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Estimation of the Quaternary stream erosion in small drainage basins (Vâlcea sub-Carpathians and Olteţ Plateau, Romania)

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Abstract

Stream erosion is a widely spread process in the Getic sub-Carpathians and Plateau (including the study sub-units). It is controlled by the high density of small drainage basins on a surface unit. Development of the 4th and 5th order valleys (according to Strahler's system) in the sub-Carpathians and of the 3rd and 4th order in the Olteţ Plateau was also determined by the high altitude of hillslopes, up to 450 meters in the Vâlcea sub-Carpathians and to 250 meters in the Olteţ Plateau, a consequence of the strong downcutting performed by the Olt river and its main tributaries in this area (Olăneşti, Bistriţa, Cerna and Olteţ). Another control factor is the friable bedrock made of sedimentary deposits: conglomerate, gravel, sand, sandstone, marl, clay, tuffs etc. in the Vâlcea sub-Carpathians and Cândeşti strata (gravels with clayey lens of Villafranchian age) in the Olteţ Plateau.

Keywords: *Small drainage basin, Stream erosion, Geomorphic balance, Sub-Carpathians, Getic Plateau*

Rezumat. Estimarea eroziunii din timpul Cuaternarului în bazinele hidrografice mici (Subcarpații Vâlcei și Podișul Oltețului, România)

Eroziunea torențială este un process cu largă răspândire în Subcarpații și Podișul Getic, inclusiv în subunitățile în care s-a efectuat studiul. Amploarea acestui proces hidro-geomorfologic este pusă în evidență de densitatea mare a organismelor torențiale raportate la unitatea de suprafață. Dezvoltarea bazinelor torențiale de ordinele IV și V (conform sistemului de ierarhizare Strahler) în Subcarpați și de ordinele III și IV în Podișul Oltețului a fost favorizată și de amplitudinea mare a versanților, de până la 450 m în Subcarpații Vâlcei și de până la 250 m în Podișul Oltețului, determinată de adâncirea accentuată a râului Olt și a principalilor afluenți din acest areal (Olănești, Bistrița, Cerna și Olteț). La aceasta se adaugă friabilitatea substratului geologic, format din depozite sedimentare: conglomerate, pietrișuri, nisipuri, gresii, marne, argile, tufuri ș.a. în Subcarpații Vâlcei și strate de Cândești (pietrișuri cu lentile argiloase de vârstă villafranchiană) în Podișul Oltețului.

Cuvinte-cheie: *Bazin hidrografic mic, Eroziune torențială, Bilanț geomorfologic, Subcarpați, Podișul Getic*

Introduction

Physical geographers and geomorphologists have constantly approached the problematic of drainage basin processes within their studies (Roehl, 1962; Gregory & Walling, 1973). Since the first significant theoretical debate conducted by Walling, (1983) regarding the sediment erosion and delivery, some researchers have paid special attention to the problem of the amount of eroded material within drainage basins (Lu et al., 2004; Lu et al., 2005). Most of the recent studies approached the GIS environment implementation. Walling's theory has been recently revised, with authors focusing on area-specific sediment yield or SSY (de Vente et al., 2007). Other papers concerned on dividing basin areas into smaller, morphological units to facilitate quantitative analyses on the sediment delivery ratio and increase the accuracy of results (Ferro & Minacapilli, 1995). The Italian geographic school had similar concerns over this subject (Pellegrini, 1983; Lupia Palmieri et al., 1998; Vianello et al., 2004; Zaccagnini, 2005), and more recent papers even developed a GIS-based approach (Vivenzio, 2002). A special attention on sediment delivery over the Romanian territory was paid by Rădoane & Rădoane (2005). Most of the Romanian studies regarding this matter focused on evaluating the gully erosion within gullying-affected landforms, particularly Moldova and Getic Plateaus (Bălteanu & Taloescu, 1978; Rădoane et al., 1999; Boengiu, 2008). Previous research on evaluating the volume of removed sediment was conducted on different landforms in Romania: Banat Mountains (Popescu, 1989); Getic Piedmont (Popescu, 1986; Ene et al., 2010; Boengiu et al., 2012); Argeș (Ene & Nedelea, 2007), Vâlcea (Ene, 2001; Tîrlă, 2012) and Curvature sub-Carpathians (Popescu et al., 2003).

Small drainage basins – reference geomorphological units in stream erosion analyses

While gullies are simple physical products of linear erosion, drainage basins result from complex

branching stream erosion, which is hierarchically superior. The two main features of a small drainage basin are: a relatively low order of the collector stream, and having "similar physiographic conditions over the whole of its surface" (Toth, 1963). Classification of drainage basins into large, medium and small (having multiple sub-units) is generally based on area size and stream order, as these two criteria were widely accepted as being the most relevant in empirical geomorphological studies (Rădoane, 2002). Under the circumstances, the basins analyzed in this paper are classified as 'small' since they have areas under the threshold value of 100 km^2 and 3rd or 4th stream order using Strahler's classification system (Strahler, 1957). They shall be further referred to either as small basins, sub-basins or catchments.

This study aims to contribute at developing the previously initiated research in the sub-Carpathian and plateau areas in Romania and quantitatively estimate the rate of erosion in small drainage basins during the Quaternary. In order to achieve this goal, we calculated the volume of eroded and evacuated sediment, concomitantly with the stream network development, and finally show the geomorphic balance of the analyzed landforms.

Morphogenetic conditions

A total of 27 small drainage basins were subject to analysis: 7 basins in the Vâlcea Sub-Carpathians and 20 basins in the Olteţ Plateau (Fig. 1, Table 1). The Sub-Carpathian sub-basins are tributary to the Olt, Olănești and Govora rivers, whereas the plateau sub-basins are tributary of the Cerna, Cernișoara and Luncavăț.

The geomorphic evolution of the Vâlcea sub-Carpathians and Olteţ Plateau was and still is controlled by a series of conditional factors (geology, structure, neotectonic movements, vegetation etc.) and triggering factors (precipitation regime, underground water circuit etc.). The type of bedrock and neotectonic movements control the intensity of erosion. We distinguished three major geological layers in the analyzed catchments (Fig. 1):

- A relatively resistant Miocene layer consisting of conglomerate, gravel, tuffs, schist and marl, found within the bedrock of 5 catchments (Glâmboaca, Pleşii, Buneşti, Strâmba and Tulburoasa), located in the north-central Vâlcea sub-Carpathians;
- A friable Upper Miocene layer (Sarmatian deposits: sand, sandstone, marl, clay, clay with coal intercalations, etc.), found only in the Creştetului and Vlădeşti catchments, located in the south-central Vâlcea sub-Carpathians;
- A Villafranchian layer consisting of gravel deposits with sand and clay intercalations (Cândeşti strata), partly mantled by loess deposits and found within all the catchments in the Olteţ Plateau.

The intensity of neotectonic movements register positive values, ranging from 0.7 mm/year in the Olteţ Plateau to 2.5 mm/year in the north-central Vâlcea sub-Carpathians (Visarion et al., 1977; Zugrăvescu et al., 1998). Precipitation is variable in this area, with heavy rainfall on summer (over 50 l/m2/day sometimes). During the last 2,000 years (and more aggressively during the last 200 years), another factor – humans – has interfered by deforesting large areas.

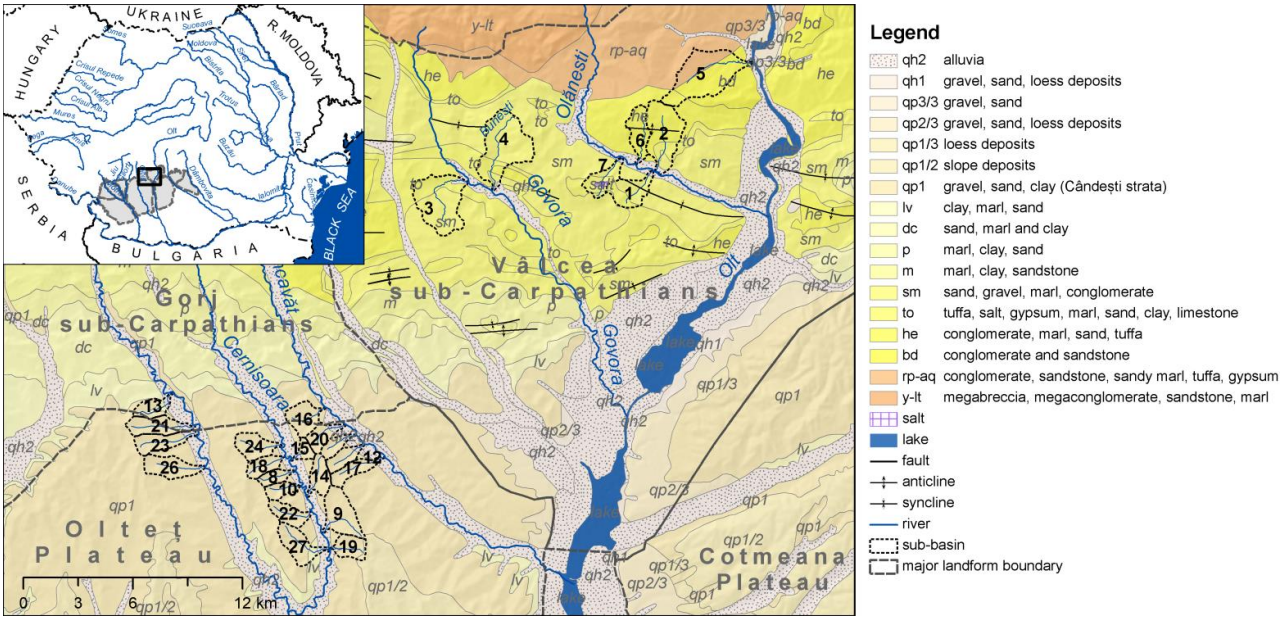

Fig. 1: Geographical setting and geology of the study sub-basins. Numbers correspond to sub-basin names given in Table 1, and the location of study area (in black) within the major landform units (in gray) is indicated in the vignette. Geology processing after (Codarcea, et al., 1967; Bombiță, et al., 1967)(SRTM, 2000; DEM by authors)

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Research methodology

We have chosen a method of determining the total fluvial erosion by calculating the evacuated volume of the studied sub-basins. Starting from the idea that the volume of the negative shape of a sub-basin is approximately equal to the volume of the material removed by erosion since that basin started to form, one can estimate the volume of material eroded during the entire evolution of that basin (Popescu, 1986). A model illustrating how the basins are divided into square units and the types of numerical analyses performed, is shown in Figure 2.

All input data were obtained by calculations according to formulas below. Topographic maps of scale at 1:25,000; geological maps of scale at 1:200,000 (Codarcea, et al., 1967; Bombiță, et al., 1967); and the neotectonic map of Romania of scale at 1:4,000,000 (Zugrăvescu et al., 1998) form the cartographic basis used within the study.

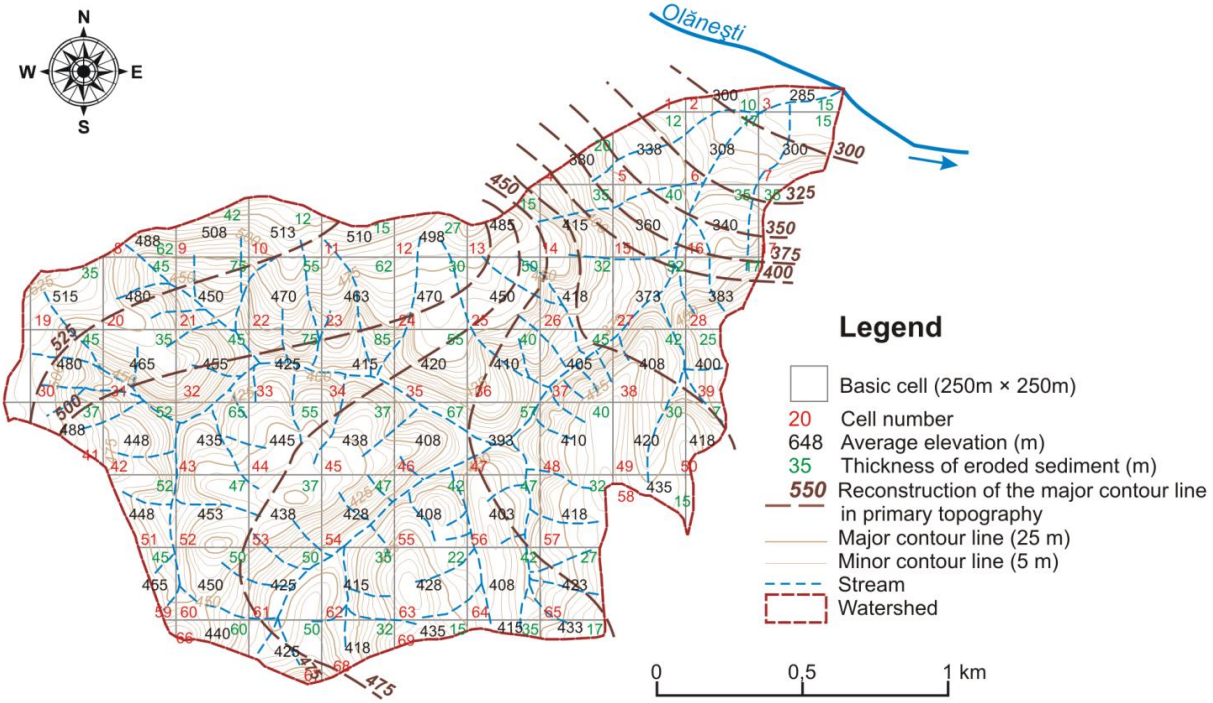

Fig. 2: Graphical and numerical analysis model applied to Glâmboaca sub-Carpathian catchment

Main working stages:

Select a series of small catchments of the same order if possible;

Measure the area for each catchment (S_b) – Fig. 3, Table 1;

Split the basin areas into cells of 250 x 250 m (62,500 m^2) which are the basis for calculation;

Calculate the average elevation (H_{med}) of each surface unit;

$$H_{med} = \frac{Alt_{max} + Alt_{min}}{2}$$

Reconstitute the primary surface as the evolution base for the gullies; in order to obtain more accurate results, we correlated all the "pieces" left from the primary level, and corrections were applied by tracing several cross sections over each catchment (Fig. 4);

Calculate the thickness of the eroded material for each surface unit:

$G_{er} = H_i - H_{med}$ (m),

where H_i is the primary average elevation.

Calculate the volume of eroded material (V_{er}) on the surface unit and the total volume of eroded material (Vt_{er}) for each analyzed catchment:

$V_{er} = G_{er} \times S$ (m_3)

$Vt_{er} = \sum V_{er}$

Calculate the eroded specific volume for each analyzed catchment (Vs_{er}):

$$Vs_{er} = \frac{Vt_{er}}{S_b} \ (m_3/km^2)$$

Calculate the specific erosion (rate of erosion, Er_s):

$$Er_s = \frac{Vs_{er}}{T} \ (\frac{m^3}{km^2}/year),$$

where T is the time during which the analyzed catchments formed.

To estimate the time necessary for the analyzed catchments to form, we considered that the moment since the erosion processes and evacuation of materials started can be placed at the end of Mindel glacial phase for the sub-Carpathian basins and at the end of the Würm I glacial phase for the 2nd

generation catchments in the plateau area (Popescu, 1986; Badea & Dinu, 1987).

Results

The basin areas vary from 1.08 km^2 in Valea Şibiţei to 12.2 km^2 in Valea Şasa (Fig. 3). After calculating the total volume removed, there resulted that in most of these cases its value is directly proportional to the catchment's area. The average of eroded specific volume is 48.7 × 10^6 m^3/km^2 for the catchments in the Vâlcea sub-Carpathians and 47.78 × 10^6 m^3/km^2 for the catchments in the Olteţ Plateau (Fig. 4). This demonstrates that similar climatic and geological conditions controlled their evolution (including the highly friable bedrock, even if the facieses differ within the two landforms). The slightly higher hardness of rocks in the Vâlcea sub-Carpathians was counterbalanced by the more intense uplift of the area, resulting in a higher rate of hillslope erosion.

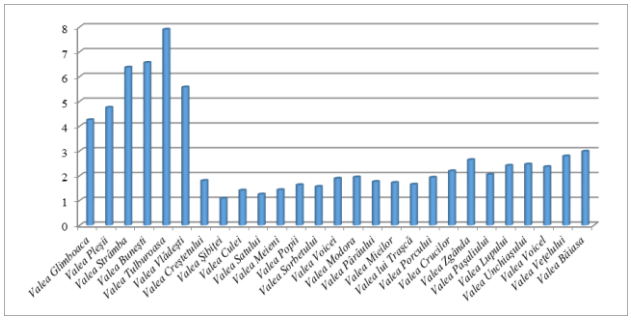

Fig. 3: The area of the catchments (in km2)

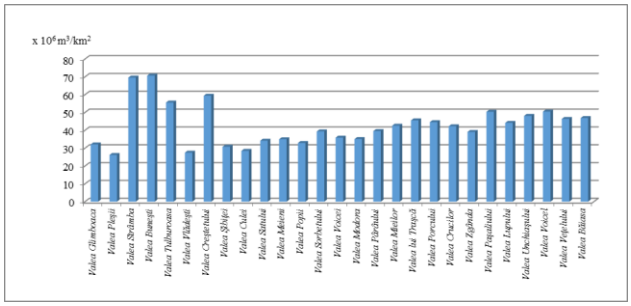

Fig. 4: Eroded specific volume (x 106 m3/km2)

Table 1: Basin area (Sb), total eroded volume (Vter) and specific eroded volume (Vser)

No.	Catchment	S_b (km^2)	Vt_{er} (x 10^{6}m^3)	Vser (x 10^{6}m^3/km^2)	Collector river	Landform unit
1	Valea Glâmboaca	4.25	86.2	32.1	Olănești	Vâlcea sub-Carpathians
2	Valea Pleşii	4.75	124.2	26.2	Olănești	
3	Valea Strâmba	6.37	443.5	69.6	Govora	
4	Valea Buneşti	6.56	463.4	70.7	Govora	
5	Valea Tulburoasa	7.90	438.9	55.6	Olt	
6	Valea Vlădeşti	5.57	153.2	27.5	Olănești	
7	Valea Creştetului	1.80	106.9	59.4	Olănești	
8	Valea Şibiţei	1.08	33.3	30.83	Cernișoara	Olteţ Plateau
9	Valea Culei	1.41	40.2	28.51	Cernișoara	
10	Valea Satului	1.25	42.8	34.24	Cernișoara	
11	Valea Meieni	1.43	50.1	35.03	Luncavăţ	
12	Valea Popii	1.63	53.6	32.90	Luncavăţ	
13	Valea Sorbetului	1.56	61.4	39.36	Cerna	
14	Valea Voicei	1.89	67.8	35.87	Cernișoara	
15	Valea Modoia	1.94	68.1	35.10	Cernișoara	
16	Valea Pârâului	1.76	69.6	39.55	Luncavăţ	
17	Valea Meilor	1.72	73.3	42.62	Luncavăţ	
18	Valea lui Traşcă	1.65	75.3	45.64	Cernișoara	
19	Valea Porcului	1.93	86.0	44.56	Cernișoara	
20	Valea Crucilor	2.19	92.6	42.28	Luncavăţ	
21	Valea Zgânda	2.64	103.3	39.13	Cerna	
22	Valea Paşaliului	2.05	103.4	50.44	Cernișoara	
23	Valea Lupului	2.41	106.5	44.19	Cerna	
24	Valea Unchiaşului	2.46	118.4	48.13	Cernișoara	
25	Valea Voicel	2.36	119.2	50.51	Cernișoara	
26	Valea Veţelului	2.79	129.5	46.42	Cerna	
27	Valea Băiașa	2.98	139.9	46.95	Cernișoara	

In order to determine the specific erosion (Ers) and the rate of erosion (D), the eroded specific volume has been related to the time necessary for each analyzed catchment to form and develop (Popescu, 1986). The geomorphic balance was calculated on the basis of knowing the rate of erosion (D) and the value of neotectonic uplifts (Fig. 5, Table 2), using data from neotectonic maps of the Romanian territory (Cornea et al., 1979; Visarion et al., 1977; Zugrăvescu et al., 1998).

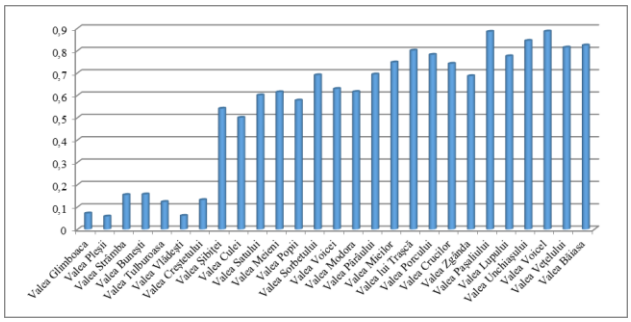

Fig. 5: Rate of erosion (mm/year)

Table 2: Specific erosion (Ers), rate of erosion (D), value of neotectonic uplift (M) and geomorphic balance (B)

No.	Catchment	T (years)	Er_s (m^3/km^2/year)	D (mm/year)	M (mm/year)	B (mm/year)
1	Valea Glâmboaca	450,000	71.8	0.0718	+1.5	+1.43
2	Valea Pleşii	450,000	58.2	0.0582	+1.5	+1.44
3	Valea Strâmba	450,000	154.7	0.1547	+1.8	+1.65
4	Valea Buneşti	450,000	157.1	0.1571	+1.8	+1.64
5	Valea Tulburoasa	450,000	123.5	0.1235	+2.5	+2.37
6	Valea Vlădeşti	450,000	61.1	0.0611	+2.5	+2.44
7	Valea Creştetului	450,000	132.0	0.1320	+1.8	+1.67
8	Valea Şibiţei	57,000	540.9	0.5409	+ 0.7	+0.16
9	Valea Culei	57,000	500.2	0.5002	+ 0.7	+0.20
10	Valea Satului	57,000	600.7	0.6007	+ 0.7	+0.10
11	Valea Meieni	57,000	614.6	0.6146	+ 1.0	+0.39
12	Valea Popii	57,000	577.2	0.5772	+ 1.0	+0.42
13	Valea Sorbetului	57,000	690.5	0.6905	+ 0.7	+0.01
14	Valea Voicei	57,000	629.3	0.6293	+ 0.7	+0.07
15	Valea Modora	57,000	615.8	0.6158	+ 0.7	+0.15
16	Valea Pârâului	57,000	693.9	0.6939	+ 1.0	+0.31
17	Valea Mieilor	57,000	747.7	0.7477	+ 1.0	+0.25
18	Valea lui Traşcă	57,000	800.7	0.8007	+ 0.7	-0.10
19	Valea Porcului	57,000	781.8	0.7818	+ 0.7	-0.08
20	Valea Crucilor	57,000	741.8	0.7418	+ 1.0	+0.26
21	Valea Zgânda	57,000	686.5	0.6865	+ 0.7	+0.01
22	Valea Paşaliului	57,000	884.9	0.8849	+ 0.7	-0.18
23	Valea Lupului	57,000	775.3	0.7753	+ 0.7	-0.08
24	Valea Unchiaşului	57,000	844.4	0.8444	+ 0.7	-0.14
25	Valea Voicel	57,000	886.1	0.8861	+ 0.7	-0.19
26	Valea Veţelului	57,000	814.4	0.8144	+ 0.7	-0.11
27	Valea Băiaşa	57,000	823.7	0.8237	+ 0.7	-0.12

After the evaluation process one could notice that most of the analyzed catchments have a positive geomorphic balance, especially in the sub-Carpathians. Values range from +1.43 mm/year (V. Glâmboaca) to +2.44 mm/year (V. Vlădeşti), which demonstrates that the landform uplifts quite rapidly, due to its proximity to the mountain area, which exceeds +3 mm/year in uplift. Consequently, external modeling agents do not succeed in eroding and removing the sediment as fast as the uplifts.

The catchments in the Olteţ Plateau register different values of geomorphic balance, from +0.42 mm/year (V. Popii) to -0.19 mm/year (V. Voicel), much lower than those in the Vâlcea sub-Carpathians. There are several factors responsible for this situation, such as the lower rate of neotectonic uplift (between +0.7 mm/year and +1.0 mm/year) and the higher friable bedrock. These conditions impose a rate of erosion up to ten times higher for the catchments in the Olteţ Plateau (Fig.

5) comparing to those in the Vâlcea sub-Carpathians. The Voicel catchment reaches the maximum value (0.8861 mm/year).

A number of 8 catchments have a negative geomorphic balance (Fig. 6). They are located in a lowly uplifting area (+0.7 to +1.0 mm/year). Overall, the Olteţ Plateau has a positive geomorphic balance, but the lower values (an average of 0.08 mm/year) comparing to Vâlcea sub-Carpathians (average of 1.81 mm/year) demonstrate a strong degradation by geomorphic processes, hardly counterbalanced by the neotectonic uplifts.

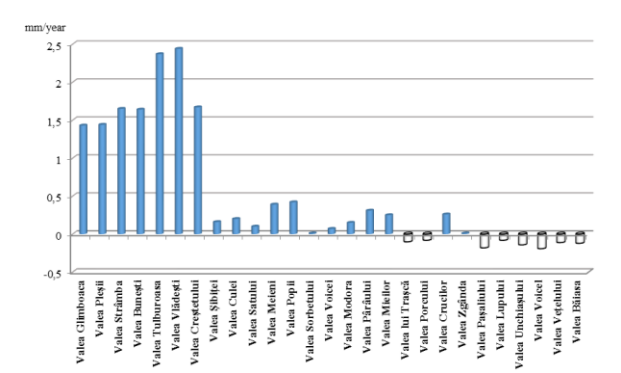

Fig. 6: Geomorphic balance (mm/year): blue = positive; white = negative

Table 3: The current rate of erosion (D) for catchments in the Vâlcea sub-Carpathians and Olteţ Plateau

Major drainage basin	Landform	D (mm/year)
Olăneşti	Vâlcea sub-Carpathians	0.393
Bistriţa	Vâlcea sub-Carpathians	0.258
Olteţ	Olteţ Plateau	0.540

Discussions

The current topography is a remnant of what at the end of Pliocene used to be a homogenous surface area, subject to stream downcutting during the Quaternary.

By comparing the results obtained to the present average values of the rate of erosion (Popescu, 1986) for the catchments in the Vâlcea sub-Carpathians and Olteţ Plateau (Table 3), we can notice that currently the erosion is more intense in the Vâlcea sub-Carpathians, possibly due to a much stronger anthropogenic activity, especially during the last 200 years. The particularly strong erosion in the Glâmboaca basin, followed by a massive sediment delivery was triggered by the uplift of salt in the nearby Sărata basin to the south. Reconstruction of the primary topography in the Olănești basin seems to certify the previous existence of a pre-Quaternary (Pliocene) erosion surface. In the Olteţ Plateau the phenomenon reverses – the rate of erosion is low if comparing to the values obtained for the whole time necessary for the catchments to form and develop. It can be explained if considering the very intense erosion during the Würm II glacial phase and the late-glacial period, when vegetation was lacking on large areas or it was very sparse.

Conclusion

Estimation of stream erosion (the main process controlling the evolution of hillslopes and landforms) by calculating the total volume of eroded material could be a useful geomorphic analysis method; the values obtained demonstrate the rhythm of erosion within various types of valleys.

Assessing the age of the primary topography in sub-basin areas is useful for a more accurate estimation of the geomorphic balance.

The values of specific erosion calculated for the sub-basins in which the solid discharge is not directly measured could be used as key-indicators in land reclamation works.

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River Change Detection and Bankline Erosion Recognition using Remote Sensing and GIS

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Abstract

Bangladesh is mainly formed by alluvial deposits, facing riverbank erosion very frequently due to unvarying alteration of river channels. This study is aimed at computing the actual bank shifting along the Manu River within Bangladesh for a period of thirteen years (1997-2010). The entire course of Manu River from upstream of India Border, Moulvibazar to the confluence with the Kushiyara River at Manumukh, Sherpur for a stretch of around 69 km has been studied using an integrated approach of Remote Sensing and Geographical Information System (GIS). The channel configuration of the Manu River has been mapped for the years 1997 and 2010 using Landsat satellite images. The analysis divulged that the Manu River is a highly meandering river with several very critical sections where the river has been suffering enormously with the erosion problem and shifting characteristics. The enumerated river shifting was found very high as the maximum left bank shifting and maximum right bank shifting had occurred at Rajnagar, Moulvibazar of 656 m and 628 m respectively, in the mentioned period. The results deliver latest and steadfast evidence on the dynamic fluvio-geomorphology of the Manu River for designing and execution of erosion control schemes.

Keywords: *River morphology, Bankline migration, Remote sensing, GIS*

Rezumat. Detectarea schimbărilor cursului râului și recunoșterea sectoarelor cu eroziune a malurilor folosind teledetecția și SIG

Bangladesh este format în principal din depozite aluviale, eroziunea fluvială fiind foarte frecventă datorită modificării continue a alviilor râurilor. Acest studiu își propune să evalueze modificările actuale ale malurilor râului Manu în Bangladesh pentru o perioadă de 13 ani (1997-2010). Întregul curs al râului Manu, de la granița cu India, Moulvibazar, până la confluența cu râul Kushiyara la Manumukh, Sherpur, pe o distanță de aproape 69 km, a fost studiat folosind o abordare ce integrează teledetecția și Sistemele informatice Geografice. Configurația albiei râului Manu a fost cartată pentru anul 1997 și 2010 folosind imaginile satelitare Landsat. Această analiză indică faptul că râul Manu este puternic meandrat, cu câteva sectoare critice, unde eroziunea este foarte accentuată, ducând la modificarea cursului. Această modificare este foarte intensă, în perioada menționată malul stâng deplasându-se cu 656 m, iar cel drept cu 628 m la Rajnagar, Moulvibazar. Acest studiu oferă cele mai recente și rapide dovezi privind geomorfologia fluvio-dinamică a râului Manu, care pot fi utilizate în conceperea și executarea schemelor pentru controlul eroziunii.

