University of Miskolc
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ADAPTATION OPPORTUNITIES OF MODERN APPROACHES OF CRIMINAL GEOGRAPHY IN DIFFERENT SPATIAL LEVELS

Theses of Ph.D. Dissertation

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I. Introduction, research background

Criminal geography is a research field, which analyses the spatial distribution of crime and the results are demonstrated primarily by crime maps. Experts have dealt with the geography of crime since the beginning of criminological researches. There are several articles in Hungarian literature as well, which analyse the connection between crime and social factors (e. g. FÖLDES 1932; KORINEK 1989A; VÍGH ET AL. 1989; GÖNCZÖL 1993; VAVRÓ 1995; FERGE 1999; HORVÁTHNÉ TAKÁCS 2003; PISKÓTI 2011A; PISKÓTI 2011B; PISKÓTI – SISKÁNÉ SZILASI 2011), the distribution of crime (e. g. HELLER FARKAS 1964; SZABÓ – KOLTAINÉ TÓTH 1987; KOVÁCS 1989; VINCZE ET AL. 1990; FAZEKAS 1997; RITECZ – SALLAI 1999; KEREZSI – RITTER 2000; KEREZSI ET AL. 2001; KEREZSI – KÓ 2001; SZŰCS 2001; SALLAI 2002; KOBOLKA – RITECZ – SALLAI 2003; KOBOLKA – SALLAI 2008; KOVACSICSNÉ NAGY 2010; PISKÓTI 2010; PISKÓTI 2011C; PISKÓTI 2011D; PATKÓS – TÓTH 2012) and the fear of crime (e. g. KORINEK 1989B; KORINEK 1995; KÓ 2005; PISKÓTI 2012A; PISKÓTI – SISKÁNÉ SZILASI 2012). In Hungary there are two Ph. D. dissertations about criminal geography in the field of earth sciences (TÓTH 2007; MÁTYÁS 2011), in addition I would mention the Ph.D. dissertation of ERDEI (2014) in the field of police science.

My Ph. D. dissertation focuses on an issue that was marginal in Hungarian literature: it analyses crime in GIS environment. Nevertheless significant international literature are available concerning this topic (e. g. CAMERON 2001; APPIAHENE – GYAMFI 2003; ACKERMAN ET AL. 2004; HARRIES 2006; WOLFF – ASCHE 2009; CECCATO – DOLMEN 2011; FERREIRA ET AL. 2012; LEI 2011; WANG ET AL. 2013). The another novelty of the dissertation is that it applies different spatial statistical methods – based on the guidance of international literature (e. g. MESSNER – ANSELIN 2004; CAHILL – MULLIGAN 2007; CRACOLICI – UBERTI 2008; BREETZKE 2010; ANDRESEN 2011); in this regard it tends to exceed the simple thematic mapping and try to visualize the results in a quantitative way.

II. Aims of the study

The aim of dissertation is to analyse the spatial distribution of crime in different regional scales: country, county and settlement level – it covers the analysis of the North-Hungarian Region. The overall objective is to explore the connection between crime indexes and socio-economic factors.

To evaluate the criminal situation of Hungary adequately, it is necessary to analyse its statistics in international context. Therefore I carry out the analysis about the criminal situation of Hungary in the aspect of crime tendencies of EU 27 countries[1]; my aim is to position Hungary in the "crime map"[2] of European Union.

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[1] I performed the analysis in 2012 that is the reason why the analysis does not involve the crime data of Croatia.

[2] The differences in legal definitions, the different procedural and data recording systems make the international comparison difficult. Direct comparison of crime data should be avoid due to different level of latent crime (KERTÉSZ 1999, TÓTH 2007).

Counties of Hungary are the next level of analysis. Before demonstrating county level crime maps, it is necessary to figure the long-term crime data of Hungary – this part could be interpreted as a passage from larger to lower scale. For this reason I study the progress of known offences and offenders between 1970 and 2012. Evaluating the criminal situation of Hungarian counties was necessary to introduce the most detailed research level. I study that what kind of differences could be detected between the distribution of offences and offenders and I attempt to limit crime attractive and offender exporter spatial units – emphasizing the situation of the region analysed in detail. In this section I selected some socio-economic factors, which could be connected with crime indexes.

