

TRANSFORMATION OF LAND USE PATTERN IN THE EAST BORSOD COAL BASIN FROM THE BEGINNING OF MINING INDUSTRY TO THE POLITICAL CHANGES

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Received 02 August 2016, accepted in revised form 18 September 2016



Abstract

Historical geographic studies on land cover may support the understanding of the recent state. Focusing on coal mining, this process was followed and analyzed in the case of the East Borsod Coal Basin from the early 20th century to the political change. The contemporaneous maps and manuscripts concerning the mining were evaluated using geoinformatic techniques. Moreover, digitalized topographic map coming from the early and late period of mining (1924 and 1989, respectively) were analyzed. To determine the degree of human disturbance hemerobic relations and changes of the given land cover patches were quantified on the basis of the maps of the three military surveys, too. It can be stated that montanogenic subtype of an industrial-agricultural landscape has been formed in the Bükkhát area. Beside the concentrated artificial surfaces, however, relative dominance of forest forming the matrix of the landscape remained.

Keywords: coal mining, historical land cover, Borsod Coal Basin, hemeroby

1. Introduction

Because of practical mitigation of damages, study of land forming role of deep mining has a long history. Size and scale of geomorphic process were estimated in the mining districts of England as early as the 15th century (Somosvári 1989; Botkin – Keller 1995). However, more or less comprehensive descriptions of the environmental impacts became usual from the middle of the last

century (Nir 1981; Erdósi 1987; Hooke 2000). Special attention must be paid to Erdósi's publications since he studied the environmental impacts of mining on historical scale and used historical records, too. Moreover, methods of Dobány (2010), which were used to reveal the connection between land cover and social-economic relations, could be adopted as well.

Our research project on landforming impact of coal mining in the Borsod Basin

belongs to these studies. Coal mining here began in the late 18th century, and it was the most intense in the period ranging from the early 20th century to the middle of the 1970s; the most significant transformation of the natural environment also happened in this interval.

2. Materials and Methods

Since its national importance, history of coal mining in the Borsod Basin has been compiled in several studies. The most detailed manuscripts were compiled by the mining engineer Lajos Ürmösy (BSzT, 1960), which have been completed with further volumes from the 1960s (BSzT, 1994). Data, photocopies, maps, and historical descriptions concerning coal mining coming from records in the Archives of the University of Miskolc were also used. The GIS database was created using the software Geomedia 5.2.

Moreover, the stereographic topographic map with the scale of 1:25000, which was compiled in 1928 and the data of which were corrected in a field work in 1924, was digitalized. The different patch types were categorized on the basis of the Corine Land Cover System taking the historical land cover system of Nagy (2009) into consideration. From the category of 'Artificial surface' (level 1) those which concern mining (waste dumps, mining site, open pit, etc.) were separated. The landscape after the most intense period of coal mining activity was characterized on the basis of the digitalized military map sheets of Gauss-Krüger system with the scale of 1:25000 which were compiled in 1989. Because of the 75-year interval we focused on comparative analysis of relationship between long distance changes and mining, only.

To evaluate landscape disturbance the method of Varga and Németh (Margóczy 1998) for evaluating vegetation from natural protection point of view as well as the complex landscape ecological evaluation of Csorba (1997) were also considered. Analyzing the intensity of anthropogenic impacts, sheets of the three military mapping (I.: 1783-1784

AD; II.: 1857-1858 AD; III.: 1883 AD) and the other map sheets used in this research were intersected using GeoMedia 5.2 software. In this way, after required corrections, the number of changes in land use types in the patches of the main land use categories was revealed.

3. Results and discussion

The hills of Bükkhát microregion form the southern part of the East Borsod Coal Basin the geological and geomorphological development of which was given by Sütő (2000). The land composed of Miocene shallow marine nearshore coal bearing sediments divided into asymmetric catchment areas by the Sajó River and its tributaries has been formed by landslides and derasion processes. These determined fundamentally the spreading of man in the hills the early phase of which associated with the initial periods of mining was discussed by Sütő – Homoki (2009).