Cuvinte-cheie: *morfologie fluvială, deplasarea malurilor, teledetecție, SIG*

Introduction

River channel changes such as bank erosion, down cutting, and bank accretion are natural processes for an alluvial river (Yao et al., 2013). The nature, rates and causes of channel change have a particular relevance to the areas where high levels of disturbance threaten engineering structures and property (Gilvear et al., 1999) and are important for conserving the biodiversity of vegetation communities within the river corridor (Gilvear, 1993; Marston et al., 1995; Bravard et al., 1997). Regional developments such as sand mining, infrastructure construction on the riverbank, artificial cutoffs, bank revetment, reservoir construction and land use alterations have changed the natural geomorphologic dynamics of rivers (Surian 1999; Kesel 2003; Surian and Rinaldi 2003; Batalla et al., 2004; Vanacker et al., 2005; Wellmeyer et al., 2005). Change detection and quantification of erosion and deposition of riverbanks is such a study that is facilitated by application of RS, GIS and GPS. Remote sensing and GIS are widely used tools for detection and monitoring of changes of the physical environment (Andrea et al., 2001; Jensen, 2005; Stabel and Löffler, 2004; Ahmed, 2002; Twumasi and Merem, 2006, Deb, Das and Uddin, 2012, Aher, Bairagi and Deshmukh, 2012). In addition, the ability to quantify errors, which affect the precision of analytical results, is greatly improved by Gurnell et al., (1994). Important studies by Gurnell et al. (1994) and Gurnell (1997) have provided a valuable insight into the possibilities that GIS offers for river channel change analysis. Due to flood and riverbank erosion, Bangladesh loses a lot of land every year. During the monsoon, floods and flows of river water erode the bank.

In the winter, the water level of the river goes down and sandbanks get deposited alongside the riverbanks. Because of erosion and deposition of riverbanks, the country loses fertile land and gains sandbanks. Bangladesh Water Development Board (BWDB) reported that there were 140 km of river banks fully eroded and another 1345 km that were partially eroded by flood in 2007 (IRIN, 2008) which created more than US$ 75 million damages (Ahmed, 2006). The River Manu is located in the northeast

region of Bangladesh, within the administrative district of Moulvibazar. It is located in between 91o 20′ E to 92o10′ E and 24o10′N to 24o45′ N. Study area of Manu River shown in the Figure 1 represents the river reach from Tripura border to the confluence with the Kushiyara River in Manumukh, Sherpur and it lengths 69.88 km. It is also an alluvial and highly sinuous river. Five major critical sections have been selected in this study reach. The mean highest and lowest water levels of the Manu River are 18.88 m and 12.77 m respectively. It is a highly sinuous river with lots of meanders and lateral bank migration in it.

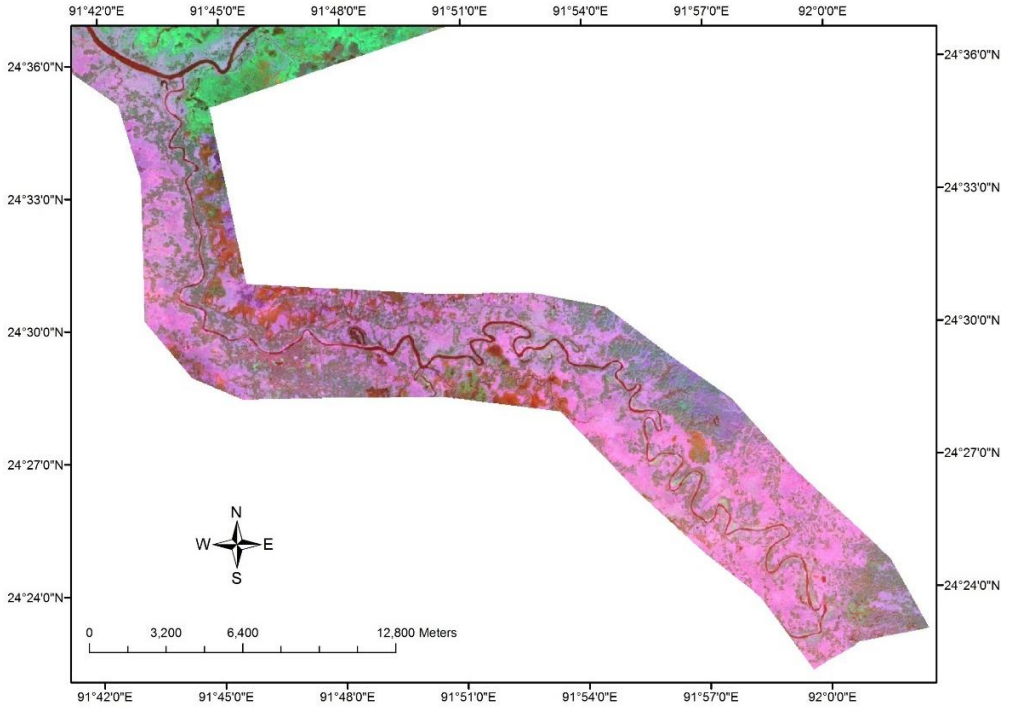


Figure 1: Raster Image of the Study Area (Manu River)

Data Collection and Methodology

Aeries of Landsat satellite images for the Manu River has been collected. Bangladesh Space Research and Remote Sensing Organization (SPARRSO) is the original source of the images. For this study, satellite images of 1997 and 2010 which were shown in Figure 2 and Figure 3 respectively, were collected directly from SPARRSO.

Figure 2: Raster Image of Manu River in 1997

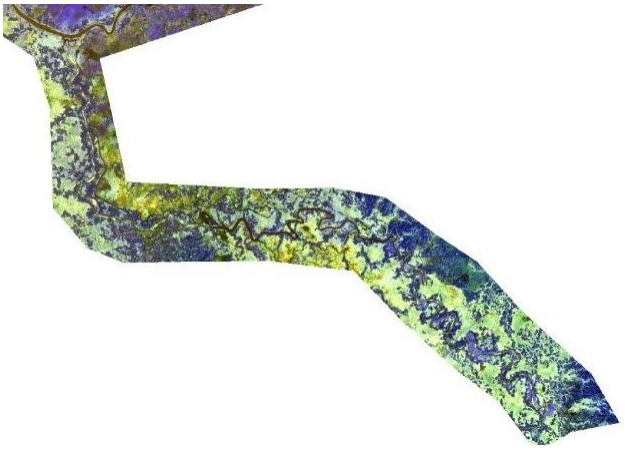


Figure 3: Raster Image of Manu River in 2010

The software ArcGIS 9.3 was used to investigate the images. The collected satellite images were pre-processed by geo-reference step and then digitized into riverbanks of the Manu River. From the scrutiny, five critical locations have been identified which are changing with the time very hastily. Critical changes on these sections were revealed in Figure 5 to Figure 9. Firstly, the river area was demarcated from the images using ArcGIS 9.3. Then, polygons of different years were digitized on each location

reach. Amount of River shifting, Bankline migration and direction of the shifting were then calculated using ArcGIS tool. Field values were also collected from Moulvibazar using GPS machine.

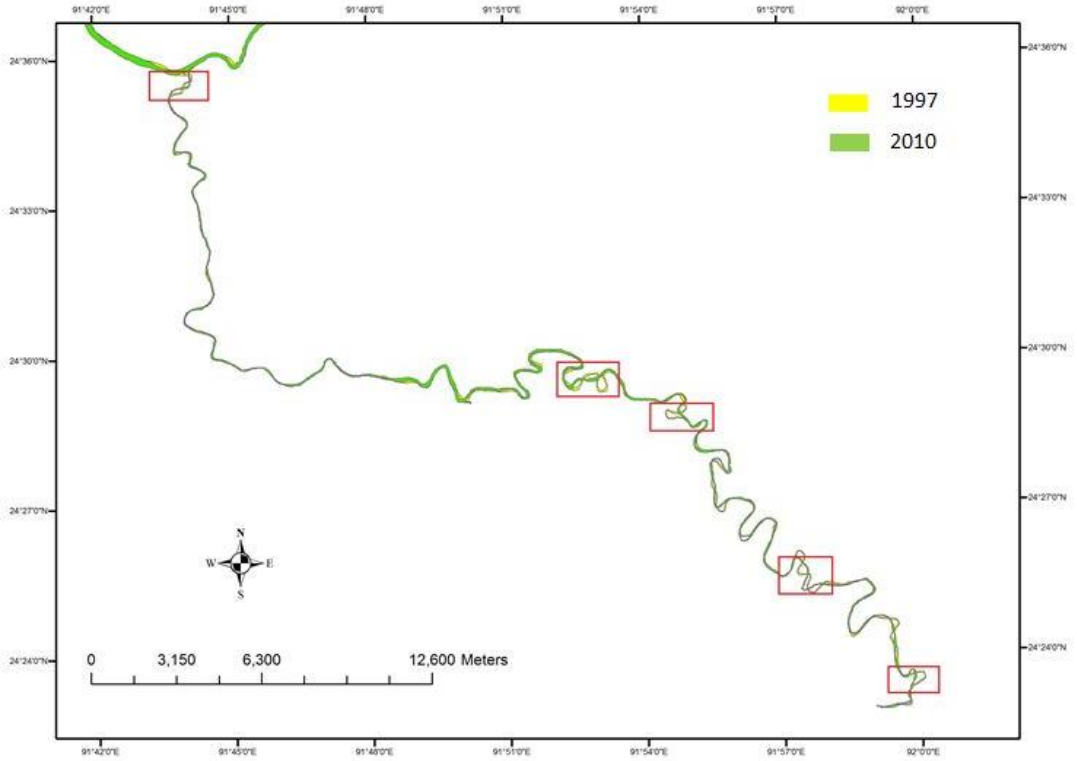


Figure 4: Critical sections for River erosion of Manu River

Results and discussions

The study has been carried out with the help of Remote Sensing data and ArcGIS 9.3 software. All this data were individually processed and analyzed in a GIS environment. After overlapping those shape files, five critical bends have been analyzed using sections.

River erosion at Location 1

At bend 01 (Manumukh, Moulvibazar District), five critical sections were taken to observe the erosion. From analyzing those shape files of the two years, 1997 and 2010, it was obvious that, the maximum left bank erosion of 282 m has occurred at section 1 in rightward direction and maximum right bank erosion of 258 m occurred at section 4.

River erosion at Location 2

At location 02 (Rajnagar, Moulvibazar District), six critical sectionswere chosen to observe the erosion. From analyzing those shape files of two years of 1997 and 2010, it was seen that, maximum left bank erosion and right bank erosion of 656 m and 628 m has occurred at section 6 in rightward direction.

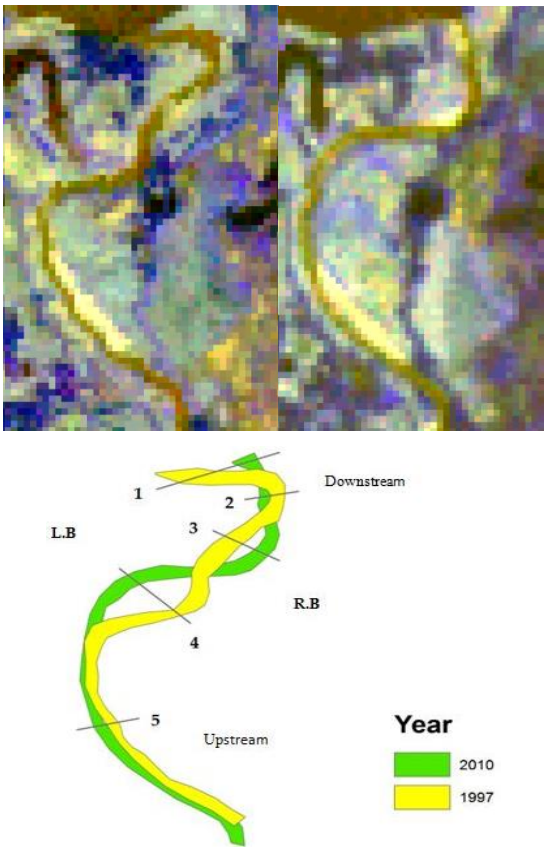


Figure 5: Raster image of 1997 and 2010 with overlapped shape files of Manumukh River erosion at Location 2

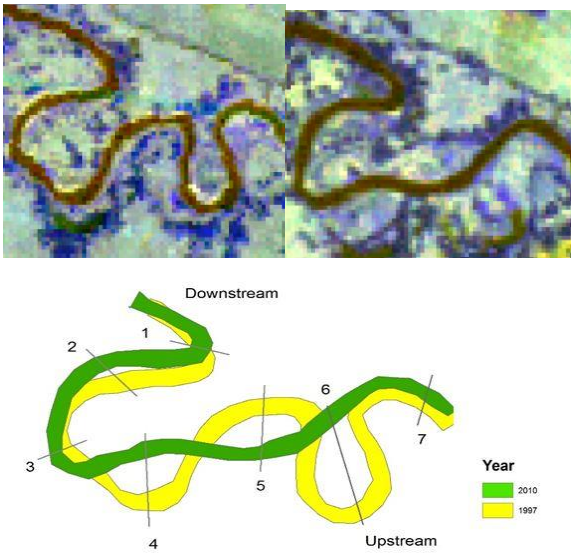


Figure 6: Raster image of 1997 and 2010 with overlapped shape files of Rajnagar

River erosion at Location 3

At critical location 03 (Brahman Bazar, Moulvibazar), five critical sections were found out to observe the erosion. The analysis shows that the maximum left bank erosion of 551 m and maximum right bank erosion of 590 m occurred at section 4 in rightward direction.

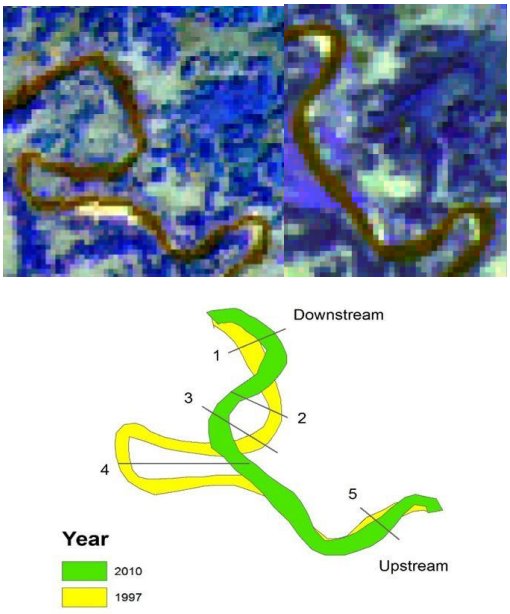


Figure 7: Raster image of 1997 and 2010 with overlapped shape files at Brahman bazar

River erosion at Location 4

At river section 04 (Manu Rail Bridge, Moulvibazar District), seven critical sections were taken to analyze the channel erosion. From analyzing those shape files of the two years, 1997 and 2010, it was observed that, maximum left bank erosion of 372 m and maximum right bank erosion of 350 m has followed at section 3 in rightward direction.

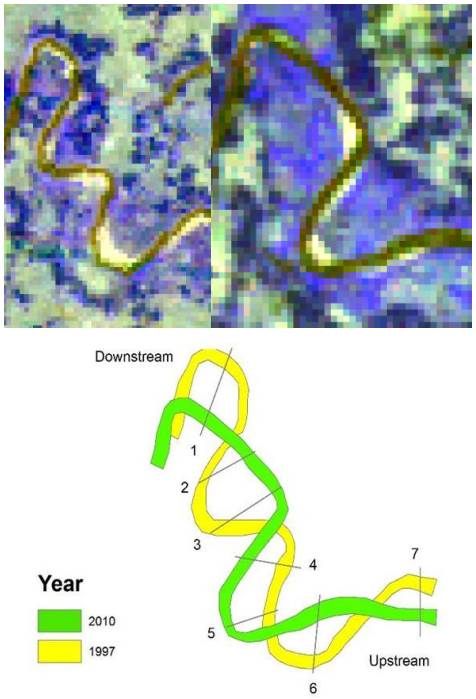
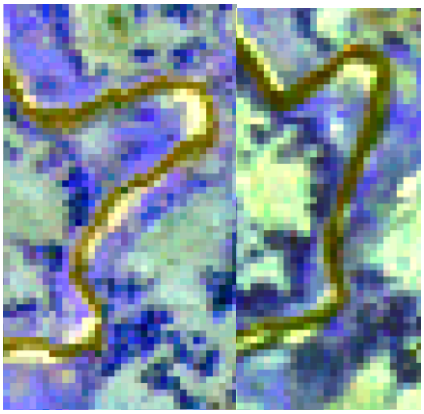


Figure 8: Raster image of 1997 and 2010 with overlapped shape files at Manu Rail Bridge

River erosion at Location 5

At bend 05 (India Border), five critical sections were taken to observe the erosion. From analyzing those shape files of two years of 1997 and 2010, it was found out that, maximum left bank erosion of 331 m and maximum right bank erosion of 345 m has occurred at section 3 in leftward direction.



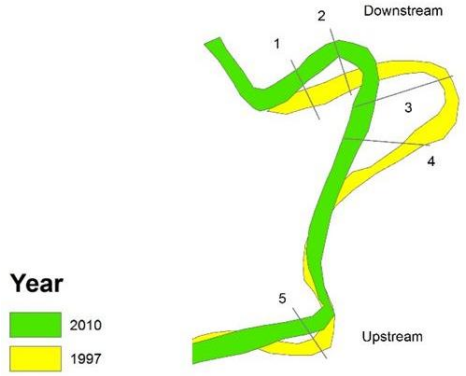


Figure 9: Raster image of 1997 and 2010 with overlapped shape files at India Border

Discussions

Rivers in Bangladesh generally carries huge amount of sediments through the whole year and the river bed gets silted up day by day during the dry season. Throughout the high flood condition, water flowing in the river creates pressure in the bank side. That is why river bend gets sinuous by the time. For that reason, we have analyzed the river water level at a specific location (lat, long- 24.495, 91.777) in the Manu River to see the fluctuations at different months of 1997, 1998, 1999, 2000 and 2001, which were the best data available from the site. Historic river discharge values from Moulvibazar Railway Bridge were also collected to support the analysis. Figure 11 shows that, during the monsoon season, the water level rises to 10.5 m and during the dry period it lowers to 6 m. Latest discharge data from the river is not available. Historic discharge values show some abrupt changes during the high flood condition, where discharge level peaked to 416 cusec (Figure 10). But in the dry season, discharge level became a minimum of 8 cusec.

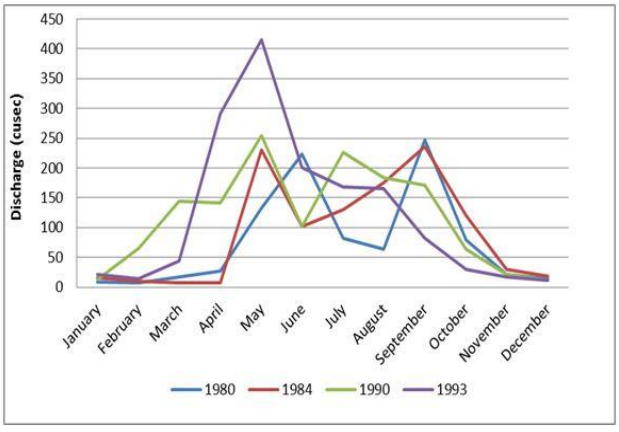


Figure 10: Monthly historic discharge variation of the Manu River

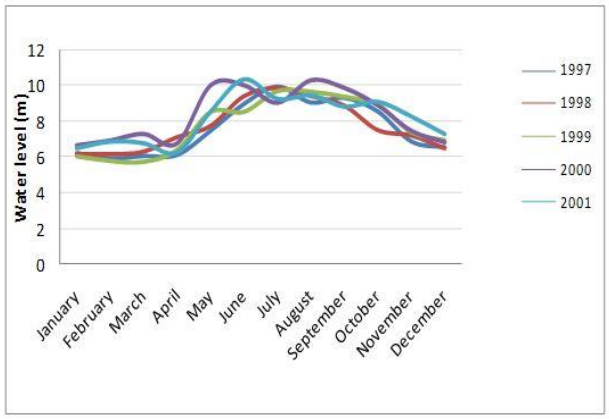


Figure 11: Monthly historic water level variation of the Manu River

Conclusion

Bank erosion and the riverbed movement can become a geopolitical and security issue if along the river the border is drawn between states or other political-territorial entities (Dragićević et al., 2013). The channel geometry and the river hydraulics have been dramatically changed during the study period. The width of the river was found to vary in the present study from bend to bend and from year to year for the Manu. The width in the Manu varied from 52.6 m to 80.6 m for different year and bends. Five critical locations have been found and analyzed, where river bank erosion is happening on a large scale and the area surrounding them are fundamentally vulnerable. Maximum left bank erosion occurred at Rajnagar (location 02) of 656 m in rightward direction and maximum right bank erosion also occurred on the same location of 628 m. The Manu River was found more sinuous in the upstream side and less sinuous in downstream side within the study period during 1997 to 2010. Formation of oxbow lake was also found on some bends in the Manu River during the study.

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Preliminary data on the Jiu River meanders in the lower course (South-West Romania)

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Abstract

The aim of this study is the complex monitoring of the Jiu river bed in terms of geometry and complexity of meanders in its lower sector (on a length of 77 km).
The detailed analysis of the lower Jiu sector meanders completes the geomorphologic knowledge of rivers in Romania, starting from the identification and determination of the type of meanders: the results that were achieved are represented by the indexes concerning their age and migration rate (wavelength, 1977 - 4721 m; meanders amplitude, 511 - 2862 m; the mean radius of curvature, 270 - 997 m and the sinuosity index, from 0.87 to 2.17).
Another aim of this study is the identification of the evolution features of the Jiu river, the relationships between some hydrological factors of control (liquid flow and suspended sediments - annual average values) and the generations of meanders (actual or open meanders, and incised meanders or paleomeanders) distributed in two sectors: Podari - Padea sector and the sector stretching from Padea up to the Danube confluence.
In addition, our concern is motivated by the fact that in the last years there were analyzed the landslides and subsidence on the right slope of the Jiu river (next to Bâzdâna and Drănic settlements), strongly eroded and in close connection with the meandering of the watercourse.

Keywords: *meanders, morphological parameters, paleomeanders, actual meanders, lower sector, the Jiu River*

Rezumat. Date preliminare asupra meandrelor râului Jiu din cursul inferior (Sud-Vest România)

Scopul prezentului studiu constă în monitorizarea complexă a albiei râului Jiu cu privire la geometria şi complexitatea meandrelor sale din cursul inferior (pe o lungime de 77 km).
Analiza detaliată a meandrelor din cursul inferior al Jiului completează cercetările geomorfologice asupra râurilor din România, pornind de la identificarea şi determinarea tipului de meandre până la rezultatele obţinute care se prezintă ca indicii ai stadiului de existenţă şi ai ratei de migrare (lungimea de undă, 1977 - 4721 m; amplitudinea meandrelor, 511 - 2862 m, raza medie de curbură, 270-997 m şi indicele de sinuozitate, 0.87-2.17).
Un alt obiectiv al acestui studiu este identificarea caracteristicilor de evoluţie a râului Jiu, relaţiile dintre o serie de factori hidrologici de control (debit lichid şi sedimente în suspensie - valori medii anuale) şi generaţiile de meandre (meandre actuale sau deschise şi meandre incizate sau paleomeandre), distribuite pe două sectoare: sectorul Podari - Padea şi sectorul Padea - confluenţă Dunăre.
În plus, cercetarea este motivată de faptul că în ultimii ani au fost analizate alunecările de teren şi surpările de pe versantul drept al râului Jiu, puternic erodat şi în strânsă legătură cu meandrarea cursului de apă (în apropiere de localităţile Bâzdâna şi Drănic).

Cuvinte-cheie: *meandre, parametri morfologici, paleomeandre, meandru actual, curs inferior, râul Jiu*

Introduction

At European level, the type and rate assessment of the historical changes of river beds (Kondolf et al. 2002, Rinaldi 2003) present results that show the aggradation processes that have affected various parts of the fluvial system.

Ichim et al. (1979) studied in detail the meanders morphology issues, which are ranked as some of the most complex for a river in our country by their implications for the paleo -evolution.

The researches in our country on the erosion-alluvial successive phases in Pleistocene-Holocene, especially in the east part of the Eastern Carpathians (Donisă 1868, Ichim 1979) show the Wurmian age of the pebbles that mudded off the bottom of the eastern-Carpathian valleys, which thus justifies the assumption of a heavy deepening during the Riss-Wurm interglacial period.

For the study area, the literature abounds in analyses of the geological characteristics (Badea 1996, Enciu 2007), geomorphologic (Geografia României 1992, Roşu 1956, Coteţ 1957, Geografia Văii Dunării Românești 1969, Stroe 2003, Romanian Academy 2005, Boengiu 2008, Badea 2009, Boengiu 2004, Boengiu et al. 2011, Ionuș et al. 2011) and hydrologic (Savin 1990, 2000; Pleniceanu 1999) features of the limitrophe regions that the valley crosses through. The analyzed Jiu River sector has a length of 77 km and is located downstream of Craiova, where the valley has developed asymmetrically with a width of over 10 km and a maximum depth of 120 m at Craiova. The right slope is steep and has a very active dynamics (Fig. 1), the left slope has a stepped profile, the floodplain 4-5 km wide (Boengiu et al. 2011).

The evolution of the Jiu watercourse and floodplain is the result of the climatic variations influencing also the hydrological regime of the Jiu River, and also the result of the neotectonic movements influence (Boengiu – Enache, 2002).

Therefore, there are basically two main causes of this major stage in the historical evolution of the Jiu river course: the tectonic one, which facilitated the divagation of the course to the right of the floodplain, and the hydrologic one, which determined its change of direction and of river bed.

The Jiu River general tendency is to build its floodplain on the left side and to destroy the right bank by lateral erosion. The altitude increases with 2-3 m due to the presence of agesters and sand dunes. An old course of the Jiu – the Jieţ can be noticed downstream of Rojiştea, on its left side (Boengiu 2005, Boengiu et al. 2010). The plain stretches on 80 km, located between the Podari – Cîrcea alignment and the confluence with the Danube, representing 8% (800 km2) of the total basin surface and has a slope of 1 - 0.3 ‰ (Savin 1990).

The very obvious horizontal instability in the last 50 years in this sector is explained by the alluvial transport type and the higher erosion of the banks. The intensity of erosion process varies from one section to another depending on the geologic structure of the river channel, slope variation (mean declivity is 7‰ - Podari and 6‰ - Zăval) (PMBH JIU 2010).

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Figure 1: The Jiu riverbed and Drănic landslide on the right slope

Source: photo by Boengiu, 2012

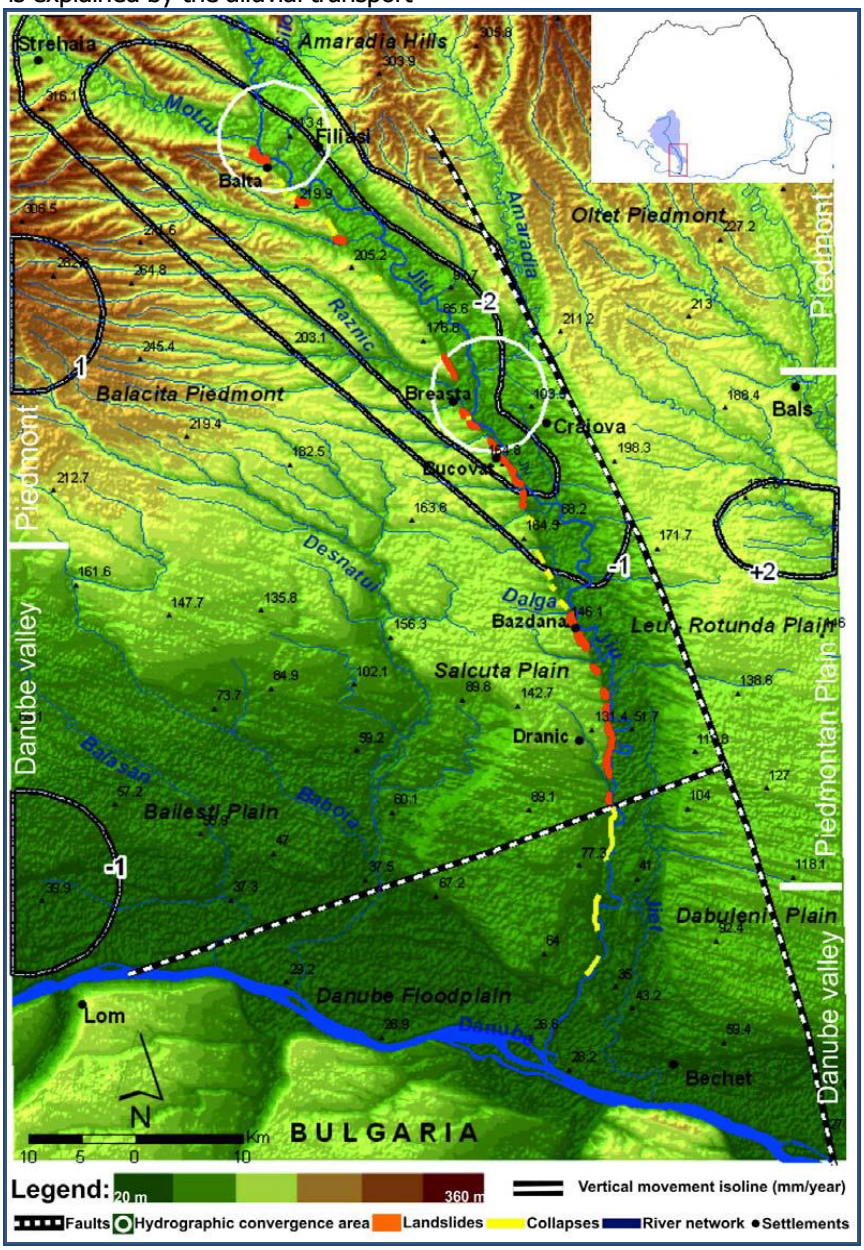

Figure 2: The general map of the study area *Source: Boengiu et al 2011*

The Jiu river bed is steeped in relatively fine deposits and reflects the type of solid flow transported by the river, respectively, suspended sediments.