Settlements of North-Hungarian Region are the third level of analysis, which contains the most detailed analysis. In my opinion this is the most appropriate level for analysing spatial distribution of crime and exploring socio-economic factors of crime.

This analysis focuses on exploring regional specificities and the backgrounds of regional arrangement. I examine the following issues: spatial pattern of crime, mapping crime clusters and modelling spatial relations – including the analysis of socio-economic factors and crime relation –, moreover I attempt to create crime surface model. Finally I demonstrate the connection between social factors and crime in the example of four settlements of Borsod-Abaúj-Zemplén County.

III. METHODOLOGY

In accordance with the aims statistical data from different sources are integrated into a unified GIS database. I apply ArcGIS 10.1 GIS software, because it provides several excellent opportunities for analysing crime data with spatial statistics and generating surface models. Besides that I use SPSS (Statistical Package for Social Sciences) statistical software for preliminary examination of statistical data and performing correlation investigations. MS Excel is applied for the simpler analysis.

Spatial data analysis is carried out in country and county level. In case of EU member states the period of 1993-2012 is analysed, in case of long-term Hungarian data the analysis covers the 1970-2012 period. The county level analysis are carried out for the period after the transition. In the settlement level analysis I examine the 2002-2011 period.

I apply global Moran's I spatial autocorrelation index for analysing the pattern of crime, and the Hot Spot Analysis (Getis-Ord Gi*) statistics for mapping clusters. I carry out crime model building in more steps: first I select the variables – based on different theories of crime –, which could be related to offending; to explore these relations I perform correlation tests. As a second step I apply a data-mining tool, which probably makes me able to define variable combinations, which can explain the offending in the best way.

To generate a crime surface model I use different interpolation techniques, in addition I analyse the opportunities for surface analysis.

I carried out an empirical research in 2008 about the connection of social and criminal factors: I selected four settlements in Borsod-Abaúj-Zemplén County, which were in the most favourable and unfavourable criminal situation according to criminal

statistics of 1996 and 2006. I made structural interviews with the Mayors' of these settlements. Demonstrating the results of the empirical research I attempt to make conclusions whether the crime model created in a theoretical way works in practice.

IV. NEW SCIENTIFIC RESULTS

Studying long-term Hungarian crime data the following conclusion can be done:

Thesis 1. Number of known offences and offenders dramatically increased after the transition if we consider the 1970-2012 period (Figure 1 and 2). This increase can be explained adequately by different theories of crime, but one must not forget about the fact that law enforcement agencies worked under a forceful pressure by power in order to produce favourable statistics. In my opinion the dramatically increase can be interpreted as the common consequence of these two mentioned phenomena.
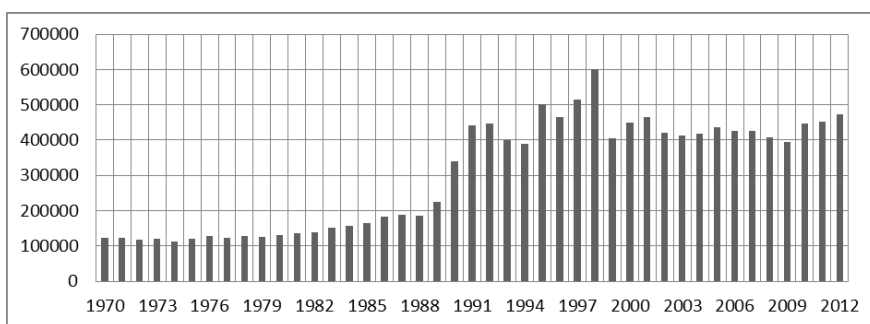

Figure 1. Change of known offences between 1970 and 2012 in Hungary
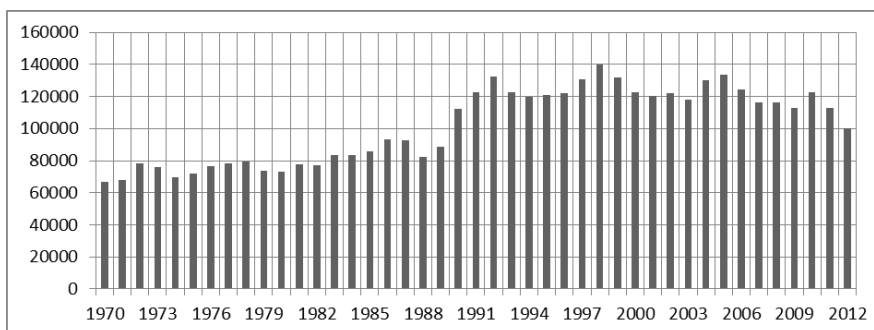
(Source: ERÜBS, ENYÜBS[3])