Period of the most intense transformation is recorded by the sheets mapped in 1924. Based on background information concerning the mining, more complex relationships can be recognized. Considering the Borsod Coal Basin 1.8 million tons of coal were produced in 1923 (BSzt 1960) that made it the largest coal mining district of Hungary at that time. Since production increased over time land use changes also appeared differentiated along the exposed coal beds. Although the size of the settlements moderately increased, however, settled terrains can be already found in each valley. The most significant changes happened in the valley of the Bán Brook and environs of Diósgyőr town because of the considerable immigration due to the running-in of coal mining. Adits were generally drifted at the exposed coal bed of the valley sides which are the site of the settlements, too. In these areas only 34% of forest and 11% of grassland were indicated by even the third military survey; at the same time total ratio of plough (40%) as well as vineyards and horticultural areas (3%)

approached the extension of the semi-natural areas.

Because of the economic value of the coal, any land use was ceased in the case of opening a mine. However, the existing land use was considered when a miner colony was established. If it was economically reasonable the living space expanded at the expense of the forested area. From landscape ecological point of view the 74.8 km long mine tramway represents a new, artificial type boundary. It is particularly unfavorable that in shorter or longer distance the tramway runs on the valley floor; consequently, it dissected the remnants of the ecologically vulnerable wetlands (marshes, wet meadows, gallery forests). Regarding land use, it was also unfavorable that the industrial expansion coincided with the phylloxera epidemic of the 1880s. In this area ratio of viniculture fell down to one tenth of the extension prior to the epidemic (Figs. 1. and 2.). In the greater catchment areas devastation could be even

two and half times higher. The relatively acknowledged vineyards in the environs of Diósgyőr have not regained their importance, either.

On the basis of land use data, landscape transformation was delayed almost half century compared to land use changes as a result of more intense land utilization elsewhere in the country (Szegedi 2002). In 1924 the number of patch types was 25 (Fig. 2.).

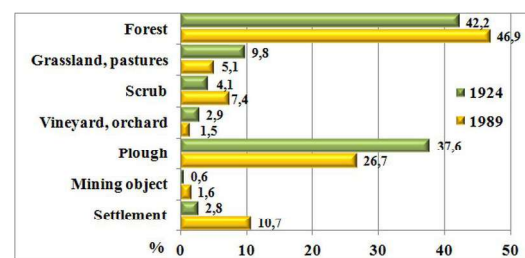


Fig. 1. Ratios of different land use categories in 1924 and 1989

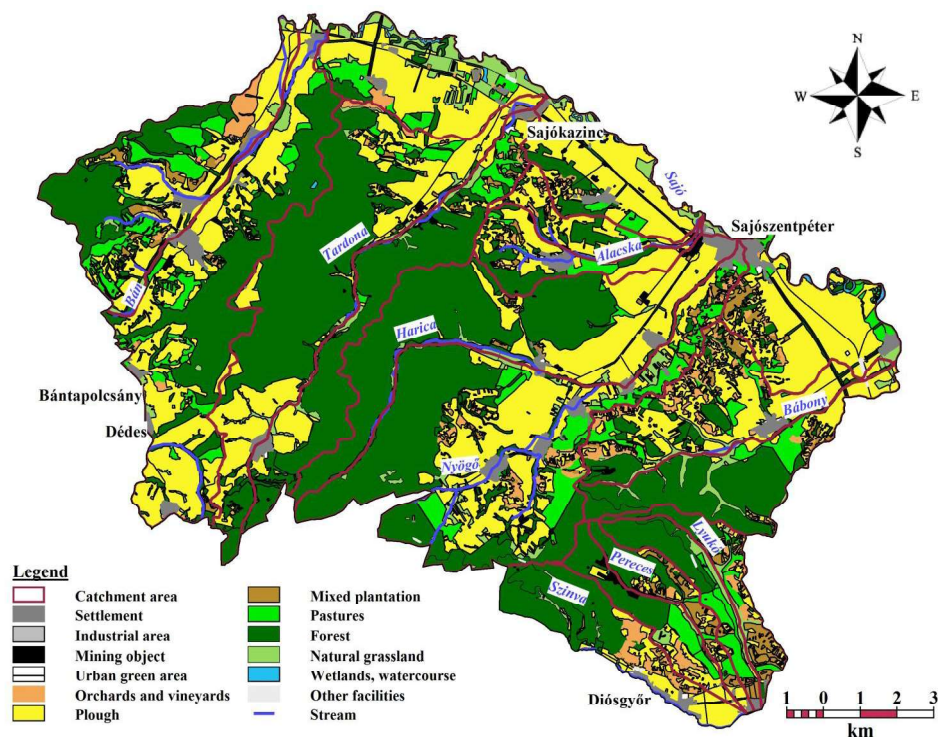


Fig. 2. Land cover in the Bükkhát area in 1924 (source: HKÁT stereographical topographic maps 1928)

Stability of semi-natural land uses could decrease in the areas wedged in cultivated lands. It is interesting that human activity did not fit for the natural running of the valleys in every case. For example the formation of the Bán Valley corridor remained uniform; the inner valley of the Tardona Brook remained forested except for the estuary and mountain front.

