind, walking the walk and journeys of the soul. The destination might not be of such importance as the route itself while travelling away from familiar surroundings a pilgrim can meditate about his life. Pilgrimage to a sacred site, especially to a historically relevant place puts the traveller in situations where they think and behave differently (Andriotis, K. 2008). Today pilgrims travel for many reasons (Rinschede, G. 1992). One of the reasons for pilgrimages and religiously motivated travels is the personal need, the belief that being in a sacred location can bring healing, spiritual experiences or they just want to "give a try". In postmodern and in stress-dominated societies where traditional values may seem to have vanished and more and more people are experiencing feelings of dislocation and rootlessness, religion and faith might be considered as islands of peace.

Participating in religiously motivated travel might have several reasons which can vary from the need for personal fulfilment, through the wish to participate at religious rituals, to offer prayers and vows or request for divine intervention in one's life. Furthermore, among the other motivations, we can find the sense of obligation to visit a sacred place because it is a must for Christians; nostalgic reasons or didactical purposes in terms of educating family members about religious beliefs (Timothy, J.D. and Olsen, H.D. 2006) and about national history which is often related to religious places as well. Fátima, in Portugal, has become a national meeting place for Portuguese people who live in another country. They come to the shrine from all over the world. Şumuleu Ciuc (Csíksomlyó), in Transylvania, is an extremely important national shrine for Hungarian pilgrims.

However, academic literature on religious tourism despite recent attention dedicated to that field is rather narrow. According to Timothy, J.D. and Olsen, H.D. (2006, p. 6), "most research and writing on the topic has centred on four distinct themes of inquiry: distinguishing the pilgrims from tourists; the characteristics and travel patterns of religious tourists; the economics of religious tourism; and the negative impacts of tourism on religious sites and ceremonies".

The detachment from everyday life enables the pilgrims and tourists to intensify their understanding of spiritual life often in a place where the natural environment is considered to have healing effects. Sharing the spiritual experiences with other fellow pilgrims makes people open to new experiences and relationships and reconsider some aspects of life. Besides, studying the meaning of pilgrimage requires an application of transdisciplinary methods based on geography and sociology but also semiology and history, involving an interpretative approach to seeking hitherto neglected alternative meanings.

## Cultural tourism at sacred sites

Cultural and heritage tourism today is connected to religious tourism since sacred sites, churches, monasteries and abbeys are not only places of religious rituals and prayers but they are monuments, ecclesiastical buildings and heritage sites as well. Holy places and sacred sites are nowadays being seen as tourist attractions and cultural resources. Following a content analysis of the UNESCO World Heritage list 2012, it has emerged that in Europe, 92 religious buildings and sites are listed and considered to have outstanding universal cultural values. Furthermore, ecclesiastical architecture and the listed religious buildings and sites reflect European history as well (*Table 1*). The number of ecclesiastical buildings listed by UNESCO *(Figure 1)* show that these monuments are considered by the international organisation unique cultural attractions.

The cultural heritage sites and better-known pilgrimage sites of Europe are capable of appealing to a wide range of visitors. According to Smith, V.L. (1992), the continuum of visitors ranges from pious pilgrims and devout Catholics to cultural tourists who consider themselves Catholic but do not attend church ceremonies to and vacationers who visit the sites during their holiday (Murray, M. and Graham, B. 1997). El Camino de Santiago de Compostela in northern Spain, the emblem of pilgrimage routes, was the first cultural itinerary in Europe to be protected by UNESCO. Every year El Camino attracts thousands of pilgrims and tourists who aim to fulfil their wish to walk along the medieval route. In 2012, a total of 192,488 pilgrims who obtained the *Compostelas* (the official certificate of having accomplished the pilgrimage) were registered (www.jacobeo.net). In Europe, other pilgrimage centres have also been included in the UNESCO list clearly evidencing the importance and cultural value of religious sites (*Table 2.)*

*Table 1. Ecclesiastical architecture in Europe on the UNESCO World Heritage List, 2012*

| Country | Number of all World Heritage sites in the country | Number of religious World Heritage sites in the country | Type of ecclesiastical architecture |
|---|---|---|---|
| Armenia | 3 | 3 | Byzantine monasteries, Armenian ecclesiastical architecture |
| Belgium | 11 | 1 | Cathedral (pre-Gothic style) |
| Bulgaria | 9 | 3 | Churches and a monastery |
| Croatia | 7 | 2 | Episcopal Complex, cathedral |
| Cyprus | 3 | 1 | Painted Churches |
| Czech Republic | 12 | 4 | Church, cathedral, Jewish Quarter in Třebíč, Holy Trinity Column |
| Denmark | 4 | 2 | Roskilde Cathedral (brick-built Gothic-style basilica), Jelling Mounds, Runic Stones and Church |
| Finland | 7 | 1 | Petäjävesi Old Church (Lutheran country church) |
| France | 38 | 11 | Abbey, cathedrals, Episcopal city, pilgrimage route |
| Georgia | 1 | 1 | Bagrati Cathedral and Gelati Monastery |
| Germany | 37 | 10 | Cathedrals, pilgrimage church, abbey, Luther Memorials, monastic island |
| Greece | 17 | 7 | Meteora, Mounth Athos, temple, sanctuary, monasteries |
| Holy See | 2 | 2 | Vatican City |
| Hungary | 8 | 1 | Benedictine Abbey |
| Italy | 47 | 7 | Church and Dominican convent, rupestrian churches, cathedrals, Basilica of San Francesco |
| Norway | 7 | 1 | Urnes Stave Church (traditional Scandinavian wooden architecture) |
| Poland | 13 | 3 | Churches, wooden churches, pilgrimage centre |
| Portugal | 14 | 4 | Convent, monastery |
| Romania | 7 | 4 | Churches and monasteries, villages with fortified churches |
| Serbia | 4 | 1 | Monastery |
| Slovakia | 7 | 1 | Wooden churches |
| Spain | 44 | 7 | Cathedrals, monasteries, route of Santiago |
| Sweden | 15 | 1 | Church Village of Gammelstad |
| Switzerland | 11 | 2 | Convents |
| Ukraine | 5 | 1 | Cathedral and Monastic Buildings |
| United Kingdom | 28 | 2 | Cathedral, abbey |

*Source*: whc.unesco.org/en/list, authors' own elaboration.

*Table 2. Pilgrimage routes and centres in Europe on the UNESCO World Heritage list, 2012*

| Name of the site with date | Country | Significance |
|---|---|---|
| Pilgrimage Church of Wies, 1983 | Germany | The pilgrimage church is a perfect masterpiece of Rococo |
| Route of Santiago de Compostela, 1993 | Spain | First European Cultural itinerary |
| Pilgrimage Church of St. John of Nepomuk at Zelená Hora, 1994 | Czech Republic | Zelena Hora pilgrimage complex since 1721 |
| Routes of Santiago de Compostela in France, 1998 | France | The route played a key role in religious and cultural exchange during the later Middle Ages |
| Kalwaria Zebrzydowska: the Mannerist Architectural and Park Landscape Complex and Pilgrimage Park, 1999 | Poland | Pilgrimage centre; outstanding example of Calvary, large-scale landscape design which incorporates national beauty with spiritual objectives |

*Source:* whc.unesco.org/en/list, authors' elaboration.

Moreover, cultural heritage sites, since they represent universal cultural values, are visited by international tourists coming from different parts of the world and having different religious beliefs. The management of those sacred sites, religious heritage complexes, cathedrals, monasteries etc. must meet various requirements by pilgrims and tourists since visitors use the same places for different reasons (Hughes, K. *et al.* 2013; Collins-Kreiner, N. 2010b). Some historical churches, cathedrals and monasteries heavily depend on tourist income and the economic benefits of cultural tourism have been widely recognised (Leask, A. 2010).

## Place interpretation and semiotics in religious tourism

Via Maria is a recently established pilgrimage route connecting the most important shrines, sacred places and cultural heritage attractions related to the devotion of the Virgin Mary. Since this route lacks a long tradition, its establishment requires promotion among pilgrims and tourists and the role of signs, symbols and interpretation are key factors in that process. In the literature review previous research on semiotics and tourism is briefly reported (Scheer, M. and Willams, J. 2003). Signs, symbols and their interpretation have always constituted a significant role in place identification and place attachment. It could be also affirmed that the use of a complex system of signs is a distinguishing characteristic of humans (Echtner, M.C. 1999). Signs are identified as anything that can be used to represent

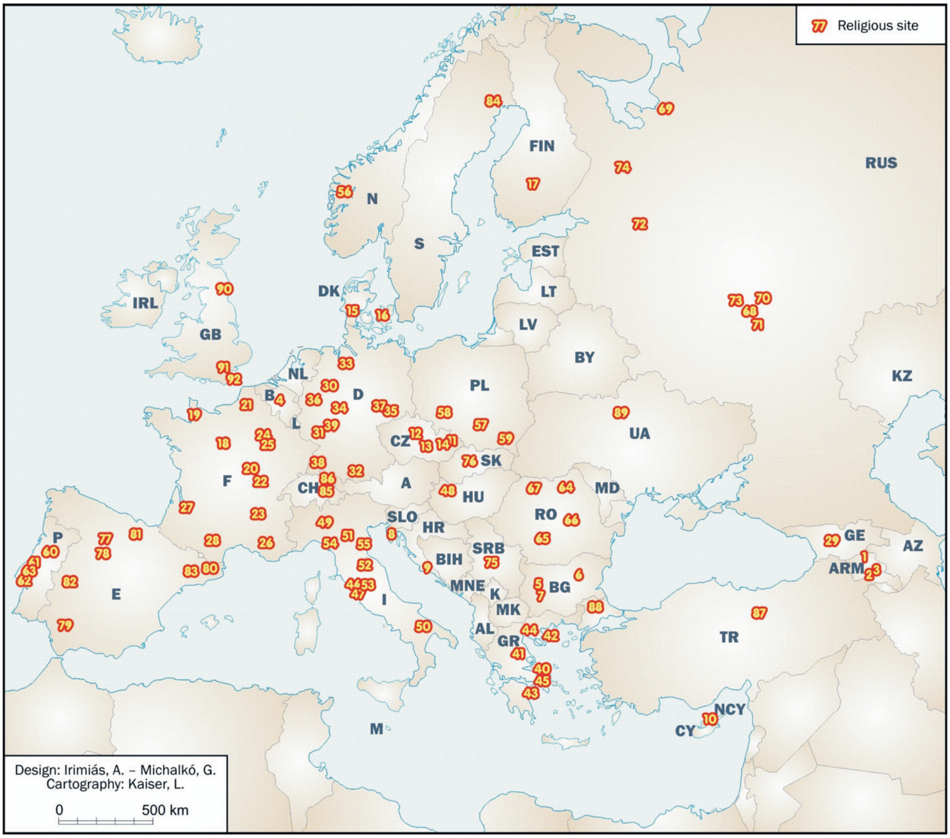


*Fig. 1*. Ecclesiastical architecture and religious sites listed by UNESCO as cultural attractions, 2012

*Armenia*: 1 = Monasteries of Haghpat and Sanahin; 2 = Cathedral and Churches of Echmiatsin and the Archaeological Site of Zvartnots; 3 = Monastery of Geghard and the Upper Azat Valley. *Belgium*: 4 = Notre-Dame Cathedral in Tournai; *Bulgaria*: 5 = Boyana Church; 6 = Rock-Hewn Churches of Ivanovo; 7 = Rila Monastery. *Croatia*: 8 = Episcopal Complex of the Euphrasian Basilica in the Historic Centre of Poreč; 9 = The Cathedral of St James in Šibenik. *Cyprus*: 10 = Painted Churches in the Troodos Region. *Czech Republic*: 11 = Pilgrimage Church of St John of Nepomuk at Zelená Hora; 12 = Kutná Hora: Historical Town Centre with the Church of St Barbara and the Cathedral of Our Lady at Sedlec; 13 = Jewish Quarter and St Procopius' Basilica in Třebíč; 14 = Holy Trinity Column in Olomouc. *Denmark*: 15 = Jelling Mounds, Runic Stones and Church; 16 = Roskilde Cathedral. *Finland*: 17 = Petäjävesi Old Church. *France*: 18 = Chartres Cathedral; 19 = Mont-Saint-Michel and its Bay; 20 = Vézelay, Church and Hill; 21 = Amiens Cathedral; 22 = Cistercian Abbey of Fontenay; 23 = Abbey Church of Saint-Savin sur Gartempe; 24 = Cathedral of Notre-Dame, Former Abbey of Saint-Rémi and Palace of Tau, Reims; 25 = Bourges Cathedral; 26 = Historic Centre of Avignon: Papal Palace, Episcopal Ensemble and Avignon Bridge; 27 = Routes of Santiago de Compostela in France; 28 = Episcopal City of Albi. *Georgia*: 29 = Bagrati