Figure 2. Change of known offenders between 1970 and 2012 in Hungary

(Source: ERÜBS, ENYÜBS)

My aim was to describe the criminal situation of Hungary by demonstrating its crime maps. Although doubts often emerge relating to reliability of crime statistics, in my view these data can be an appropriate basis for different social geographical

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[3] ERÜBS: Egységes Rendőrségi-Ügyészségi Bűnügyi Statisztika; ENYÜBS: Egységes Nyomozóhatósági Ügyészségi Bűnügyi Statisztika

analysis. The passage of time can facilitate that, because even more data will be available, better corrections of outlier data could be done, in addition it will be possible to explore certain long-term trends. Considering spatial distribution of crime the following statements can be done in county level:

Thesis 2. Number of known offences is the highest in Budapest according to its calculated mean (in the proportion of population) based on the period of 1990-2012. Budapest is followed by Somogy, Csongrád, Hajdú-Bihar, Fejér, Komárom-Esztergom, and Baranya Counties. The least offences were committed in Vas, Nógrád, and Békés Counties in the analysed period (Figure 3). Regarding to known offenders we can make the conclusion, that the most offenders came from Borsod-Abaúj-Zemplén County in the analysed period (Figure 4), value of the index is 129 % of the country mean. This county is followed by Szabolcs-Szatmár-Bereg, Hajdú-Bihar, and Komárom-Esztergom Counties. The least offenders are from Győr-Moson-Sopron, Vas, and Fejér Counties.

A. If we analyse the mean of known offences in case of western and eastern counties (without the data of capital town), it can be concluded that the western counties of Hungary have higher rates slightly: the value is 390,2 in case of Western-Hungarian counties is, while in case of eastern ones it is 374,87.

B. In case of known offenders the eastern counties have higher rates: mean of eastern counties is 122,69 (without Budapest), while in the case of western ones it is 109,15. Therefore a more significant difference (~11 %) can be established between the western and eastern counties.
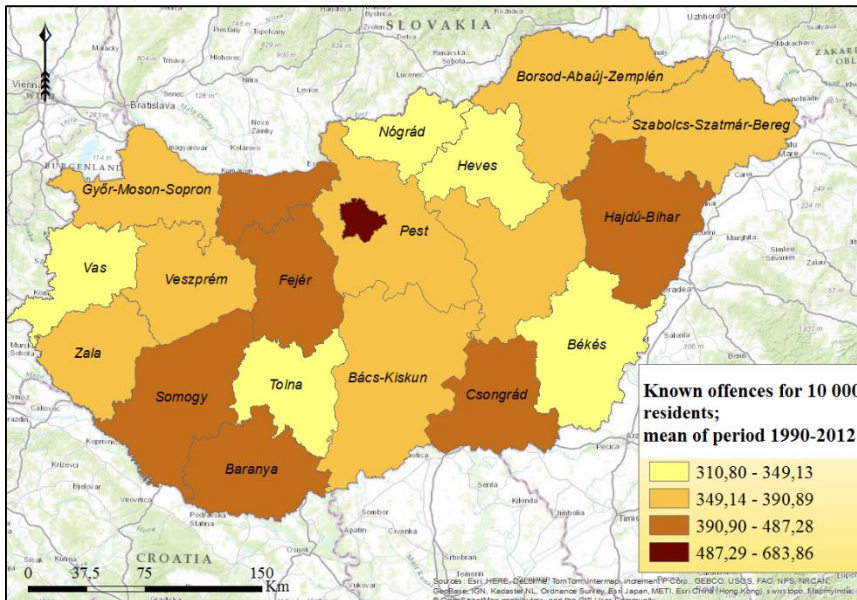

Figure 3. Spatial distribution of offences after the transition in Hungary
(Source: own edition based on *crimestat.b-m.hu and KSH[4]* data)