The sinuosity index (sinuosity index: Podari - 1.96, Zăval - 1.25) is used to determine the types of river beds along the river, but also for capturing some evolution tendencies on a larger scale (Ichim

et al. 1989, Rădoane – Rădoane 2008). The values below 1.5 (Leopold – Wolman 1957) rank the river sector within the category of sinuous river bed type, and the values higher or equal to 1.5 are associated with the meander river bed sectors. The formation and deepening of the minor river bed on the current path must be of recent geological time, or even of historical age, as many traces of watercourses, river branches and abandoned meanders indicates an intense activity of the river in the last period of time (Savin 1990, Rădoane et al. 2008)

Data and methods

To characterize the Jiu river bed from the geomorphologic point of view, a morphometric database was created correlated with the meandering process in the lower sector. In order to create a database, there was necessary to define the morphometric parameters of meander loops and their actual measurements using cartographic support (orthophotos, scale 1:5000, 2009) and the ArcGIS 9.3 software.

The measured parameters for a meander: wavelength, meander amplitude, mean radius of curvature and sinuosity coefficient are already acknowledged in the fluvial geomorphology (Rădoane – Rădoane 2003).

The Jiu minor riverbed was monitored hydrologically in the two control sections of the lower sector: Podari hydrometric station and Zăval hydrometric station between 1967 and 2010.

The modification of the river bed was correlated with the water and sediment transport along the river as they were measured at the mentioned hydrometric stations.

Results and discussions

The Jiu River channel is very dynamic due to the correlation between the morphometric and hydraulic elements in the cross section with the water flow and level, as it can be seen from the parameters registered at the two hydrometric stations located within the analysed sector: Podari (S – 9253 km2, average height – 446 m), Zăval (S – 10046 km2, average height – 417 m), (Atlasul Cadastrului apelor din România 1992).

The liquid flow and suspended solid flow which crossed the river bed section in the monitored period are the most important and sensitive factors, which determined the behaviour of the river bed (Fig. 3). Thus, we notice that during the studied period, the liquid flow had a variation with a slightly negative trend during 1971-1990, and then there were alternating years with high values of the flow with years in which the flow had values lower than the average yearly value of the period (88.3 m3/s - Podari and 92.2 m3/s Zăval).

The highest value of the liquid flow was registered in 1969 (153 cm/s - Podari, 154 cm/s - Zăval) and 2005 (150 cm/s - Podari, 153 cm/s - Zăval) for both hydrometric stations and the lowest value in 1993 (45.8 cm/s - Podari, 41.9 cm/s - Zăval). But the amount of sediments that crossed the Zăval section was much higher.

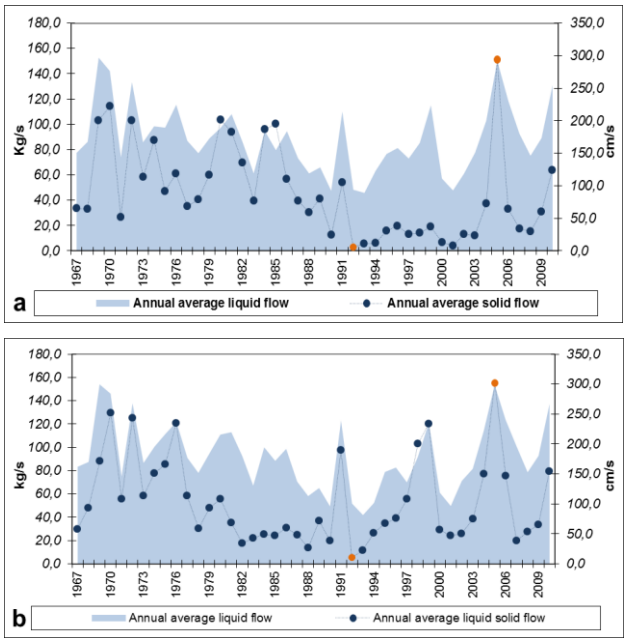

Figure 3: Variation of the annual average liquid and solid flows of the Jiu river: a. Podari hydrometric station; b. Zăval hydrometric station

Source: processing of the data supplied by the "Romanian Waters" National Administration—the Jiu Branch

The suspended sediments value decreased below the annual average value (103.5 kg/s) during 1976-1990, then it varied between the two threshold values, the minimum of 10.9 kg/s and maximum of 302 kg/s. The year 2005 registered the highest annual average values of suspended sediments at the both hydrometric stations (294 kg/s - Podari, 302 kg/s - Zăval). We conclude therefore that the size of alluvial flow that crossed the Zăval section had direct influence in the river bed behaviour: the oscillation of sediments transport after 1992 had direct influence in the appearance of the instability tendency of the minor river bed.

The observations derived from the analysis of the Fig. 3 are closely related to those resulted from the variability of water and sediments flow in the Podari and Zăval sections. After 1990, the riverbed tends to slightly increase its sinuosity due to the reduction of the sediments transport (even if the liquid flow volume in the river bed remains constant or even increases slightly).

The period between 2004 and 2006 was outstanding for Romania because of the recorded values of the liquid flow and suspended sediments in the two control sections of the Jiu River. There were no damages and destructions along the Jiu River, as it was for other rivers, such as the Timiș, Trotuș, Siret or the Danube (Romanian Ministry of Environment 2006).

In terms of the development of the meandering process, the Jiu River can be subdivided into the following sectors:

- the sector between the Amaradia`s confluence and Malu Mare, where there are no meanders at all of the watercourse;
- Podari – Padea sector, where there are meanders with very large bends and some broad changes in stream direction, moving the watercourse under the right slope (Fig. 4, 5 and 6);
- Padea – the Danube confluence sector, in which there are paleomeanders sectors and sectors where the Jiu watercourse slightly winds horizontally under the right slope, to the mouth of the river.

The meanders from the sectors of Malu Mare and Padea localities are the most typical and well-developed with large bends on a broad surface of the floodplain width (1/3-2/3). Starting from Podari to Zăval, in the direction of water flow, the analyzed meanders received a serial number to facilitate the subsequent measurements (Table 1).

Table 1: The Jiu River's present and paleo-meanders morphometry (lower sector)

A	B	C	D	E
1	3277	2862	516	1,87
2	3850	1260	899	1,50
3	4223	875	786	1,46
4	2380	1050	315	1,95
5	1977	900	270	2,17
6	2637	1808	479	2.03
7	2826	1855	478	2,13
8	2789	633	596	1,17
9	4632	1080	513	1,23
10	3552	511	997	0,87
11	4721	2042	471	1,68
12	3567	639	397	1,25
13	3072	1058	383	1,33

A - Meander no.; B - Wavelenght (λ, m)
C - Meanders amplitude (a, m)
D - The mean radius of curvature (Rc, m)
E - Sinuosity index (k)

The actual meanders of the Jiu river overlap a large sinuous path indicating an earlier phase of river meandering, because their dimension contrasts sharply with the current river flows, too small to explain their formation (Dury, 1964). Thus we can talk about two generations of meanders, actual meanders and paleomeanders. In figure 7 there are examples of these types of meanders.

Figure 4: The Jiu riverbed branches in the Bâzdâna sector Source: photo by Boengiu, 2012

Figure 5: Meander "goose neck" of the Jiu river in the Drănic sector *Source: photo by Boengiu, 2012*

Figure 6: The Jiu riverbed branches in the Drănic sector Source: photo by Boengiu, 2012

The incised meanders (paleomeanders) develop on almost 80% of the river length and the open or alluvial meanders (actual meanders) are formed on approximately 3.5 km in Padea locality (meander 8), on 4 km in Horezu Poenari locality (meander 10) and on 4.5 km in Comoşteni locality (meander 12).

The wavelength and the meanders amplitude of the incised meanders are much higher (λ = 4721 m, a = 2862 m) than those of the open meanders (λ = 1977 m; a = 511 m), the values are reflected in the development of "goose neck" type uniform meanders, which favoured the self-capture (Fig. 5).

These meanders overlap much larger meanders loops (with wavelengths above 2000 m and amplitude of 1000 m), which testify for several generations of paleomeanders, a phenomenon previously presented at the national level for the Bârlad river (Rădoane and Rădoane, 2003).

The meanders mean radius of curvature is lower than 1.3 m at the actual meanders, in comparison to the values of paleomeanders ranging between 1.30 - 2.17 m. The explanation is that the incised meanders inherit the shape of the river beds modelled by other liquid flows than those that control currently the minor riverbed.

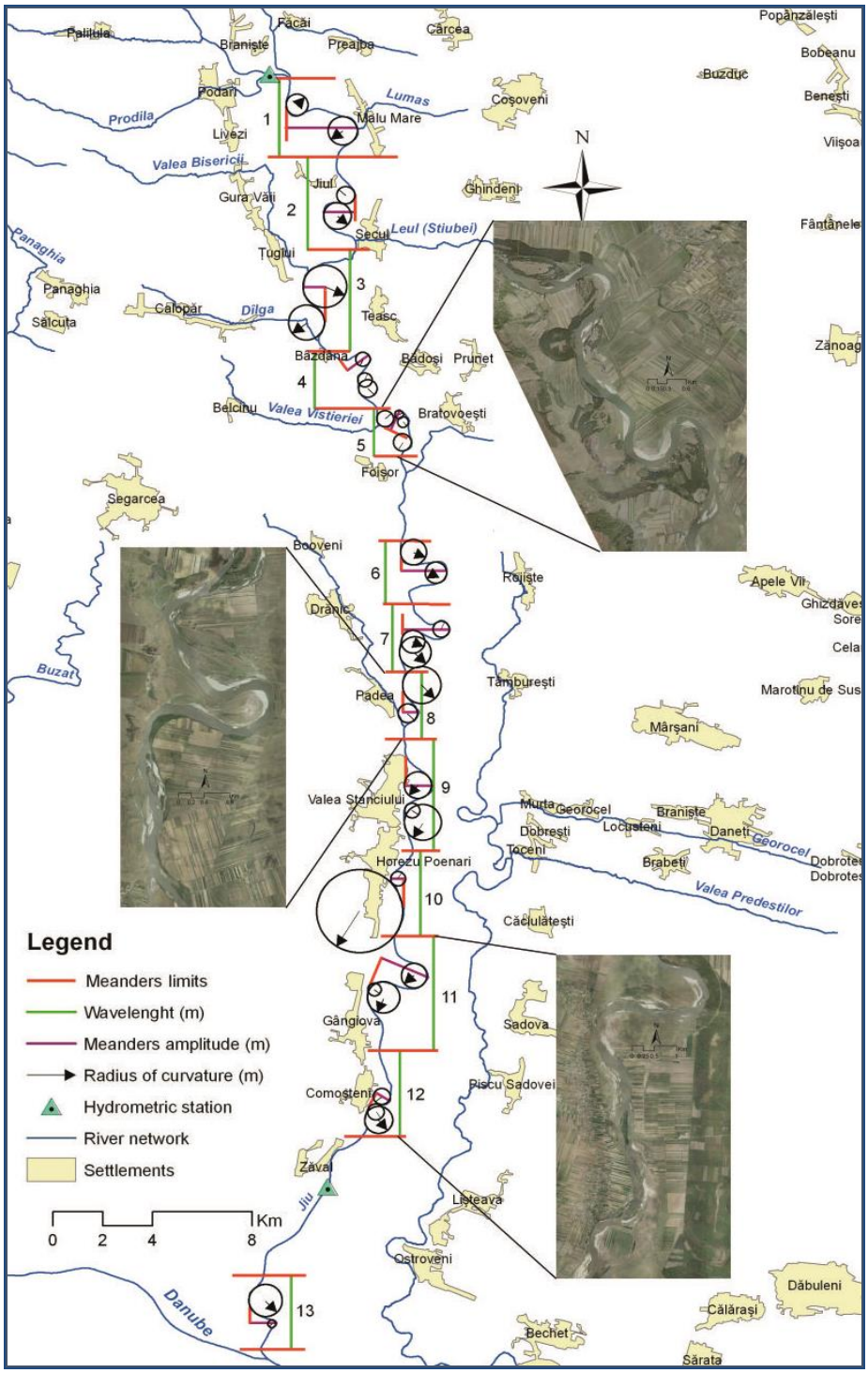

Figure 7: Types of meanders of the Jiu River in the lower sector (case studies)

(Processing of cartographic data supplied in the orthophotos, scale 1:5000, 2009)

The phenomenon also stands out from the presentation of meanders variability in longitudinal profile of the Jiu river (Fig. 8), where the variability of wavelength and meanders amplitude are much higher for the incised meanders (paleomeanders) than for the open ones (the actual ones).

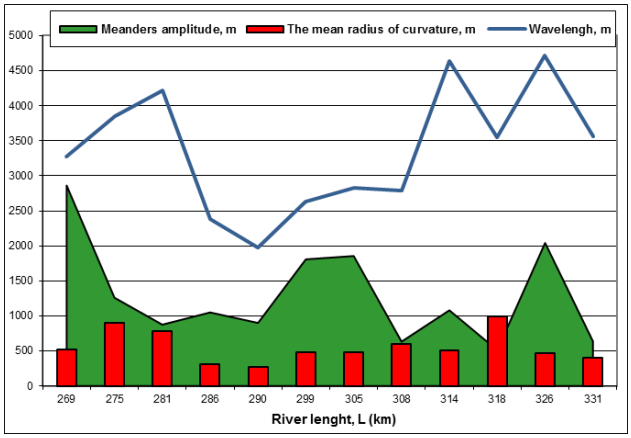

Figure 8: Variation in longitudinal profile of Jiu river`s meanders morphometry

(Processing data after the orthophotos, scale 1:5000, 2009)

The consequences on the river bed dynamics are high because the river is forced to rebuild its solid load by erosion in the cross section.

Based on the relations and the formula proposed by Dury (1976) and Gabris (1986) there can be determined the relationship between meander wavelength and mean discharge: L/2 = 80,3 (Q cp.)°´³6. A new formula was derived from the original data of Gabris (Timar et al. 2008) as the following - Q cp. = 0.0009 (L/2)¹´8, cited by Popov and al. 2008 and applied for the Tisa Valley.

Conclusions

The morphological, morphometric and hydrographical characteristics were evaluated to analyze the current geomorphologic processes.

The data obtained from measurements (made on the orthophotos, 1:5000, 2009 and updated through field observations in spring 2012) lead us to the following conclusions:

- the disequilibrium of the river bed is highlighted by the increase of the sinuosity index values, calculated for a meander;
- the sinuosity of the minor river bed developed, creating some complex meanders (almost incised or paleomeanders);
- the paleomeanders amplitude is generally decreasing, indicating an approaching tendency of the meander loops.

In this context, creating the fluvial geomorphologic database of the Jiu river meanders, a direct tributary of the Danube in the south-west of Romania, was a real challenge.

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Remote Sensing data & GIS for flood risk zonation mapping in Varanasi District, India

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Abstract

Flood is one of the natural disasters causing colossal loss of life and property. It occurs with a strange regularity in different parts of India, thus devastating those particular areas. The most flood prone areas in the country are in the Ganga and Brahmaputra basins whilst the annual flood damages in the Ganga basin account for about 60 percent of the total. The extent of the damages shows a pattern of increase from west to east (downstream along the Ganga) and from south to north (towards the hills). The present study delineates the application of geographic information system (GIS) in mapping flood risk zones in Varanasi, one of the prominent districts of the Indo-Gangetic plain. The whole district witnesses havoc of flood in rainy season due to impounding of huge amount of water in the Ganga river. The damage and loss of life and cattle due to floods in the area under study are increasing year after year. It could be stated that high magnitude floods occurred in 2013 during the month of August, when the flood plains were mostly used for periodicity and gravity of food. Recognition of flooding parts and flood risk zones in the area under study are the primary steps in the flood control measures. GIS data base has been well utilized in delineating and tackling flood related problems in the area. An attempt has been made to prepare a map of an area measuring about 1526 sq. km. showing flood risk zone with the help of remote sensing data (IRS-P6, LISS III, 2008). A total of five flood risk zones are delineated in Varanasi district. With the help of remote sensing data, flood risk zones in the study area are categorized into low, middle, high, higher and highest level flood zones.

Keywords: *Flood, GIS, Remote Sensing, IRS-P6, Varanasi district*

Rezumat. Utilizarea SIG și teledetecției pentru cartarea zonelor de risc la inundații în districtul Varanasi, India

Inundațiile reprezintă unul din dezastrele naturale care determină pierderi considerabile de vieți omenești și pagube materiale, ce se produc cu o frecvență stranie în diferite părți ale țării, pe care deseori le devastează. Zonele cele mai expuse la inundații din India sunt cele din bazinele fluviilor Gange și Brahmaputra, pagubele produse de inundații în bazinul Gangelui reprezentând aproape 60% din totalul înregistrat la nivelul țării. Frecvența acestora crește dinsre vest spre est (de-a lungul Gangelui) și de la sud spre nord (spre zona colinară). Articolul de față aduce în discuție utilizarea sistemelor informatice geografice (SIG) pentru cartarea zonelor supuse riscului la inundații în Varanasi, unul din cele mai importante districte din Câmpia Indo-Gangetică. Acest district se confruntă cu inundații serioase în sezonul ploios ca urmare a cantităților uriașe de precipitații căzute în bazinul Gangeluui. Pierderile de vieți omenești și pagubele materiale datorate inundațiilor cresc de la an la an în zona de studiu. Putem spune că cele mai mari inundații au avut loc în luna august din anul 2013, când majoritatea câmpiilor, utilizate intens în agricultură, au fost serios afectate. Identificarea zonelor predispuse la inundații din aria de studiu reprezintă primul pas pentru prevenirea și atenuarea efectelor inundațiilor. Baza de date oferită de SIG a fost utilizată pentru a delimita și trata problemele legate de inundații din aria de studiu. S-a realizat o hartă a zonei de studiu, ce acoperă o suprafață de 1526 km^2, ce prezintă zonele supuse riscului la inundații cu ajutorul datelor oferite de teledetecție (IRS-P6, LISS III, 2008). în total, în districtul Varanasi, au fost identificate cinci zone de risc. Cu ajutorul teledetecției, aceste zone au fost clasificate ca zone cu risc mic, mediu, mare, foarte mare și extrem.

Cuvinte cheie: Inundații, SIG, teledetecție, IRS-P6, districtul Varanasi

Introduction

A flood is an overflow of water that submerges or "drown land". Flooding may result from the volume of water within a body of water, such as a river. A river is stated to flood when the flow exceeds the capacity within the banks.

Floods often cause damage to homes and business if they are in the natural flood plains of rivers. The damages could be attributed to the urbanization of flood plains and the indiscriminate development of industries in areas normally liable to flood. Flood result from excessive rainfall within the short duration of time and consequent high river discharge damaging crop and infrastructures (Joy&Lu, 2004).

In the area under investigation, a flood like situation prevailed in the urban localities and in the villages situated in the low lying areas of the district every year. The central water commission, a central government department, measures the hydrological data pertaining to different river in the country. The data are gauge, discharge, sediment and water quality-maximum, average, minimum water level during monsoon and non-monsoon periods. The commission cited the highest water level in August 2013 as 71.66 m above mean sea level, the normal water level being 66m above mean sea level.

For the last two decades, advancement in the field of remote sensing and geographic information system (GIS) has greatly facilitated the operation of flood mapping and flood risk assessment. Satellite

remote sensing coupled with Geographical Information System (GIS) has a powerful role in monitoring and mapping flood inundated and drainage congested areas. It is evident that GIS has a great role to play in natural hazard management because natural hazards are multi-dimensional and the spatial component is inherent (Coppock, 1995). The main advantage of using GIS for flood management is that it not only generates a visualization of flooding, but also creates potential to further analyze this product to estimate probable damage due to flood (Hausmann &Webber, 1998; Clark, 1998). Nowadays, modern techniques and tools, especially remote sensing, help the planners to evaluate the potential of natural dangers caused by flood in the least time and it is a good method to evaluate the damages. Satellite images are used widely to investigate the flood zone of hazardous regions (Nawaz and Shafique, 2003). Remote sensing data acquired in the visible, near infrared (IR) and short-wave infrared (SWIR) regions were utilized for providing information on spatial pattern of flood inundation (Chopra et. al., 1993, Jha, 1993 and Rao et. al., 1998). Aerial imagery and satellite images are used widely to investigate the flood zone of hazardous regions. Nawaz has used remote sensing and GIS software to analyse flood danger; the aim of his research was to develop a map for crop fields of mozafrabad, and developing a GIS based database for damageable regions and to show the highlighted installation which were exposed to flood (Nawaz and Shafique, 2003).

Area under study

Varanasi is located in the Gangetic plain of Uttar Pradesh. It is the oldest living city in the world. Varanasi district, extending between 25°10′ to 25°37′ N latitude and 82°39′ to 83°10′ E, lies in eastern Uttar Pradesh (Fig. 1).

The city is spreading over an area of 1454.11 sq.km, it has a total population of 1,425,113 (as year 2011 census report) persons (751,060 males and 674,053 females). Study area as viewed on satellite data is shown in the fig. 2

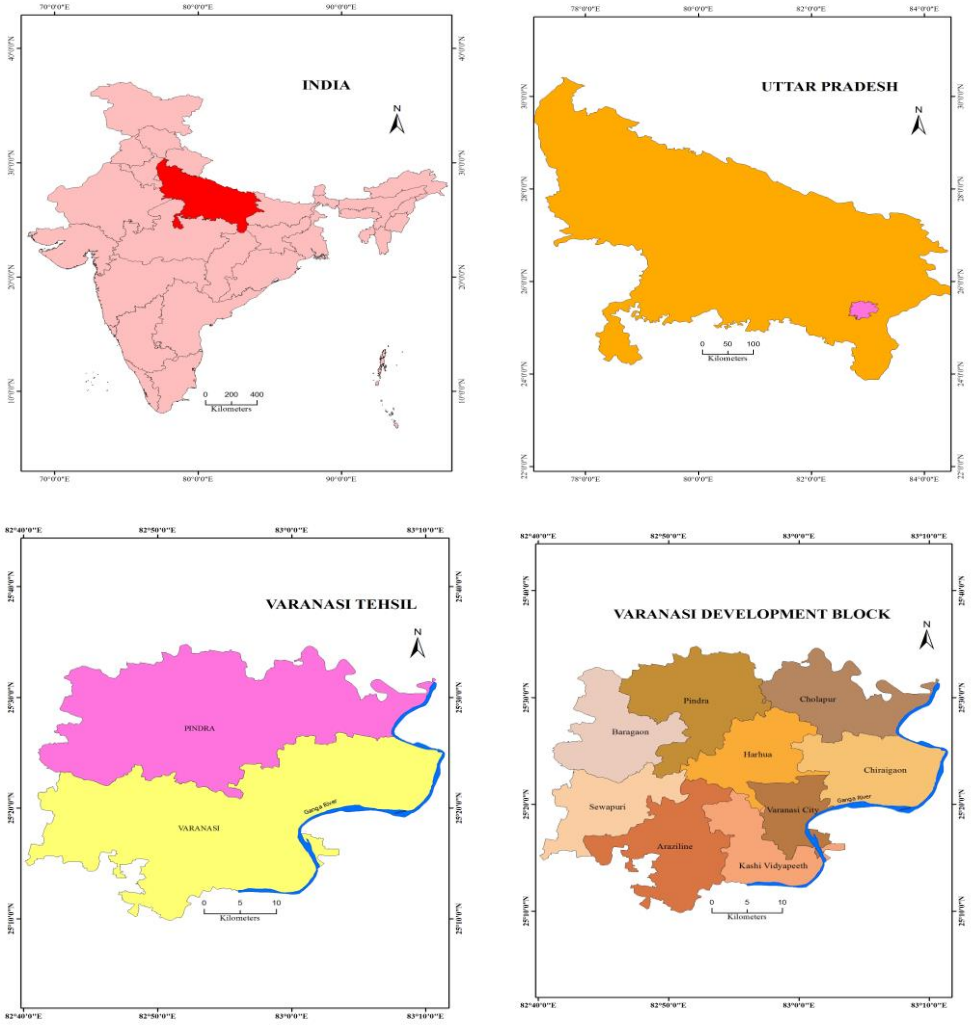

Fig. 1: Location of the Study Area

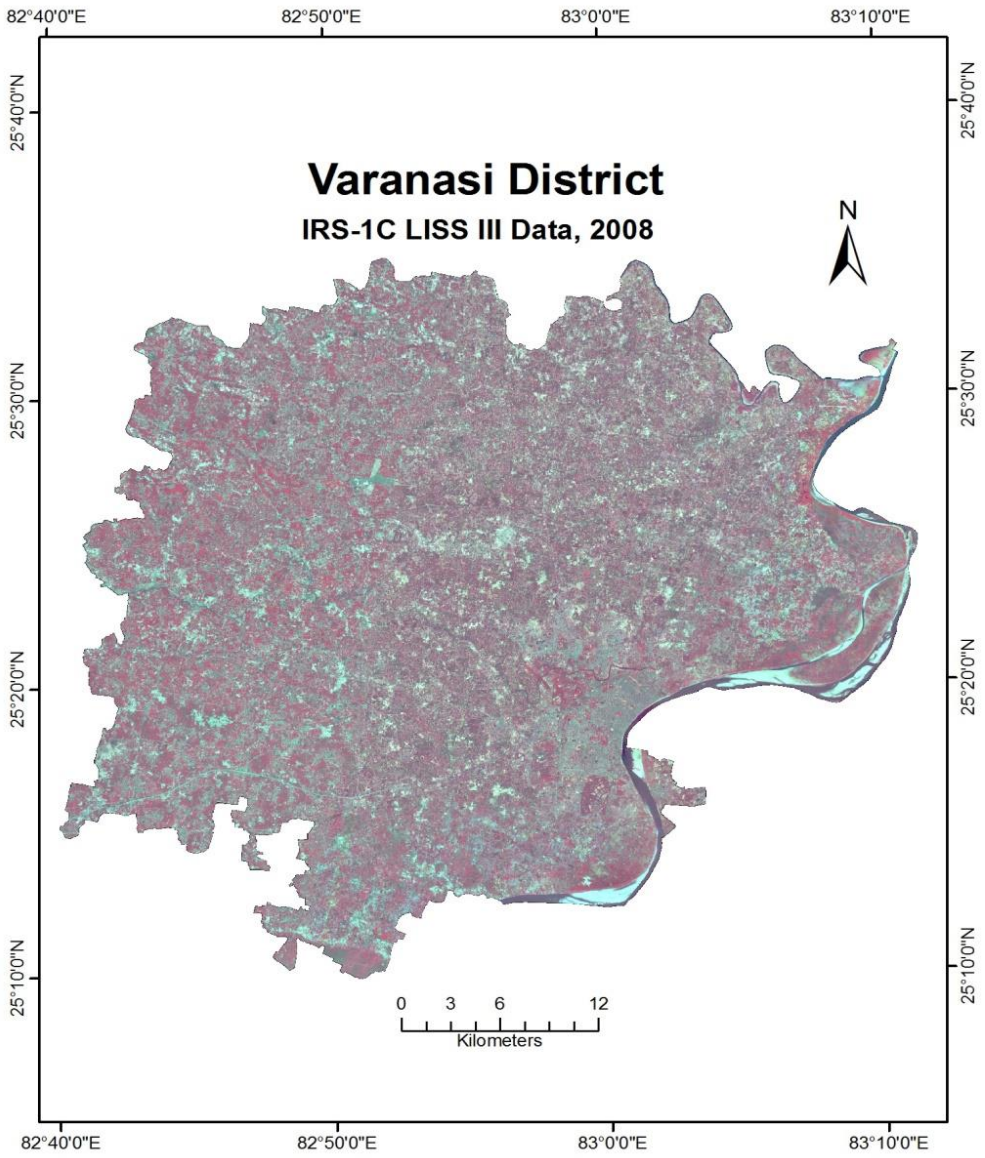

Fig. 2: Study Area as viewed on IRS-1C LISS III data, 2008

Preparation of mapping parameters through remote sensing

Geology of the area

The area is underlain by the alluvial deposits of Quaternary age. The older alluvium of the Ganga valley form slightly elevated land surface of the area. This deposit is believed to be middle to upper Pleistocene and lies well above the highest flood level of the rivers of the area. The Newer Alluvium generally occupies the lower elevation and is restricted to the flood plains of the present day river along their channels and consists of fine to medium grained sands, silts and minor amount of clays. However, there is not always a clear demarcation line between Older Alluvium and Newer Alluvium. The Older Alluvium is dark coloured and generally rich in concretions and nodules of impure calcium carbonate. These concretions are of various shape and size and are known as 'Kankar' (Kankar is a local term defining hard and coarse materials). The Varanasi Older Alluvial Plain represents the oldest geomorphic surface occurring at highest tectonic level in the Gangetic plain. The study-area lies between the Ganga in the south and the Gomti in the north with the river Varuna river flowing in the central part imprinting upon the geology of the areas as it's consists of inter-bedded layers of sand, silt and clay with off and on association of 'Kankar' and clay.