Relationship between geographic endowments, mining and land cover can be best demonstrated in the case of the catchment of Harica-Nyögő brooks and other brooks in their vicinity (Fig. 2.). The upper part of the valley of Harica Brook is a hardly disturbed forested area. From the estuary of the Nyögő Brook, however, mining activities were scattered – thanks to a complex geology – therefore anthropogenic land use expanded in a wide zone from Sajószentpéter toward the Bükk Mountains along the complete length of the brook. Along the lower sections of Nyögő Brook the dissected steep slopes on the right side did not provide enough cultivatable land for the population of the settlements; therefore, cultivation expanded on the left side of the neighbouring Bábony Brook which had been undisturbed. Woodland remnants between the mining sites and villages may have remained in connection with the inner part of the Bükk Mts. A process similar to this can be detected in its initial stage in the inner part of the Harica-Nyögő catchment along the Harica Brook via which the forest in the Tardona Valley might be in connection with the inner part of the Bükk Mts. This can be explained by that the development of mining at Sajókazinc is still in its initial phase. But this forest is partly isolated from the forest matrix due to extending cultivated lands between the villages. This fact resulted in the special situation that patch density on the left side of the Harica and right side of the Bábony valleys is one third of the more cultivated opposite sides. In spite of the fact that the extension of mining increased, the impact of agriculture on the landscape was more significant (Fig. 1). However, mining locally resulted in environmental impacts,

too, which cannot be traced in the land use pattern.

The map of 1989 contains most of the 36 Corine categories in the coal basin. From a landscape ecological point of view, unfavorable new types of patches belonging to the category of 'Artificial surface' are the urban terrains built-in with multi-storey houses, technical structures and heaps (except of waste dumps). Lakes in the open pits, however, can be regarded as favorable. The highest patch density values can be found at the meeting of orchards, open built-up areas and the former mining properties (Lyukóbánya, Pereces, catchment area of the Alacska Brook, southern part of Kazincbarcika, and environs of Sajószentpéter).

In spite of the fact that mining is an eminent landscape forming activity, it enables the forests to survive in the Bükkhát area as a whole. Although building of mining structures and timber demand of mining led to deforestation of certain areas, however, other types of land use were restricted for protecting the mining claim. Partly it resulted in that the forested area began to increase again by 1989 (114 km²) exceeding its extension of 1924 (Fig. 3.). It is noteworthy from landscape ecological point of view that the ratio of the original matrix of the landscape is 40%, i.e. it has preserved relative dominancy (Fig. 1.), although its present ecological value is lower than that of the original one. The most favorable reforestation can be found in the catchment area of the Harica-Nyögő brooks (+7.4 km²), while the most significant deforestation happened in the catchment of the Bábony Brook (-10%). The deforested area has been occupied by ploughs and industrial plants. Some parts of the ploughs have been uncultivated. The lowest ratio of the forests can be found in the alluvium of the Sajó River, however, due to economic importance of the valley, this area was deforested as early as the end of the 19th century.

Simultaneously to the prosperity of coal mining, agricultural production significantly