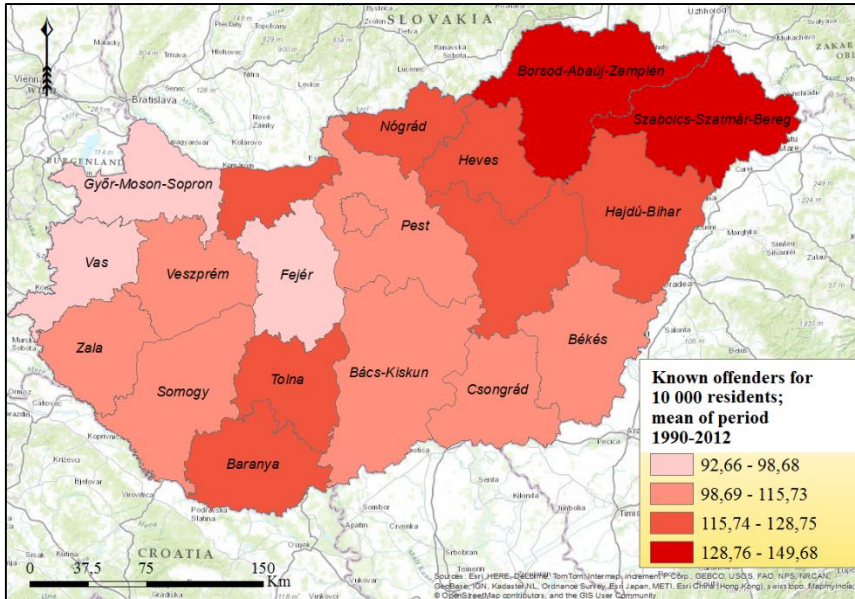[4] KSH: Központi Statisztikai Hivatal, Central Statistical Office.

Figure 4. Spatial distribution of offenders after the transition in Hungary
(Source: own edition based on *crimestat.b-m.hu and KSH* data)

Thesis 3. According to the numbers of known offences and offenders the Hungarian counties can be classified into three classes: crime attractive (Class 1), neutral spatial units (Class 2) and offender exporter (Class 3) (Figure 5). Offender exporter counties can be found mainly in East-Hungary, while crime attractive ones are related basically to Transdanubium.
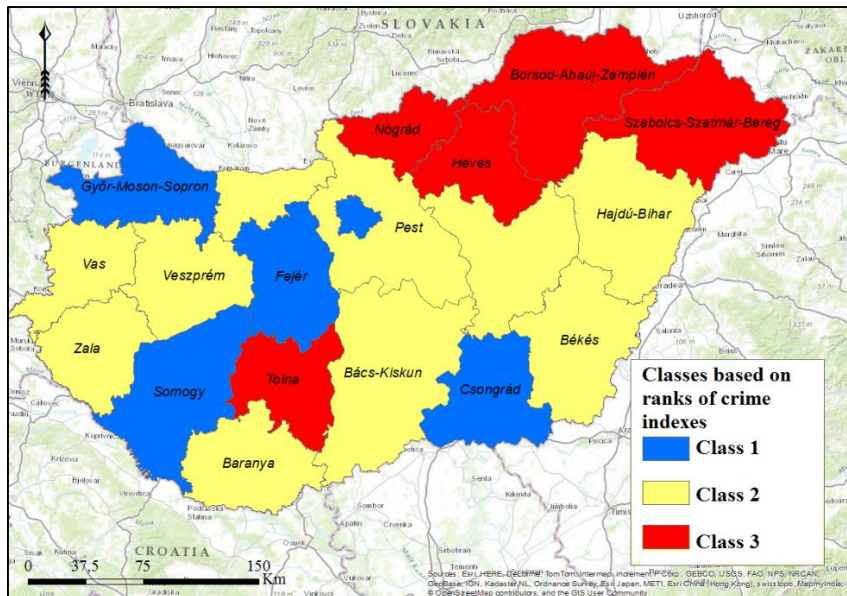

Figure 5. Classes based on ranks of known offences and offenders (Source: own edition)

After demonstrating the spatial distribution of crime using county level data it is worth to analyse what kind of social and economic factors could stand in the background. For this purpose I selected some social and economic factors, which could connect to crime indexes. As the first step I drew the scatter plots of variables; if linear connection could be considered I calculated Pearson correlation coefficient.