Physiographic divisions

On the basis of relief variation, geology and drainage characteristics, the study area has been divided into three physiographic divisions:

i) Upper Ganga-Varuna plain,
ii) Varuna-Gomati interfluence and
iii) Ganga-Varuna interfluence.

Upper Ganga-Varuna plain

The Upper Ganga-Varuna plain is spread over nearly 31.05% of the district. Varanasi is situated on the left bank of the Ganga river and lies in the heart of the Middle Ganga plain. The Varuna river enters from the western side along the Dhaukalganj lying in Bharagaon development block and drains Pindra and Harahua development blocks.

The region representing a near level surface having alluvium deposits may be divided into parts: (a) low land and (ii) upland. The low land locally known as 'Tarai' is the recent creation of river floods, formed of newly deposited alluvium soil, and locally termed as 'Bhangar' lying well above the present flood plain, is mainly composed of concretionary material. The general slope of this tract is form west to the east and south-east.

Varuna-Gomati interfluence

The Varuna-Gomati Interfluence covers about 40.84% of the total area of the district. It is again sub-divided into two units: (i) upper region (Uparwar) and lower land (Tarai).

The upper region lies in the northern and western parts of the district where no flood occurs even in the rainy season also. The low land (Tarai) has further been divided into: i) Inundated areas along the Varuna river, and ii) inundated areas along the Gomati river and its tributaries. Towards the side of the Varuna river in Varuna-Gomati interfluve, the villages, namely Sirisi, Barthara, Kalan, Parnapur, Amauli, eastern part of Jalhuapur, Mustafabad, Ambapur, Dhobahi, Shidasa Goberha, Rampur etc. are usually flooded during the rainy season locally called as tari villages. The eastern part of Bela, Azagara, Bartharakhund and Rampur etc. are flooded by the Nand river, a tributary of the Gomati in the period of heavy downpour. The northern part of Rajwari and Tekuri, western part of Dhauradhara and eastern part of Azgara etc. are also flooded. Hathi nala, another tributary, is frequently flooded during the rainy season, causing much damage of the life and property to villages such as Azgara, Benipur etc. A very small area of Akatha, Baraipur villages and the northern part of Hiramanpur covered by Narokhar, Tal, along the river Varuna, is also flooded during the rainy season.

The Ganga-Varuna interfluence

The region covers the areas of Sewapuri, Araziline and Kashi Vidyapeeth development blocks lying in the western and southern part of the district. It covers about 28.11% of the total areas of the district. It can further be sub-divided into two parts:

i) The Upper Plain of Ganga-Varuna interfluence, and
ii) The flood zone

Over all, Varanasi district unfolds 4.79% of the total land along the river banks to be frequently flooded during the rainy season, causing damage both to human life and property.

The uplands are designated as *Bhangar* (locally known as *Uparwar*) and the low lying areas liable to floods in the rainy period are known as *Khadar* (known as *Tarai*) with newer alluvium deposited by the rivers during the floods. Gemorhological map of the study area has been prepared through remote sensing data and the area is classified into only 5 important geomorphological class i.e. alluvial plain, point bars, sand bars, river island with alluvial deposits and river island with sand deposits (Fig. 3). The study area belongs to the flood plain deposit, so that no other geomorphological features are identified.

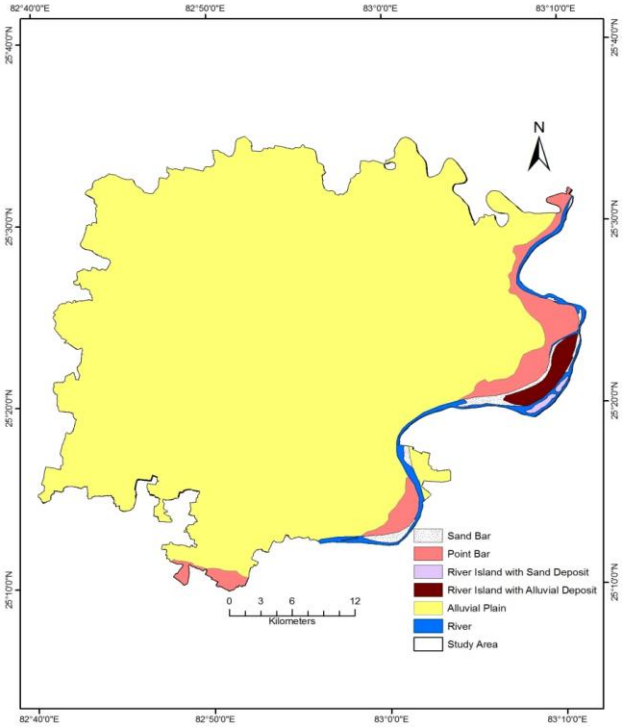

Fig. 3: Geomorphological features in Varanasi district

Drainage and water ponds

Drainage plays a very important role in shaping the physical characteristics of the area under study. The Ganga with its tributaries, Gomti and Varuna, form the drainage pattern of the study area. The Ganga river is an important source of drinking water as well for irrigation. The existing water bodies are extracted through IRS-P6 LISS III Remote Sensing data, 2008 (Fig. 2).

The Ganga and its tributaries

The Ganga river, the main drainage line of the study area, is flowing from the eastern side of the Varanasi city. The river flow towards the east in Araziline development block and takes a turn towards the north where the city of Varanasi is located on high platform formed of pebbles and *Kankars*. From Chandrawati to Kaithi (in Cholapur

development block) it flows northwards, resembling to its flow at Varanasi, thus Kaithi is known as Up-Kashi. The Gomati river, a meandering river, touches the Varanasi district near Bhadwan village in Cholapur development block and forms its northern boundary (33 km), debouching into the Ganga flowing through Niyardih, Babatpur, Azagara, Dhaurhara, Tekuri, Rajwari and Kaithi villages. Its main tributary is the Nand river, which flows into the Gomati river at Ajgara village. The Varuna, a perennial river, divides the Varanasi district into two parts and joins the Ganga near Sarai Mohan, east of Varanasi city after flowing for nearly 40 km through Akohra, Kundi, Gaharwar, and Koirajpur villages. It has no important tributary excepting the Bisuhil. Throughout its course, the Varuna river has a fairly high bank which is scoured on either side by numerous ravines. Assi is a small local rain fed stream, the old historical southern boundary of Varanasi, highly polluted and congested, chocking due to encroachment. Now due to enormous load of pollution, the river 'Assi' has been turned into a 'Nallah' i.e. a sewer-line. The Ganga, Varuna and Assi are the three natural streams which finally receive the storm water flows into the city of Varanasi. A number of interconnected ponds play a significant role in the drainage of the storm water e.g. 'Sitakund' and 'Ramkumd'.

Soils

Soils are the valuable resources for the luxuriant growth of natural vegetation and cultivated plants. Soils, alluvium in nature in the area are classified with the help of IRS-P6 LISS III data, 2008 by applying supervised classification techniques (Fig. 4). The soils of Varanasi district can be classified into four categories depending upon their texture, composition and formation process as the rivers have played a major role in it.

i) Ganga sandy loam,
ii) Western low land soil,
iii) Western upland soil and
iv) Loamy soil.

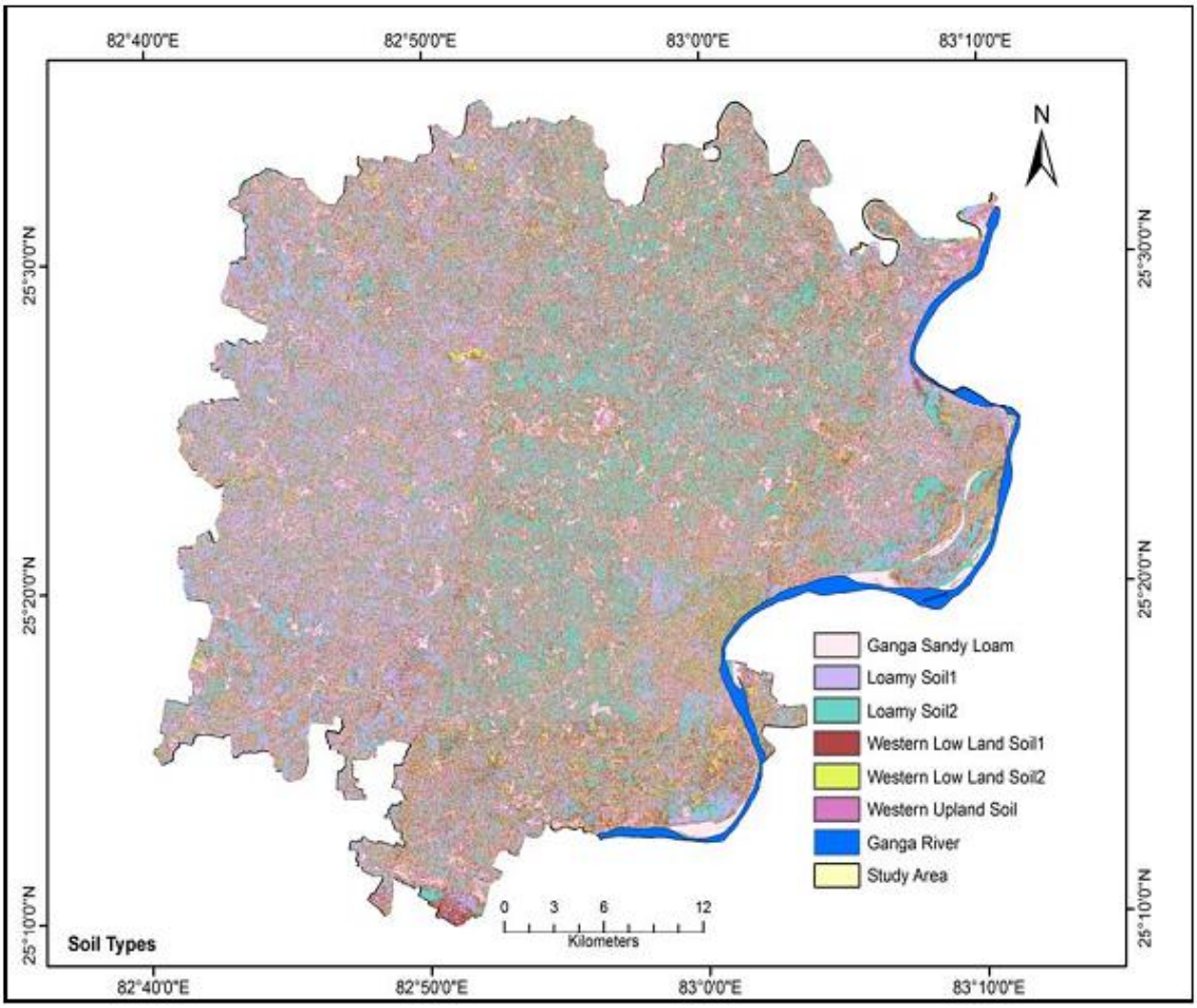

Fig. 4: Soils in the study area

Ganga sandy soil

It covers 25% of the area along the bank of the river Ganga and the lower part of the Gomati river especially lying in the inundated or flooded areas in the rainy season.

Sandy soil has either sands or a mixture of small fine particles of soil suitable for Zaid crops.

Western low land soil

It occupies the northern part of the district along the Gomati river and its tributary. It is a fertile loamy soil and neutral in character, brownish, with sufficiently mature profile. There are certain usar and semi usar (barren land) patches scattered here and there in Cholapur and Chiraigaon development blocks. They are unclassified and lack in well development profiles. These are moderately alkaline in nature with a pH value of 8.2.

Western upland soil

It is a stiff clay loam type of soil and covers most of the areas of the district intermixed with alluvial soil in different parts.

In some scattered patches, this soil is affected by saline or salt and locally called '*Reh*' or salt affected soil. In these patches, hard formation can be seen at a depth of about 5m below the ground, which restricts infiltration of rain water.

Loamy soil

This soil is found in the northern part of the Cholapur development block along the bank of the Gomati river. The soil consists of fine and coarse sand. It is deficient in plant nutrients with low water holding capacity.

In general, the soils of the district may broadly be divided into two major types:

(i) Khadar and (ii) Bhanger

A Khadar (newer alluvium) covers the flood plains in the vicinity of the rivers including their reaches and also old beds. It is replenished annually by new deposits.

The soil naturally remains moist as its derives moisture from the river through seepage in the dry season and are capable of growing Rabi and Zaid crops without irrigation. These are locally know as 'Tari' and are classified as Ganga sandy soils consisting of fine silts along the Ganga and Gomati rivers. The newer alluvial soil contains a low percentage of humus content and nitrogen. Being more silty in texture, it is highly friable and favourable for the Bhadai (Kharif), Rabi and Zaid crops (especially root crops). Under secured irrigation facilities, some of the areas with these soils are producing rice too, especially the early varieties.

The Bhangar is older alluvium with no flood effect, except for the low lying areas in patches which are either termed as *Tal* or consist of impervious clay layer found in the sub soil. It is often heavier, with higher proportion of clay. Being sticky and usually not well drained, it is richer in lime content and *kankar* and is more suitable for rice cultivation. The low lying areas which hold water for a long time and become dry in winter season are good for cultivation of Rabi crops.

Land use and natural vegetation

For a long time human survival was based on plough and pastoral activities. It has almost destroyed all the forest covers lying earlier in the study region by direct cutting, burning and grazing. Presently, the afforested area is almost negligible.

Only in the Tari part of the district, it is observed in its natural form. In cultivated areas, it is found in the form of gardens, groves and trees planted under social forestry. Mango and Banyan tress are observed throughout the region.

The grasses that grow in the forest are Kaans (*Saccharum spontaneum*), Munj (*Erianthus munia*), Kala Siris (*Albiziz lebbeck*) etc., trees like Pipal (*Fiscus religiosa*), Shisham (*Dalbergia sissoo*), Neem (*Azadirachta indica*), Bel (*Aegle marmelos*), Jamun (*Syzgium cumuni*), Kadam (*Anthro cephalus cadamba)*, Chilbil (*Holaptelia integrifolia*), Jackfruit, Guava (*Psidium guajava*), Mahua (*Madhuca indica*) are some common plant species found everywhere within the study area. Transplantation of trees under social forestry programme has started in the study area along the railway lines, canals and roads, on vacant lands of Gram Panchayats. Munj, sarpat and some local grasses and bushes along the rivers and undulating lands provide a scenario of the natural vegetation although their natural panorama is distributed and altered these days by the inhabitants to fulfill their growing demand for building materials and other domestic uses.

Using IRS-P6 LISS III Remote Sensing data, 2008, land use/land cover map is prepared using Image Processing Supervised Classification Techniques, in which five important classes are delineated i.e. agricultural field, fallow land, vegetation, built-up area, and water bodies (Fig. 5).

The study area mainly comes under the Ganga plain having good fertile soils, so that majority of the area comes under very good agricultural area. Forest area is being reduced by pushing the frontier of agriculture. On the other hand, good agricultural land is being usurped by urban sprawls, industrial establishments and expansion of human settlements and infra-structural facilities.

The district is covered by 2961 hectares of forest and dense bushes in 2001. However, it is quite below the norms of 'Natural Forest Policy' stipulating that 33% of land should be covered with forest, so that greenery may be maintained.

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Methodology for flood risk zonation

In the present paper an attempt has been made to prepare the map of an area covering Varanasi district, measuring about 1560 sq. km. (Fig. 1 & 2). The major rivers that flow through this area are the Ganga and Varuna. Some of the major tributaries of the Ganga, like the Yamuna, Chambal, Ghagara are responsible for increasing the potential of flood in the area. The methodology adopted for flood risk zonation is described as follows:

- Georeferenced IRS P6, LISS III data (false color composite, scale 1 : 50,000), of 2008.
- Survey of India Topographic Map, scale 1 : 50,000
- Computer hardware and software which include ARC GIS version-9.3 and Erdas Imagine-9.2.

For this study, georeferenced image is added onto ARC GIS platform and was manually digitized and some attributes were also added. Based on onscreen digitization, flood zonation areas are demarcated.

Data available through attribute table of ARC GIS shape file is used to generate some simple statistical information related to flood zone areas.

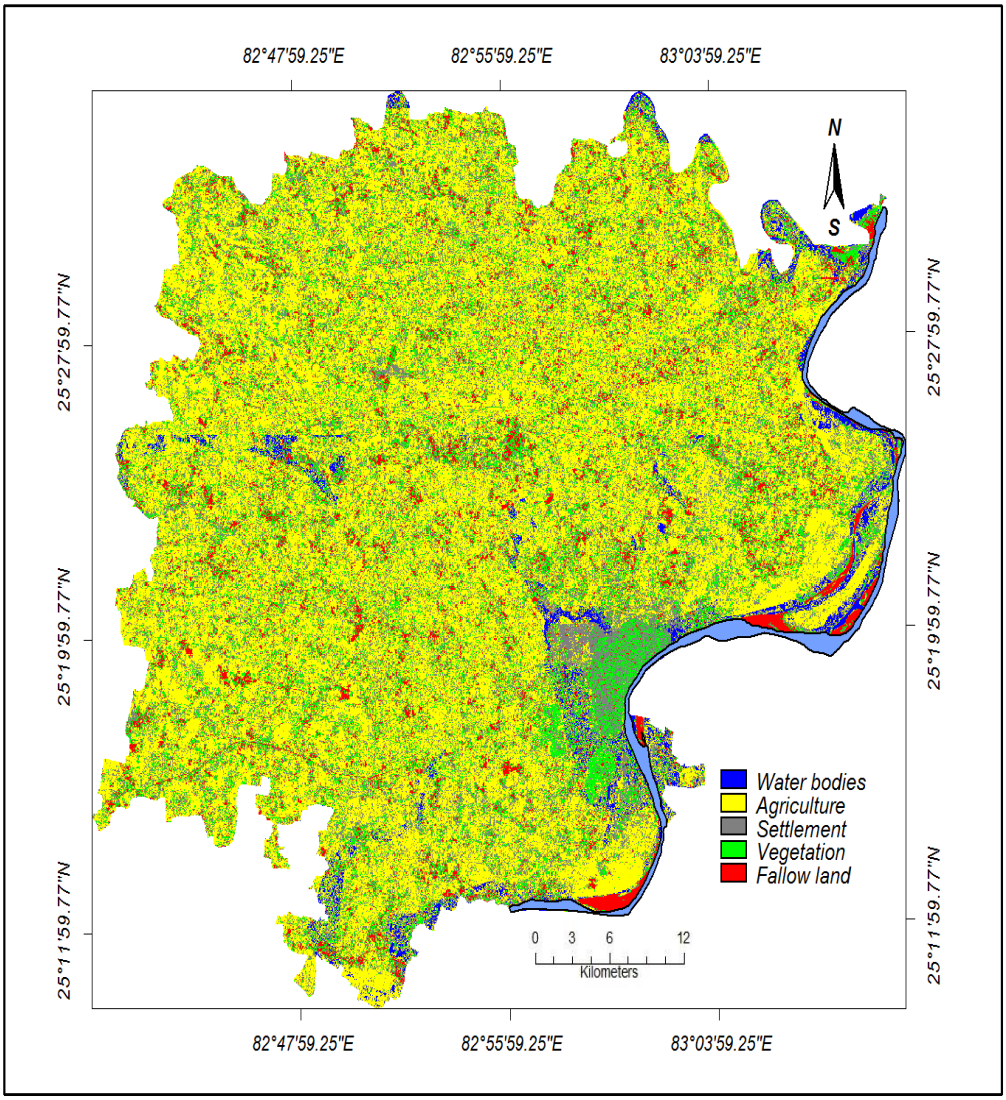

Fig. 5: Land Use/Land Cover of Varanasi district, 2008

Results and discussion

In the map produced (Fig. 6), a total of five flood risk zone are delineated in Varanasi district and flood risk factors are indicated in the legend with increasing number. The extent of the flood risk zones are presented in Table 1.

The water bodies in the satellite data are shown in light to dark blue every year, but this unit was not considered under flood risk zones.

The stabilized river islands occupied by vegetation and agricultural crops are clearly identified with the help of remote sensing satellite data; this unit is considered under low level flood plain. Sand banks and temporary river islands are showing herein as a brighter white color. This category includes the parts which are being flooded during the rainy season every years.

The flood plain alongside minor stream drainage in northern, north-eastern and in between the study area comes under low and middle level flood plain as the stream is inundated. Low and middle level flood plains are also delineated along the Ganga river. Low level and middle level flood plain get submerged every year during the monsoon season. The low level and middle level flood plain are located alongside the Ganga, Varuna and Gomti rivers, which is nothing but the meander belts which are clearly interpreted with numerous impressions of natural levees, point bars and ox-bow lakes fall. Some higher natural levees in this zone can stand high and dry in moderate flooding. Low level flood zone is flooded during heavy rains of the season almost every year where as middle level gets flooded in 10-15 years flood.

Flood risk is less in other area than along the rivers. The flood plains alongside the Ganga and Varuna rivers are also showing higher level flood risk zone and here flood risk is lesser as the slopes/gradient of the Ganga, Varuna and Gomti rivers are quite high compared to other parts within the study area.

Higher and highest level flood plain have a higher elevation than the others and get flooded only once in a 100 year flood (Mohan et. al., 2011). Higher and highest level flood plain can be identified in the middle part and south-eastern part of Varanasi district.

Table 1: Area statistics of different flood risk zones

S.No.	Flood Risk Zone	Area in sq.km.	Area in %
1	Sand Banks/Temporary/Stabilized River Island and River	36.98	2.42
2	Low Level Flood	122.20	8.01
3	Middle Level Flood Plain	422.58	27.69
4	High Level Flood Plain	413.35	27.09
5	Higher Level Flood Plain	119.64	7.84
6	Highest Level flood Plain	411.00	26.93

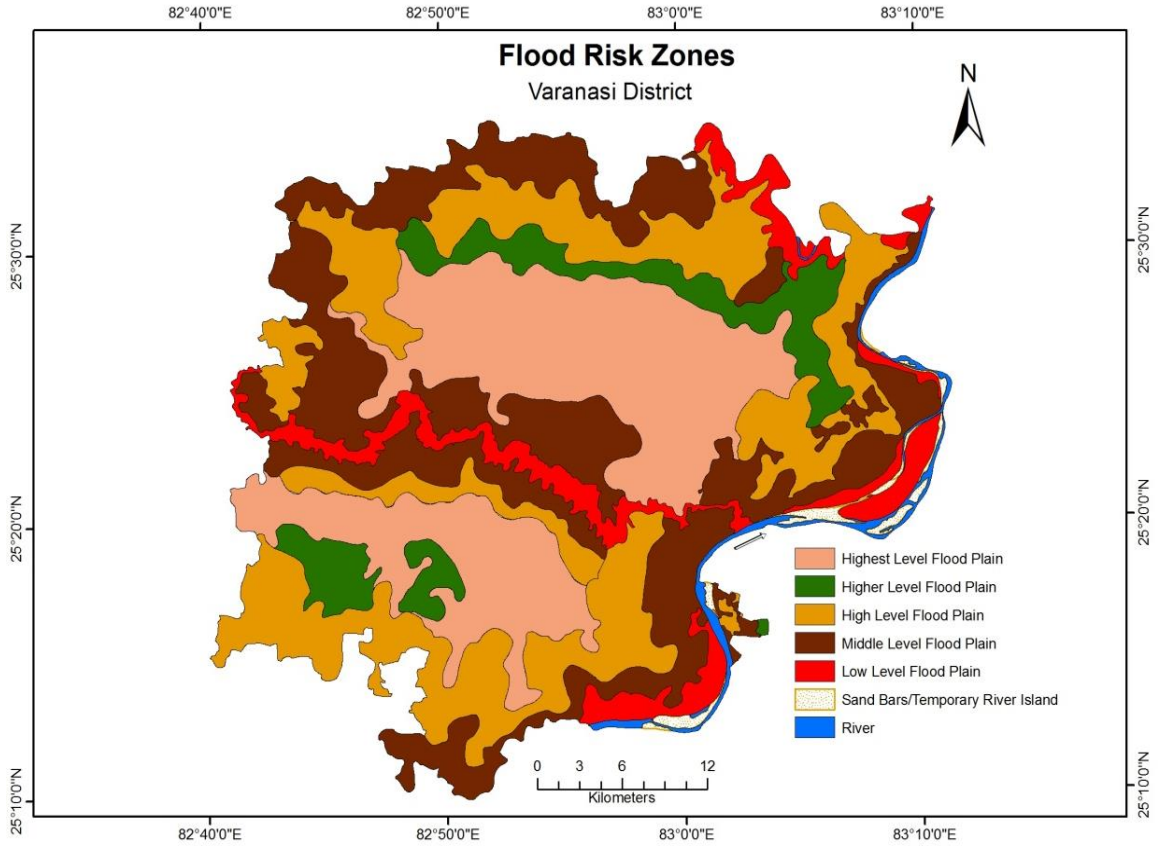

Fig. 6: Flood risk zones

Conclusion

Satellite remote sensing integrated with Geographical Information System (GIS) plays a powerful role in monitoring and mapping flooded and drainage congested areas.

It is evident that GIS has a great role to play in natural hazard management because natural hazards are multi-dimensional and the spatial component is inherent.

With the help of remote sensing data, study area has been divided into five flood risk zones i.e. low, middle, high, higher and highest level. Based on the above study, it is found that maximum 422.58 sq. km. area comes under middle level flood risk zone where as high, higher and highest level flood zones constitute around 433.35, 119.64 and 411 sq.km.

Acknowledgement

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Extreme low flow of the Topolovets and Voinishka Rivers (Danube tributaries, Bulgaria)

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Abstract

The minimal stream flow is the most sensitive characteristic of stream flow. The aim of the paper is the assessment of the duration and the frequency of low flow through threshold method on daily discharges. The daily data of the two Danube tributaries (the Topolovets and Voinishka) have been used. The results present the following: low flow typically appears in the summer and episodically in the spring and winter; the duration varies between some days to month; the spatial distribution of extreme minimum flow is discrete and depends on climatic and anthropogenic activities. The method of quantiles gives good threshold level for defining extremely low stream flow, but have to apply in keeping with concrete conditions and purposes.

Keywords: *low flow, threshold level method, the Danube tributaries*

Rezumat. Valori extreme ale scurgerii minime pentru râurile Topolovets şi Voinishka (afluenţi ai Dunării, Bulgaria)

Debitul minim reprezintă cea mai sensibilă caracteristică a scurgerii râurilor. Scopul acestei lucrări este de a evalua durata și frecvența debitelor reduse prin metoda pragurilor bazată pe valorile debitelor zilnice. Pentru aceasta, am folosit datele zilnice pentru doi afluenți ai Dunării (Topolovets și Voinishka). Rezultatele obținute indică faptul că scurgerea minimă este tipică pentru sezonul cald și apare episodic primăvara și iarna; durata variază de la câteva zile până la o lună, distribuția spațială a debitelor minime este redusă, depinzând de factorii climatici şi antropici. Metoda cuantilă oferă praguri ce pot fi folosite foarte bine pentru definirea valorilor extreme ale scurgerii minime, dar trebuie aplicată ținând cont de condițiile concrete și scopul studiului.

Cuvinte-cheie: *scurgere minimă, metoda pragurilor, afluenți ai Dunării*

Introduction

Low flow and especially its lower limit, minimal flow is very important for some economic activities as public water supply, irrigation, hydro-electric and industrial productions, and also for water quality management and the status of the aquatic ecosystems. It is a basic parameter of analysis of the hydrological drought. There are a lot of publications devoted to the methods used for estimation the minimum flow (minimum monthly flows, Wood et al., 2000; annual minimum flows, Wood et al., 2000, Clausen & Biggs, 2000; low flow index, Poff and Ward, 1989; Julian date of annual minimum, Clausen &Biggs, 2000, Richter et al., 1996, 1998; three kind baseflow indexes, Clausen and Biggs, 1997, 2000, Richter et al., 1998; Poff, 1996; for duration of low flow – annual minima of daily discharge, Richter et al., 1996, 1998; means of minima of daily discharge, Clausen & Biggs, 2000; low flow pulse duration, Richter et al., 1996, 1998, number of zero-flow days; percent of zero-flow months and etc.). The threshold level method (originally named method of crossing theory), although very popular worldwide, is not widely used in Bulgaria. Bulgarian engineering practice uses values of mean annual flow with different probability. For instance, a discharge value of or below 75% P (probability) is considered a dry period for irrigation systems, 80% P – for hydro-power plants, 95% P – for water supply. This work analyzes the extreme low and low flow for two tributaries of the Danube River through the threshold level method on daily discharges and compares the results with those obtained by other methods.

The two Danube tributaries that we analysed are the Topolovets River (L – 67.6 km, F – 582.8 km^2) and the Voinishka River (L – 55.2 km, F – 276.5 km^2). These rivers are the first and second order tributary of the Danube on Bulgarian territory. They pertain to the Danube North-west river basin of Danube hydro-geographical region (Hristova, 2011, Hristova, 2012). The rivers collect their waters from the northern slopes of the Balkan Mountains. They are classified as „medium" according to the length and also to catchment area (Sarafska, 2003). The Topolovets and Voinishka Rivers have similar hydrographic parameters (length and catchment area, average density – 0.5–0.6 km/km^2, few tributaries), natural conditions (prevalent hill and flat relief, canyon-like valleys; European-Continental climate (minimum air temperature in January and maximum – in July, continental regime of precipitation – with maximum June and minimum – in February), Sarmatian and Pliocene sediments, Quaternary loess and Alluvium in lower reaches;

small reserves of groundwater, small areas of oak forests) and economic activities (8 small dams in the catchment area of the Topolovets River and 6 small dams in the catchment area of the Voinishka River, large agricultural areas) (Fig. 1).