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Cathedral and Gelati Monastery. *Germany*: 30 = Aachen Cathedral; 31 = Speyer Cathedral; 32 = Pilgrimage Church of Wies; 33 = St Mary's Cathedral and St Michael's Church at Hildesheim; 34 = Abbey and Altenmünster of Lorsch; 35 = Collegiate Church, Castle and Old Town of Quedlinburg; 36 = Cologne Cathedral; 37 = Luther Memorials in Eisleben and Wittenberg; 38 = Monastic Island of Reichenau; 39 = Roman Monuments, Cathedral of St Peter and Church of Our Lady in Trier. *Greece*: 40 = Temple of Apollo Epicurius at Bassae; 41 = Meteora; 42 = Mount Athos; 43 = Sanctuary of Asklepios at Epidaurus; 44 = Paleochristian and Byzantine Monuments of Thessalonika; 45 = Monasteries of Daphni, Hosios Loukas and Nea Moni of Chios. *Holy See:* 46 = Historic Centre of Rome, the Properties of the Holy See; 47 = Vatican City. *Hungary*: 48 = Millenary Benedictine Abbey of Pannonhalma and its Natural Environment. *Italy*: 49 = Church and Dominican Convent of Santa Italy Maria delle Grazie with "The Last Supper" by Leonardo da Vinci; 50 = The Sassi and the Park of the Rupestrian Churches of Matera; 51 = Cathedral, Torre Civica and Piazza Grande, Modena; 52 = Assisi, the Basilica of San Francesco and Other Franciscan Sites; 53 = Historic Centre of Rome, the Properties of the Holy See; 54 = Piazza del Duomo, Pisa; 55 = Early Christian Monuments of Ravenna. *Norway*: 56 = Urnes Stave Church. *Poland*: 57 = Kalwaria Zebrzydowska: the Mannerist Architectural and Park Landscape Complex and Pilgrimage Park; 58 = Churches of Peace in Jawor and Świdnica; 59 = Wooden Churches of Southern Little Poland. *Portugal*: 60 = Convent of Christ in Tomar; 61 = Monastery of Batalha; 62 = Monastery of the Hieronymites and Tower of Belém in Lisbon; 63 = Monastery of Alcobaça. *Romania*: 64 = Churches of Moldavia; 65 = Monastery of Horezu; 66 = Villages with Fortified Churches in Transylvania; 67 = Wooden Churches of Maramureş. *Russia*: 68 = St Basil's Basilica, Moscow; 69 = Cultural and Historic Ensemble of the Solovetsky Island; 70 = Architectural Ensemble of the Trinity Sergius Lavra in Sergiev Posad; 71 = Church of the Ascension, Kolomenskoye; 72 = Ensemble of the Ferrapontov Monastery; 73 = Ensemble of the Novodevichy Convent; 74 = Wooden Churches of Kizhi Pogost. *Serbia*: 75 = Studenica Monastery. *Slovakia*: 76 = Wooden Churches of the Slovak part of the Carpathian Mountain Area. *Spain*: 77 = Burgos Cathedral; 78 = Monastery and Site of the Escurial, Madrid; 79 = Cathedral, Alcázar and Archivo de Indias in Seville; 80 = Poblet Monastery; 81 = Route of Santiago de Compostela; 82 = Royal Monastery of Santa María de Guadalupe; 83 = Catalan Romanesque Churches of the Vall de Boí. *Sweeden*: 84 = Church Village of Gammelstad, Luleå. *Switzerland*: 85 = Benedictine Convent of St John at Müstair; 86 = Convent of St Gall. *Turkey*; 87 = Great Mosque and Hospital of Divriği; 88 = Selimiye Mosque and its Social Complex. *Ukraine*: 89 = Kiev: Saint-Sophia Cathedral and Related Monastic Buildings, Kiev-Pechersk Lavra. *United Kingdom*: 90 = Durham Castle and Cathedral; 91 = Westminster Palace, Westminster Abbey and Saint Margaret's Church; 92 = Canterbury Cathedral, St Augustine's Abbey, and St Martin's Church something else, holding a second layer of meaning. Semiotics recognised that there are usually several layers of meaning (Barthes, R. 1995) within a sign system and they are bound in culture and context. Semioticians set out that the meanings of sign structures are not inherent and universal, but they are arbitrary and established through particular social conventions.

The Swiss linguist, Ferdinand de Saussure (1978) coined the term 'semiology' in linguistic studies analysed the sign as created by the relationship between the signifier (a word) and the signified (the object or concept). However, the interpretation of signs could be dated back to the Graeco-Roman period, represented by the etymology of the word itself, since 'sign' derives from Gr. *semeion*. Texts, representations, icons and places related to world religions, including Christianity, are heavily interwoven with signs and symbols interpreted by Christians. Cohen, E. (2008) referring to research on Jewish adolescents highlighted that symbols are important in representing ethnic and religious identities.

As Echtner, M.C. (1999) observes the applications of semiotics in tourism research are still focusing on the system of signs and the layers of meaning applied to tourism marketing. Knudsen, D.C. and Rickly-Boyed, D.M. (2012) in their recently published research note on tourism sites debate on the conceptualisation of tourism as performance and the role of semiotics related to authenticity. Their findings are relevant to the examination of the complex system of signs applied for the promotion of a pilgrimage route evidencing place authenticity (Belhassen, Y. *et al.* 2008). Belhassen, Y. *et al.* argue that physical features of place and the socio-political context for its understanding, especially in the case of pilgrimage, are deeply influenced by the interconnections between human experience, perceptions and social meaning.

## Geographical scale of religious sites

Throughout Europe there are numerous pilgrimage sites which attract pious believers and secular tourists as well. The range of attraction of those sacred sites can be international, national, regional and local level. The term religious tourism according to the officials of the Roman Catholic Church in Europe is used to refer to all travels directed to destinations associated with Roman Catholic faith. That system encompasses a range of holy places, great cathedrals, monasteries, rural chapels as well as the service facilities associated with those sacred sites, religious rituals, ceremonies, choir performances etc. (Nolan, M.L. and Nolan, S. 1992; Rinschede, G. 1992)

The geographical characteristics of religious sites are extremely determinant for two reasons, on one hand, numerous sacred sites have become the economical resource for regional development (Gatrell, J.D. and Collins-

Kreiner, N. 2006). Highly evolved pilgrimage centres have an international catchment area and they usually represent the main economical engine for the villages and their surrounding areas. International airports operate to meet the tourism requirements of pilgrims, for example in Lourdes located in southern France; in the small Irish city of Knock; in Fátima in Portugal and in Santiago de Compostela in northern Spain.

On the other hand, the use of space is influenced by heavy infrastructural development and constructions but the aim is still to conserve place identity and evidence the holiness of the site. Ambrósio, V. (2003) elaborated different categories of shrines and religious tourist attractions according to their visitor numbers and religious functions. Three major categories were identified:

1. Pilgrimage shrines both with low (Fátima in Portugal) or high (Burgos in Spain) value as tourist attractions, shrines with pilgrimage events (St. Torcato in Portugal).

2. Religious tourist attractions (ecclesiastical structures, famous cathedrals and monasteries).

3. Sites of religious festivals (Holy Week and Corpus Christi processions).

With the aim of providing religious services and tourism facilities, a significant sum has been spent on the construction of local airports, on road networks, accommodation services such as hotels, apartments, transport and on health care for pilgrims and tourists alike. The level of commercial development located in the large surrounding area of a shrine exceeded in some cases the carrying capacity of the place. The overcommercialization of some sacred sites, as in the case of Lourdes and Santiago de Compostela, might have a negative influence on pilgrims' experiences once at the places in question. Some pilgrimage sites have become extremely popular and they attract hundreds of thousands of pilgrims and tourists from all over Europe and in some cases even from outside of Europe.

Large shrine complexes constructed in small communities generate a significant place transformation and they also influence the socio-economical and natural environment. The small and remote village of Međugorje in Bosnia-Herzegovina has recently been discovered as a sacred place (Vukonić, B. 1992) but the increased number of pilgrims and visitors has transformed the place. Vukonić, B. (1992) noted that the parish office estimated the arrival of 3,000–5,000 people in Međugorje each day. According to recent statistics, a total of 47,500 holy communions were distributed in January 2013 (www.medjugorje.hr). The popularity of the site is in part due to the Catholic press which spread 'news' of the Virgin Mary's appearance and of some miraculous healing cases said to have been experienced in Međugorje. Sites can be arranged in a hierarchy according to the size of their catchment areas. The small village in Bosnia-Herzegovina has definitely a global catchment area since pilgrims arrive not only from Europe but also from the United States of America, Argentina and Japan.

### Invisible tourism and its aspects in religious tourism

The conceptual framework of invisible tourism includes all those travels which could be positioned in the liminal zone of conventional tourism activities. Short-term tourism distinguishes itself by spatially limited travels and short stays (Brand, H. *et al.* 2008; Glinos, I. *et al*. 2010). Same-day visitors who stay less than 24 hours at a destination cannot be registered at public accommodation services and they are invisible to official tourism data collection. Tourism consumption of invisible tourists can be identified despite the statistical gap. Religious tourism in Central and Southeastern Europe, and in particular in Hungary, usually attracts only one-day visitors. The distance between the travelers' home and the religious site is relatively short. Those one-day domestic travels elude the official survey system and for that reason it is difficult to measure the importance and the range of religiously motivated travels.

The organisational form of religious tourism highlights new aspects of invisible tourism. Shinde, K. (2012) notes that the contemporary religious tourism industry evolved from traditional pilgrimages and religious actors continue to drive the industry by providing transportation and accommodation services along with religious services during the journey and at the destination. People travelling alone along a pilgrimage route or visiting a sacred shrine by themselves are extremely rare, they represent the minority. Undertaking a journey to a sacred site and participating in a pilgrimage evokes interactions with other fellows. For this reason people on a religious trip generally prefer to belong to a large or a small group of organized pilgrims. The pilgrimage groups are mostly organized by offically credited travel agencies, however, tours for fellow believers are often organized by parishes, dioceses, youth groups, schools or senior clubs. In this case, commerical activities related to religious tourism remain invisible and hidden since they fail to meet the offical requirements of tour organization.

Tour organization for pilgrimage groups by parishes or dioceses has historical roots. In Poland, for example, following the end of the Second World War and during the decades of Soviet state control, pilgrimages were secretly organized at national and local level. The communist authorities tried to weaken the influence of the Church and they systematically refused to give permissions for group travels especially to pilgrimage sites (Jackowski, A. and Smith, V.L. 1992). In Poland, the Catholic Church represents one of the strongest elements of Polish nationalism and identity and one which could not be oppressed by communist rule. Pilgrimages to Kalwaria Zebrzydowska and to Częstochowa were organised illegally.

Furthermore, as Nolan, M.L. and Nolan, S. (1992) highlighted in their research on pilgrimages, invisible tourist activity is also present on the supply side. Religiously motivated travels like all tourist activities which last more than one day need tourism related services. In the case of pilgrimages organized by parishes or dioceses, sometimes private homes offer accommodation and food for religious tourists. At the pilgrimage site of San Sebastian de Garabandal, in northern Spain and in San Damiano, in northern Italy, which are geographically small and hidden pilgrimage sites, service facilities are sponsored by nonprofit groups.

## The geographical and historical context of Hungarian religious tourism

During the last century, in the historical turmoil, populations living in Central and Southeastern Europe witnessed several political, social and economical changes having a great influence on people's private lives as well. Since the outbreak of the financial and economic crisis in 2008, general living conditions have continued to worsen in these countries where social fragmentation and the dissolution of family ties due to the emigration of relatives and friends have had a great influence on the quality of life of individuals (Egedy, T. 2012).

The relationship between the State and the Catholic Church has faced several conflicts. The tragedies of the 20th century, the two world wars, the right and left wing dictatorships and the establishment of the Communist political system significantly affected the role of the Catholic Church in those countries (Romsics, I. 2005). After the end of the First World War, the aim of the short-lived Hungarian Soviet Republic in Hungary was to mop-up the Catholic Church. Under the terms of the peace-treaty imposed on Hungary, the country lost a great part of its territories and population which made the devastation of the war even more tragic due to Hungary's new borders and her contested role within the region (Kocsis, K. and Váradi, M.M. 2011). During the period between the two world wars, the State and the Church worked in symbiosis in order to reconstruct the country from its ashes. The position of the Catholic parties in politics was highly significant (Irimiás, A. 2009) since the aim was to build a national and Catholic country. The relationship between the State and the Church changed drastically some years later.

Following the end of the Second World War, Hungary was "liberated" by the troops of the Soviet Union and the establishment of the Communist political and social system began in 1947. The Church became one of the main enemies of the system therefore it had to endure several punishments during the Communist dictatorship (confiscation of properties, schools, institutions etc.). Religion was banned and many (politically active) priests, friars and even the cardinal were persecuted (Romsics, I. 2005). In 1989 following the fall of the Berlin Wall and with the change of the socio-political system in Hungary, the Church started to regain its power and influence.

The "rebirth" of the Catholic Church and faith and the rediscovery of the cultural and religious heritage related to Maria, the patron saint of Hungary, highlight the importance of this study. The Via Maria pilgrimage route is 1,400 km long and it connects the sacred and cultural heritage sites related to the Virgin in the Carpathian Basin. The Hungarian regions have several socio-economic and regional differences (Kovács, Z. 2004) which might influence the pilgrimage experiences along the route. One of the aims of the founders and managers of the route was to attract not only devout pilgrims but tourists as well. Since the route is set mainly in forests and in conservation areas far from urban centres, it presents some implications to develop sustainable tourism along the route. Pilgrimage is strongly linked to sustainability since it promises not only physical but spiritual well-being too. In the case of the sacred site of Mátraverebély-Szentkút, the function of the holy well is embedded in the need of pilgrims to search for something material which is believed to have healing power because of its holiness.

The cult of Maria began in the 12th century and spread rapidly. It has had a great influence in Hungary since Maria is the patron saint of the country. Originally, Marian shrines included such relics as hair, bits of clothing and milk, however, later the relics were replaced by statues of the Virgin as objects of devotion. The small Maria statue of Szentkút is considered to be special, so its clothing and hair are taken care of and the statue is adored for its power to cure infertility of women. The devotion to Maria became localized in a number of specific places, and people accepted the plurality of Virgins. Mary's gender, some think, plays an important role in her appeal. Concepts perceived to be feminine such as motherhood, faith, tenderness, forgiveness and hope are represented by the Virgin. The model to establish the Via Maria pilgrimage route was the Camino towards Santiago de Compostela, however, the managers of the route underlined the specificity of Via Maria, since it is a female pilgrimage route opposed to the masculinity of the Camino.

## Methodology

The research on this recently established Via Maria pilgrimage route in Hungary is concerned with applied implications of the phenomena of sustainable tourism and management of religious tourism sites. The geographical perspective highlights the importance of place and landscape since the route leads mainly through protected natural areas and is connected to already existing trekking paths. The relationship of sites, location and images of the sacred place of Mátraverebély-Szentkút were analysed applying, in part, the methodology used by semioticians to understand the different layers of meaning to a place. Data on the routes of movement, the catchment areas of pilgrims and the size and scale of pilgrimage were obtained from secondary sources published by the managers of the route itself.

In 2012, field research was conducted at one of the major stations of the route, Mátraverebély-Szentkút, which is a holy well for Christian devotees. The methodology of observation was applied documenting the pilgrims' movements, clothing and the rituals during the mass celebration by taking photographs and notes. Moreover, some pilgrims were interviewed informally on the spot. The shrine was visited several times during the summer of 2012 on Sundays when the holy mass was celebrated for pilgrims. The calendar of the mass celebrations is published online by the Friars on the site3. The dates of mass celebrations are linked to Catholic festivities, however, the most important patronal festival is dedicated to Saint Anne on 28–29 July. At Szentkút, several pilgrimages and patronal festivals are organised for different target groups such as children, the elderly, young couples, single persons etc. Special events, especially festive pilgrimages involving folkloric expressions, draw a highly mixed crowd of participants and visitors to the shrine. Since pilgrims' motivations can vary and the "thematic" patronal festivals address different target groups, several site visits were needed during the research.