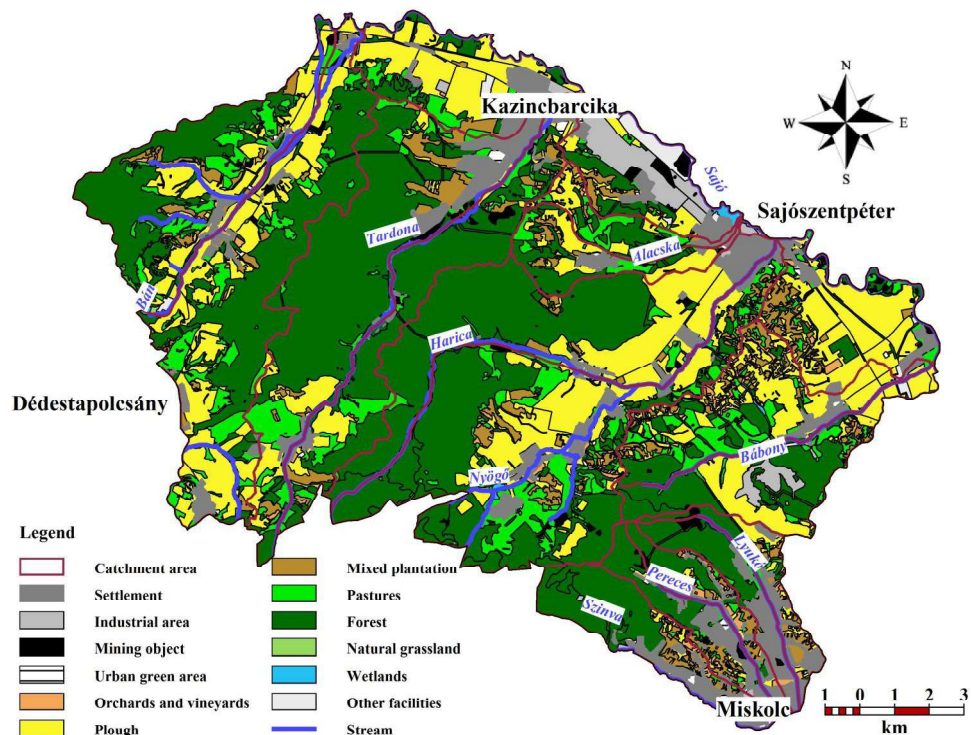


Fig. 3. Land cover in the Bükkhát area in 1989

(source: MH Gauss-Krüger topographic maps, 1:25000) (Settlement and Industrial area contain the Artificial surfaces; the mining object contains dumps, (lake in) open pits, claim).

decreased. Area of ploughs is not more than half of the area of forests, and area of cultivated lands decreased by 8-22% almost in every catchment area. On the one hand, an extended area was withdrawn from cultivation because of industrial investments, on the other hand, transformation of human activity led to decrease in the number of agricultural workers. Because of the decrease of cultivated lands, concentration of some branches and land use categories can be noticed, e.g. combination of gardens, vineyards and ploughs. As a consequence, extension of pure orchards and vineyard reduced to two third and one sixth, respectively.

The most important change is the dramatic decrease in the ratio of natural grasslands and soft-wood galleries (Fig. 1). Wetlands located in the inner tributary valleys are only small, isolated patch-fragments. The former natural grasslands used for pasturing

and hay-making were replaced by weedy marshlands desiccating every summer. The former ecological corridors are almost entirely affected by human impact because of increasing area of the roads running on the alluvium, expansion of motored transportation, and building up the former orchards.

Analysis of the changes in the ratio of semi-arid grasslands is the most difficult task. In some areas abandonment of cultivation resulted in the increase of ratios of biologically more active surface covers. Because of anthropogenic impacts, succession of plough – grassland – forest has stagnated generally at the level of degenerated shrubby grasslands. Meadows, however, may play important ecologic role since they are wedged in ploughs, making in this way the migration of species towards the forest possible. Degenerated associations expand along the former industrial railways, too. Consequently,

patches of 'plough, degraded grassland' usually refer to vegetation characterized by the dominance of disturbance-suffering and generalist species. Increase of grasslands in the place of abandoned mine properties may come from former ploughs which may improve naturalness degree of land cover.

To our time metahemerobic artificial environments (settlements, industrial areas, mining objects etc.) were also formed (Fig. 1.). The present average size of the settlements is twice higher than in 1924, and three times higher than it was at the time of the first military survey. Moreover, nowadays, much more artificial material is used, and area of the covered surface has been multiplied, too. Similarly, overburden coming from expansion of living- and weekend-houses in the gardens located in the former open space of the slopes represents increased environmental risk source. It is particularly risky in the undermined suburban terrains, e.g. in the margin of Miskolc and Kazincbarcika, where instability of the slopes originating

from geological and geomorphological fundamentals was also ignored.