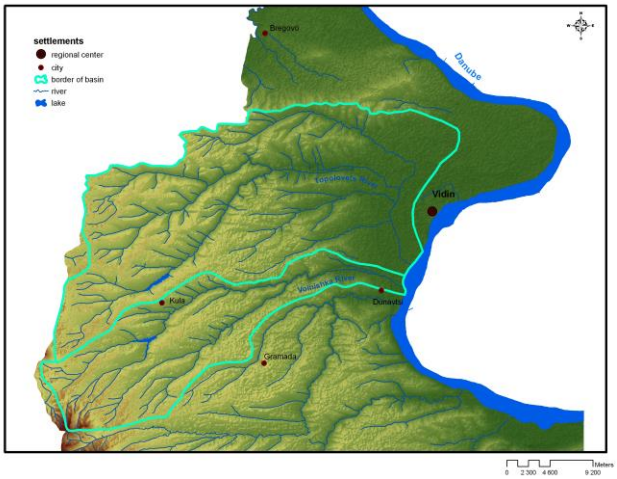


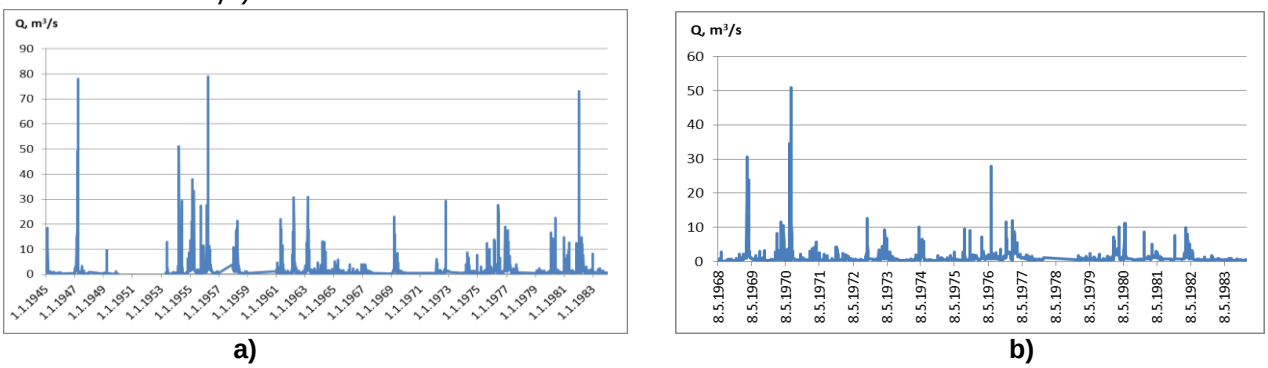
Fig. 1: River network and relief

River regime for the two rivers is similar – the period with high waters is from February till June, the period of low waters – from July till October (about 100–140 days).

November, December and January are months with transitional river flow. All rivers belong to continental type regime, second below type (Hristova, 2004). The monthly and seasonal variations are very big (Hristova, 1986), reflection of large fluctuation of daily discharges (Fig. 2).

The volume of low flow during the period with low waters is 5.22.106 m^3 (18,1% of the annual flow) for the Topolovets River and 3.06.106 m^3 (12,9% of the annual flow) for the Voinishka River (Dakova, 1976). Mean annual low flow for the Topolovets River is 0.164 m^3/s and for Voinishka River – 0.206 m^3/s. Maximum of mean monthly low flow is in March for the Topolovets River and during April for the Voinishka River (Table 1).

The minimum of mean monthly low flow appears in October for the Topolovets River and in August for the Voinishka River. The value of index $I=Q_{min}/Q_{an}$ (Q_{min} is smallest monthly low flow, Q_{an} – annual flow), proposed by Hamilton & Bergersen, (1984), is 0.10 (Voinishka River) and 0.20 (Topolovets River) and shows small stability of low flow. Absolute minimum stream flow for Topolovets River is 0.129 m^3/s, for Voinishka River – 0.073 m^3/s.



a) **b)**

Fig. 2: Hydrograph of: a) the Topolovets River; b) the Voinishka River

Table 1: Mean monthly low flow

River	Months											
	J	F	M	D	D	J	J	A	S	O	N	D
Topolovets – Akatsievo	0201	0.212	0.226	0.142	0.140	0.109	0.107	0.117	0.064	0.030	0.039	0.095
Voinishka – Tarnjane	0.210	0.222	0.243	0.255	0.122	0.093	0.036	0.016	0.024	0.060	0.115	0.178

Methods

The low flow and extreme low flow are extracted by threshold level method. „A threshold level which is too low might lead to a high number of no-drought years making the few identified drought events statistically uncertain to evaluate. On the other hand, with a high threshold level, the likelihood for a series of small single drought events being combined into one severe multi-year drought (drought lasting longer than a year) increases" (Lehner &Döll, 2001). The threshold might be chosen in a number of ways – percentage of the mean flow or a percentile from the duration curve (Hisdal et al., 2006). Usually, the threshold method uses monthly discharge data.

This work accepts quantiles, which are proposed by the National Institute of Meteorology and Hydrology – 10% quartile (Q10) for extreme low waters, which are defined trough 50% quartile

(Q50) of all daily discharges. The length during which the stream flow is below the threshold level is termed duration of extreme low flow (D_{lf}), the volume below threshold – deficit volume.

Frequency of extreme minimum flow (F_{lf}) is presented in percentages per months. It is also calculated according to the coefficient of Hughes & James (1989), which is total number of low flow spells (threshold equal to 5% of mean daily flow) divided by the record length). A low flow frequency analysis evaluates the probability of flow occurring and remaining below a specified (low) threshold for a given length of time.

The number of classes for the frequency and the duration of extreme low runoff are isolated according to Sturges' formula.

$$K = 1 + 3.322 \log N \quad (1)$$

where K = number of class

log N = logarithm of total number of observations

The class width is obtained using the formula

$$h = (h_{max} - h_{min})/k. \quad (2)$$

The series from daily discharges for the Topolovets and Voinishka Rivers are the base for counting. There are available daily hydrological data for 38 years (1945–1983 period) (13,870 daily discharges) for the Topolovets River and 36 years (1947–1983 period) (13,140 daily discharges) for Voinishka River. The series of daily discharges are very long and representative. The data after 1983 is not available.

Discussion

The threshold discharge of the Topolovets River for low flow is 0.62 m^3/s (51% of the annual stream flow) and for extreme low flow – 0.21 m^3/s (17% of the annual runoff) (Table 2).

The magnitude of extreme low flow is not conform to minimum flow, calculated for different theoretical probabilities (Table 3). It is more than 5% (Q5 is 0.06 m^3/s) of the annual runoff, recommended by Hughes & James (1989) and more than 10% (Q10 is 0.12 m^3/s), recommended by the Bulgarian standard for ecological discharge. The threshold discharge of the Topolovets River for extreme low flow is more than the ecological discharge of 0.015 m^3/s, which is calculated by Zaharieva (2006) according to her method.

Table 2: Threshold level discharges (m^3/s)

River	For low flow (Q50) of whole daily discharges	For extreme low flow (Q10) of low river flow
Topolovets	0.62	0.21
Voinishka	0.52	0.09

Table 3: Minimum flow (m^3/s) with different probability

River	Probability, %			
	75	90	95	99
Topolovets	0.140	0.080	0.042	0.000
Voinishka	0.060	0.042	0.033	0.006

Source: Dakova (1980)

Extreme low stream flow for the Topolovets River is between 0.05 and 0.21 m^3/s and it is not recorded every year. It is typical for August, September and October, rare in June and July and occurs sometimes during the winter (Table 4). The average duration is between 1 to 14 days, the probability for appearance – from 1% (the winter months) to 28% (August).

The frequency of low flow, calculated according to the coefficient of Hughes & James (1989) is 5 days per year. The duration of extreme low flow over the years is between one to 55 days (1949 year). The longest periods of extremely low waters are registered until 1960.

Extreme low flow was especially protracted during 1949 (143 days). Other years with long low flow are 1947 (67 days), 1953 (104 days) and 1954 (67 days). The picture of days with extremely low water shows the decrease of duration of this hydrological parameters and advent only in summer-autumn season (Fig. 3).

The statistical analysis presents the following: the distribution of extreme low stream flow is negatively asymmetric – mode: 0.20 m^3/s, median: 0.16 m^3/s and average: 0.14 m^3/s; dominate discharges more than 0.18 m^3/s; the typical duration is one and two days; the most common value is 0.18-0.21 m^3/s (Fig. 4).

Table 4: Duration (D_f, days) and frequency (F_f, %) of extreme low flow

River basin		Months											
		J	F	M	D	D	J	J	A	S	O	N	D
Topolovets – Akatsievo	D_{lf}	2	1	2	4	7	8	7	10	14	11	1	2
	F_{lf}	8	5	2	8	5	10	26	28	23	23	8	8
Voinishka – Tarnjane	D_{lf}	–	–	8	8	11	9	17	19	14	12	–	–
	F_{lf}	–	–	3	8	8	8	18	18	19	18	–	–

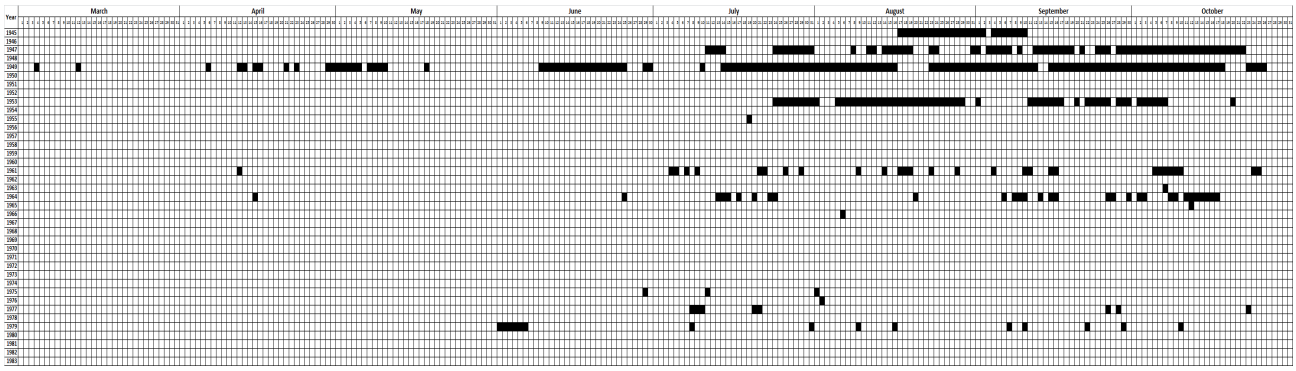


Fig. 3: Days with extreme low flow for the Topolovets River

The threshold discharge of the Voinishka River for extreme low flow is 0.09 m^3/s (Table 2). It is more than 5% and 10% of the annual runoff and more than 0.015 m^3/s, which is calculated by Zaharieva (2006). Extremely low flow for the Voinishka River is 0.02–0.09 m^3/s. It is not recorded every year and unlike the Topolovets River, it is not registered in winter (Table 2, Fig. 5).It normally occurs during the summer and autumn months. The average duration is between 8 to 19 days, the probability for appearance – from 3% (the spring months) till 19% (September).

Typical duration is one or two weeks (Table 5). Extreme low river flow was especially protracted during 1947, 1949, 1953, 1967 and 1968. The duration of extremely low flow over the years varies between one to 54 days (1949).

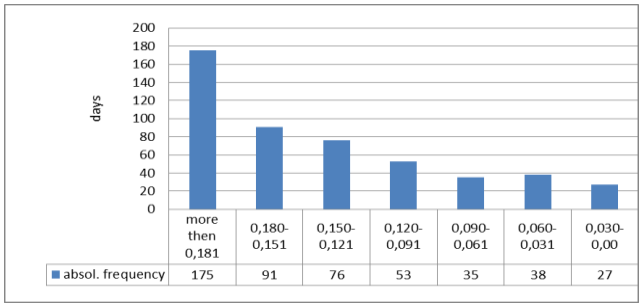


Fig. 4: Frequency of extreme low flow with definite value for the Topolovets River

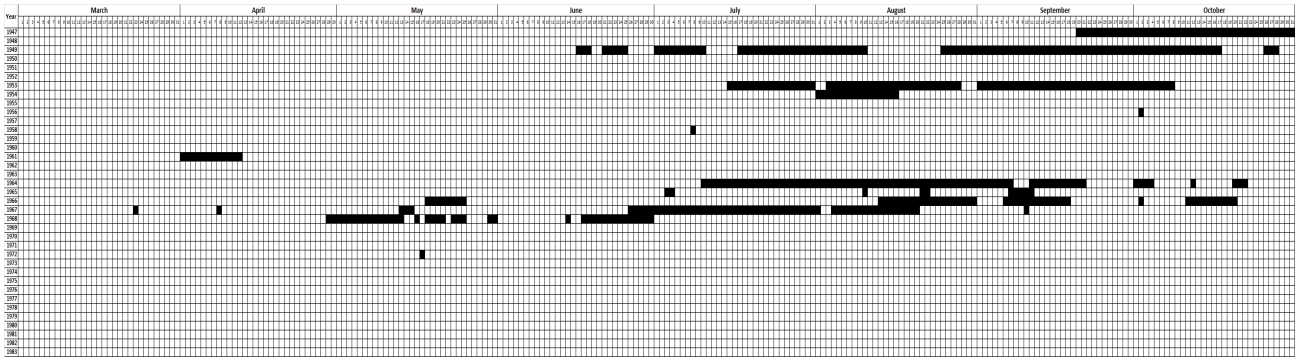


Fig. 5: Days with extreme low flow for the Voinishka River

Table 5: Number of causes with definite duration and definite value of extremely low flow for the Voinishka River

Duration			Value		
Days	Causes		m^3/s	Causes	
	number	%		number	%
1-8	30	60	0,02	10	1,9
9-16	10	20	0,03	31	5,7
17-25	3	6	0,04	97	18,0
26-34	3	6	0,05	27	5,0
35-42	2	4	0,06	77	14,2
43-49	1	2	0,07	116	21,4
50-58	1	2	0,08	53	9,8
			0,09	130	2,04

The extremely low flow is most common 0.04 m^3/s, 0.07 m^3/s and 0.09 m^3/s. Its distribution is negative asymmetric too – the mode: 0.07 m^3/s, the median: 0.09 m^3/s and the average:0.06 m^3/s.

Conclusion

Extremely low flow, calculated by threshold method in this work, occurs normally during summer and autumn and continues between one day and two months. It was especially protracted during 1949. This year is the driest up to now, so the duration of low flow in this year could be accepted as a top end. A lot of days with very low flow for the Topolovets and Voinishka Rivers are established for 1947 and 1953. Extremely low river flow has large

temporal and spatial variations depending of climatic and hydrogeological conditions and also of the economic activities. Its values, as opposed to the duration, can be predicted. Extremely low flow is less than the Baseflow index by Tennant (1976) for the two rivers and greater than 10% of the average flow (the mean daily flow average over all years of record) for the Topolovets River and less than for Voinishka River. Its value, calculated through the chosen method, for these rivers is very different as compared to those calculated according to other methods. So, the threshold level method, which is proposed by National Institute of Meteorology and Hydrology (50% quartile of all daily discharges for low flow and 10% quartile from low waters for extremely low flow), maybe have to be corrected for low flow. Extremely low river flow should be defined as hydrological drought.

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The analysis of the susceptibility of the flash-floods' genesis in the area of the hydrographical basin of Bâsca Chiojdului river

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Abstract

The present article aims to identify the areas with high susceptibility in the acceleration of the surface flowing of the water and thus, in the delivery of the flash-floods from the hydrographical basin of the Bâsca Chiojdului river, which is situated in one of the most vulnerable areas in Romania (bend area) at the hydrological phenomena of risk. The analysis of the susceptibility was possible by taking into consideration ten main factors that we considered to play an essential role in the genesis of the flash-floods. There resulted a map of the flank's surfaces with high susceptibility in the flash-floods' delivery and their triggering at the layer level of the hydrographical network in the basin. The proposed index, FFSI (Flash Floods Susceptibility Index), resulted from the summation of the analyzed factors, presents mainly the highest values within the area of Drajna Depression, where most of the settlements from the basin are located. The high genesis susceptibility of the flash-floods in this area is due to the association of the most numerous risk factors that we analysed, namely lithology favourable to the pronounced flowing, slopes with high values, high degree of deforestation etc. The areas identified as being critical from the point of view of the potential of flash-floods formation present a high risk for the genesis and triggering other related phenomena such as floods and landslides.

Keywords: *flash-floods, susceptibility, Bâsca Chiojdului basin, FFSI*

Rezumat. Analiza susceptibilității genezei viiturilor în aria bazinului hidrografic al râului Bâsca Chiojdului

Prezentul articol își propune identificarea arealelor cu susceptibilitate mare în accelerarea scurgerii de suprafață a apei și astfel în alimentarea viiturilor din bazinul hidrografic al râului Bâsca Chiojdului, bazin situat în una din cele mai vulnerabile zone din România (zona de curbură) la fenomenele hidrice de risc. Analiza susceptibilității a fost posibilă prin luarea în considerare a zece factori principali cu un rol esențial în geneza viiturilor pentru ca în final să rezulte o hartă a suprafețelor de versanți cu susceptibilitate ridicată în alimentarea viiturilor și declanșarea acestora la nivelul albiei râurilor din bazin. Indicele propus, FFSI (Flash Floods Susceptibility Index), rezultat în urma însumării factorilor analizați, prezintă cele mai ridicate valori în general în cadrul arealului depresiunii Drajna, în această zonă fiind situate principalele localități din cadrul bazinului. Susceptibilitatea ridicată a genezei viiturilor în această zonă se datorează asocierii a celor mai mulți factori de risc din cei analizați și anume litologie favorabilă scurgerii accentuate, pante cu valori ridicate, grad mare de despădurire ș.a. De asemenea, arealele identificate ca fiind critice din punct de vedere al potențialului de formare a viiturilor prezintă un risc ridicat și la geneza și declanșarea altor fenomene asociate precum inundațiile și alunecările de teren.

Cuvinte-cheie: *viituri, susceptibilitate, bazinul Bâsca Chiojdului, FFSI*

Introduction

The analysis of the hydrological phenomena of risk represents an actual concern of the scientists, especially in the context in which these present an increasingly frequency at the global level during the last decades (Cao&Yue, 2006). Thus, nowadays, the flash-floods represent one of the most dangerous hydrological phenomena of risk, the worst consequences being of a socio-economic nature (Gaume et al., 2009). Climatic changes are one of the main causes of the intensification of these phenomena both in the last decades, and very probable also in the future, is represented by the (IPPC, 2007), but also by the inadequate anthropic actions in the environment (eg. uncontrolled deforestations).

The term of flash-floods means the quick rise of a river's level and flow, as an effect of an increased quantity of fallout in a short period of time, this being corroborated with an accelerated surface flow due to some favourable factors, thus remains a very short period of time for warning (Norbiato et al., 2008). At the same time, the concept of susceptibility represents the probability that a certain phenomenon to occur in an area characterized by certain favourable environmental conditions (Prefac, 2008).

The analysis of the susceptibility of the genesis' premises and of the flash-floods' manifestation mode is of a vital importance because if this is acknowledged, the socio-economic and ecologic disasters can be prevented. Nowadays, in the specialized literature there are numerous studies regarding flash-floods as a factor of risk, these being made especially at a regional scale (Gaume et al., 2009; Marchi et al. 2010), but especially at a local scale (Gaume et al., 2004; Sahoo et al, 2006; Koutroulis & Tsanis, 2010; Zanon et al., 2010; Zoccatelli et al., 2010 etc.). At European level, there are three representative regions with a very high potential of occurrence of the flash-floods, namely the Mediterranean, alpine and continental areas (Norbiato et al., 2008), Romania coming under the

continental region with a high potential of occurrence of these hydrological risk phenomena.

Also, the methodologies utilized are diverse in the specialized literature in the flash-floods' analysis as hydrological risk phenomena, but nowadays there are several accepted methods which are very efficient regarding the forecast and the prevention of the catastrophic effects of the flash-floods (Norbiato et al., 2008; Braud et al., 2010). These are based especially on the climatic factor analysis (in general, the precipitations as a main factor that generates the flash-floods) in relation with the hydrological factor, in this case being the behaviour of the precipitations at the contact with the terrestrial surface, thus the intensity and the volume of the surface flowing being influenced directly by the features of the relief (lithology, slope, the extent of the terrains etc.).

From the exclusive point of view of the analysis of the flash-floods formation potential, in the specialized literature one of the first evaluation attempts of the flash-floods genesis susceptibility at the level of a hydrographical basin belongs to Greg Smith (2003), taking into consideration certain favourable factors of the active surface flow in order to bound the areas with a high potential of flash-flood formation in the area of the Colorado river basin in USA.In Romania, important studies regarding the evaluation of the high potential of the surface flow and therefore of the flash-flood have been made by Chendeș (2007), Zoccatelli et al. (2010), Mătreaţă & Mătreaţă (2010), Teodor & Mătreaţă (2011), Minea (2011), Zaharia et al. (2012), these studies mainly taking over and adapting the initial methodology proposed by Greg Smith. At a particular case, at the level of the analyzed basin, studies regarding the occurrence of the flash-floods and of other related phenomena, such as the floods have been made by Zarea (2011), Zarea & Ionuș (2012).

Study area

The hydrographical basin of the Bâsca Chiojdului river, sub basin of the Buzău river, is situated in Romania's central south-eastern part (figure 1), at the boundary between the Curvature Carpathians and Subcarpathians, spreading approximately equally on the two relief units. The mountain part of the basin overlaps the Buzău Mountains, more exactly, the southern part of the Siriu Mountains, while the Subcarpathian unit is represented by Cornet , Pripor and Salcia Hills and Pătârlagele Depression. Also, between the hill and mountain units here is also the submountaineous Drajna Depression.

From the point of view of the surface, this occupies an area of approximately 340 km2, coming under the category of small basins, the most vulnerable at the hydrological risk phenomena, such as the quick flash-floods (Braud et al., 2010).

The relief of the basin presents heights between 239 m in Pătârlagele Depression and 1496 m in Curmătura Peak (Zarea, 2011) from Tătarului Crest, with an average of 668 m. Over 79% of the basin surface presents slopes that exceed 7°, these reaching the value of 37° on the most sloped surfaces. The average slope of the basin is of 11,6°, this being one of the most important factors in generating the flash-floods by accelerating the surface flow (Constantinescu, 2006). Likewise, over 42% of the surfaces included in the Bâsca Chiojdului Basin have a general southern distribution, above these, during the summer there are forming convective torrential rains (Roșu, 1980), potential flash-floods generator.

The lithology is characterized mainly by the presence of the sedimentary formations of the Paleogene flysch, and in a small degree by the Cretaceous flysch (Velcea & Savu, 1982). The correspondents of the Cretaceous formations from the Bâsca Chiojdului basin territory are hard rocks such as limeous sandstones, green sloughing shales, green shales, granodiorites with arkose etc. (The Geological Map of Romania 1:200000 scale, 1970), these being favourable for the occurrence of flash-floods.

The climate is characterized by average annual temperatures of 7° C (Clima României, 2008) in the entire basin, while the quantity of precipitations rises from 600 mm in Pătârlagele Depression to 1200 mm in Tătarului Crest (The Climatic Atlas of R.S.R., 1966), thus determining a high potential of flash-floods formation in the mountain area.

The hydrography is represented by the main collector river, the Bâsca Chiojdului, with a total length of 42 km and a multiannual average flow of 1,2 mc/s at the exit from the mountain space, respectively 2,65 mc/s at the inflow in the Buzău river, which receives the main affluents Bâsca fără Cale, Stâmnic, Zeletin etc. One of the most important factors of the hydrography in flash-floods formations is the convergence, this being favourable for the quick flow by the increase of the water concentration degree along a hydrographical network.

The natural vegetation of the basin includes broadleaf forests such as the beech, the oak (Fagus sylvatica, Quercus petraea) etc., and mixed forests in the sector of the basin which overlap the Curvature Carpathians with species of deciduous trees mixed with coniferous such as the fir (Abies alba), the pine (Pinus silvestris) and the spruce (Picea abies) (Doniță et al., 2005). The forestation

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index of the basin presents values of approximately 50% (CLC, 2006), which testifies for a high potential of flash-floods formation as an effect of the lack of the sylvan layer on approximately half of the basin's surface. From the point of view of the hydrological role, the forest plays an important role in the reduction of the negative effects of the surface flow (Arghiriade, 1977), weighing against the accentuated flow on the flank and thus, the flash-floods formation.

The pedological layer of Bâsca Chiojdului basin is formed in proportion of 53% of cambisols, followed by evolved truncated soils and by loamy soils (ICPA, București). Cambisols and loamy soils with a clayish texture favour the production of floods, generally, there are soils with clayish texture, where water from precipitation hardly infiltrates, thus accelerating the surface flow (Mătreață & Mătreață, 2011).

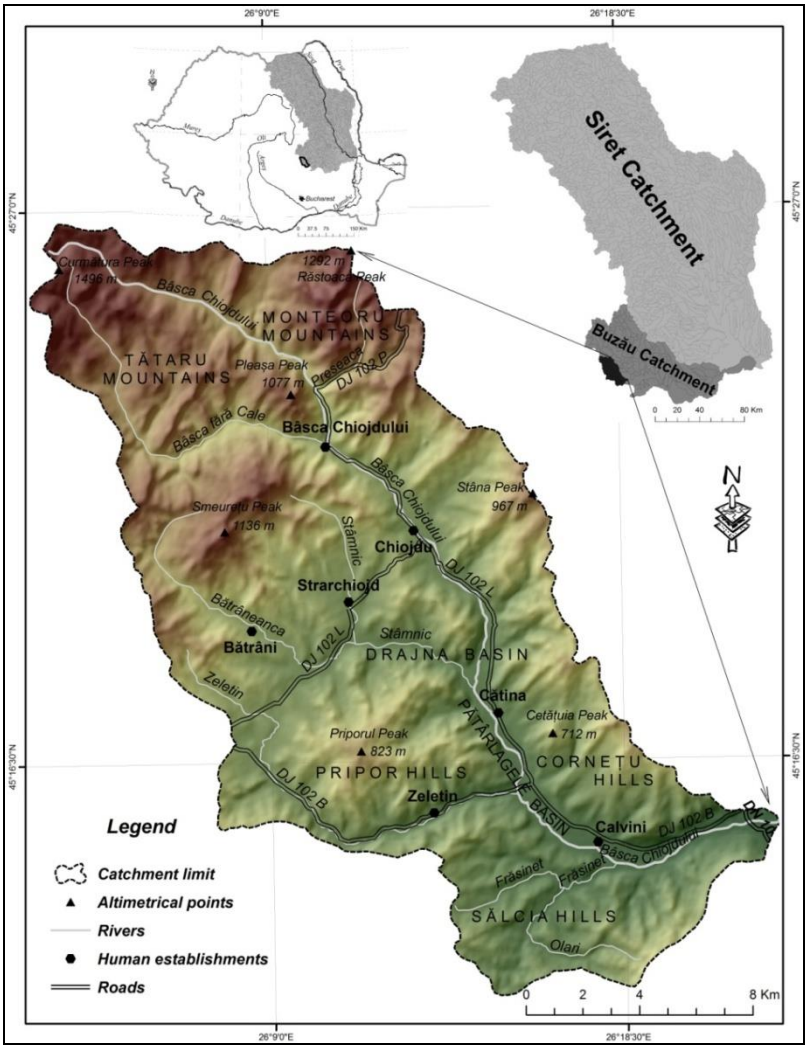

Figure 1: Localization of the hydrographical basin of the Bâsca Chiojdului

data processing geo-spatial.com

Data and methods

In order to highlight the areas with a certain potential in the flash-floods formation, the FFSI index (Flash Floods Susceptibility Index) was proposed, this representing an adapted and improved variant of the so-called FFPI (Flash Flood Potential Index), which was proposed by Smith (2003) and undertaken and adapted at the level of Romania, as it was previously mentioned by Mătreaţă & Mătreaţă (2010), Teodor & Mătreaţă (2011), Minea (2011) si Zaharia et al. (2012).

Thus, in order to increase the scientific exactness in the bounding of the areas with high susceptibility in the delivery and formation of the flash-floods, the FFSI index was obtained by the integration of ten physical, geographical and anthropic factors (figures 2, 3, 4) namely: lithology, the relief slope, the profile curvature of the surfaces from the basin, the proportion between the flanks' length and their slope (L-S factor), the aspect (a very important

factor in the formation of the torrential convective rains), the average annual sums of precipitations, the convergence index, the shape factor of the type I sub basins within Bâsca Chiojdului basin, the texture of the soils and the extent of the terrains within the territory of the basin.