## Findings (case study of Szentkút)

This section sets the Mátraverebély-Szentkút phenomenon within the historical context of journeys taking place over the last several centuries in Hungary for the purpose of obtaining redemption from sin or cures for infertility. At that pilgrimage site, pilgrims pray to Mary that she will intercede for them. The Via Maria route *(Figure 2*) traverses northern Hungary, an interior region of rural tourism.

The need to mark and authenticate sites of importance to the Catholic history of Hungary connecting specific locations to the pilgrimage route like Mátraverebély-Szentkút was the basis for the establishment of the trail *(Photo 1).* Mátraverebély-Szentkút is a shrine close to the Hungarian-Slovakian state border located in a hilly region. Similarly to other places of worship managed historically by Franciscans, Szentkút has always been a common place to meet different people. Franciscan monasteries have always been multiethnic and the church services were delivered in the mother tongues of the people.

This sacred site is a highly relevant place in Hungarian history because of its legends related to Ladislaus I of Hungary, a chivalrous king in the 11$^{th}$ century. In 1091–1092, King Saint Ladislaus, according to the legend, was escaping from his enemies when he reached a precipice which forced him to stop and make his horse jump over the precipice. When his horse jumped, miraculously, a well

[3] www.szentkut.hu


*Fig. 2*. The Via Maria pilgrimage routes in Central and Southeastern Europe, 2012

Stations of the Częstochowa–Međugorje (North-South) route: *Poland*: 1 = Olsztyn; 2 = Karlin; 3 = Krzeszowice-Kamien; 4 = Kalwaria Zebrzydowska; 5 = Jordanów; 6 = Orawka. *Slovakia*: 7 = Oravský Podzámok (Árvaváralja); 8 = Ružomberok (Rózsahegy); 9 = Liptovská Osada (Oszada); 10 = Staré Hory (Óhegy); 11 = Banská Bystrica (Besztercebánya); 12 = Zvolen (Zólyom); 13 = Banská Štiavnica (Selmecbánya); 14 = Hontianske Nemce (Hontnémeti); 15 = Plášťovce (Palást). *Hungary*: 16 = Kemence; 17 = Márianosztra; 18 = Esztergom; 19 = Dobogókő; 20 = Márianosztra; 21 = Budapest-Máriaremete; 22 = Szigetszentmiklós; 23 = Ráckeve; 24 = Dunavecse; 25 = Solt-Kalimajor; 26 = Kalocsa; 27 = Fajsz; 28 = Szekszárd; 29 = Ófalu; 30 = Püspökszentlászló; 31 = Pécs; 32 = Máriagyűd. *Croatia*: 33 = Donji Miholjac; 34 = Beničanci; 35 = Našice; 36 = Čaglin; 37 = Podcrkavlje. *Bosnia and Herzegovina*: 38 = Kolibe Gornje; 39 = Derventa; 40 = Kotorsko; 41 = Doboj; 42 = Maglaj; 43 = Žepče; 44 = Nemila; 45 = Zenica; 46 = Novi Travnik; 47 = Bugojno; 48 = Kupres; 49 = Šujica; 50 = Donji Brišnik;

*Photo 1*. Pilgrimage to Szentkút, 2012 (Photo by Irimiás, A.)

←

51 = Corići; 52 = Široki Brijeg. Stations of the Mariazell–Şumuleu Ciuc (Csíksomlyó) (West-East) route: *Austria*: 1 = Terz; 2 = Höllental; 3 = Schottwien; 4 = Unterberg; 5 = Rattersdorf. *Hungary*: 6 = Kőszeg: 7 = Csepreg; 8 = Csénye; 9 = Sárvár; 10 = Celldömölk; 11 = Mihályháza; 12 = Attyapuszta (Pápa); 13 = Bakonybél; 14 = Csatka-Szentkút; 15 = Bodajk; 16 = Majkpuszta (Oroszlány); 17 = Nagyegyháza (Felcsút); 18 = Zsámbék; 19 = -Máriaremete (Budapest); 20 = Szent Anna-rét (Budapest); 21 = Rákosszentmihály (Budapest); 22 = Máriabesnyő (Gödöllő); 23 = Petőfi-forrás (Bag); 24 = Ecséd; 25 = Kisnána-Eger; 26 = Kács; 27 = Miskolc-Görömböly; 28 = Mád; 29 = Tarcal; 30 = Tokaj; 31 = Rakamaz; 32 = Nyíregyháza; 33 = Napkor; 34 = Máriapócs. *Romania*: 35 = Foieni (Mezőfény); 36 = Tiream (Mezőterem); 37 = Tăşnad (Tasnád); 38 = Carastelec (Kárásztelek); 39 = Şimleu Silvaniei (Szilágysomlyó); 40 = Zalău (Zilah); 41 = Hida (Hidalmás); 42 = Şărmaşu (Nagysármás); 43 = Fânaţele Mădăraşului (Hidegvölgy); 44 = Târgu Mureş (Marosvásárhely); 45 = Valea (Jobbágyfalva); 46 = Sărăţeni (Sóvárad); 47 = Praid (Parajd); 48 = Suseni (Gyergyóújfalu); 49 = Cârţa (Karcfalva)

sprang up on the spot. This legend and the king's great achievements provided the basis to elaborate a literary figure of him. An image, according to which Ladislaus can be compared to Moses emerged. It is believed that the Hungarian king is the one who brought order to his people through his laws like Moses did with the Commandments to the Hebrew people. Springs of mysterious origin are common in Catholic history. Water has a high importance in religions throughout the world. Water, as a literature *topos* as well, means cleanness, purity and regeneration. That interpretation is present in the case of Szentkút, since it is reflected in the location's name itself, Szentkút means a 'Holy well'.

The well is thought to have healing forces. The first event of a miraculous recovery (from an illness) at Szentkút was dated back to the 13th century when the Holy Mother with her son in her arms appeared to a mute shepherd. During her appearance, Maria told him to dig (a hole) into the soil and drink the water of the spring he would find there. The boy obeyed her and was cured miraculously, his ability to speak being given back to him.

Pilgrims started to construct a church in the village of Mátraverebély around 1210 from where a procession was organised to the holy spring at Szentkút (about 4 km away from the village inhabited mainly by a Roma population). The Church recognised the holiness of the place (crediting the miraculous events to it) and since 1400 has afforded the shrine the highest benefits. In 1700, Pope Clement XI ordered the detailed analysis of some miraculous healing events at Szentkút following which he declared that those were all authentic. Deep in the surrounding forests there are some hermit's abodes, still open to tourists, which were used by hermits until the second half of the 18th century. Traditionally, the Franciscans were the inhabitants of the monastery and the shrine was still flourishing in the period between the two world wars. However, its evolution was sharply stopped by the system of Communist rule. In 1950, the Friars were expelled by the Communist dictatorship, the monastery was overtaken by the state and it was made to become a home for the elderly. The Franciscans could only come back to Szentkút in 1989 when the Communist system collapsed and they had the opportunity to purchase their once owned properties which they started to develop and restore to their former glory.

The tradition of pilgrimage on foot has become reinforced since the beginning of 1990's. The shrine attracts devotees from a distance up to 150 km. In 2006, the shrine was declared to be the most significant place of worship by the cardinal who entitled it as a National Shrine. Not only pilgrims but also cultural tourists visit the shrine and their visits frequently embrace a subconscious emotional dimension as well. Various reasons have been put forward for the recent resurgence in pilgrimage to Szentkút and other shrines. The phenomenon should be viewed not only on a personal level but taking in consideration the social, cultural, political and economic environment.

This place of worship unlike other significant pilgrimage sites in Europe devoted to Mary could not be developed because of the forty years of Communist rule in Hungary and in Central and Southeastern Europe in general. However, in 2012 more than 200,000 pilgrims visited the shire and the holy well to enjoy the wild beauty of nature and to feel the Holy presence during the mass service and to find alleviation through confession and during prayer.

There is a long tradition of mixing the sacred and the secular at pilgrimage sites in Western Europe. It is similar in Central and Southeastern Europe as well and visitors are impressed by the contrast between piety and commercialism, between serenity of religious worship and the chatter of a festival. During the field observations, that contrast was evidenced delineating a clear geographic aspect of space where two distinct areas could be distinguished. The profane space is nearby the main route with small shops selling souvenirs, toys, devotional objects and bottles of holy water along with street vendors of hamburger, sweets and, in small amounts, alcohol. While the sacred space is restricted to the area that surrounds the basilica minor, the confessionals (12 ones), the grotto (cave) and the holy well. Tourism consumption, buying memorabilia, postcards and toys were practiced by pilgrims and many of them took home several bottles of holy water from the well.

There are two types of pilgrims who come for mainly religious purposes: the ones who come with an organised group, usually organised by their own congregation or group of students organised by their school, and the individuals and families. Today pilgrims come by bus, by private car or on foot. The pilgrimages are organised by dioceses or by local parishes. Schools are the most important tour organisers of groups for the ceremonies dedicated to children and young students. In July, during the fieldwork, labourers and rural, elderly people were strongly represented among pilgrims. The majority of them were women and two-thirds of them were over 60. Although many, if not all visitors, consider themselves to be pilgrims, others would call themselves tourists (informal interviews on site).

At Szentkút, one of the most significant moments of the pilgrimage is the confession. Pilgrims often come from small communities, from villages where they know each other's private lives. From the interviews with the Friars, it turned out that many pilgrims wanted to confess their sins to someone other than the local parish priest. Confession is also considered to have purifying effects. Since medieval times, there has been a common belief that physical diseases might have spiritual causes (such as sin) and the specific goal of a religious pilgrimage, in the past and today as well, has been a cure for diseases. As emerged from the informal interviews with pilgrims, landscape and the peaceful natural surrounding have a relatively important role in the healing process. Szentkút is enclosed in a spectacular natural beauty, it is relatively isolated, far from urban centres and human activities. Pilgrims affirmed that the location of Szentkút and its deep connection to nature enhances the pilgrimage experience, along with the perception of intimacy with the patron saint and the physicality of the holy water, to be a sacral one. Drinking water from the holy well reinforces the spiritual experience and makes the pilgrims feel that they have done something to their health.

## Conclusions

The Via Maria pilgrimage route is an artificially constructed trail linking the sacral and the secular heritage sites related to the Virgin in Central and Southeastern Europe. The establishment of the pilgrimage route, based on the example of the UNESCO World Heritage route El Camino, was the first initiative in the region to bring together pilgrims and tourists to visit the religious and cultural sites of the Carpathian Basin. The route has a particular resonance in itself during the Communist period religion and religious activities were banished and they had to be practiced illegally. The properties of the Church were confiscated and priests were persecuted. However, some shrines and sacral places linked to the devotion of Maria managed to function also during the Communist period. The rebirth of the Catholic Church can be dated back to 1990. Sacred sites are socially constructed as sacred and they are accepted by believers to have a special power on individuals' lives. The Virgin Mary is considered to be a holy figure who alleviates pain, offers hope and cures infertility. However, the importance of Szentkút also has national historical roots linked to one of the Hungarian kings.

Pilgrims and tourists who visit sacred sites may experience intense personal, emotional experiences which are mediated by the visitors' beliefs. Since the pilgrimage route Via Maria has been recently established the management of the route has applied signs and symbols to delineate the path (the pictogram indicating the Via Maria depicts a male and a female pilgrim on their way) and the route in some places coincides with previously lined trekking routes. The aim of the managers and organisers of the pilgrimage route was to attract believers, pilgrims and tourists as well. However, some implications (e.g. the conservation of natural protected areas) to sustainably manage the route has to be faced. Sacred sites as Szentkút, one of the most important shrines on the route, seem to have succeed in managing the massive arrivals of pilgrims. On Sundays 4,000–5,000 pilgrims attend the mass services and participate the patronal festivals. The shrine and the holy well can only be reached on foot. All vehicles are banned from the site and must be parked near the basilica minor.

Sustainability is one of the key factors in the development of the pilgrimage route since the landscape and natural environment are key attractions along the route. The conservational areas located in a beautiful natural environment are tourist attractions as well. Moreover, it was outlined by the interviewed pilgrims that the beauty of landscape was perceived to have some healing effect on them and reinforce the spirituality of their experience. During the communist era religiousness was banned. Faith could be practiced privately or illegally and this process had a great effect on individuals' perception and their relationship with the Church. During the field research at Szentkút it has been observed that the communication of the Friars during the mass services were continuously referring to the past years dominated by Communism. The Friars tenderly addressed the pilgrims and the common participation at the mass service created a friendly, almost a familiar atmosphere. It has emerged from the informal interviews that pilgrims had felt alleviated after the ceremony and their perception of well-being had changed in a positive way.

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# Commuting patterns of secondary school students in the functional urban region of Budapest

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## Abstract

Children's regular travel to school is the third most important travel purpose in Hungary. While commuting to school has been studied from several aspects, there has been little research carried out on the differences in demand for and supply of schools in the functional urban region (FUR) of Budapest. The objective of this study is to explore the potential imbalance between demand for secondary education and the supply of schools within the social activity space of education in the functional urban region of Budapest and analyse the regional patterns of the resulting commuting. An expansion of the definition of commuting to daily travel to school is suggested based on the fundamental similarities to commuting to work. The analysis is carried out on two levels combining municipality level and household data from a household survey in the functional urban area of Budapest. The results show that the increasing imbalance between regional demand and supply has led to a spatial imbalance within the functional spatial structure of education. The inconsistency between demand and supply has been growing in the past 20 years and resulted in more intensive commuting. The pattern of commuting has not changed, though. As opposed to commuting to work, the dominance of Budapest as a commuting destination has increased. A connection between commuting characteristics and the educational qualifications of the parents, family income and car ownership has also been demonstrated. The results show that socio-economic changes due to suburbanisation in the functional urban area might lead to increasing commuting to Budapest and to a growing car use.


**Keywords**: urban region, commuting to school, secondary schools, surburbanisation

## Introduction

Social space is understood by the Munich school of social geographers[2] as a series of activity spaces which are interconnected in a number of ways, e.g.

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[2] Social geography and social geographers will be understood as the followers of the Munich School of "Sozialgeografie" in this study.