The approximately 4 km² of mining properties and landforms is the remnant created during prosperous period of mining activity. The partly abandoned mining properties, entrances of adits and shifts, and heaps are determinant factors of the landscape. The artificially dissected terrains prevent agricultural activity and expansion of settlements. Where they presented direct risk to human activity planned landscaping was performed but elsewhere natural processes form the land even today. Moreover, indirect processes (landslides, water and air pollution, damage in vegetation and built environment, etc.) are added to the mountainous impacts; total area of the affected land is 27% of the Bükkhát.

According to the patch change map it can be stated that the original land use has survived almost in one third of the area (32.7%) (Fig. 4.). In spite of intense mining activity, the results suggest stability of the forests;

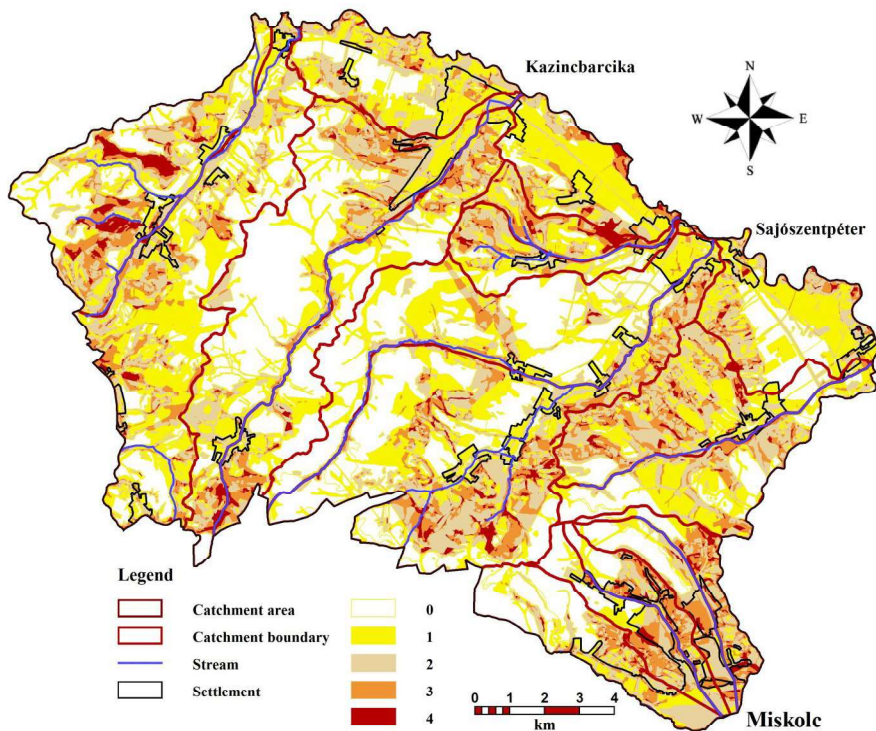


Fig. 4. The patch of land cover change map in the Bükkhát area

20% of the Bükkhát forest cover indicates no changes. From a landscape ecological point of view this fact is quite favorable in an industrial zone. Transection of the first military survey map and map of 1989 shows continuity for 68% of the forested area, i.e. a significant part of the forests is secondarily planted. Considering only the ratio of forested areas it seems to be acceptable, however, the ratio of forests of lower ecological value may be high. The primary land use structure is indicated by the fact that tilling of plough has remained in 8% of the area. In almost half of the ploughs this land use can be found even now, i.e. if there was any change at all, the suitable terrains were cultivated again. The most frequent change is resulted by building-up of grasslands, vineyards and ploughs. Decrease of the area of natural grasslands is due to tilling of ploughs (more than 25%), but forestation represents similar effect; role of mining is much lower. Nowadays, almost 50% of the lands of complex cultivation structure located in the vicinity of the settlements are inhabited area. One of the most various transformations happened in the site of the former vineyards. They were mainly replaced by forest, but ploughs, building-up areas and orchards were also formed.

Until the beginning of the 20th century the

number of patches increased by one and a half times, however, due to anthropogenic activity of lower intensity, weighted areal average of hemeroby values of the categories suggests that naturalness degree is slightly higher than the limit of the degraded state (hemeroby level: 2.99). Up till now the number of patches increased by one and a half times, again. Changes in average hemeroby value does not seem to be significant (2.83), however, ratio of degraded and artificial (meta- and polyhemerobic) patches increased (Fig. 5). The most favorable processes are obviously in association with the extension of industrial-mining activity and the increase of inhabited areas.