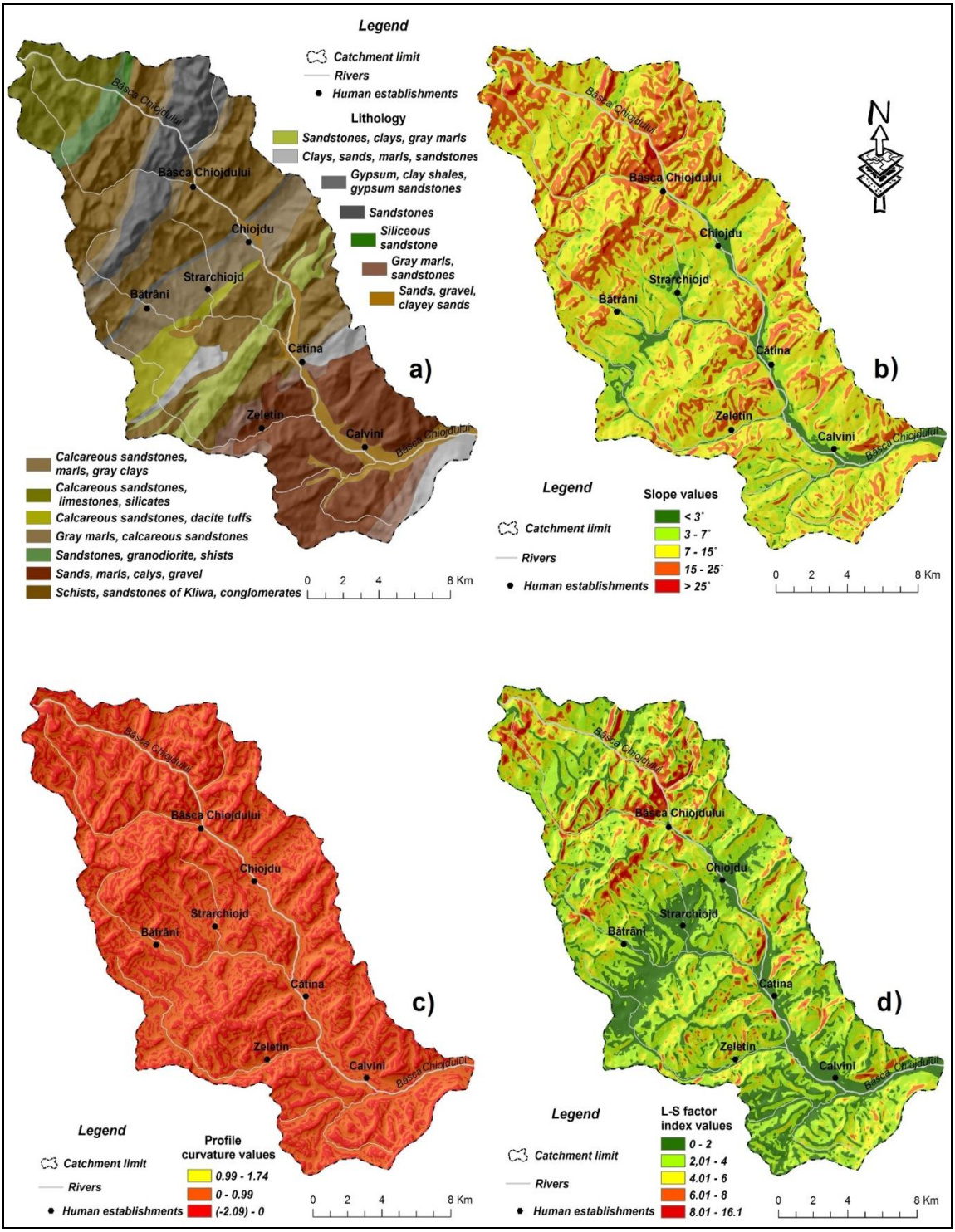

Figure 2: The spatial representation of the lithology (a), the values of the slopes (b), the profile curvature (c) and the L-S factor index in the Bâsca Chiojdului basin

Factors such as the lithological composition, the precipitations, the extent of the terrains, the texture of the soils and the shape factor of the sub basins have been initially obtained in a polygon vector shape file, after which they have been transformed in ArcGIS 9.3, in a raster format with the dimension of the cell of 20m*20m (400 m²).

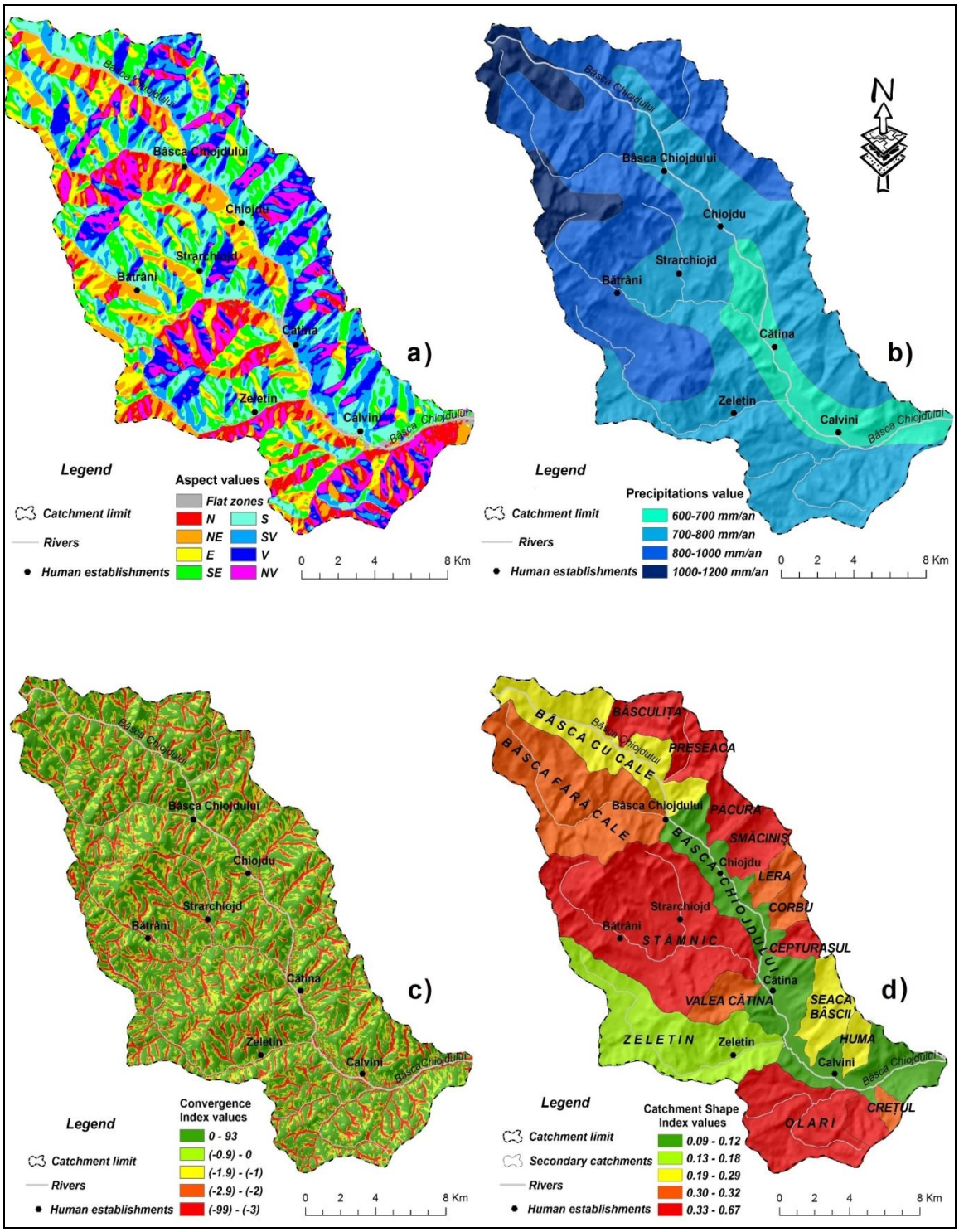

Figure 3: The spatial representation of the aspect values (a), the annual average sums of precipitations (b), the values of the convergence index (c) and catchment shape index (d) of Bâsca Chiojdului basin

At the same time, in the case of the lithological spatialization, the Geological Map of Romania 1:50000 has been utilized in the projection system Stereo 70, while in the case of the precipitations, Romanian Climate, 2008 served as cartographic support. Likewise, the extent of the terrains has been obtained with the help of Corine Land Cover 2006 database (European Environmental Agency), while the texture of the soils has been obtained with the pedological map 1:20000 in the projection Stereo 70.

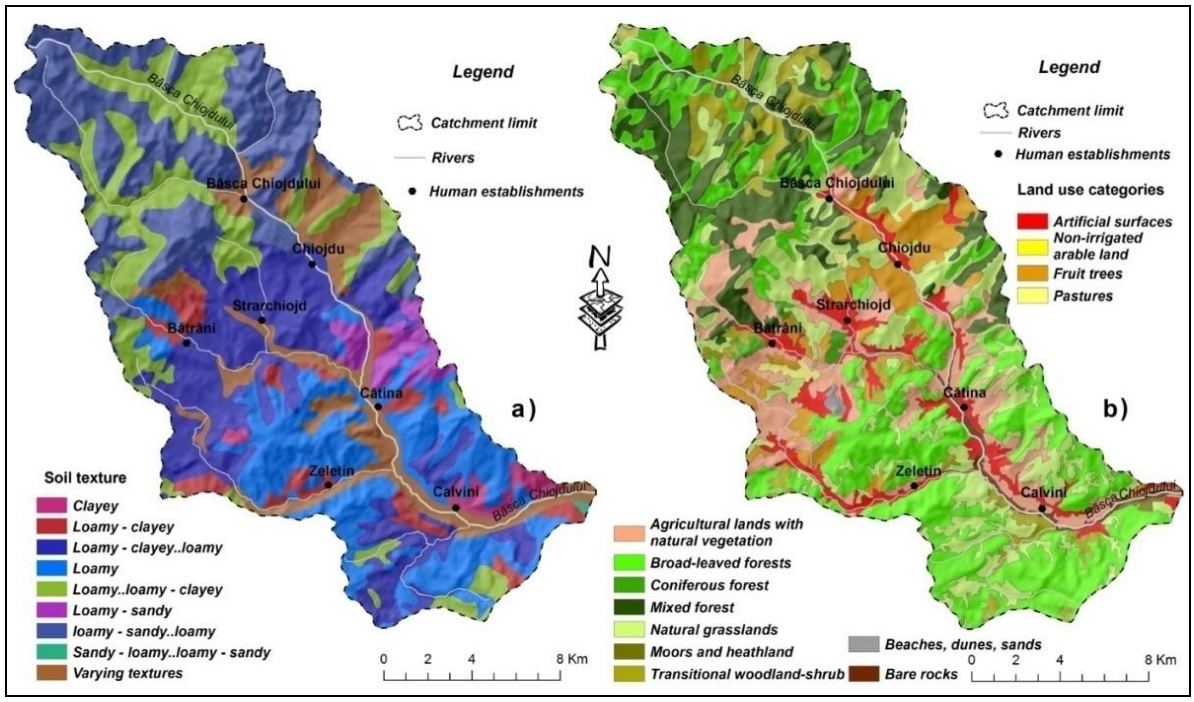

Figure 4: The spatial representation of the pedological texture (a) and of the land cover (b) in Bâsca Chiojdului basin

Georeferencing and projecting the cartographical support has been realized with the help of Global Mapper 12. The other 5 factors have been obtained by their deduction from the Digital Elevation Model corresponding to the hydrographical basin of the Bâsca Chiojdului, obtained from the isoline and the digitized altitude points from the topographical maps 1:25000, projection Stereo 70. The slope, the aspect and the profile curvature have been derived with the help of the corresponding tools within ArcGIS 9.3 software. The convergence index and the L-S factor have been obtained by derivation from the Digital Elevation Model in SAGA GIS 2.0.8. software via the Basic Terrain Analysis module.

It must be mentioned the fact that the convergence index and the L-S factor don't have a specific unity of measure. In the case of the convergence index, the maximum divergence is marked by positive values (maximum 100) (chart 1), and the maximum convergence by negative values (maximum -100) (Constantinescu, 2006).

The calculation of the L-S factor index is based on the formula: $LS = (m+1)(As/22,13)m (\sin \beta/0,0896)n$, where m=0,4 and n=1,3 (Constantinescu, 2006). The values which are close to zero indicate a reduced slope corroborated with a large length of the flank, while the high values indicate a high slope corroborated with a small length of the flank, which amplifies the water flow speed. The shape factor has also been calculated using the formula $Ff=F/L^2$, where F – the surface of the basin and L – the length of the basin. Therefore, as the basins tend to have a circular shape, the values of the shape factor increase, indicating a high potential of flash-floods formation, due to the quicker concentration of the flow in the collector river (Pișota et al., 2010). Contrary, in the case of an elongated shape of the basins, the flow is less intense and with a lower erosive force, thus the potential of flash-floods formation being more reduced.

The adding of the ten previously mentioned factors has been realized in GIS medium, by summing up the rasters corresponding to their spatialization within the territory of the basin. The operation was effectuated in the ArcGIS 9.3 software with the help of the Raster Calculator tool from the Spatial Analyst extension. The cells' side of the ten grids has the dimension of 20 m. Each factor was divided into 5 classes of values (chart 1) depending on the degree of favourability at the occurrence of the flash-floods which is presented by their features. The utilization of the ortophotomaps 1:5000 from 2005, overlapped final map of susceptibility, have confirmed the delimitation of areas with high susceptibility in the genesis of flash-floods, therefore numerous hydrographical torrential generators of quick flash-floods and of high intensity being observed.

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Table 1: The classification and the labelling of the physical, geographical and anthropic factors for obtaining the susceptibility index FFSI in Bâsca Chiojdului basin

Parameters	Type/values				
Lithology		*Clays, sands, marls, sandstones, calcareous sandstones*	*Gray marls, sandstones, siliceous sandstones, marls, limestones, silicates, dacite tuffs*	*Shists, clay shales, gypsum sandstones*	*Sandstones, granodiorite, shists*
Slope gradient (°)	*0 - 3*	*3 - 7*	*7 - 15*	*15 - 25*	*> 25*
Profil curvature (radiani/m)			*0,99 - 1,74*	*0 - 0,99*	*(-2) - 0*
L-S Factor	*0 - 2*	*2 - 4*	*4 - 6*	*6 – 8*	*> 8*
Aspect	*N, NE*	*NV, E*	*Flat zones*	*SE, V*	*S, SV*
Precipitations (mm/an)		*600 - 700*	*700 - 800*	*800 - 1000*	*1000 - 1200*
Convergence index	*> 0*	*0 - (-1)*	*(-1) - (-2)*	*(-2) – (-3)*	*(-3)- (-100)*
Catchment shape index	*0,09*	*0,18 – 0,19*	*0,21 – 0,3*	*0,31 – 0,38*	*0,42 – 0,67*
Soil texture	*Sandy-loamy...loamy-sandy*	*Loamy-sandy...loamy, Loamy-sandy*	*Loamy... Loamy-clayey, varying textures, loamy*	*Loamy-clayey...clayey, Loamy-clayey*	*Loamy*
Land use	*Broad-leaved forests, coniferous forests, mixed forests*	*Fruit-trees, transitional woodland-shrub*	*Arable land, agricultural lands with natural vegetations, moors and heathland*	*Natural grasslands, pastures*	*Artificial surfaces, bare rocks*
Score given	*1*	*2*	*3*	*4*	*5*
FFSI (class)	*Very low 16 - 21.2*	*Low 21.2 - 26.4*	*Medium 26.4 - 31.6*	*High 31.6 - 36.8*	*Very high 36.8 - 42*

Results

After the application of the presented methodology, the FFSI spatialization within the territory of Bâsca Chiojdului basin was obtained (Fig. 5), having values between 16 and 42, these being divided into 5 equal classes, each class representing a certain degree of susceptibility of flash-floods formation.

In this way, it is observed that the surfaces with high inclination, corroborated with the surfaces that lack sylvan vegetation and which overlap the hard rocks, as well as those which present a high convergence of the hydrographical network, and the shape of the basins is circular greatly favour the emergence and occurrence of the flash-floods.

The high and very high values of the index, of over 31,6, appear in a proportion of 28%, especially on the deforested flanks, with a reduced length, with high slopes, characterized generally by an increased convergence of the torrential and river organisms. The most surfaces are concentrated around Drajna Depression, an area with a low degree of forestation, generally on the flanks which descend from the neighbouring mountain units.

The average values of FFSI occupy the greatest weight, i.e. 48% of the basin's surface. The areas with values between 26,4 and 31,6 of FFSI are spread equally on the territory of the basin.

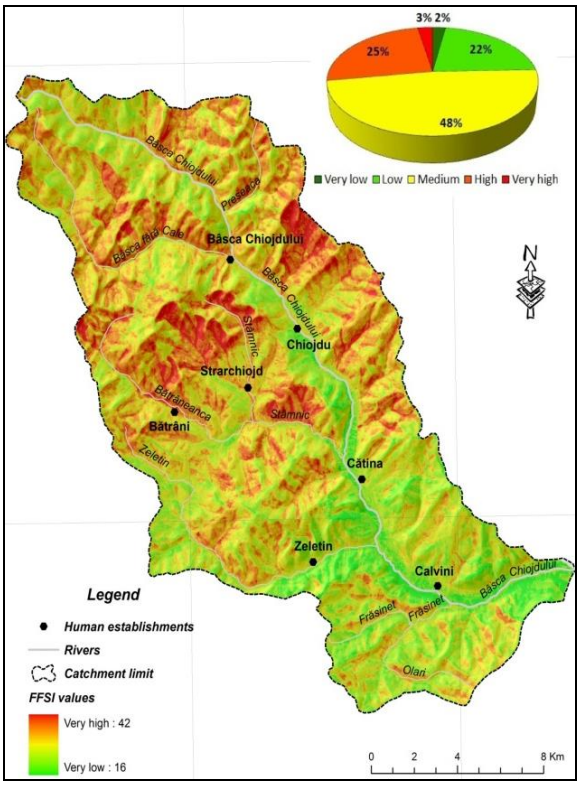

Figure 5: The spatial representation of FFSI index values within Bâsca Chiojdului basin

The small and very small values, under 26,4 of FFSI, occupy approximately 24% of the basin's surface and generally characterizes the valley of the Bâsca Chiojdului downstream of Chiojdu until it flows into the Buzău river as well as the affluents subbasins from the lower sector of the main basin: Frăsinet, Olari, the lower part of Zeletin Basin, Seaca

Bâscii and Huma. These low values of FFSI appear as a consequence of the slope's low values which are present along the valley of the main river, as well as the presence of the sylvan vegetation in the secondary basins, on a sub layer generally formed by gravel and sand formations. In this case, the generating potential of some quick flash-floods is reduced.The southern contact of Tătarului Crest with Drajna Depression in the northern proximity of Starchiojd and Bătrâni villages (fig. 6) is an area with a great concentration, of over 52%, of the values which exceed 31,6 of FFSI.

Several torrential organisms with a high potential of flash-floods formation (fig. 7) approach towards these villages, determining an increased vulnerability at these hydrological risk phenomena. Another vulnerability element which is present in this area is the County Road 102L, which connects the neighbouring villages from Prahova and Buzău counties.

Another predisposed area to the flash-floods formation appears in the perimeter of Păcura and Smăciniș basins, affluents on the left side of Bâsca Chiojdului river. Here, the weight of the high and very high values of FFSI reaches 55%. This area predisposes Chiojdu village, situated in the south-west, at a major risk in the case of the occurrence of some quick flash-floods. In this region, an element of vulnerability is represented also by the County Road 102P placed in the major bed of the Bâsca Chiojdului river. The hydrographical basin of Bâsca fără Cale is also characterized in the lower sector by a great potential of delivering the flash-floods, especially on the steep slopes from the left side of the river. This area increases the risk for Bâsca Chiojdului village, situated at the junction of Bâsca fără Cale and Bâsca Chiojdului rivers in the case of some torrential precipitations, potential generators of quick flash-floods.

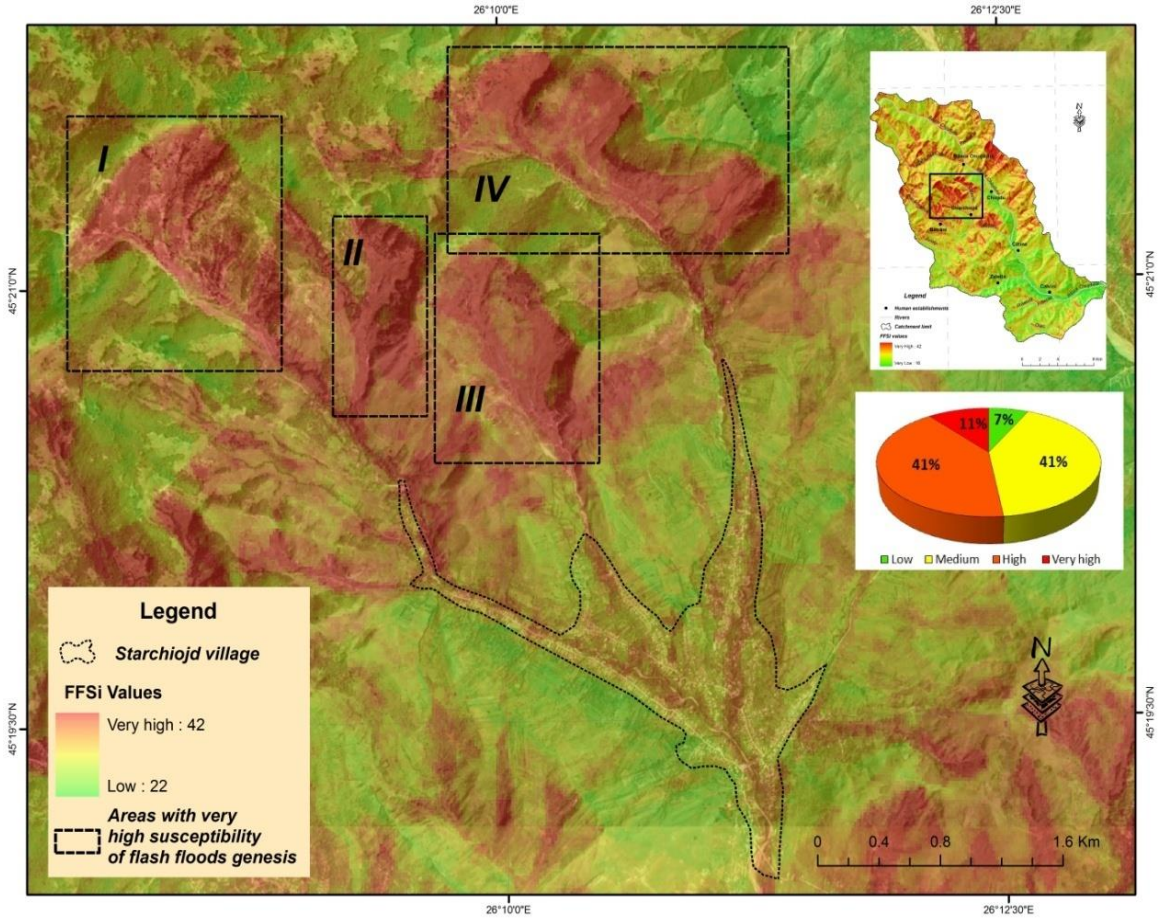

Figure 6: The spatialization of the areas with a very high susceptibility in the flash-floods genesis in the north of Starchiojd village

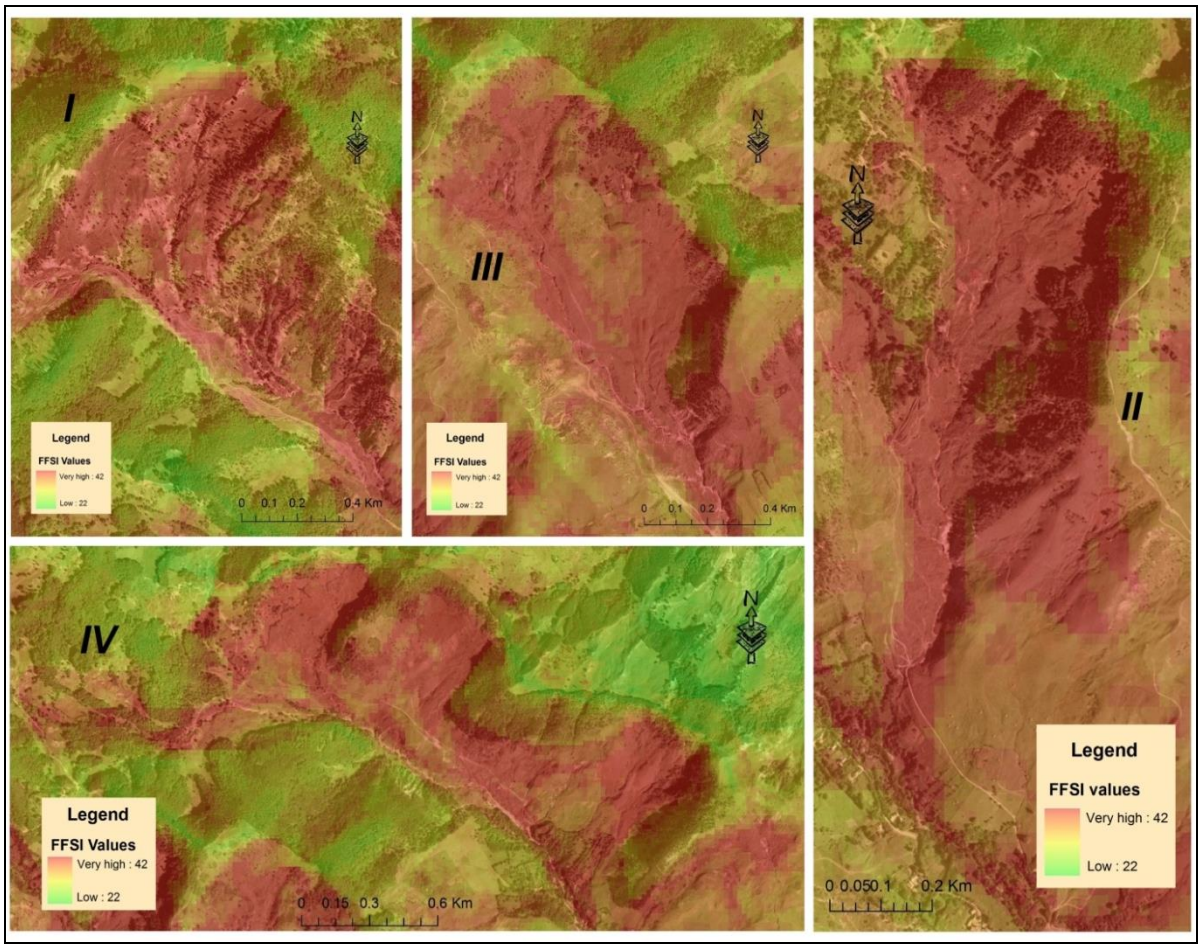

Figure 7: The delimitation of the hydrographical torrential organisms with a very high potential of flash-floods formation in the north of Starchiojd village

The high values of FFSI in these perimeters are the result of the lack of the sylvan vegetation on the flanks with slopes of over 15°, with a high convergence of the hydrographical network, in the context of the existence of a hard lithological substratum, formed of kliwa sandstones, schist and conglomerates.

It should be noted that the very high values of the Flash Floods Potential Index (which represents slope surfaces with high potential of runoff surface) can provide indirectly information about the formation potential of downstream floods, in the meadow area of rivers. Following the accomplishment of some studies on the formation potential of floods (Costache & Prăvălie, 2012), another hydrological phenomenon of risk, it was found that the middle sectors of Bătrâneanca and Stâmnic rivulets, and the major part of the meadow of the Bâsca Chiojdului river, are highly susceptible to the occurrence of this phenomenon. This is due, on the one hand, to the morphometric peculiarities of the river bed in these sectors (large width, small depth), and on the other hand, to the potential of accelerated drainage from the upstream slopes, potential analyzed in the present work.

Conclusion

The proposal of FFSI index, as an evaluation methodology of the potential of flash-floods formation, could have a special importance, because these hydrological risk phenomena represent actual issues in the contemporary society, current research indicating the tendency of increased frequency in the future. At the same time, the pragmatic results of the proposed index may consist of the spatial representation of the areas with a major risk in triggering the flash-floods, therefore, existing the possibility of preventing the negative effects by the anthropic intervention and arrangement in the critical areas.

Regarding the reliability of this proposed index, following the spatial analysis via GIS systems, but also following the direct observations on the field, we consider that this succeeds the approximative delimitation of the areas with high susceptibility in the formation of the flash-floods. Its general application at the level of the small basins, with a high potential in the formation of the flash-floods may represent an important methodology in the prevention of the hydrological risk phenomena, but,

however, it must be taken into consideration the fact that the flash-floods are very quick hydrological phenomena, with an occurrence which depends on a great number of variables, thus their exact prevention proving to be a very difficult one.

Acknowledgments

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Statistical assessing of hydrological alteration of Buzău River induced by Siriu Dam (Romania)

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Abstract

In this paper we evaluate the hydrological impact produced on the river mean daily discharge (water) of Buzău River by Siriu Dam. The study data was the daily mean discharge registered from the 1st of January 1955 to the 31st of December 2010, at the Nehoiu hydrometric station on the Buzău River. The flow of this river is controlled in its upper reach by Siriu Dam, from 1984. The main method used for the evaluation of the hydrologic alteration at temporal scale was based on the tests provided by the Indicators of Hydrologic Alteration (IHA) software. The statistical analysis proved that the built of Siriu Dam had a moderate influence on the mean daily discharge regime of Buzău River at large time intervals, significant changes appearing at small time scales.

Keywords: *daily mean discharges, hydrologic alteration, the Buzău River, Siriu Dam, IHA*

Rezumat. Evaluarea statistică a modificărilor hidrologice pe râul Buzău asociate barajului Siriu

În această lucrare se evaluează impactul modificărilor hidrologice produse debitelor medii zilnice de apă pe râul Buzău, de către barajul Siriu. S-au studiat debitele medii zilnice înregistrate în perioada 1 ianuarie 1955 – 31 decembrie 2010, la stația hidrometrică Nehoiu, de pe râul Buzău, a cărui curgere este controlată din 1984 de barajul Siriu. Principala metodă folosită pentru evaluarea modificării hidrologice la scară temporală s-a bazat pe teste ale aplicației Indicatori ai Modificării Hidrologice (IHA). Analizele statistice au arătat că barajul Siriu a avut o influență moderată asupra regimului debitelor medii zilnice la intervale mari de timp, schimbări majore apărând la intervale mici de timp (1, 3 și 7 zile).