Partzsch (1964), Ruppert and Schäffer (1969) (in Berényi, I. 1997). Those activity spaces are linked to the fundamental functions of social activities[3]. One of the basic social geographical functions is *education, training* and *culture*. It is concerned with the availability of the institutions providing such services and the spatial movements some groups of the local society have to make in order to access them. The availability of educational institutions is spatially uneven. The supply of and the demand for education are major determinants of spatial activities within the educational functional space (Berényi, I. 1997).

When a qualitative or quantitative imbalance between demand and supply persists, certain members of the local society have to travel regularly between the place of residence and the place of education. That movement connects two social geographical functions: *living*, i. e. the residence of students and *education*, the activity they wish to pursue. In most cases, a third basic function, *transport* provides the connection between the two if the place of residence and education are not at the same location.

In case of education, there is a controversy over how the regular movement of people should be referred to. In the majority of the literature (Gordon, P. *et al.* 1991; Van Ommeren, J.N. 2000; Schwanen, T. *et al.* 2004; Sohn, J. 2005; Aguiléra, A. 2005; Helminen, V. *et al.* 2012) and official statistics (Department for Transport, 2010; United States Census Bureau 2012), commuting has traditionally been identified with regular travel to work. In most cases, that has been the case in Hungary, as well (Kapitány, G. and Lakatos, M. 1993; Szabó, P. 1998; Illés, S. 2000; Lakatos, M. and Váradi, R. 2009; Bartus, T. 2012) with the restriction that the definition of Hungarian statistics restricts commuting to home-to-work journeys crossing municipality borders (KSH 2007, 2008). In a number of countries (e.g. Austria, Germany and Switzerland), however, statisticians distinguish between student and employee commuters (Statistisches Bundesamt, 1991; Bundesamt für Statistik, 2005; Statistik Austria, 2012).

According to Bőhm and Pál's research carried out in Hungary in the 1970–80s (Bőhm, A. and Pál, L. 1979, 1985), (employment) commuting emerges when the following four conditions prevail:

– a qualitative or quantitative mismatch of the demand and supply of workforce in the sending settlement,

– vacant jobs in the destination settlement,

– suitable transport connections between the two settlements,

– travel time to the other settlement should be acceptable for the commuter.

[3] According to Partsch (in Berényi, I. 1997) the basic social geographical functions are: work; living; services; education, training and culture; transport and communication; leisure time activities; and the local community.

Our opinion is that a student's daily travel to school is fundamentally similar to commuting to the workplace as it conforms to Bőhm and Pál's criteria. Therefore, if we transcribe the above criteria to students, commuting to school emerges if:

– educational services are not available in the sending settlement at all or not in the required specialisation or quality;

– destination settlements need to have available places at schools;

– a transport connection and especially public transport is necessary between the settlements;

– travel time should be acceptable for the students.

Notwithstanding the differences, we think that daily travel to school is fundamentally similar to daily commuting to the workplace. Based on the fundamental similarities between regular travel to work and school, for the ease of understanding, I will, henceforth refer to daily travel to school as *commuting to school* or *school commuting* as opposed to *commuting to work* or *employment commuting.*

Children's regular travel to school is the third most important travel purpose after travelling to work and shopping in Hungary (KSH, 2010). In 2010, 64,953 primary and secondary school pupils, 20% of all students studying at schools in the functional urban region (FUR) of Budapest commuted daily.

The decision made usually at the age of 13[4] about the choice of secondary school is fundamental regarding commuting. The choice of the secondary school determines commuting distance, travel time and very often travel mode, as well. School choice is a process of contemplating several different options based on a complex set of criteria (Bowe, T. *et al.* 1994). The possible factors that play a part in the decision are as follows:

– parents' considerations usually based on their own socio-economic and educational background,

– interests of the child,

– school performance of the child,

– availability of schools in the vicinity of the residence,

– required specialisation (languages, technical, professional etc.),

– opinion about local and nearby schools,

– affordability of commuting or hall of residence.

In Scotland, specialisation of schools is a key aspect of school choice and commuting (Derek Halden Consultancy, 2002). Research carried out in Dresden has shown that parents choose schools that are further off from their home if the school offers a special profile or above-the-average quality of teaching (private schools) (Müller, S. *et al.* 2008). In Hungary, bilingual gram-

[4] There are also 8 and 6-grade grammar schools which pupils attend from the age of 10 and 12 respectively. The majority of secondary schools are, however, 4-grade schools attended by the age group 14–17.

mar schools are good examples of institutions attracting students from a wide area. 6 and 8-form grammar schools are considered to offer the best education, especially in Budapest where they provide education for the elite (Balázs, É. 2005). There is also a preference towards church schools and some privately operated schools (e.g. international schools). It has been shown that non-state schools have a higher proportion of higher-status students and attract more commuters (Neuwirth, G. and Horn, D. 2007).

In recent years, there has been increased attention to children's commuting from different aspects. Andersson, E. *et al.* (2012) examined children's travel-to-school distances in Sweden, while Halás, M. *et al*. (2010) and Hołowiecka, B. and Szymańska, D. (2008) used students commuting data to determine functional urban areas. Several studies investigated the travel behaviour of students concentrating on mode choice (Wilson, E.J. *et al*. 2007, 2010; McMillan, T.E. 2007) and the health consequences of travelling to school by car (Hillman, M. 1997; Cooper, A.R. *et al.* 2003).

In Hungary little research has been carried out on student travel. The topic has been studied primarily by educational researchers investigating the relationship of student commuting and primary school segregation (Kertesi, G. and Kézdi, G. 2005a,b), and the effects of free choice of schools on mobility (Econmet Kft. 2008; Andor, M. and Liskó, I. 1999). Transport researchers have primarily approached students' travel to school with a focus on traffic safety (Nemzeti Közlekedési Hatóság, 2009). Due to the limited availability of data, regional differences between commuting to school were studied at an aggregate level. Garami, E. (2003) and Balázs, E. (2005), for example, investigated the regional differences in commuting to school at county level.

While the metropolitan area of Budapest has undergone fundamental spatial changes in the past 20 years, there has been no research carried out on the potential linkages between that transformation and changes in the commuting patterns of students. According to Berényi, I. (1997), social geographic space changes dynamically through the activities of social activity groups. Economic and social changes may influence the behaviour of those activity groups, which can lead to spatial instability. The transformation of the functional spatial structure is slower than that of the society, which may lead to inconsistencies between the availability of the basic social geographic functions and the requirements of the changing society.

One of the most significant spatial, social and demographic changes around Budapest is the large scale residential suburbanisation taking place since the 1990s. Budapest lost a significant proportion of its young population, while smaller municipalities in the FUR have undergone considerable socio-economic changes (Kovács, K. 1999; Dövényi, Z. and Kovács, Z. 1999, 2006; Szirmai, V. *et al*. 2011). In those municipalities, the number of young residents and the socio-economic status of the population increased. It can be assumed that this process had major consequences on several socio-economic functions and specifically on education. Such a phenomenon may increase commuting and the transformation of commuting patterns due to the imbalance between the supply of educational institutions and the requirements of the society.

There has been, however, no research carried out on the influences of spatial changes on school commuters in functional urban areas in Hungary, and sources elsewhere are also limited. Previous researches focused mainly on the influences of urban form on mode choice at a neighbourhood scale (Schlossberg, M. *et al.* 2005; McMillan, T.E. 2007; Larsen, K. *et al.* 2009; Lin, J.-J. and Chang, H.-T. 2009), while studies on the potential linkage between the location of homes and schools and school commuting are few in number (see e.g. Marique, A.F. *et al*. 2013).

The objective of this study is to explore how the supply of and demand for secondary school education has changed since 1990 and how it affected the commuting patterns of students. While it is in the nature of secondary education that there is an imbalance between the demand and supply, and hence commuting occurs, changes in the regional distribution of the secondary-school age population as well as the number and type of educational institutions may affect the extent and patterns of commuting. Consequently, an analysis of recent trends may highlight possible links between current spatial transformations and the commuting of students. Here has to mention that a sub-discipline of social geography, "social transport geography" emphasizes the need for analysis on less aggregate levels to study characteristics of spatial movements of different social groups based on household data (Tiner, T. 1986). According to Schwanen, T. *et al*. (2004), commuting in urban areas should be examined on multiple spatial levels to capture variations in travel patterns influenced by factors on different geographical levels.

As this research has been carried out as part of a comprehensive research on commuting of employees and students around Budapest, the study area covers the functional urban region (FUR) of Budapest. As no data is available on the home municipalities of commuters to school, data on commuters to work have been used to delineate the FUR. It covers all municipalities from where at least 15% of the population in employment commuted to Budapest in 2001[5] (Van den Berg, L. *et al.* 1982). This area is broader than the administrative category of the Budapest Agglomeration and extends beyond the boundaries of Pest County. The Budapest FUR incorporates 170 settlements with more than 2.8 million inhabitants, more than one-quarter of the population of Hungary. Although Budapest itself is part of the FUR, for the ease of understanding I, henceforth refer to all municipalities within the FUR outside Budapest as FUR (*Figure 1*).

[5] As the results of the latest National Census of 2011 have not been published in 2012, data on commuting from the previous Census carried out in 2001 have been used.

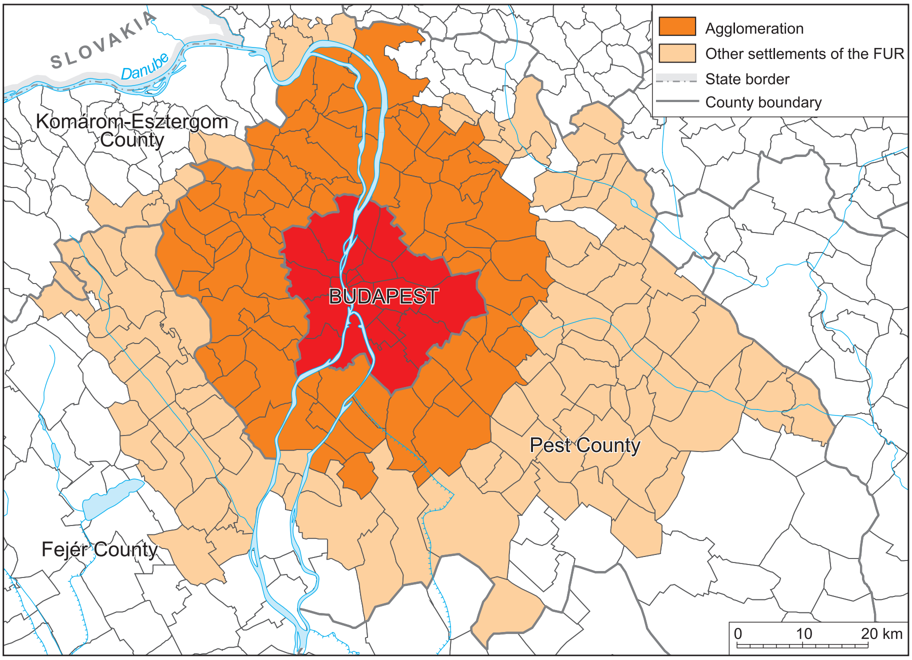


*Fig. 1.* The zones of the Budapest FUR

In the first part of the paper, the regional distribution of secondary schools in the FUR is analysed and changes in the school offer between 1990 and 2010 is investigated. The second section presents the analysis of changes in demand, i.e. secondary-school-age population. The last section focuses on changes in commuting patterns.

The analysis is based on data published by the KSH (Hungarian Central Statistical Office, HCSO) and the Office for Education (Public Education Information System available at www.oktatas.hu). The analysis is limited to students attending grammar and technical secondary schools as no municipality-level data are available on the commuting patterns of vocational school students.

## Supply of secondary schools

The supply of education is determined by the spatial distribution, quality, capacity and specialisation of schools. If certain levels of education are not provided in each locality, there is high likelihood that students need to travel daily to another settlement to attend school.

In Hungary, education is compulsory by law until the age of 18[6]. Pupils between the age of 6–14 are usually educated in primary schools (*általános iskola*). Secondary education is diversified: there are grammar schools (*gimnázium*) providing general education and the foundations to go on to university; they may also specialise on a certain subject area, for example language or arts. Technical secondary schools (*szakközépiskola*) are similar to grammar schools but they also focus on a special area (economics, printing, engineering, nursing etc.) providing a professional qualification. Vocational schools (*szakiskola* and previously *szakmunkásképző*) do not entitle students to go on to university but provide them with vocational qualifications (e.g. tailor, carpenter, machinery operator etc.).

After 1990, the secondary school offer increased rapidly due to increasing competition among schools for students in a race to compensate for the drop in school-age population, shrinking financial resources and the decline in demand for vocational schools (Lannert, J. 2004). This phenomenon occurred in Central Hungary (Budapest and Pest County) even earlier, therefore this region had a higher proportion of secondary school students compared to the national average already before 1990. Secondary schools also tried to diversify their educational offer by launching new specialisations and forms of education. Grammar schools often started technical classes, while former technical secondary schools introduced grammar school-type education[7]. By the end of the 1990s the proportion of schools offering solely one type of secondary or vocational education decreased to 30% (Garami, E. 2003).

Between 1990 and 1999, the number of secondary schools increased by 40% countrywide, while the number of vocational schools by 20%. The expansion was above the average in Budapest and Pest County (Garami, E. 2003). After 2001, the number of secondary schools continued to increase, although at a slower rate. Between 2001 and 2010 the number of grammar schools[8] increased from 51 to 70 (37%) in the FUR, while the number of grammar schools in Budapest increased from 169 to 183 (8%). The rise of the number of secondary technical schools was more moderate: from 45 to 51 (13%) in the FUR, and from 182 to 188 (3%) in Budapest.

Currently, 43 municipalities offer secondary or vocational education in the FUR of Budapest, as opposed to 163 settlements with primary schools. Secondary education is concentrated in Budapest with 183 grammar schools and 188 technical secondary schools[9]. Most schools are concentrated in the

[6] From 1 September 2012, education is compulsory until the age of 16. As my paper is based on earlier data this change does not affect the current analysis.
[7] Schools providing both grammar school and technical secondary school education will be referred to as mixed schools.
[8] The statistics reflect the number of school sites. A school can have several sites at different locations.
[9] Statistics include all school sites irrespective of the administrative centre of the school

inner districts as well as the Buda (western) side (Districts XI and XII). The outer districts in the eastern and southern side of the capital have few secondary schools; District XXIII, for instance, has only one grammar school. While technical secondary schools are concentrated on the (eastern) Pest side, there are more grammar schools in the districts of the Buda side (*Figure 2*).