4. Conclusions

Mining and landscape historical information suggest that the most significant period of transformation of the hilly area to a cultural landscape was the turn of the 20th century when, due to the formation of large-scale mining, this agricultural landscape transformed to an agricultural-industrial one. Map compiled in 1924 indicated mining of local impact, but concentrations of human activities resulting in high disturbance can be also identified. Although, the increase of

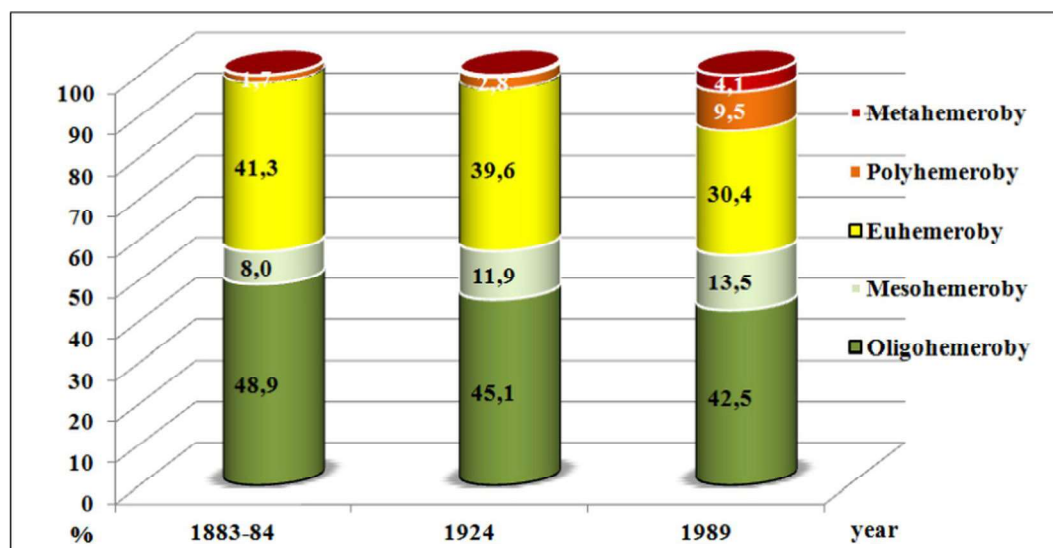


Fig. 5. Areal ratios of patches of different hemeroby values in 1883; 1924 and 1989

ploughs can also be noticed, only indirectly due to the increase of population generated by mining and industry.

Growth of coal production promoted further industrial investments, resulting in the formation of an industrial-agricultural landscape as early as the mid 20th century, which can be called as montanogenic subtype by reasons of its features. One of its most typical characters is the rapid development of the built-up area, and almost every form of which can be associated with the mining activity. Little villages were replaced by new type towns and industrial plants of artificially covered surface. Mining dramatically transformed the topography and disturbed the hydrological systems, and in this way new landscape elements were created and semi-anthropogenic processes were induced. Increase of density of road and railway systems as well as other artificial landscape elements resulted in a significant decline of hemeroby conditions. Dissection of the natural landscape elements can be noticed, too, which endangers the self-supporting ability of some associations in some places (e.g. wetland habitats). Spatial changes of distribution of patch density obviously indicate that human impact expands along the mountain front valleys toward the inner terrains. Inside of the hilly area the ratio of forests is similar to the state recorded in 1924. In the vicinity of built-in areas in the place of former mining sites and along valleys forming major corridors patch density is greater than the average.

Present state of the landscape has been formed after abandonment of deep coal mining. The disadvantageous conditions generally characteristic for settlements in intramontane basins in Hungary have been re-established. During the last one hundred years the traditional agricultural branches have declined, the landscape has been seriously damaged; therefore, in this way, their state has become more disadvantageous. Re-naturalization of the montanogenic forms happens partly by spontaneous process and partly by planned human activity. Agriculture

has not regained its former importance and self-supporting role in the environments overloaded by mining. However, forests remained dominant land use category, and this fact makes the formation of a semi-natural landscape possible.

Acknowledgements

Research work of László Sütő was supported by the European Union and the State of Hungary, co-financed by the European Social Fund in the framework of TÁMOP-4.2.4.A/ 2-11/1-2012-0001 'National Excellence Program'. The authors also thank the support of the Hungarian National Scientific Research Fund (OTKA Grant No. 101787).

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