Cuvinte-cheie: *debite medii zilnice, modificări hidrologice, râul Buzău, barajul Siriu, IHA*

Introduction

The precipitation regime and anthropogenic activities are the main factors that influence the river flow temporal oscillations. Therefore, structural measures are implemented for the assurance of flow regulation and the flood mitigation (ISDR, 2004; Hsieh et al., 2006). Dams building represent one of these measures, so their major impact on streamflow regime was analyzed in many works (Brandt, 2000; Kondolf, 1997; Magilligan and Nislow, 2005; Poff et al., 1997; Postel and Richter 2003; Richter et al., 1996, 1997; Vörösmarty et al., 2003; Şerban et al., 1989). Over 2100 artificial lakes are operational in Romania, holding about 13 billion m^3 of water are (Zaharia and Patru, 2008). There is a large amount of literature that presents the results of evaluation of the reservoirs and dams' impact on the environment (Baxter, 1977; Fitz Hugh and Vogel, 2010; Graf, 2001, 2006; Nilsson, 2009; Rădoane et al., 2013; Zaharia et al., 2011). Analyzing the variation of the mean discharge of Buzău River (Romania), Chendeş (2011) and Minea (2011) did not divide the studied period in the sub-period before and after the construction of Siriu Dam. Therefore, our study comes to complete this gap, performing statistical analyses of the sub-series of mean flow obtained by dividing the flow series in the pre- and post-impact of Siriu Dam.

Study area

The study area is a part of the Buzău River's catchment (5264 km^2), presented in Fig. 1. The catchment is situated in a region of temperate - continental climate, influenced by the foehn, with a mean annual air temperature (the last 50 years) of about 6°C and the minimum one about 1°C, the mean multi-annual average precipitation (I the period 1950 - 2010) between 500 mm and 1000 mm and the maximum precipitation of 130 mm (Chendeş, 2011), registered in the period June – July. The mean monthly precipitation (%) registered at Nehoiu station in the period 1955 - 2010 is respectively: 4.4 (Jan), 4.5 (Feb), 5 (March), 7 (April), 12.1 (May), 15 (June and July), 13.1 (Aug), 8.5 (Sept), 5.9 (Oct), 4.6 (Nov), 4.7 (Dec).

The studied series were collected at two hydrometric stations, which have the following morphometric and hydrological characteristics (National Institute of Hydrology and Water Management, 2013):

a) Bâsca Roziliei (on the Bâsca River) is situated at the latitude of 45°26'32", the longitude of 26°16'38", the river length from the source to the hydrometric station (L) is 17.1 km, the average slope of the river from the source to the hydrometric station (I) -1.66°, the basin area associated to the hydrometric station (A) - 107 km^2, the average

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elevation of the basin at the hydrometric station (H) – 1275 m, the average multi-annual fluid flow (Q) – 2.3 m^3/s; the specific mean (q) - 21.5 $l/s.km^2$;
b) Nehoiu (on Buzău River) is situated at the latitude of 45°25'29", the longitude of 26°18'27", L = 71.5 km, I = 0.73°, A = 1567 km^2, H = 1043 m, Q = 21.9 m^3/s, q = 17 $l/s.km^2$; at Nehoiu hydrometric station the river drains a surface of 1,567 km^2.

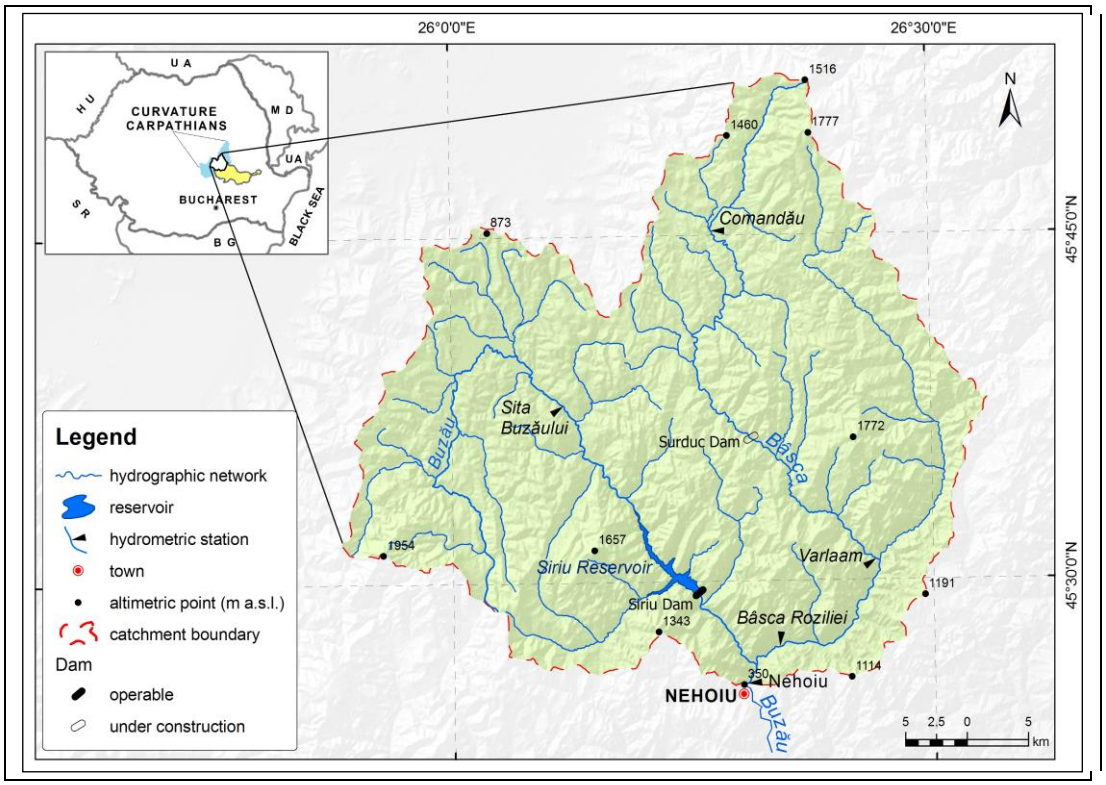

Figure 1: The upper part of the Buzău River Catchment

Average flow of the Buzău River registered a spatial and temporal variability, function of the basin's altitude and surface of drained area. The mean monthly liquid discharge registered in the period 1955 – 2010 at Nehoiu station was respectively of: 4.1 (Jan), 4.7 (Feb), 9.9 (March), 21 (April), 17.6 (May), 13.2 (June), 11.8 (July), 7.9(Aug), 7 (Sept), 5.4 (Oct), 5.2 (Nov), 5.2 (Dec). The minimum discharge was registered in autumn, as effect of the low precipitation. Floods occurs episodically at Nehoiu, especially in July (or the late spring), having higher and shorter that the nival ones. Examples of such episodes are: 02.07.1975, 13.07.1969, 02.07.1971, 19.06.1991, with the maximum discharges between 770 m^3/s and 1400 m^3/s. Siriu Reservoir, with a maximum storage capacity of 125 million m^3, the area of 420 ha, the dam height of 122 m and length of 570 m, is situated in the upper part of the Buzău River and its catchment drains 56.1% from the study area. It was built after the flood from 02.07.1975 and was partially inaugurated on 30th of September 1984 (Diaconu, 2008; Romanian National Committee on Large Dams, 2000).

Data and Methods

The data base was formed by the daily mean discharge at Nehoiu hs, on the Buzău River, measured in the period 01.01.1955 – 31.12.2010 and the daily mean discharge at Bâsca Roziliei hs, data provided by the National Institute of Hydrology and Water Management (NIHWM). Each series was divided in two subseries: 1955-1983 and 1984 – 2010, corresponding to the pre- and post-impact period of Siriu Dam. The length of the data series corresponds to the specific methodological requests of the hydrological series - minimum of 20 years of continuous record - to define the variability of the natural hydrological system and detect shifts in high flow statistics. The statistical evaluation of the pre/post impact of the mean liquid discharge has been done using the version 7.1 of IHA software. The input of IHA software is formed by the mean daily discharges and the output is formed by 33 parameters, organized in 5 groups, as follows:
a) group 1: monthly average values (either means or medians);
b) group 2: maximum and minimum values for 1- to 90-day averages;

c) group 3: Julian Dates (day of year) of the one-day minimum and maximum values;
d) group 4: "pulses" in the water conditions, defined as periods when the water conditions are greater than the default or user-defined high flood threshold, or less than the low pulse threshold;
e) group 5: rises, falls, and reversals in water conditions, containing the parameters: the average rate at which water levels or flow rises, the average rate of fall, and the number of times that the hydrograph switched from a rising to a falling condition or vice versa (The Nature Conservancy, 2009).

IHA software non-parameters scorecards computes the median (i.e. the 50th percentile) for each of the two periods, pre and post-impact, displaying:
- the coefficient of dispersion (CoD) for each period, defined as = (the 75th percentile - the 25th percentile) / the 50th percentile;
- the deviation factor of the post-impact period from the pre-impact one, defined as [(Post-impact value) - (Pre-impact value)]/(Pre-impact value).

Alteration is evaluated by comparing pre-impact and post-impact values of variables, using the Range of Variability Approach (RVA). RVA scorecard displays the results in percentiles (25th - $P_{0.25}$, 50th - $P_{0.50}$ = median, 75th - $P_{0.75}$), coefficients of dispersion, maximum and minimum values, as in Table 1.

Table 1: Results of the IHA analysis for the Buzău River at Nehoiu (1955-2010)

IHA group	Pre-impact period: 1955-1983				Post-impact period: 1984-2010			
	median (m^3/s)	CoD*	min (m^3/s)	max (m^3/s)	median (m^3/s)	CoD	min (m^3/s)	max (m^3/s)
Monthly magnitude								
January	7.05	0.97	2.08	24.2	9.18	0.79	3.92	22.9
February	10.4	0.61	2.35	37.3	9.1	0.76	3.83	28.6
March	17.1	0.89	3.49	73.2	16	0.84	4.25	45
April	36.3	0.90	12.95	85.1	38.4	0.72	11.4	92
May	29.4	0.55	11.5	96	22	0.99	8.67	66.2
June	23.7	0.43	5.27	42	19.45	0.90	7.99	55.2
July	20.8	0.69	7.43	39	16.9	0.79	6.58	48.2
August	13.7	0.71	4.23	31	11.9	0.64	4.52	42.1
September	9.4	0.70	3.4	42.8	10	0.64	2.61	33.1
October	8.1	0.91	3.6	58.9	10.1	1.01	3.07	27.2
November	9.47	0.82	3.65	32.3	9.76	0.87	2.61	24.5
December	9.4	0.91	3.12	21.6	8.86	0.91	3.63	29.3
Magnitude and duration of annual extreme								
1-day min	3.8	0.50	1.75	7.8	3.37	0.55	1.73	7.59
3-day min	4.09	0.45	1.78	7.8	3.64	0.64	1.757	7.90
7-day min	4.46	0.44	1.90	7.96	4.60	0.62	1.91	9.88
30-day min	5.54	0.68	2.15	11.4	5.61	0.59	2.52	13.1
90-day min	8.79	0.61	3.44	17.1	9.62	0.58	3.14	24.9
1-day max	207	0.78	111	743	120	1.13	51.5	707
3-day max	156	0.65	78.1	549	112.7	1.01	45.8	359
7-day max	109	0.56	62.3	325.8	98.2	0.71	31.2	208
30-day max	65	0.42	41.8	121.7	57.8	0.61	19.1	95.4
90-day max	45.4	0.40	28.6	92.6	39.6	0.50	16.4	69.8
Base flow index	0.19	0.43	0.08	0.36	0.25	0.45	0.14	0.31
Timing of annual extreme								
Date of min	360	0.12	5	366	362	0.13	4	362
Date of max	150	0.30	68	319	158	0.27	83	280
Frequency (days) and duration of high and low pulses (per year)								
Low pulse count	8	0.75	2	16	16	0.68	3	38
High pulse count	13	0.26	5	18	14	0.85	2	33
Low pulse duration	5	1.4	1	25	2	1	1	14.5
High pulse duration	3.5	0.42	1	8	3	0.66	1	8
Rate and frequency of water condition change								
Rise rate	1.8	0.56	0.9	4.55	2.6	0.72	0.48	6.8
Fall rate	-1.5	-0.43	-3	-0.7	-2.1	-0.89	-4.6	-0.37
No of reversals	117	0.15	89	136	168	0.16	96	194

** CoD (Coefficients of dispersion) is defined as = (75th percentile - 25th percentile)/50th percentile*

After the statistical analysis of data series, we modeled the data series of the daily mean liquid discharge registered at Nehoiu sh (denoted by NH) and Bâsca Roziliei sh (denoted by BS) in the period

1st of January 1955 - 31st of December 2010. The subseries registered before 30.12.1984 are called NH1 and BS1 and those registered and after 30.12.1984 are called NH2 and BS2. The steps in the mathematical modeling were:

a) determination of a linear dependence between NH and BS, NH1 and BS1, NM2 – BS2, calculating the correlation coefficient;

b) if the correlation coefficient is high, building the models;

c) testing significance of the models' coefficient, at the significance level of 0.05, using the t-tests and the F test;

d) testing the residual properties, as autocorrelation, normality and the constant variance (homoscedasticity) using respectively the autocorrelation function, the Anderson – Darling and the Levene test (Bărbulescu, 2002).

The same method was successfully used by Barbeș et al., 2014. Another possible approach would be the use of General Regression Neural Networks for modeling the flow trend, for each series, function of time, as in the studies of Cigizoglu (2005), for intermittent river flow, Kisi (2006), for evapotranspiration modeling, Bărbulescu and Barbeş (2013) – for estimation of pollutants diffusion. In this case, the models' quality is different, using MAPE (see equation 1) and NMSE (see equation 2) (http://www.dtreg.com/mlfn.htm):

$$MAPE = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{A_i - F_i}{A_i}\right| \quad 1)$$

$$NMSE = \frac{1}{n}\sum_{i=1}^{n}\frac{(A_i - F_i)^2}{\bar{A}\bar{F}} \quad 2)$$

where:

A_i is the *i* - the actual value of the studied series,

F_i - the *i* - the predicted value;

$\bar{A}$ - the mean value of the actual ones,

$\bar{F}$ - the mean value of the predicted ones,

n - the data number

Results and Discussion

Statistical analysis of the discharges measured at Nehoiu hs were done at daily, weekly, monthly and seasonal scales. The results are presented in Table 1. At daily scale (1 and 3 days) and weekly scale (7 days), all statistics, but maxima, registered small variation. The maxima registered significant variations of the median (which decreased with 42%) and minimum (that decreased with 53%). The decreasing of 1-day maximum discharge in the post - dam period, at all daily and weekly scales is also evident. The minimum discharges registered post – impact alterations at all time scales - 1, 3 and 7 days. The highest increment was registered by $P_{0.75}$ for 7 days and $P_{0.25}$ for 1-day discharges. Medians of 1-day and 3 - day discharges indicate the highest decreasing. The median of maximum discharges also decreased. The highest alterations correspond to the 1-day discharges that are related to the periods of floods (Fig. 2). At weekly scale, the most significant changes were registered by the extremes: a decreasing of 49% as registered for 7-day maximum and with 35.8%, for 7- day minimum. Also, the minimum of all minima increased with 24.1% and the median augmented with 2.9%. Comparing the distribution of the monthly medians, we remark the highest values in January (30.2%) and April, and the significant decreasing the period May – July, after 1984, indicating the dam's role during periods of heavy rainfall. The smallest hydrologic alteration corresponds to the month of November. Value registered by the third quartile ($P_{0.75}$) relives that largest decrease was registered in spring (especially in April - 10.3%) and autumn (especially in October) and the existence of balance of 3.9%. At seasonal scale, during the post-impact period we notice the increment of the minimum discharges' median (with 9.4%) and the decreasing of the maximum flow (with 12.6%). The extreme values registered the most significant decrement in the post – impact period: the (90-day max)'s minimum - from 28.6 to 16.4 m^3/s, and the (90-day max)'s maximum - from 92.6 to 69.8 m^3/s. Contrary, the maximum of 90 - day min increased with 45.8%. The results presented here are in concordance with those from the Romanian literature, pointing out that the timing of annual extremes for the autumn months is approximately the same, excepting the date of their appearance.

Figure 2: The pre and post-impact Siriu Dam variability of mean discharge of the Buzău River at Nehoiu hs (1955-2010): (a) 1-day min, (b) 1-day max, (c) 3-day min, (d) 3-day max, (e) 7–day min, (f) 7-day max, (g), 90-day min, (h) 90-day

Mathematical models

In the following we denote by $(y_t)_{t=\overline{1,n}}$ (see equation 3) the values of NH (respectively NH1, NH2) and the values of BS (respectively BS1, BS2) series. We intend to build a model for the type:

(3) $y_t = a + bx_t + e_t$,

where:

$t = \overline{1,20454}$ for the NH and BS series,

$t = \overline{1,10593}$ for the NH1 and BS1 series,

$t = \overline{1,9861}$ for NH2 and BS2 series,

a, b are parameters in the model,

e_t is the error.

The values of the correlation coefficient were respectively: 0.938, 0.944 and 0.945, so the linear dependence NH-BS, NH1-BS1, NH2-BS2 are very strong, so we have season to build linear models. The results of t-tests and the F test on the models' coefficients are given in Tables 2-4, where rows 2 and 3 contain the values of the coefficients, the standard error of their calculation, the value of statistics of the t-test, the p-value and the inferior and superior limits of the confidence intervals at the confidence level of 95%, The second part (ANOVA) of the Tables contains the results of analysis of variance, where df is the degree of freedom, SS is respectively the explained variance (corresponding to the regression), the unexplained variance and the total one, MS is the ratio between SS and df, and F is the value of F-statistics, obtained as the ratio between the MS. Since the p-values corresponding to the t- test are 0, so less than 0.05, the hypothesis that the coefficients of the model (a and b) are significant cannot be rejected. Also, since the p-value corresponding to the F – test is less than 0.05, we accept the hypothesis that the model (1) is significant in its whole.

Table 2: Results of t-tests and F-test for the model NH function of SH

Coefficients	*Values*	*Standard Error*	*t Stat*	*p-value*	*Lower 95%*	*Upper 95%*
a	**3.2443**	**0.0827**	**39.211**	**0**	**3.082**	**3.406**
b	**1.5668**	**0.0040**	**388.731**	**0**	**1.559**	**1.574**
ANOVA	*df*	*SS*	*MS*	*F*	*p-value*	
Regression	**1**	**13917240.76**	**13917241**	**151112.1**	**0**	
Residual	**20453**	**1883604.352**	**92.09879**			
Total	**20454**	**15800845.11**				

Table 3: Parameters in the model (1) for NH1 function of BS1

Coefficients	*Values*	*Standard Error*	*t Stat*	*p-value*	*Lower 95%*	*Upper 95%*
a	**2.8779**	**0.1192**	**24.1297**	**2.8E-125**	**2.644**	**3.111**
b	**1.6636**	**0.0056**	**296.0189**	**0**	**1.652**	**1.675**
ANOVA	*df*	*SS*	*MS*	*F*	*p-value*	
Regression	**1**	**8814704**	**8814704**	**87627.22**	**0**	
Residual	**10591**	**1065383**	**100.5932**			
Total	**10592**	**9880086**				

Table 4: Parameters in the model (1) for NH2 function of BS2

Coefficients	*Values*	*Standard Error*	*t Stat*	*p-value*	*Lower 95%*	*Upper 95%*
a	**3.845**	**0.108196**	**35.5449218**	**1.7E-260**	**3.633742**	**4.057915**
b	**1.441**	**0.005477**	**263.10961**	**0**	**1.430261**	**1.451732**
ANOVA	*df*	*SS*	*MS*	*F*	*p-value*	
Regression	**1**	**5156218**	**5156218.3**	**69226.67**	**0**	
Residual	**9859**	**734329.1**	**74.4831221**			
Total	**9860**	**5890547**				

The study of autocorrelation functions of the errors in the model (1) proves that the errors present autocorrelation (Fig. 3). Indeed, the vertical lines represent the values of the autocorrelation function and the dotted ones, the limits of the confidence interval at the confidence level of 95%. Since there are values of the autocorrelation functions outside the limits of the confidence intervals, we conclude that the errors present autocorrelation.

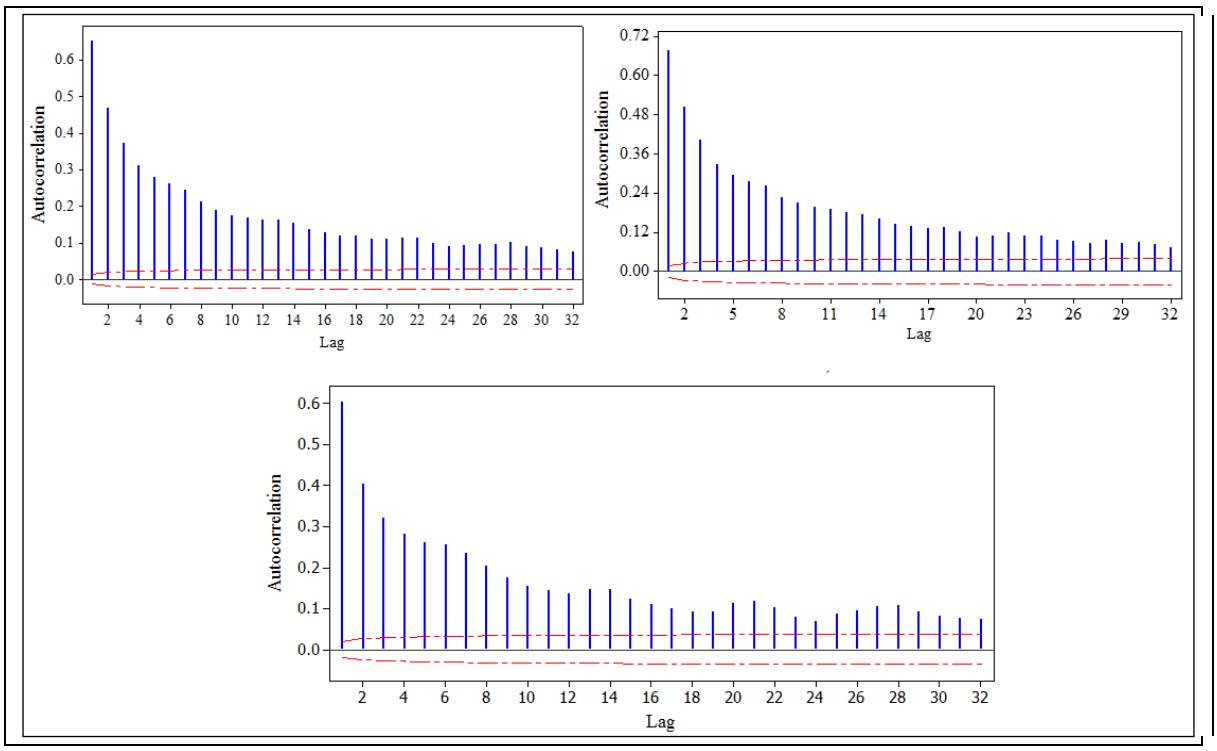

Figure 3: Autocorrelation functions of the errors in the models NH vs. BS (a), NH1 vs. BS1 (b), NH2 vs. BS2 (c)

The results of Anderson – Darling test (Table 5) prove that the series are not Gaussian, because the p-values are less than 0.05.

Table 5: Results of Anderson- Darling test of normality

Model	Value of AD -statistics	p-value
NH vs. BS	1232.389	< 0.005
NH1 vs. BS1	841.449	< 0.005
NH2 vs. BS2	408.966	< 0.005

The results of the Levene prove that the errors are homoscedastic (have the same variance) only in the model NH2 vs. BS2. Finally, we present the charts of predicted values vs. the actual ones in all models (Fig.4).

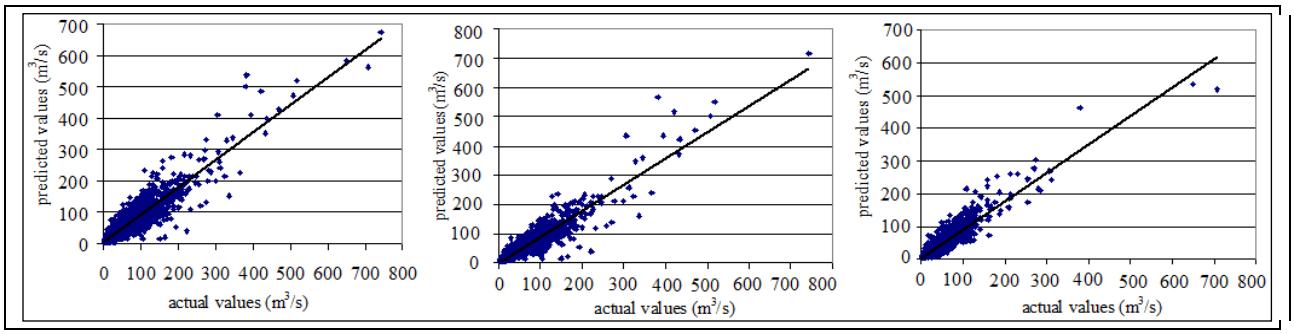

Figure 4: Predicted values vs. actual values in the models NH vs. BS (a), NH1 vs. BS1 (b), NH2 vs. BS2 (c)

Conclusion

Based on the statistical analysis performed using IHA software, we consider that the hydrologic alterations of daily mean discharge of the Buzău River, registered at Nehoiu hs was moderate in the period 1984 – 2010, after the inauguration of Siriu Dam. The flow intensity of the Buzău River was affected, e.g. by decreasing the maximum values and increasing the minima. On the other hand, it was proved that the daily mean discharge of the Buzău River, registered at Nehoiu is in a strong linear dependence with the flow of Bâsca River. New changes, probably more significant, in the hydrological regime of the upper part of Buzău River Catchment will appear at the release of Surduc Dam on main tributary, Bâsca River.

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The environmental impact of arable land in a protected area of community interest. Case study: ROSCI0123 Măcin Mountains, Romania

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Abstract

Plant cultivation activities represent the widest form of environmental agression at global scale. Their sustainability influences the stability of natural ecosystems at local, regional and global level. In this context, the aim of this study is to assess the sustainability of arable land in ROSCI0123 Măcin Mountains using the Pimentel- Eulenstein model. The model takes into account as input data various parameters characterizing the agricultural activities in the whole area occupied by six administrative units (mechanization, chemical treatment, irrigation etc.), this way assesing the energy efficiency and sustainability of crop plants. The results show that the exploitation of arable land in ROSCI0123 Măcin Mountains is done unsustainably in terms of energy efficiency, leading to a medium risk of affecting the valuable environmental components. Under these conditions, improved farming management is a key component in the management of ROSCI0123 Măcin Mountains.

Keywords: *arable lands, crops, energetic efficiency, sustenability, Nature 2000, the Măcin Mountains, Romania*

Rezumat. Impactul asupra mediului al terenurilor arabile într-o arie protejată de interes comunitar. Studiu de caz: ROSCI0123 Munții Măcinului, România

Cultura plantelor reprezintă forma de agresare a mediului cu cea mai largă răspândire la nivel global. Sustenabilitatea lor influențează stabilitatea ecosistemelor naturale la scară locală, regională și globală. În acest context, studiul prezent își propune să evalueze sustenabilitatea terenurilor arabile din situl de interes comunitar Munții Măcinului, folosind modelul Pimentel-Eulenstein. Modelul ia in considerare ca date de intrare diferiți parametri de caracterizare a activităților agricole la nivelul întregii suprafețe ocupate de cele 6 unități administrativ teritoriale (mecanizare, chimizare, irigații etc.), evaluând eficiența energetică și durabilitatea activităților de cultură a plantelor. Rezultatele arată că exploatarea terenurilor arabile din situl de importanță comunitară Munții Măcinului se realizează nesustenabil din punct de vedere al eficienței energetice, existând astfel un risc mediu de afectare al componentelor de mediu. Coeficientul Pimentel a demonstrat o diferențiere mare între unitățile zonei de studiu (Măcin - 463.65, Greci - 0.47, Turcoaia - 81.42, Cerna - 41.06, Hamcearca - 223.71, Jijila - 304.54), același fenomen existând și pentru nivelul entropiei (Măcin - 1700844.5, Greci - 3929266.5, Turcoaia - 267121.2, Cerna - 916651.7, Hamcearca - 800669.4, Jijila - 1103915.8). În aceste condiții, îmbunătățirea managementul activităților agricole reprezintă o componentă cheie în procesul de gestionare a sitului de importanță comunitară ROSCI0123 Munții Măcinului.

Cuvinte-cheie: *terenuri arabile, culturi, eficiență energetică, sustenabilitate, Natura 2000, Munții Măcin, România*

Introduction

Agricultural activities, through the diversity of their forms (crops, deforestation, mechanization etc.), are a major threat to the environment and biodiversity by default (Henle et al. 2008), sometimes even causing local extinctions. Intake of heavy metals by using chemical fertilizer and pesticide application are key factors in the diffuse pollution and degradation of water and soil components, contributing significantly to the decline of biodiversity (Ribeiro et al. 2009, Lisec &Pintar 2005; McLaughlina &Mineau 1995).

Aggressive and disorganized agricultural practices may be contrary to the objectives and provisions of the Convention on Biological Diversity and the Common Agricultural Policy to promote sustainable use of resources and to contribute to the conservation of biological diversity. Also, as stated in the EU Biodiversity Strategy (European Commission, 2011), it is necessary to integrate biodiversity protection objectives in the tools provided by the Common Agricultural Policy (European Environment Agency, 2009). These objectives can include promoting agricultural practices that do not affect biodiversity components or setting the standards of good agricultural practices to reduce the risk of soil pollution that generates environmental disturbances (European Commission, 2011).