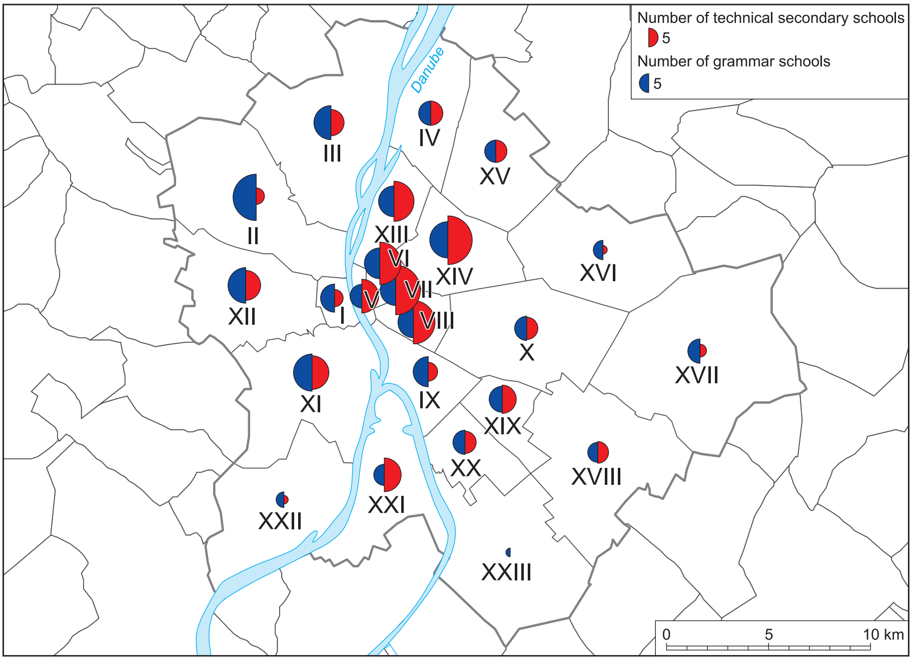


*Fig. 2.* The distribution of secondary schools in Budapest, 2010. *Source*: Own elaboration based on the HCSO Dissemination Database – Regional statistics: http://statinfo.ksh.hu)

There are 70 grammar schools and 51 technical secondary schools in the FUR. Larger towns in FUR usually have more than one secondary school (Vác, Gödöllő, Szentendre) (*Figure 3*), but there are some smaller towns that became centres for secondary education. Agglomeration town Szigetszentmiklós, for example, has a population of 26,662, but it has 36% more secondary school students than an other one, Érd with a population of 65,000.

Between 1990 and 2010, the number of full-time students[10] attending secondary school in the FUR increased by 114%. The growth was, however, not uniform. Four patterns of change can be identified. Firstly, a significant

as well as all branch institutions that provide full- or part-time education. Some of these branches are very small, and they may only have students in adult education.

[10] Wherever the dataset allows only full-time students are considered as they commute daily to school as opposed to part-time students who usually only commute weekly.

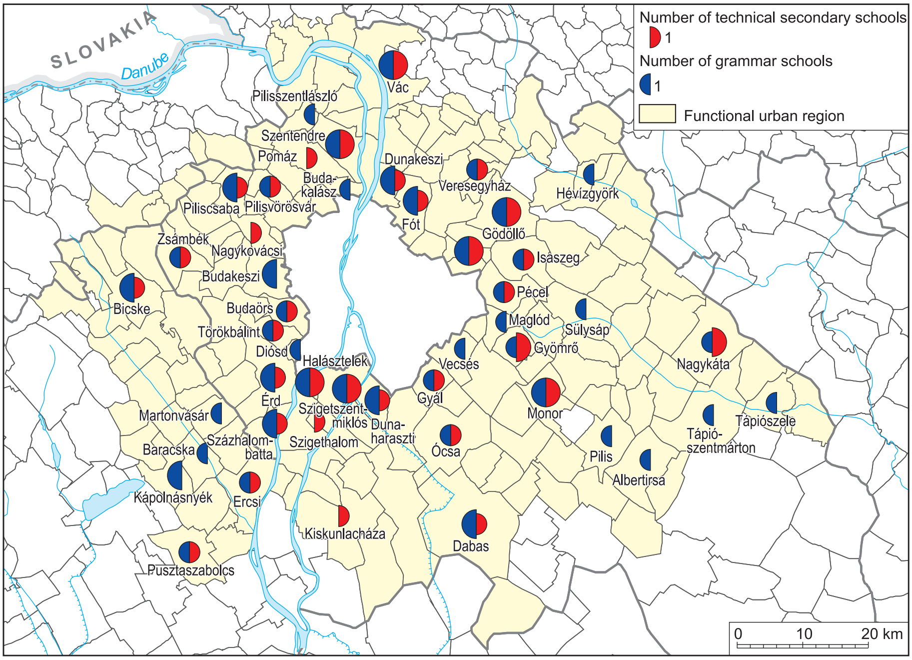


*Fig. 3.* The distribution of secondary schools in the Budapest FUR, 2010. *Source*: See *Fig 2*.

increase can be detected in the major towns of the FUR, which has established schools that had attracted a significant number of students even before 1990 (Vác, Szentendre, Gödöllő, Monor) (*Figure 4*).

Secondly, the number of students also increased considerably in a number of municipalities with smaller or fewer schools. They are easier to identify if we consider the percentage change of the number of students for each municipality between 1990 and 2010 (*Figure 2)*. Most schools other than the ones in the above-mentioned major towns had 200–300 students in 1990 which increased to 600–800 by 2010. These municipalities include Szigetszentmiklós (364% growth), Törökbálint (518%), Budakeszi (239%), Pilisvörösvár (204%), Piliscsaba (202%), Fót (116%), Százhalombatta (178%) and Ócsa (119%).

The third group of municipalities that increased the number of secondary school students at their schools did not operate a secondary school before 1990 (see shaded areas in *Figure 2*). Some of these new schools were opened by the church (Zsámbék); expanded an existing primary school with secondary school classes (Vecsés, Pomáz); were founded by a private organisation (International Christian School of Budapest in Diósd); or a public foundation (*közalapítvány*) that has close ties to the local municipality (Gyömrő, Isaszeg) (*Figure 5*).

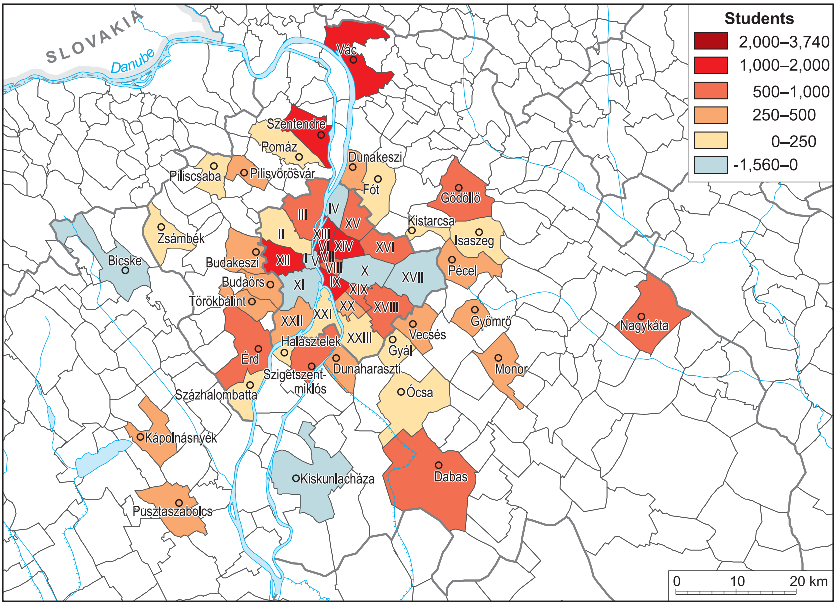


*Fig. 4*. Change in the number of full-time secondary school students 1990*/1995**–2010. *FUR, **Data for Budapest are only available from 1995. *Source*: See *Fig 2*.

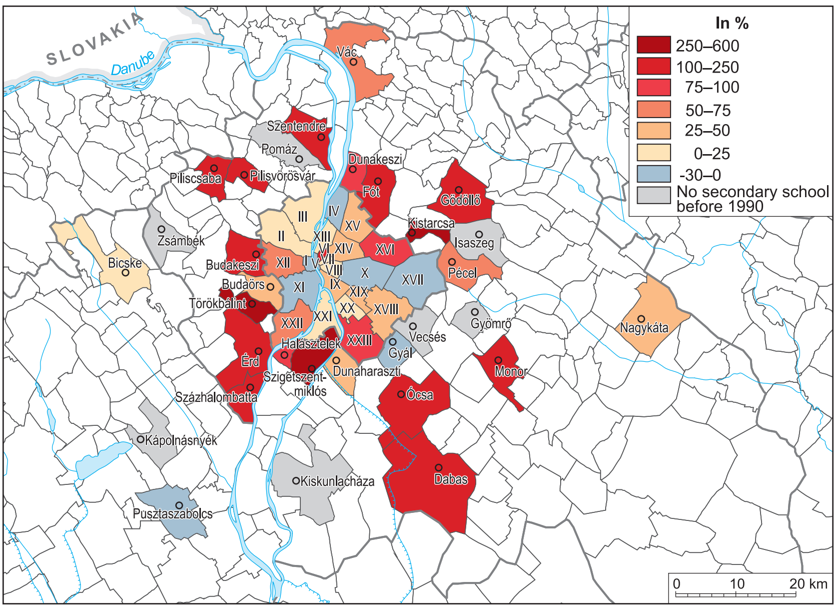


*Fig. 5*. Change in the number of full-time secondary school students, 1990*/1995**–2010 in %. *FUR, **Data for Budapest are only available from 1995. *Source*: See *Fig 2*.

In the fourth group of municipalities, the number of secondary school students decreased between 1990 and 2010. Some institutions even ceased operation. The technical secondary school in Kistarcsa, for example, was closed in 2011 because the local municipality did not have the resources to continue operation[11]. Students were taken over by the nearby schools in Aszód and Gödöllő. Some institutions maintained by public foundations were also closed down in Tök, Nagymaros and Páty. Apart from the secondary school in Kistarcsa, which was attended by 233 students when it ceased operation, the other schools that were closed down were small institutions with a low number of students so their closures did not affect the overall school offer of the FUR significantly.

In Hungary, secondary schools are usually operated by the state, municipalities, the church and other non-state organisations (foundations, private entities, private companies etc.). The ownership of the school is often a consideration when choosing a secondary school, because many of the church and private schools focus on elite education. The proportion of non-public schools is relatively low. In 2009, 79% of all secondary school students attended public schools, 9% church schools and 11% other non-state schools in the country. Their proportion is higher in Central Hungary and especially in Budapest than the national average.

The proportion of students attending non-state schools has been increased by 41% between 2001 and 2009 while the school-age population was shrinking (Balázs, É. 2011). It could mean that a further increase in the number of non-sate schools may also increase the overall rate of commuting.

Since 1989, there has been a proliferation of six and eight-form grammar schools usually within existing secondary schools. They attract 10- and 12-year olds from primary schools whose parents want to ensure that their children get good quality education paving the way to university at an early stage. Better student performance at these schools is indicated by results of competency tests (Neuwirth, G. and Horn, D. 2007). In 2009, students in 8-form grammar schools performed best in mathematics and reading comprehension, followed by 6-form and 4-form students (Balázs, É. *et al.* ed. 2011). In 2000, 9.6% of all applicants to secondary schools wished to attend a six or eight-form grammar school. In Budapest and Pest County, the proportion of such applications was higher than the national average (Balázs, É. 2005). In 2009, 10.3% of grammar school students has been attended 6- or 8-form schools in Budapest, while in Pest County covering roughly the area of the FUR, the proportion was even higher (14.5% compared to the national average of 9.4%).

[11] The closure of the school is not reflected on the maps as the latest statistical data available is from 2010.

The quality of teaching can also be a determining factor of school choice. There is a significant difference between the attractiveness of different grammar and secondary schools.

It is reflected by the results of students measured by a national competence test, the rate of admission to university, inter-school competition results, the number of students with language test certificates and the proportion of students admitted to higher education (Dugasz, J. 2011; Köznevelés 2010). Secondary schools often refer to these ratings in their promotional materials to attract the best students.

Students attending schools maintained by the church have the highest rate of admission to university education (63%), well above the national average (42%). Contrary to common belief, schools maintained by public or private foundations are the worst performers with only 30% of students admitted to higher education on average between 2001 and 2006. There is also a difference between school types (grammar school, technical secondary school, mixed school).

Grammar schools tend to have the best rates of admission to higher education (66%), followed by mixed schools (39%), and technical secondary schools (24%). Within grammar schools there is a difference between 4-, 6- and 8-form schools with the 6- and 8-form systems having higher admission rates (Neuwirth, G. and Horn, D. 2007).

The admission rates of schools both in Pest County (41%) and Budapest (37%) are lower than the national average (42%). Schools in Budapest, however, perform much better as regards study competition results; the proportion of students who receive a language certificate until leaving secondary school; the results of written admission tests to higher education; and results in mathematics and reading comprehension on the national competence test (Neuwirth, G. and Horn, D. 2007). If we examine the ratings of secondary schools, it is obvious that Budapest has the largest number of well-performing schools (*Table 1*).

*Table 1. Number of top rated schools in Budapest and the FUR*

| Area | Top rated schools* | | | |
|---|---|---|---|---|
| | grammar school | technical secondary school | mixed school** | Together |
| Budapest | 20 | 17 | 6 | *43* |
| FUR | 4 | 2 | 5 | *11* |

*Schools are in the best 10% based on admission to higher education, language skills and competition results
**Schools provide both grammar school and technical secondary school education
*Data source*: Köznevelés, 2010

## Demand for secondary schools

As opposed to school locations, data about the location of homes of secondary school students are not available. Commuting data published by KSH only indicate the place of school they attend. As education is compulsory for 6–18 year old pupils in Hungary, demand for secondary schools can be determined by the population of the age group 14–17 typically attending secondary education[12]. As 96.6% of primary school pupils go on to secondary or vocational education (Garami, E. 2003), the examination of the size of secondary school age population can give us an indication of the demand for secondary education.