Thesis 4. Concerning the connection between county level crime data and some selected social and economic variables the following statements can be made:

- Spatial inequalities of GDP per capita does not explain the spatial distribution of known offences in the relation of Hungarian counties (Figure 6).

- There is a linear connection between known offenders and activity, employment and unemployment rates. Strong negative connection can be detected in case of activity and employment rate, and strong positive connection can be found in case of unemployment rate. According to that we can say that the selected indexes describing labour market have a significant influence on the distribution of offences in county scale.
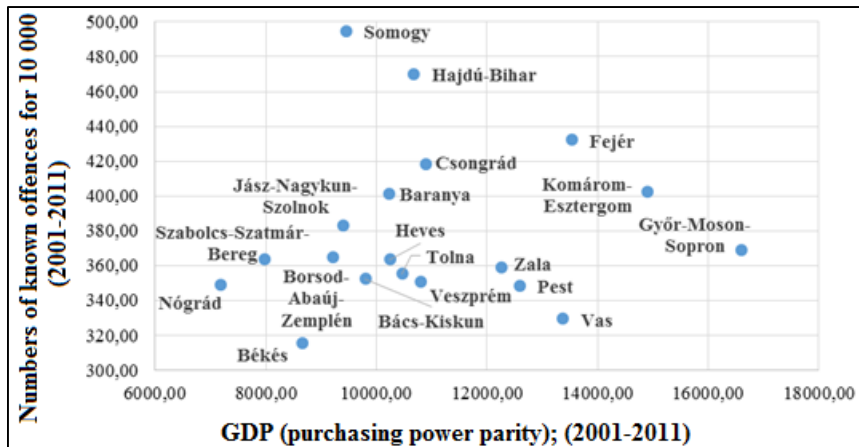

Figure 6. Connection between number of offences and GDP (purchasing power parity)
(Source: own edition according to KSH[5] data)

According to my assumption the spatial distribution of offences and offenders is not random, settlements having high crime rates could be found in the neighbourhood of settlements having similar high crime values, and settlements characterized by low crime values are close to settlements having similar low crime rates. To examine this assumption I calculated the global Moran's I index of spatial autocorrelation. My second hypothesis is that the concentration of settlements having high or low crime values can be detected in the North-Hungarian Region. Considering settlement level data I made the following statements:

Thesis 5. It could be concluded that there is a regularity in spatial distribution of crime data by the help of global Moran's I spatial autocorrelation index: positive spatial

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[5] KSH: Központi Statisztikai Hivatal, Central Statistical Office.

autocorrelation was experienced in the relation of both crime indexes in significant part of the period under investigation. It refers that settlements having high crime rates can be found in the neighbourhood of high crime rate settlements; at the same time settlements having low crime rates are close to settlements having similar low crime values.

A. Besides that it can be concluded that the value of Moran's I index shows an increasing tendency concerning both crime indexes, which refers that the concentration of settlements having low and high crime rates is getting more intensive.

Thesis 6. By the help of crime Hot Spot Analysis it was successful to delimit areas, where settlements with high or low crime rates concentrated. Determined hot and cold spots by Getis-Ord Gi* local statistical method are justified by crime surface model as well.

A. Certain settlements situated in the southern part of Heves County have outstanding high crime rates (in the relation of both analysed period), the other problematic area is in the northern part of Borsod-Abaúj-Zemplén County (according to the maps of 2010/2011) (Figure 7 and 8). The definitely low population could influence the significance of the second group of hot spots.