Demographic trends and suburbanisation affected the size of secondary school population. The number of 14–17 year olds decreased by 24% countrywide between 1990 and 2010. In contrast, the drop was only 10% in the FUR, while Budapest lost more than half of its adolescent population. There were municipalities in the FUR, which even managed to increase their young population; in some cases by more than 50% (e.g. Telki 261%, Leányfalu 127%, Kisoroszi 100%).

The regional differences of the change in population of 14–17 years old are highlighted on *Figure 6.* Most municipalities with increasing young population are situated in the western (e.g. Diósd, Páty, Biatorbágy), northwestern (e.g. Csobánka, Pilisborosjenő, Solymár, Nagykovácsi, Telki, Budajenő), and northern (e.g. Csömör, Mogyoród, Szada) agglomeration of Budapest. These settlements have been popular targets for suburbanisation (Keserű, I. 2004; Bajmócy, P. 2006). Demographic change itself, i.e. the increasing proportion of the younger generation has been linked to residential suburbanisation (Szirmai, V. *et al.* 2011).

## Commuting of secondary school students between 1990 and 2010

The intensity of commuting in the FUR can be estimated by analysing data collected by the Central Statistical Office about the number of students attending secondary schools in each municipality and the number of in-commuters to these municipalities[13]. During the 20 years between 1990 and 2010, secondary school attendance and commuting underwent considerable changes (*Figure 7*).

[12] According to data available about the age of students for Pest County, the typical age to attend secondary school is 14–18 with a mixture of 14–15 year olds in the 9th (typically the first year of secondary education) and 17–18 year olds in the 12th classes (typically the last year of secondary education). At least two thirds of secondary school students start secondary education at the age of 14. In addition, detailed population data retrospectively to 1990 is only available for the age group of 14–17. Hence, this group is used for further analysis.

[13] Commuter data only includes grammar and technical secondary schools and no such commuting data is available for vocational schools.

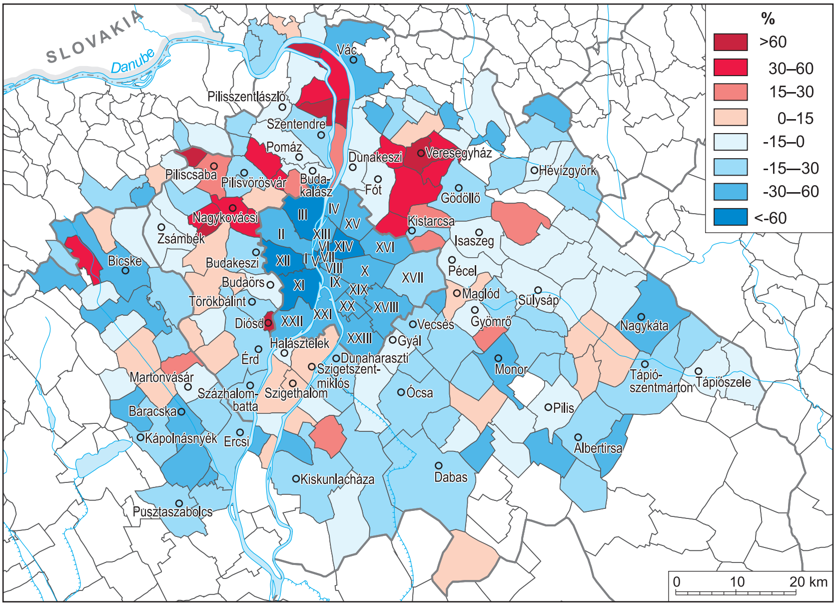


*Fig. 6*. Change of the size of age group 14–17 between 1990 and 2010. (In case of Budapest between 1991 and 2010). *Source*: See *Fig 2*.

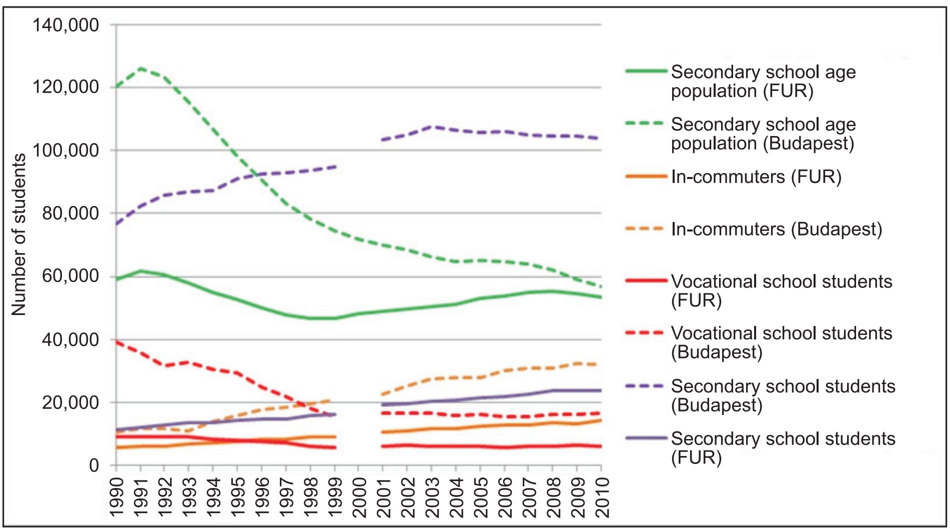


*Fig. 7*. Number of students attending and commuting to secondary schools and vocational schools in Budapest and the municipalities of the FUR. (Data for the year 2000 were not published due to inaccuracies in the KSH database). *Source*: See *Fig 2*.

The dominant role of Budapest in secondary education has not been challenged. At the same time, schools in the FUR expanded significantly educating 20% of all secondary and vocational students by 2010. While the expansion of secondary schools was continuous in the FUR between 1990 and 2010, the number of students in Budapest rose only until 2001 and stagnated afterwards. This indicates that growth in student numbers shifted to the FUR after 2001. Stagnation in case of Budapest is still remarkable in the light of the halving of the secondary school age population in the capital. The phenomenon can be explained by the rise in the number of students commuting to secondary schools in Budapest but living elsewhere.

The imbalance between the demand and supply of secondary education[14] can be demonstrated by calculating the number of secondary school students per children between the age of 14–17 (*Table 2*). The figures demonstrate the imbalance between demand and supply in relation to Budapest and the FUR. They also reflect a fast growth of secondary schools between 1990 and 2001 in the FUR and a very slow climb after that while the dominance of Budapest continued to increase.

*Table 2. The number of secondary and vocational school students per 14–17 year olds*

| Area | 1990 | 2001 | 2010 |
|---|---|---|---|
| FUR | 34 | 52 | 56 |
| Budapest | 96 | 172 | 212 |

*Source*: Own elaboration based on the HCSO Dissemination Database – Regional statistics: http://statinfo.ksh.hu).

If we compare the number of the students with the size of secondary school age[15] population, it is important to highlight that while the number of 14–17 year olds decreased only slightly from 59,087 to 53,362 in the FUR, the number of students attending school there doubled. This could indicate that demand and supply have been levelling off, hence commuting has decreased. If we examine commuting data in the FUR and Budapest, however, a dramatic intensification of commuting between 1990 and 2010 can be observed.

Commuting to Budapest saw a threefold increase from 10,588 to 31,974. In 2010, 31% of all secondary students studying in Budapest were commuters. In the rest of the FUR, the increase was also remarkable, the number of commuters increased from 5,630 to 14,094. It is unlikely that daily commuting to Budapest from outside of the FUR increased significantly during this period

[14] In this particular case data was available for vocational school students as well.

[15] 14–17 year olds are generally considered as secondary school age population. Since 2001, children attending 6 and 8-form grammar schools from the age of 10 or 12, respectively, are included in the statistics for secondary schools. As here we compared 1990, 2001 and 2010 data and 6 and 8 form grammar schools proliferated after 1990, this did not affect the comparability of the data.

due to the long distance. Thus it can be assumed that the intensification of commuting from the FUR to Budapest compensated for the fall in the number of secondary school age population in the capital.

The most important source of commuters to Budapest is Pest County. In 2011, 72% of all applicants to secondary schools in Budapest lived in Budapest while 91% of those who did not live in the capital had a residence in Pest County.

As our data shows, local demand for educational services decreased considerably in the central city, while it stagnated in the FUR with growing demand in some suburbanising municipalities. At the same time, the supply of educational services did not keep up with the change of demand in the FUR on the quantitative and qualitative side, which led to increasing commuting to Budapest originating from the FUR. This is an evidence of the mismatch between the transformed socio-economic composition of the society and the spatial distribution of educational institutions.

The slow adaptation of the school system is partly due to the fact that it takes decades for a school to create an attractive profile that is very much tied to cities (e.g. high profile secondary schools with long traditions in central Budapest, Vác, Szentendre, and Gödöllő). On the other hand, there are emotional reactions from the local communities to any plans to change the educational system. The combination of tradition and emotion makes it a time-consuming process to implement any changes in the fabric of the school network (Berényi, I. 1997). If we accept that suburbanisation leads to an increase in the school-age population, it can be assumed that there is a link between suburbanisation and commuting if the school supply is unable to fulfil the increasing demand in the suburbanising settlements.

In aggregate, between 1990 and 2010, Budapest's dominance on the secondary education market only slightly decreased. In 1990, 87% of all secondary school students in the FUR and Budapest attended schools in Budapest, while in 2010 the proportion fell to 81% *(Table 3)*. At the same time Budapest's proportion of 14–17 year olds within the functional urban area fell considerably from 67% to 52%. This indicates that the discrepancy between demand and supply within the whole FUR (including Budapest) grew.

Consequently, the proportion of students commuting to Budapest, however, increased. In 1990, 12% of all students studying in the FUR and Budapest commuted to Budapest, while only 6% to the FUR (cross-commuting). Although the proportion of commuters to municipalities in the FUR increased to 11% by 2010, so did the share of commuters to Budapest (25%). In the past 20 years commuting intensity increased to both Budapest and the FUR in similar proportions. This indicates that the imbalance between demand for and supply of secondary schools has not been relieved. While a shift from the traditional suburb-city commuting pattern has been detected to cross-commuting as regards employees, the proportion of secondary school commuters to the core city in fact increased.

The overall growth of the proportion of commuters may have several underlying reasons. It may be caused by a change in the school offer (new schools and specialisations); an increasing qualitative imbalance in secondary school supply and demand (families moving to the suburbs with high income and educational status cannot find suitable high quality schools locally); demographic changes (drop in the number of secondary school age population in the centre of Budapest).

If we examine the inflow of secondary school commuters on municipality level, it is apparent that Budapest has the greatest level of attraction (*Figure 8*). As opposed to the commuting of primary school pupils, whose parents tend to choose schools at nearby settlements due to the children's limited independence (Keserű, I. 2012), secondary school students seem to commute farther. This is especially apparent in Budapest, where the highest number of commuters from outside of the capital attend schools in the inner districts (Districts VII, VIII, IX and XIII). This may also be a reflection of better transport connections into the city centre (railway terminuses, metro network), which may make it easier to reach a school in the centre than in one of the outer districts.

If we examine the change in the number of incommuters between 1995 and 2010, we should note that in some districts and municipalities, the number of commuters increased by more than 100% (*Figure 9*)[16]. It is apparent that growth was concentrated on the outer districts of Budapest (East: XV, XVI, XVII; West: XXII). Outside of Budapest, the only significant increase occurred in some of the most suburbanised municipalities in the Western agglomeration (Pilisvörösvár, Budaörs, Törökbálint, Budakeszi).

*Table 3. Distribution of students and commuters within the functional urban region of Budapest (including Budapest), %*

| Indicator | 1990 | | 2001 | | 2010 | |
|---|---|---|---|---|---|---|
| | Budapest | FUR | Budapest | FUR | Budapest | FUR |
| Proportion of secondary school students | 87 | 13 | 84 | 16 | 81 | 19 |
| Proportion of commuters | 65 | 35 | 68 | 32 | 69 | 31 |
| Proportion of 14–17 year olds | 67 | 33 | 59 | 41 | 52 | 48 |
| Proportion of commuters of all students in the FUR and Budapest | 12 | 6 | 18 | 9 | 25 | 11 |

*Source*: *Source*: Own elaboration based on the HCSO Dissemination Database – Regional statistics: http://statinfo.ksh.hu).

[16] New secondary schools were opened in the mid-1990s in Gyömrő, Piliscsaba, Százhalombatta and in Budapest's District XXIII, hence the growth in the number of students and commuters is not comparable to other districts.

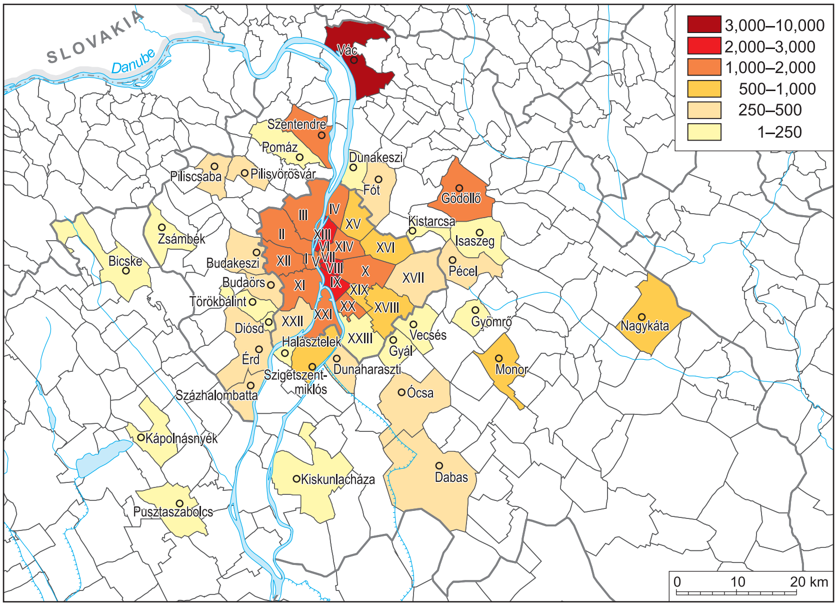


*Fig. 8*. Number of secondary school commuters in 2010 in the FUR of Budapest. *Source*: See *Fig 2*.

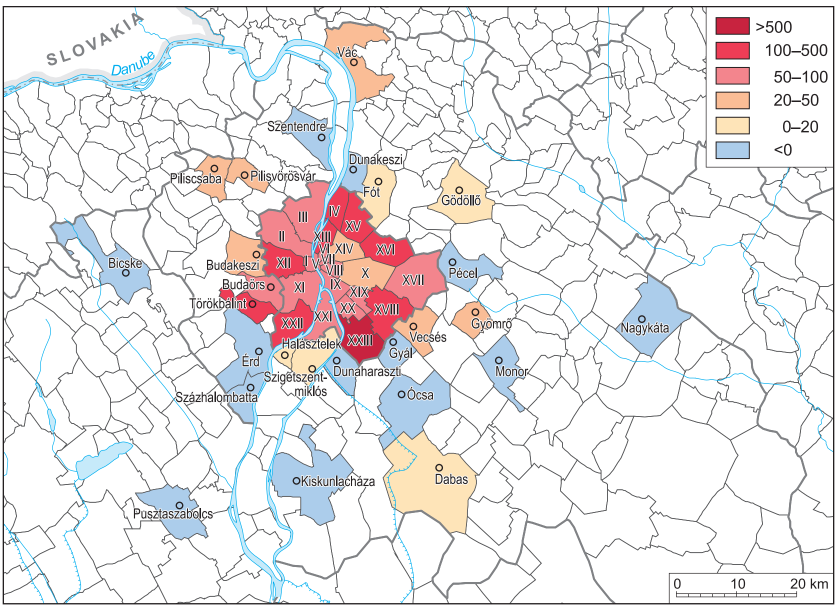


*Fig. 9*. Change of the number of commuting secondary school students between 1995 and 2010 in the FUR of Budapest. *Source*: See *Fig 2*.

## Conclusions

The objective of this paper was to explore the potential imbalance between demand for secondary education and the supply of schools within the social activity space of education in the functional urban region of Budapest. It has been suggested that the definition of commuting should be extended to daily travel to school besides travel to work based on the fundamental similarities. The longitudinal analysis of the demand and supply of secondary education showed that while local demand for secondary education (14–17 year old population) was halved in Budapest between 1990 and 2010, the drop was only 10% in the rest of the FUR. This difference has been explained by suburbanisation, as the major social and spatial transformation of the past 20 years around Budapest, which fostered the migration of the younger population to the suburban ring and shifted demand for secondary education to the FUR.

Although the capacity of secondary schools expanded in the FUR through new school openings and the expansion of existing capacities, Budapest's predominance in the educational market has not been challenged. This increasing imbalance between regional demand and supply has led to a spatial imbalance within the functional spatial structure of education. Due to the delay of the institutional framework of education to adapt to societal changes, the inconsistency between the requirements of the changing society (qualitative and quantitative demand for secondary education) and the provision of educational services (qualitative and quantitative supply of secondary schools) resulted in more intensive commuting and increased the size of the spatial activity group of secondary school commuters. While demand in Budapest (school-age population) decreased significantly, commuting to the capital continued to rise.

The pattern of change has been different to commuting to work, where decentralisation of employment has led to an increase in the proportion of cross-commuting and a drop in commuting to Budapest. In case of secondary school commuters, however, the proportion of commuters to Budapest has increased for the past 20 years and secondary school commuting remained largely monocentral.

Possible reasons for the continuing dominance of Budapest have also been highlighted. Church-owned and private secondary schools, which attract commuters from a wider area, are concentrated in Budapest. In addition the performance of secondary school students in Budapest is better than in schools in the surrounding Pest County.

Both commuting to Budapest and to the FUR saw a threefold increase during the 20 years. The regional distribution of the increase shows a concentration in the outer districts of Budapest, and the most intensively suburbanising municipalities in the northwestern part of the FUR. This suggests the intensification of spatial interactions in the suburban zone as regards commuting to school.

In an ideal case, balance between supply and demand could eliminate commuting. Due to free choice of schools, specialisations, differences in teaching quality and different popularity of schools, however, commuting persists even from municipalities where there are local schools. Hence, further research is needed based on empirical data to explore the influence of different motivations of school choice in the functional urban region. It is recommended that future investigations address the question of the relevance of teaching quality as opposed to distance to school preferably carrying out the investigation at school site level as macro-level data masks the effects of local circumstances. In addition, the influence of educational policy, the differences in the quality of transport provision and the accessibility of schools need to be addressed, too.

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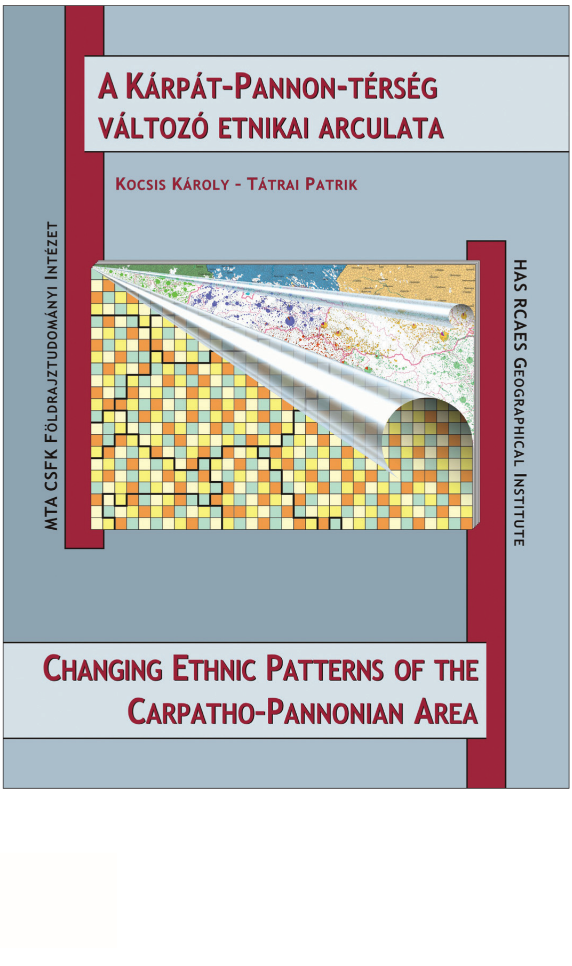
# Changing Ethnic Patterns of the Carpatho–Pannonian Area from the Late 15th until the Early 21st Century

Edited by
Károly KOCSIS and Patrik TÁTRAI

*Hungarian Academy of Sciences, Research Centre for Astronomy and Earth Sciences*
*Budapest, 2012.*

This is a collection of maps that visually introduces the changing ethnic patterns of the ethnically, religiously, culturally unique and diverse Carpathian Basin and its neighbourhood, the Carpatho-Pannonian area.

The Hungarian and English volume consist of three structural units. On the main map, pie charts depict the ethnic structure of the settlements in proportion to the population based on census data et the millennium. In the supplementary maps, changes of the ethnic structure can be seen at nine dates (in 1495, 1784, 1880, 1910, 1930, 1941, 1960, 1990 and 2001). The third unit of the work is the accompanying text, which outlines the ethnic trends of the past five hundred years in the studied area.




The antecedent of this publication is the „series of ethnic maps" published by the Geographical Research Institute of the Hungarian Academy of Sciences from the middle of the 1990's, which displayed each of the regions of the Carpathian Basin (in order of publication: Transylvania, Slovakia, Transcarpathia, Pannonian Croatica, Vojvodina, Transmura Region, Burgenland, Hungary). This work represents, on the one hand, the updated and revised version of these areas, and, on the other hand, regions beyond the Carpathian Basin not included on previous maps. Thus, the reader can browse ethnic data of some thirty thousand settlements in different maps.

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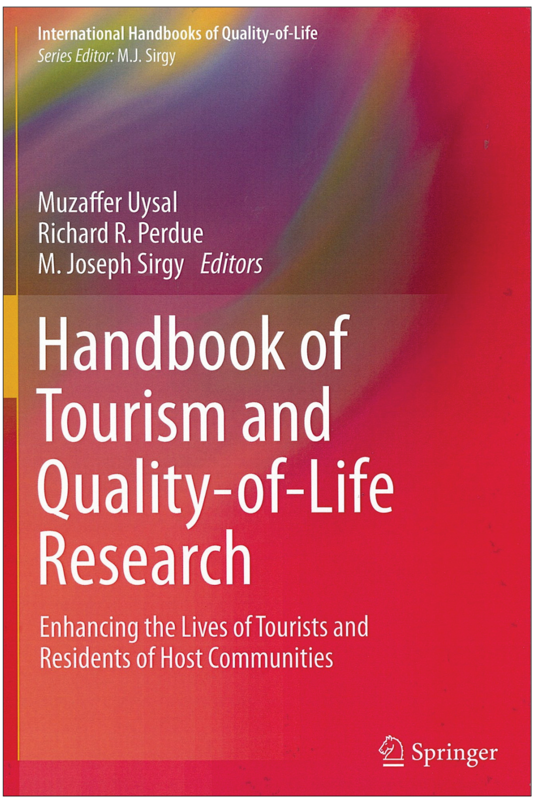
*Hungarian Geographical Bulletin 62 (2) (2013) pp. 221–225.*

**Uysal, M., Perdue, R. and Sirgy, M.J. eds.: Handbook of Tourism and Quality-of-Life Research. Enhancing the Lives of Tourists and Residents of Host Communities**. Dordrecht, Springer, 2012, 702 p.

Over the last two decades, it has become obvious for both tourism researchers and practitioners that tourism may have a major impact on the quality of life (QOL) of all those involved: local communities, including those employed in tourism, are affected by the way tourism services and facilities are being developed in their destination, while tourists' perceived quality of life is influenced by their travel experiences. Although certain types of tourism products such as medical tourism, or emerging social phenomena such residential tourism, have higher than average impact on travellers' QOL, the editors of the handbook clearly aimed to provide the widest possible overview of all kinds of implications travel and tourism on residents and tourists' quality of life. Although the topic has become relatively well-represented in tourism studies in many countries, the handbook is the first international reference book in the field, bringing together much of the current research on the topic to help practitioners use well-being performance measures in their decision making processes and aid academic researchers further develop their future research programmes.




The handbook has two main goals: to provide a platform for scholars to explore the linkage between tourism activities and QOL of tourists, residents and workforce employed in the tourism industry, and to initiate new directions of research in this field. The 38-chapter volume is divided into three parts: a comprehensive discussion of the complex relationship of tourism and QOL is followed by papers relating to travellers/tourists, and studies relating to the residents of host communities. The multidisciplinary volume covers the complex relationship of economic, social, environmental, health and QOL aspects using a holistic approach.

The Foreword written by Jafar Jafari is based on the theme "a nice place to live is a nice place to visit".

This is a notion that has been widely embraced by tourism researchers in Hungary as well, from the classic work of Lengyel, M. 'A general theory of tourism' (1992) to the recent studies of Michalkó, G. and Rátz, T. A destination that delivers poor quality of life to its residents cannot offer high quality tourism experience; in contrast, a satisfied community attracts visitors who will enjoy an experience provided by satisfied service personnel, leading to improved quality of life of all stakeholders. Consequently, a destination that focuses on the happiness of their residents has a better chance to increase the expenditure of tourists who are searching for high-quality experiences that can only be based on local, community-based hospitality.

Since it is not possible to discuss every chapter of the conceptually rich and well-structured volume within the framework of this review, the topics considered as the most relevant for a Hungarian scholarly audience are highlighted.

Chapter 2 by Philip R. Pearce reviews various relationships that occur in different tourism contexts, and discusses the influences of these interactions on the experiences and the well-being of tourists. Both the relationships that tourists have in large groups and those taking place in small, specialist travel parties are considered, including travel relationships for backpackers, volunteers, the disabled, single travellers, female travellers and gay men. The QOL implications explored by the author include positive travel benefits such as improving skills and character strengths or building an emotional preparedness to be receptive to others.

Chapter 3 by Sebastian Filep focuses on the linkages of tourism and positive psychology, a growing global research field of psychology, with relatively under-explored applications in tourism. The author highlights three linkages: positive psychology research on happiness and its use in measuring and conceptualising happy, satisfying tourist experiences; positive psychology character strengths and their potential to contribute to tourism education values; and positive psychology research on humour and its ability to promote productive working environments in tourism. Some key challenges for the future development of tourism and positive psychology research are also discussed, including the challenge to connect with health, i.e. to integrate physical health indicators and subjective benefits of tourism. The need to reach out and learn from other disciplines, to employ a wider range of research methods and to accept and embrace non-Western perspectives is also emphasised by the author.

Chapter 7 by Janne Liburd, Pierre Benckendorff and Jack Carlsen analyzes the contribution that tourism development makes to QOL. In contrast to the more common community perception-based impact studies, the authors use an importance-performance analysis (IPA) to understand how economic, social, and environmental impacts of tourism are manifested and how tourism is contributing to QOL and overall life satisfaction. It is concluded that tourism has the potential to contribute to enhance QOL through economic benefits, but this can be at the expense of social equity, cultural identity, and environmental sustainability.

Chapter 12 by Daniel R. Williams and Norman McIntyre is based on the theory that the twin processes of lifestyle mobilities and place affinities are inseparable and essential to the understanding of quality of life. In today's globalised world where many people are empowered to actively circulate among many places, the quality of life of various stakeholders is affected by tourists' and other lifestyle migrants' mobility and activities, creating conflicted and contested places. The authors raise a series of thought-provoking questions about the interactions among place, mobility and globalisation, their impact on the ways in which places are created and experienced through tourism, and the relationship of these processes to QOL issues.

Chapter 15 by László Puczkó and Melanie Smith examine the relationship between tourism and QOL from a demand perspective, based on the analysis of tourists' motivations for and perceptions of travel, and the role of travel in their lives. The authors raise various questions concerning the relationship between QOL and satisfaction, or the permanent or temporary nature of well-being or happiness related to travel. In addition, the chapter assesses the applicability of Rahman, T. *et al.*'s (2005) 'QOL domains model' to tourism, resulting in a more comprehensive conceptual framework of the tourism-QOL linkage.

Chapter 17 by Sara Dolnicar, Katie Lazarevski and Venkata Yanamandram reviews the literature of travel motivation and quality of life with the aim to understand the extent to which vacations contribute to different travellers' QOL, taking into consideration the differences of people's travel motivations at various stages of their travel career or at different stages of their lives. Based on a thorough analysis of the available literature, the chapter proposes a conceptual framework that integrates the notions of QOL and travel motivations in a tourism context.