B. In addition it is necessary to draw the attention for two areas according to the maps of 2010/2011, which appear as cold spots in the relation of both crime indexes. One of them is in the border of Nógrád and Pest County, while the other one is in the north-western and south-western neighbourhood of Miskolc.
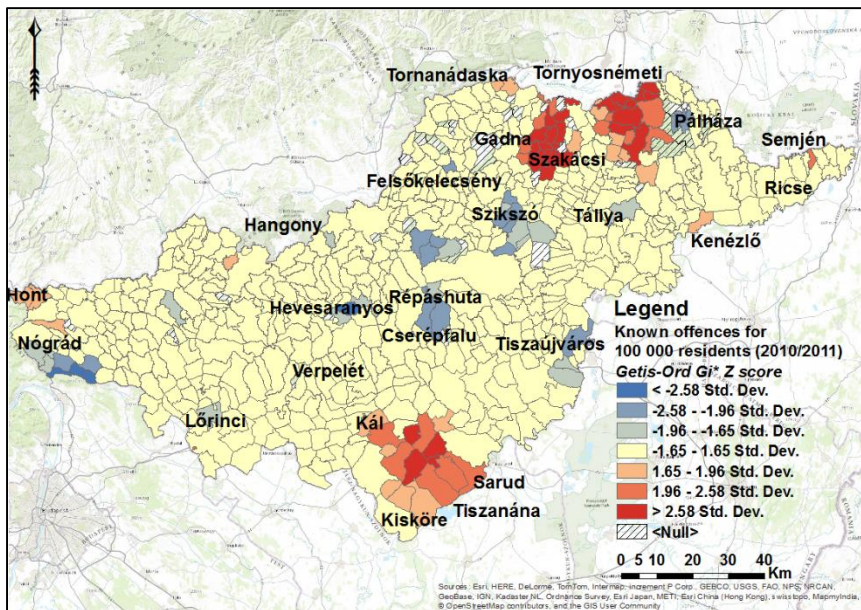

Figure 7. Offence hot spot map of the North-Hungarian Region for 2010-2011 period
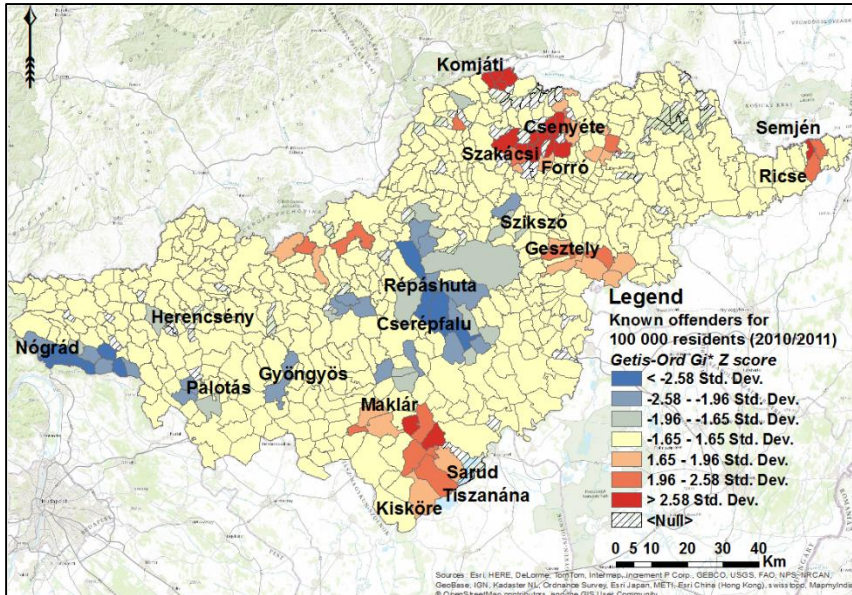(Source: own edition)

Figure 8. Offender hot spot map of the North-Hungarian Region for the 2010-2011 period (Source: own edition)

During the studies I generated crime surface model, and I made the following statements:

Thesis 7. Crime surface models are the new generation of crime maps. By the help of surfacing processes crime becomes to be interpreted in three dimensions (Figure 9). The utilization of surface models would be definitely justified in analysing larger spatial units – county, region, country –, because on the one hand they could help to support the explored nexus, on the other hand they could provide a better visualization method comparing to traditional thematic crime maps.

A. According to the opinion of JAKOBI (2009A) the same analytical capabilities are available for surface model generated from social data, like in case of traditional digital elevation models. It could be justified by a digital surface model generated by crime data.
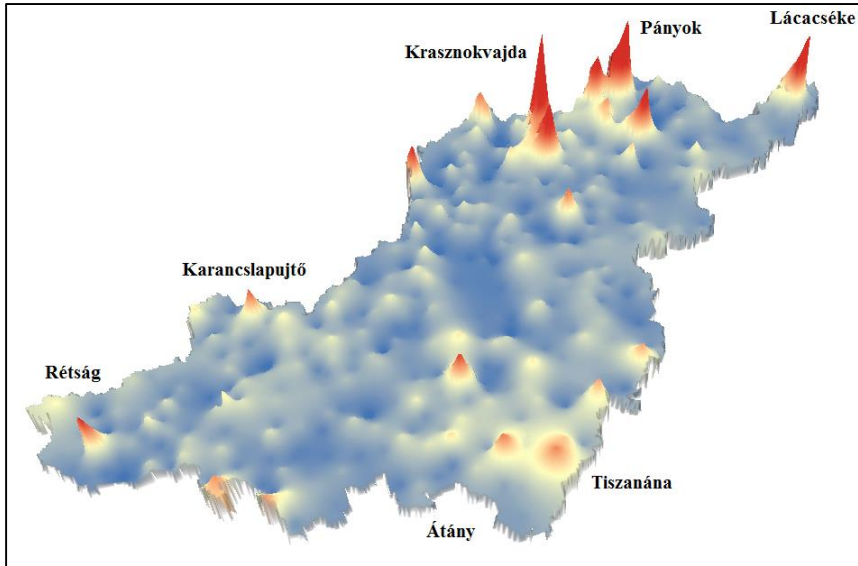
Figure 9. Visualizing surface model in 3D generated from number of offences

(Source: own edition)

Several Hungarian literature dealt with the connection of crime and social factors, but the studying these relations with the help of mathematical-statistical methods were marginalized in criminology and sociology. I made the following findings:

Thesis 8. After overviewing the international articles focusing on the analysis of social background of crime it can be established, that they attempt to build a crime model by analysing only crimes against property; there are just a few which try to explain the whole criminality. In the aspect of methodologies it can be established that they use some kind of regression techniques.

Thesis 9. According to Pearson correlation coefficients the findings are the followings: there is a positive relationship between known offenders and proportion of jobseekers, the proportion of social assistance recipients, proportion of job-replacing assistance, unemployment rate and ethnic diversity. Negative relationship can be recognized in case of following variables: comfort index, proportion of population having car, proportion of population aged punishable, education index, and numbers of elderly people for 100 children aged.

Thesis 10. I involved social factors having an effect on number of offenders into a regression model. As a result of that a crime model is built for the settlements of North-Hungarian Region, which supports fundamentally social disorganisation theory, and it explains the 23 % of variance of offenders for 100 000 residents[6].

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[6] Similar adjusted R^2 were achieved in case of crime models demonstrated in international literature: for instance in case of BREETZKE (2012) crime model the adjusted R^2 is between 0,185 and 0,220; in case of CAHILL – MULLIGAN (2007) it was 0,361.

A. It is concluded that being unemployed and getting into the periphery of labour market can be defined as the highest risk factor in the aspect of crime offending.

B. Analysis of the four selected settlements are consistent with the results of crime model, with the only exception of religiousness. Mathematical relation between crime and religiousness could not be justified according to investigation performed in 453 settlements, but the beneficial effect of religiousness on public safety can be univocally established according to the experiences of the sample settlements.

V. UTILIZATION OPPORTUNITIES OF THE RESULTS

There are several opportunities for utilizing the results of criminal geographical researches, including the adaptation of crime maps through operative police work. They could be utilized in the field of crime prevention, organisation of police patrol service, analytical-evaluation work, moreover in police leadership and education as well. In addition crime maps could be useful for making region development conceptions and urban planning (MÁTYÁS – SALLAI 2014).

It is worth to separate the opportunities provided by maps, which are drawn in different scales. Settlement-level crime maps could be utilized in the following fields: making spatial-specified crime prevention strategies, analytical and evaluation work, defining optimal place for police stations; defining optimal place for new penitentiary facilities considering the spatial distribution of offenders.

PÖDÖR (2007) lists the adaptation opportunities of crime maps in her conference presentation. Among them it is worth to underline the followings – in the level within the municipal level –: service management, organization of patrol routes; determining the area of law enforcement and criminal actions, organizing the quick close – for example in case of robbery –; locating missing person – delimiting the most optimal area for the sake of search; exploring crime series.

According to the opinion of MÁTYÁS – SALLAI (2014) crime maps are not appropriate by themselves for solving problems, but their utilization promote the police work. „Crime map is an opportunity for police experts, it cannot be ignored by the police of 21st Century through its everyday work" (MÁTYÁS – SALLAI 2014; 354P.).

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