Chapter 24 by Gianna Moscardo is based on the 'full world' model of Constanza, R. (2008) in which, in contrast with the classic economic approach, the QOL of individuals and the well-being of communities is dependent on benefits derived from different forms of capital, including, among others, social capital. The author analyses in detail how tourism can affect the social capital of the host population, and examines the ways how tourism development can be used to actively build social capital.

Chapter 25 by Muzaffer Uysal, Eunju Woo and Manisha Singal reviews the connection between the tourism area life cycle (TALC) model and its impacts on the QOL of the host community. Tourist experiences take place in physical settings as a result of interaction between demand and supply factors which change over time, resulting in destinations going through cycles of development, influencing the nature of their attractiveness. Places as destinations experience different phases of evolution, and each cycle affect the QOL of stakeholders in the destination, in terms of both intangible and tangible benefits that are brought about by tourism activities.

In addition to presenting valuable theoretical concepts and empirical research findings, the authors of the handbook also formulate research questions in order to stimulate further studies in the field of QOL and tourism. Due to its comprehensive coverage, the volume may be recommended both for researchers representing tourism studies, social geography or social sciences in general, and for local and regional decision-makers searching for a deeper understanding of the potential impacts of tourism development on local communities' QOL.

Tamara RÁTZ

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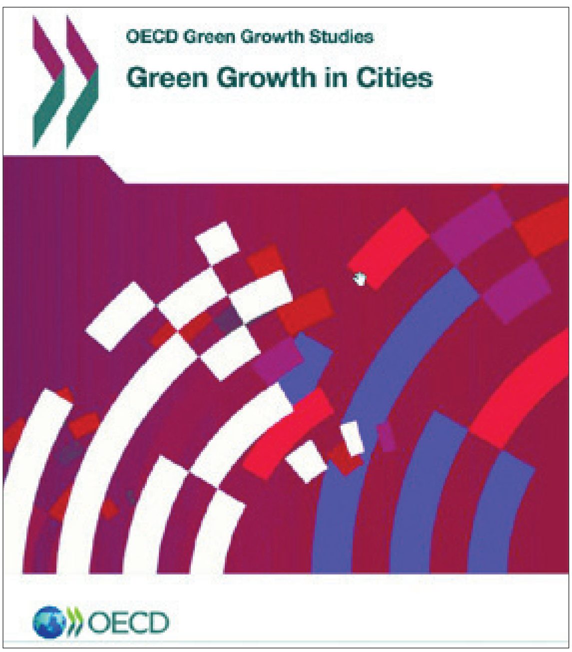
**Green Growth in Cities.** OECD Green Growth Studies. OECD Publishing, Paris, 2013 136 p.

Today more than half of the world population live in or near cities. By the middle of the 21st century, urban areas will host to over two-thirds of the global population and a large share of economic activities and wealth. Cities can generate economic growth and creating jobs while becoming greener – this is the key message of the OECD's new "Green Growth in Cities" report. Based on case studies of Paris, Chicago, Kitakyushu and Stockholm, the report identifies green policies that can respond to urban growth priorities and suggests how to implement and finance them.

Cities must be an integral part of international and national efforts to make economies more sustainable, societies more inclusive, to reduce increasing urban environmental impact, stimulate economic growth and improve well-being of their residents. The potential synergies and interlinkages between the environment and the economy in cities are obvious. For example, reducing traffic congestion and air pollution makes a city more efficient and more attractive to firms and highly skilled workers, healthier and more liveable for the local population.

The OECD's city-level case studies provide city leaders with new insights on how well-designed environmental policies can contribute to different types of growth. Right urban sustainability policies can create new jobs including retrofitting the existing building stock for improved energy efficiency. For example, the Chicago Tri-State metropolitan region has built a regional specialty in green building design and retrofitting. In 2010 it gave 45,000 people green jobs, 36% of which were in the green building sector.

Efficient transport systems, in particular, good public transport networks, help cities to attract new firms to invest and workers as well. The private sector in the Paris/Île-de-France region has long recognised this, and firms that benefit from proximity to the transportation system contribute to its financing.




Cities can also foster innovation, entrepreneurial spirit which can stimulate growth of the green technology sector by creating green regional clusters that build on existing industries, services, research and innovation. Kitakyushu in Japan has built an impressive recycling cluster, the Eco-Town, which recycles hundreds of tons of industrial waste every day, while producing energy for residential and commercial purposes in neighbourhoods.

Urban redevelopment, housing stock renewal and development of eco-districts can enhance land values while increasing density and reducing residents' environmental impact. Following the success of its Hammarby Sjöstad eco-district, city of Stockholm is now working with the private sector to develop the Stockholm Royal Seaport eco-district following the SymbioCity concept. The buildings there will use less than the energy of others in Stockholm and the new district will have an advanced smart grid and district heating system.

According to the findings of the OECD report there is an urgent need to find better ways to "green" urban finance and to mobilise private sector money for green infrastructure development. Introducing green incentives into municipal revenue streams would be a big step towards a more sustainable growth path. Property taxes could help prevent urban sprawl by eliminating the preferential tax treatment of single-family homes that exists in many places. Traffic regulation, congestion charges and parking fees can help reduce traffic and air pollution, while fees for water and waste services should be more responsive to actual resources used consumers. For example, the city of Stockholm is greening its income with revenues from the traffic congestion charges system. Introduced in 2006, this system has led to lower carbon dioxide emission and traffic congestion and is also becoming a substantial source of local government's income. National governments also have an important role to play in setting the right price signals and standards that will provide coherent and attractive environment for green financing.

This book is recommended for urban geographers, planners, environmental scientists as well as wider audience interested in urban issues and environmental challenges.

István POMÁZI

*Hungarian Geographical Bulletin 62 (2) (2013) pp. 226–230.*

**International workshop on metropolitan regions**

*Cluj-Napoca, 9–l0 Nov. 2012*

The organisation of the workshop "Lessons from metropolitan region - building: socio-spatial polarisation and territorial development in Central and Eastern Europe" based on the quite tight relationship between the Leibniz Institute für Länderkunde (Leipzig, Germany) and Babeş-Bolyai University, Faculty of Geography (Cluj-Napoca, Romania), more precisely the research co-ordinator of IfL, Thilo Lang and the leader of the Geographical Institute, József Benedek, exterior member of Hungarian Academy of Sciences on Regional Science. Fortunately, we had the opportunity to meet the young researchers of the Doctoral School of the Geographical Institute before and after the sessions.

Firstly, a few words about the background of the conference. In the last two decades there has been an increasing interest in metropolitan regions among researchers and practitioners dealing with regional policy issues. The idea of promoting metropolitan regions thereby seems to be based on a widespread big city enthusiasm for the the economic power of global cities and a dominant discourse describing the big agglomerations as being international, innovative, economically successful and in general future oriented and less vulnerable to crisis. As an emerging paradigm, the idea has spread from Western

The workshop members listen the presentation of the director in TETAROM Industrial Park

A short breefing before the field trip on Saturday morning by József Benedek


A warm welcome to the participants after the field trip

Europe to countries such as Poland and Romania. At the same time, the emergence of policies supporting the development of a smaller number of strong metropolitan regions has triggered a growing concern about socio-spatial polarization. Especially in Central and Eastern Europe where regional disparities often measured in demographic or economic terms have been growing.

A good example for the dominance of the bigger centres against other areas is the debate about metropolitan regions in Germany. With the definition of the first six in 1995, metropolitan regions nowadays cover nearly the whole area of Germany and can be seen as a current paradigm of spatial planning. This parallels similar political discourses in other EU-countries such as France, Hungary, the United Kingdom, Poland or Romania and at EU level. Whereas in Central and Eastern European countries the role of regional development policies was somewhat neglected in the early years after transition, a new debate has emerged in the last years. For example, in Hungary the re-orientation of regional policy with trends towards centralisation has been experienced since 1998 and it was further enhanced after recent national elections. Poland had struggles with metropolitan regional strategies provoking debates relating to core/periphery dualities.

In Poland, the debate has become more vigorous recently raising serious concerns in the context of the new National Strategy of Regional Development 2010–2020 and the emerging Conception of Poland's spatial organization. The role of regional policy has also gained importance in Romania since 1998 with the de- and re-limitation of 8 development regions. That was the first step towards the formation of metropolitan regions with European and national significance.

For a two-day workshop, the organisers invited presenters and discussants dealing with regional policy and territorial development in CEE and at European level. The aim of the workshop was to discuss the European and national paradigms following and opposing the metropolitan regions model. In doing so, the participants aimed to supplement research on regional policy in Central and Eastern Europe which has mainly dealt with the governance of metropolitan regions so far. Contributions to the workshop should deal with issues of uneven development in relation to different attempts to regional policy within a dominant EU policy framework.

The five key questions of the two-day workshop were:

– Why has the debate on metropolitan regions in Europe received such a noticeable character in the last two decades?

– How do governments try to achieve global economic significance with promoting metropolitan regions without neglecting other areas and furthering socio-economic polarization?

– What are the key lines of discourse between global competitiveness and territorial cohesion in that context?

– Which paradigms do governments follow in the interlinked debates and what new forms of governance are emerging?

– What is the relation between European, national and regional policies and which key actors are involved?

The official programme started on Friday morning with two presentations after a short welcome speech by the host institution. Thilo Lang illustrated the process of metropolitan region built in Germany and in a wider perspective in the CEE region. The new phenomena of EU Cohesion Policy after 2014 tend to national governments to react and reform their spatial/administrative structures to define urban/metropolitan regions which should be the new key actors in EU cohesion. Germany is an extreme example where 90% of the territory is covered by metropolitan areas. In Germany more than 60% of the whole area were defined as less-developed, peripheral, sometimes rural a decade ago. József Benedek and Marius Cristea went back to the 'classic' theory of growth poles, as a basis of new trend in metropolization. Their case study area was the post-transition Romania where the most characteristic changes in urban hierarchy were highly influenced by the administrative reforms. The major break in the hierarchy of larger centres (over 100 thousands inhabitants) depended on the status of being 'metropolis[1]' or not, and having the function of 'regional centre' or not[2].

After the coffee break, Zoltán Kovács gave us a scheme about the development of Budapest Metropolitan zone in the point of view of National Policies and local responses. As we could see, the local actors were proactive to co-operate with each other or with some other groups of actors in the agglomeration/suburban zone around the capital city during some periods , which correlated with the most impressive development phases of Budapest. Tomasz Kaczmarek and Lukasz Mikula from Poland represented Poznań Metropolitan Region. They presented a very accurate method of region-building process and the first few steps of success to co-operation. The Polish system gave certain legal framework to improve metropolitan-regional collaboration through stimulating common development actions in infrastructure building, sharing costs of operating public services, state financed development funds for improving regional co-operation capacities.

During the first afternoon session, Marius Czepczynski described the emerging metropolitan regions in Poland with the special interest on the Gdańsk–Gdynia–Sopot three-pole urban region. Spatial structure of Poland is historically based on regions, the traditional provinces with large cities, as centres in the core. That urban hierarchy and spatial structure should be an advantage in the new period of EU Cohesion Policy, because the government has tried to strengthen the role of metropolis regions with the reform of regional policy in the last decade. Comparing the Polish and German spatial structure, we can recognise that the influence of larger urban centres and zones in Poland seems much weaker. As we can see, at least 60–70% of the whole area of the country was defined as out of metropolis position without strong connections to the large urban centres.

Tassilo Herrschel's key question was whether we were moving towards a post-regional perspective and Agenda in the EU? Concluding his presentation, the answer was dominantly yes. Both new elements of the renewing cohesion policy of EU – ITI, CLLD – based on metropolis regions, or urban–rural co-operation based local administrative units far from the NUTS2 based regional policy. In the Central and Western part of the EU, most of the national governments tend to the post-regional way of thinking in solving spatial imbalances, moderating the effect of uneven development. Those actions are visible in the Eastern part, too, but in a more sporadic way, and in a less complex form without radically reforming the existing regional policies.

Sophie Magnon described the different phases of co-operation forms in the rural France following the 1950s administrative reform. We can find some similarities with the Hungarian system of small-regional (LAU1 level) collaboration systems established after 2004 reforms. Both national governments tried to find a more effective but less expensive

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[1] If an urban centre has the right, it has the opportunity to organise the development of the surrounding area (Zona Metropolitana) through public services, regional and physical planning.

[2] For example Timișoara and Cluj are regional centres with metropolis regions, Oradea has a metropolis zone, but without the role of regional centre, and Arad existing without these two status.

way of operation of local public services. The overall experience of the reforms showed both positive and negative effects, too.

The Hungarian and the French governments reacted to the facts differently: the French emerged the fiscal advantages to force small settlements to co-operate, while the Hungarian tried to solve the whole problem with a radical administrative reform (they dissolved small-regions and created 'járás' system). Last but not least, Judit Tímár and Gábor Nagy presented the "Changing 'metropolitan' – 'non-metropolitan' relations in the perceived and conceived spaces of Hungary". While Judit Tímár presented the theoretical concept based on Lefevbre's theory, namely, how and why Budapest had a unique role in the Hungarian regional policies, Gábor Nagy gave a wide range of samples, how and in which forms we could mark that central role with or without the agglomeration/suburban zone of the capital city in economy, administration, investments etc.

On Saturday morning, a field trip was organised by the host institution. We got some examples for the socialist urbanisation in a high-density residential area (Manastur) with large-scaled housing estate developments in Cluj. We visited the TETAROM Industrial Park which is an example for the economic restructuring of the city region. As we saw, there are five industrial parks in Cluj, the local economy is booming, however, Nokia left the whole area (small and medium-sized local firms and a large-scaled investor filled in its place). We got a set of urban and regional development projects: urban highways, motorway development (North Transylvania motorway construction[3]), railway station renewal, the development of an international airport (the third largest one following Bucharest and Timisoara in Romania with approximately 1 million travellers per year). We saw the marks of spatial and social segregation, the urban sprawl around the city as new poles of residential suburbanisation, recreational functions, and in some cases economic activities.

Gábor NAGY

[3] In May 2013 the Romanian Government broke the contract with the developer Bechtel Co. (USA), because of high prices (34.7 million USD per km). The Company also tried to close this co-operation, because the state did not paid the price of the finished parts of the motorway.