Aggressive farming activities may conflict with the objectives of the Birds and Habitats Directives to

avoid activities that may damage the priority habitats and species of community interest (European Council, 1979, 1992).

Threats attributed to agriculture include: conversion of natural ecosystems, impaired biogeochemical circuits, increased risk of developing illnesses, favorable conditions for the development of opportunistic species (including invasive species), depletion of key resources for ecosystems, habitat fragmentation or aggressive practices in agroecosystems (Bayne &Hobson 1998; Firbank et al. 2008; Primack et al. 2008, Herzog et al. 2006).

Currently, in the circumstances of disorganized practices related to the use of pesticides and fertilizers (Herzog et al. 2006), especially on lands within a Natura 2000 network of protected areas (Iojă et al., 2010), it is necessary to asses the impact of agricultural sources of degradation (Iojă et al. 2011; Straus et al. 2011). The study aims to evaluate the energy efficiency and sustainability of arable crops in ROSCI0123 Măcin Mountains.

Study Area

ROSCI0123 Măcin Mountains is located in the eastern part of Romania, Tulcea county, and covers an area of 16,893 hectares (Ministry of Environment and Forests, 2011). From the European biogeographic regions point of view, the protected area belongs to the Steppe region characterized by an arid climate and limited hydrological resources. With an average rainfall below 400 mm / year and low flow rivers mainly fed by precipitation (Pișota &Bogdan 2005; Török 2008), Măcin Mountains agricultural area may be affected by seasons of dryness, process reflected by the biologically active horizon, agricultural productivity and the need for addition of fertilizer.

The use of different types of fertilizers explains why this protected area is located in a Vulnerable Area to Nitrate Pollution (Ministry of Environment and Sustainable Development, 2008). The analysis performed is focused on the six administrative units (NUTS 3 level) representative for the study area - Măcin, Greci, Cerna, Turcoaia, Hamcearca and Jijila (Fig. 1) and distributed in ROSCI0123 with different weights. Luncavita territorial administrative unit has no arable land in the territory of the protected area. The analysis takes into account the surface of the protected area under its limit in 2007 because of the expanded distribution of arable land at that time. Although in 2011 the protected area boundaries changed and its surface shrank, and much of the arable land is no longer part of a protection zone regime, they remain a threat to biodiversity resulting in true environmental conflicts especially at the boundary.

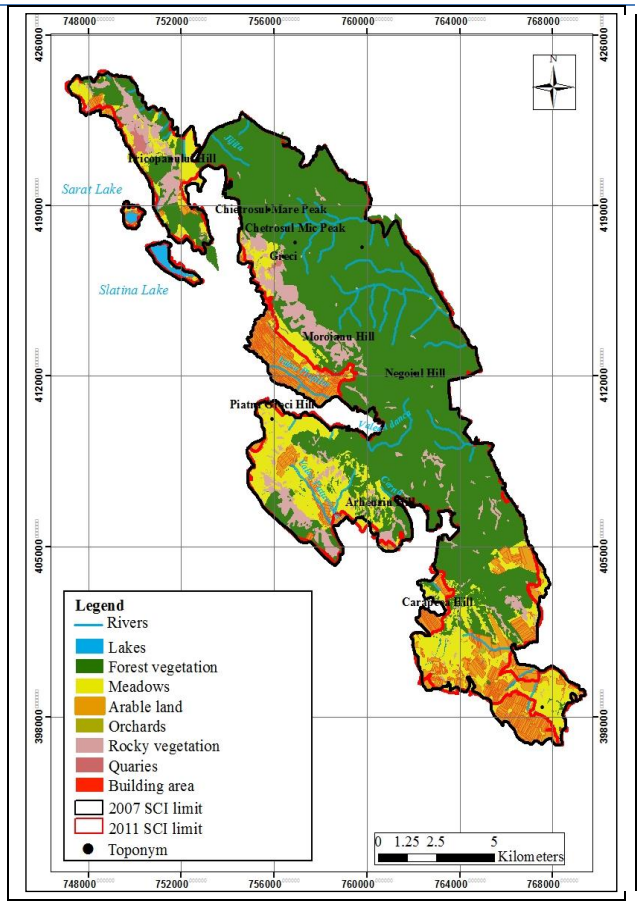

Fig. 1: Spatial distribution of arable land in ROSCI0123 Măcin Mountains

Data source: 2005 Ortophotoplan, 1:5000

Data and Methods

We used statistical data for the assesments of environmental impact (National Statistics Institute, 2012) such as the irrigated area surface (hectares), agricultural production by crop type (kg/hectare), the quantities of applied nutrients (nitrogen, phosphorus and potassium – kg/hectare), labor force, and mechanisation (tractors/hectare), for the six administrative units. Spatial representations were made using 2005 ortophotoplans, the soil map at 1:200,000 scale (Geological Institute, 1971) and the digital elevation model with 30 m resolution. The geospatial data processing was performed using ArcGIS software, version 10.1.

The Pimentel-Eulenstein model (Pimentel et al. 1973) considers all sources of energy used by an agroecosystem to obtain agricultural production in order to evaluate the efficiency of the arable land in ROSCI0123 Măcin Mountains.

The input data required for the agroecosystem – labor, mechanization, chemical processing (nutrients and pesticides applied), use of fuel and irrigation – were converted into energy values (kcal/hectare) (Iojă 2009). In order to obtain the energy efficiency

we calculated the Pimentel coefficient that uses a ratio equation between the input data and the value of agricultural production (Iojă et al. 2007), in this case the wheat production (Table 1).

The values of Pimentel coefficient close to 100 emphasize a balance between the amount of energy introduced into the system and the result in form of agricultural production. If the values of Pimentel coefficient are below 100, the system is characterized by intensive human activities and uploading entropy (Iojă 2009). At the same time, values above the threshold of 100 characterize the agricultural practices that lead to depletion of agroecosystems and generate imbalances in the soil quality (Iojă 2009).

Table 1: Distribution of main crops in the study area in 2010

NUTS	TOTAL-Arable land (hectares)	Wheat (hectares)	Sunflower (hectares)	Canola (hectares)	Barley (hectares)	Corn (hectares)
Turcoaia	2613.7	824.97	276.99	313.1	344.55	312.51
Jijila	5724.06	1422.29	726.74	544.3	909.36	1336.1
Hamcearca	3367.5	754.91	413.47	505.64	1319.25	242.7
Greci	4433.82	1320.81	749.07	38.28	688.29	857.91
Cerna	10678.7	3442.5	1685.76	1350.6	1700.58	1673.96
Măcin	2546.32	636.61	89.79	282.19	586.16	105.99

Data source: National Statistics Institute, 2012

To assess the sustainability and durability of agroecosystems in ROSCI0123, the following parameters were calculated: the entropy balance (Table 2), critical energy threshold and sustainable production (Table 3) (Iojă 2009; Pimentel et al. 1973). High values of entropy highlight the diversity of human pressure and high agricultural production, aspects that subsequently lead to imbalances in the agroecosystem as a synergetic effect (Iojă et al. 2007). The calculation of this parameter took into account the amount of artificial energy input to the system, the Pimentel coefficient, the yield per hectare and the specific parameters of the natural steppe ecosystem - net primary production of the ecosystem, the temperature in the growing season and the respiration coefficient (Iojă, 2009).

Table 2: Entropy level equation

$\sigma = \frac{1}{T} * [W * (1- \eta + \frac{\eta}{s}) - P_0]$
σ = entropy level (J/K)
T = The temperature in the growing season (K)
W = The amount of anthropogenic energy input to the system (J/m^2)
η = Pimentel Coefficient
s = k*(1-r) where1-r = Respiration Coefficient ; k = 0.5; r=0.4;
P_0 = Net primary production of natural ecosystem (J/m^2)

Equation source: Pimentel et al., 1973; Iojă, 2009

In order to determine at what point the human intervention creates major imbalances in the agroecosystems, we evaluated a critical energy threshold and sustainable production, based on the characteristics of a complex and natural ecosystem and thus its capacity of support (Pătroescu et al. 2007).

Table 3: Critical energy threshold and sustainable production equations

$\mathbf{Wcr} = \frac{Po}{1-\eta+\frac{\eta}{s}}$
$\mathbf{Ycr} = \frac{Po}{\frac{1}{\eta}+\frac{1}{s}-1}$
Wcr = Critical energy threshold (J/m^2)
Ycr = Sustainable production (J/m^2)
P_0 = Net primary production of natural ecosystem (J/m^2)
η = Pimentel Coefficient
s = k*(1-r) where 1-r = Respiration Coefficient; k = 0.5; r=0.4;

Equation source: Pimentel et al., 1973; Iojă, 2009

Results

The sustainability of agricultural activities, calculated using the specified parameters and methodology reveal differences between the six administrative units covered by the study.

Regarding the energy efficiency resulting from the calculation of Pimentel coefficient (Table 3), the territorial administrative units apart as follows: low energy efficiency for Cerna and Greci and energy efficiency that exceeds the carrying capacity of the environment for Măcin, Hamcearca and Jijila (Table 3).

The estimation of entropy balance in the agroecosystems of ROSCI0123 stressed obvious differences between the six administrative units. The first category includes administrative units with high levels of entropy (Greci) that can be explained by the imbalances caused by human interventions (Fig. 2); places where the imbalances in the ecosystem occur beyond the level of affordability (Măcin and

Jijila) and towns situated on the edge - Cerna and Hamceaca (Table 4).

Table 4: Energy efficiency values for agroecosystems in ROSCI0123 Măcin Mountains

NUTS level 3	Qi – The quantity of input energy (kcal/ha)	Q0 – The quantity of produced energy – agricultural production (kcal/ha)	Pimentel Coefficient η = Qo *100 /Qi (%)
Măcin	1892833.01	8776125.00	463.65
Greci	1336853693.69	6264000.00	0.47
Turcoaia	7685521.01	6264000.00	81.42
Cerna	16307750.81	6695391.71	41.06
Hamcearca	2069843.47	4630530.61	223.71
Jijila	2758798.32	8401714.29	304.54

Equation Source: Pimentel et al., 1973

Turcoaia administrative unit presents the most favorable situation, both in terms of energy efficiency and entropy level. This is due to a low anthropogenic contribution with subsistence agriculture characterized by the lack of irrigation and reduced mechanized means.

If we look at the ratio of energy used by the agroecosystem and the critical energy threshold up to which it can operate without affecting the environmental components, the administrative units can be classified according to the pressure applied to the system. In the case of Greci, the anthropogenic pressure is the highest, Măcin and Jijila have a medium human pressure and Cerna, Hamcearca and Turcoaia the lowest (Fig. 2). Also, the agroecosystems can be ranked considering the resulting ratio of annual production and sustainable production (Fig. 2).

The agricultural activity in ROSCI0123 is characterized by an average anthropogenic pressure, determined by the diversity of components entered into the system in order to obtain a bigger agricultural production.

Table 5: Assessing the sustainability of agroecosystems in ROSCI0123 Măcin Mountains

NUTS		Măcin	Greci	Turcoaia	Cerna	Hamcearca	Jijila
Entropy level (σ)	J/K	1700844.5	3929266.5	267121.2	916651.7	800669.4	1103915.8
Anthropogenic energy input (W)	J/m^2	471350.9	555895967	471350.9	2897942.2	471350.9	471350.9
Critical energy threshold (Wcr)	J/m^2	10897.2	5636996.5	61726.2	121902.7	22562.2	16582.4
Agricultural production (Y)	J/m^2	3671930	2620857	2620857	2801351	1937414	3515277
Sustainable production (Ycr)	J/m^2	50524726	2641287.2	5030688.7	5004898.8	5047473.4	5047473.4
Ratio between consumed energy and critical energy threshold (W/Wr)		43.25	98.62	7.36	23.77	20.89	28.42
Ratio between annual production and sustainable production (Y/Yr)		0.73	0.99	0.52	0.56	0.38	0.7

Data source: National Statistics Institute, 2012

Discussions

The results of the study emphasize that agricultural practices carried over the arable land in ROSIC0123 Măcin Mountains have a medium risk of affecting the environmental components and hence biodiversity.

The arable land shows a heterogeneous spatial distribution with a different impact on the environment, aggression being given by the use of chemical fertilizers, improper agricultural equipment, irrigation systems, introduction of crops such as canola and agricultural wastes (Kelly et al. 2007). The process of conversion from cereal crops to biodiesel manufacturer or new constructions in the vicinity of ROSCI0123 can raise conflicts and can decrease the efficiency of biodiversity conservation actions, actions that can maintain healthy habitats for plant and animal communities.

The effect of these aggressions raises problems for the quality of water and soil resources and can disrupt macronutrients cycles (Kelly et al. 2007). The synergism of these issues degrades the natural habitats and can affect living and feeding spaces of species of community interest.

The negative consequences of agriculture in general and for ROSCI0123 in particular are supported by studies of other authors (Henle et al. 2008; Relyea 2005; Ribeirao et al. 2009; Young et al. 2006) that mentioned the significant environmental impacts of agressive practices and diffuse pollution.

The arable land in Cerna and Greci administrative units has a high energy inefficiency, a phenomenon caused by high anthropogenic pressure. Regarding the critical energy threshold and the high values for sustainable production, Greci, Hamcearca, Jijila and Cerna reveal obvious imbalance in the ecosystem. The consequences of these exceedances are observed in the quality of soil resources through their enhanced acidification and nutrient depletion (Ignat et al. 2009), with a direct effect on the presence of primary producers.

Energy inefficiency of agroecosystems, as revealed by studies at national and international level, has been associated with major breaches of critical energy thresholds or sustainable yields.

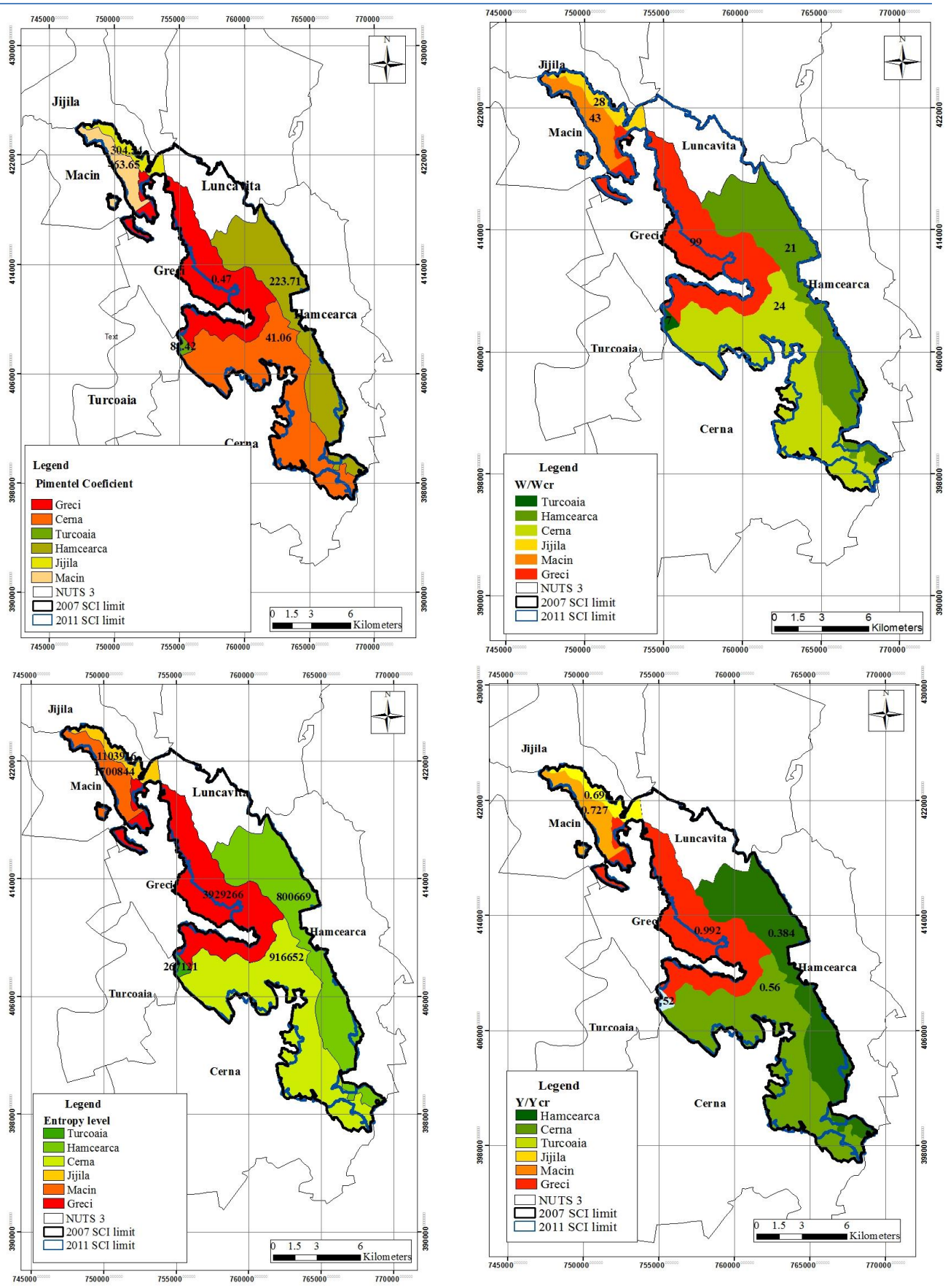

Fig. 2: Spatial distribution of Pimentel-Eulenstein model parameters

Data source: National Statistics Institute, 2012

Quantities of chemicals applied to arable land in ROSCI0123 Măcin Mountains, an area of high conservation value and close to an area with high biodiversity, have considerable potential to affect species of birds, small mammals and invertebrates . Studies of other authors for this category of land use have concluded that the application of pesticides and chemical fertilizers cause reductions in populations of animals in general and birds in particular. Our results are supported by these conclusions that emphasize the high environmental pressure caused by major chemical inputs.

Conclusion

Currently, by integrating the socio-economic component within protected areas such as Natura 2000 network, conservation objectives can fail to be met , but a careful and responsible management of these activities can help maintain a considerable biodiversity in the analyzed area.

With great importance among human activities allowed in protected areas of interest , traditionally practiced agriculture, without chemical inputs, can be employed effectively in the process of sustainable development.

Also, creating forest areas with appropriate size, that can offset the impact of arable land, is an issue that should attract the attention of future studies. Another important assesment in ROSCI0123 Măcin Mountains is the evaluation of the distance by which one can see the projection of farming in order to articulate farming practices to conservation objectives of habitats and species of community interest.

In this regard, the management of arable land should have important financial instruments to determine farmers to practice organic agriculture, to develop agroforestry systems that can help maintain a fair balance of the forest/arable or shrubs/ arable ratio and to compensate for impacts on biodiversity.

Where careful control of agressive practices or sanctions do not deliver viable results and especially in the context of biodiversity loss observed at global, European and national scale, the authorities responsible for ROSCI0123 Măcin Mountains management may consider using interventionist instruments.

Acknowledgements

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The Mateiaş limestone quarry (Southern Carpathians): changes in spatial extent and local perception on the related environmental issues

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Abstract

The various natural resources and the industrialization policies implemented during the communist regime have resulted in the opening of many mines and quarries, inclunding the Mount Mateiaş exploitation. The aim of this study is to give warning against open pit mining, which has a direct and conspicuous impact on landscape dynamics and the cultural-historical value of Mount Mateiaş.
The research methodology consisted in field observations, accomplished during the period 2009-2012, the analysis of limestone quarry expansion by using GIS techniques, and the application of a semi-structured interview, the results of which were processed subsequently in QSR-Nvivo 10. The analysis and processing of cartographic materials highlighted that during the interval 1979-2012 strip mining has dramatically altered the topography (by excavation works, land leveling, access road construction, accelerated slope erosion, collapses, torrential erosion etc.). These add to other processes and phenomena that have a negative impact on the environment (soil loss, massive deforestations, air pollution with suspended particles etc.). Despite these realities, most people living in the neighborhood of Mount Mateiaş (the Valea Mare-Pravăț, Dragoslavele, Stoenești and Câmpulung communes) deem that quarrying is vital for the development of local communities. Under the circumstances, the only economically productive and ecollogically protective measure advanced by the authors is the identification of possible solutions for the restauration of the quarry, given that limestone exploitation will not end in the medium term. Last, but not least, we suggest that the results of the present investigation be included in the pre- feasibility and feasibility studies of a potential future rehabilitation.

Keywords: *Limestone quarry, Spatial extent, Landscape, Local perception, Mount Mateiaş, Romania*

Rezumat. Modificări în extinderea spațială și percepția locală asupra problemelor de mediu derivate: Cariera de calcar Mateiaș (Carpații Meridionali)

Resursele minerale variate şi politicile de industrializare a ţării promovate în perioada comunistă în România au contribuit la deschiderea a numeroase mine şi cariere, printre care se află şi cariera de calcar de pe Muntele Mateiaş. Scopul acestui studiu este acela de a trage un semnal de alarmă în privinţa exploatărilor în carieră, care au un impact direct şi vizibil atât asupra dinamicii peisajului, cât şi asupra valorii cultural-istorice a Muntelui Mateiaş.
Metodologia de studiu s-a bazat pe: observaţiile efectuate pe teren în perioada 2009–2012, analiza extinderii carierei prin utilizarea tehnicilor GIS și realizarea interviurilor semistructurate, prelucrate ulterior în aplicația QSR-Nvivo 10. În aproape 40 de ani de exploatare a calcarului, peisajul geomorfologic al Muntelui Mateiaş a suferit modificări ireversibile. Analiza şi prelucrarea materialelor cartografice a pus în evidenţă faptul că în intervalul 1979 – 2012 exploatările în carieră au generat modificarea dramatică a suprafeței topografice (prin excavaţii, lucrări de nivelare, construirea unor drumuri de acces, accelerarea proceselor de versant, prăbuşiri, torenţialitate etc.). Acestea se adaugă celorlalte procese şi fenomene cu impact negativ asupra mediului (eliminarea suportului edafic, deteriorarea învelișului vegetal prin despăduriri masive şi poluare cu particule în suspensie etc.). În pofida acestor realități, majoritatea oamenilor care locuiesc în vecinătatea Muntelui Mateiaş (comunele Valea Mare-Pravăț, Dragoslavele, Stoenești, Câmpulung) consideră că exploatările în carieră sunt vitale pentru dezvoltarea comunităților locale. În aceste condiții, singura măsură economic productivă și ecologic protectivă avansată de autori este identificarea unor soluții posibile de reabilitare a carierei, în contextul în care exploatarea de calcar nu se va încheia pe termen mediu. În final, se propune integrarea rezultatelor obținute în materialul de față în studiile de pre- și fezabilitate, obligatorii în cazul unei viitoare reabilitări.

Cuvinte-cheie: *Carieră de calcar, Extindere spaţială, Peisaj, Percepţie locală, Muntele Mateiaş, România*

Introduction

For centuries, the mountain has represented for the human kind a symbol of power and greatness, a place of refuge and shelter, and last but not least a source of unexpected and precious resources: large forests and grasslands, clear springs, minerals and rocks, valuable fauna species etc. Since ancient times, man has been attracted by the mountain's richness, which he has started to appropriate,

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timidly in the beginning, then with increasingly ease. The 18th century, the beginning of the industrial revolution also marked the beginning of the ecological disasters for the mountain environment. Undoubtedly, the most aggressive forms of human pressure on the mountain realm are represented by the intensive exploitation – sometimes pushed until the mountain disappearance – of the soil and subsoil resources: building rocks, ores and fossil fuel (coal).

Mining workings exert both a positive and a negative impact at environmental, social and economic level (Worrall et al., 2010). Limestone quarrying is important for the development of human communities. At the same time, the extraction and processing of the building materials negatively impact the landscape by breaking aggressively and visibly the structure of the natural environment, which in the end affects the functionality, the health state and the aesthetics of the natural and anthropogenic ecosystems. The opening of quarries and the extraction of various rocks are responsible for the mutilation of positive landforms. During operation, the quarries alter significantly the substratum (Stehouwer et al., 2006) changing the environment's characteristics and integrity (Jomaa et al., 2008). consequently, landslides, rockfalls and soil erosion proliferate, the quarries lying on steep slopes (as in the case of Mateiaș), which are the most prone to landslides and slope failure (Zuquette et al., 2002; Milgrom, 2008). The spoil banks, no matter how small, are built on very inclined slopes and consequently are unstable and prone to sliding down. The visual impact is much stronger than that generated by less visible phenomena like for instance the physical, chemical and biological pollution of water, air etc. (Fodor, 2006).

The complexity of the geological structure of the Romanian territory explains the remarkable diversity of subsoil resources, which over the time have offered extremely favorable conditions for the development of mining, quarrying and processing activities. The multitude of subsoil resources and the industrialization policies of Romania at high levels, promoted during the communist regime, were the premises for the opening of numerous mines and quarries (Fig. 1), including the Mateiaş limestone quarry in Southern Carpathians, Argeș County.

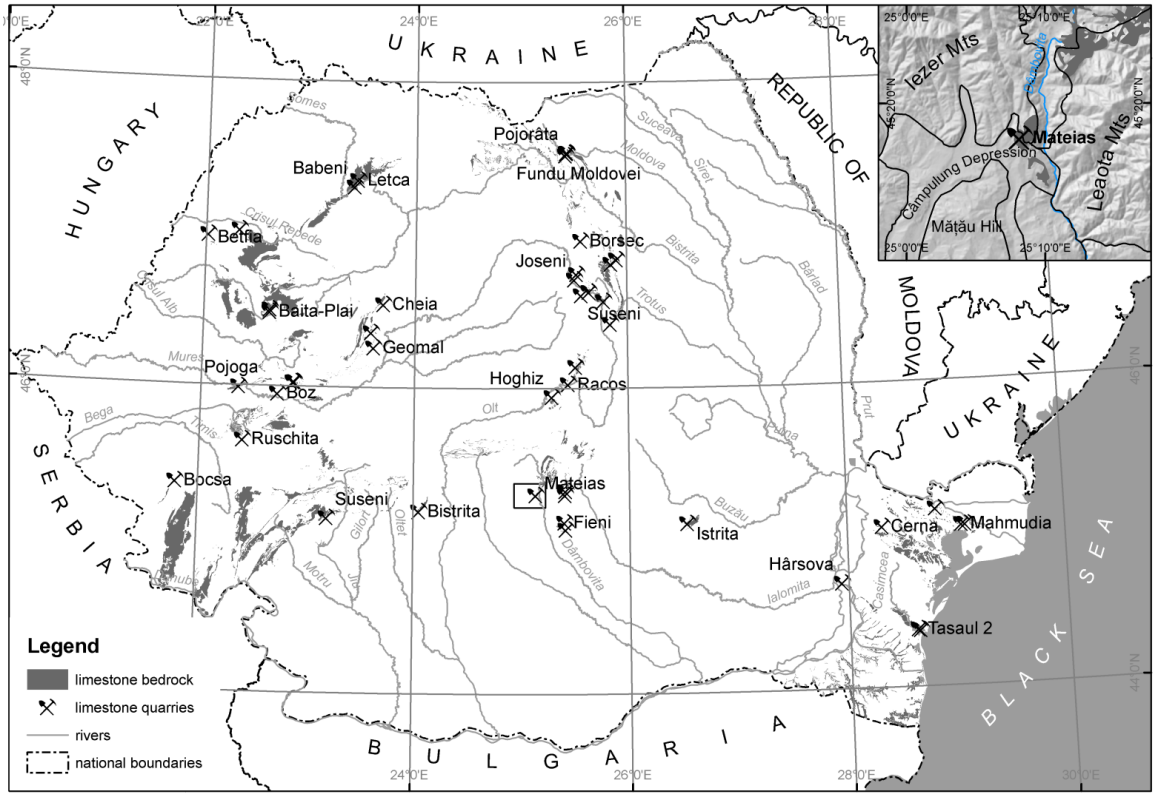

Fig. 1: Romanian limestone resource and quarries. The inset is detailed in the vignette - geographical setting of the Mateiaș Mount and quarry (SRTM3, 2000; DEM by L. Tîrlă)

Study area

The study area is represented by Mount Mateiaş, which is lying on the southern edge of the Iezer Massif (Southern Carpathians). With an altitude of 1239 m, it resembles a solitary piece of rock which offers a viewpoint not only on the surrounding mountains (Iezer, Piatra Craiului and Leaota-Bucegi), but also on the mountain and sub-Carpathian corridor of the Dâmboviţa River (Manea et.al., 2012). Mount Mateiaş corresponds to the boundary between the Iezer Mts.

and the Argeș Hillocks, making the transition from the Jurassic limestone to the marl, sandstone and disodylic schists in the eastern part of the Câmpulung Depression (Fig. 2). Mount Mateiaș consists of massive reef limestone of Kimmeridgian-Tithonian age (Upper Jurassic), a remnant of the Getic Carbonate Platform, which covered large areas during the Austrian-Laramian orogenesis. The Mateiaș limestone is the most similar to Vânturarița formation in the Vânturarița-Buila Massif, other remnant of the former carbonate platform (Dragastan, 2010). The limestone deposits overlay the metamorphic basement (Lerești Group), resembling many common features of the marginal area of the Getic Unit, a major structural entities of the Southern Carpathians (Oncescu, 1965; Patrulius, 1969).

The aggression on Mount Mateiaş began in 1969, when the Cement Binders Factory at Câmpulung came into existence. This production unit is situated in the northeastern part of the Valea Mare-Pravăţ commune. In 1989 it changed its name into CIMUS S.A., while in 1999 was taken over by Holcim S.A. Company.

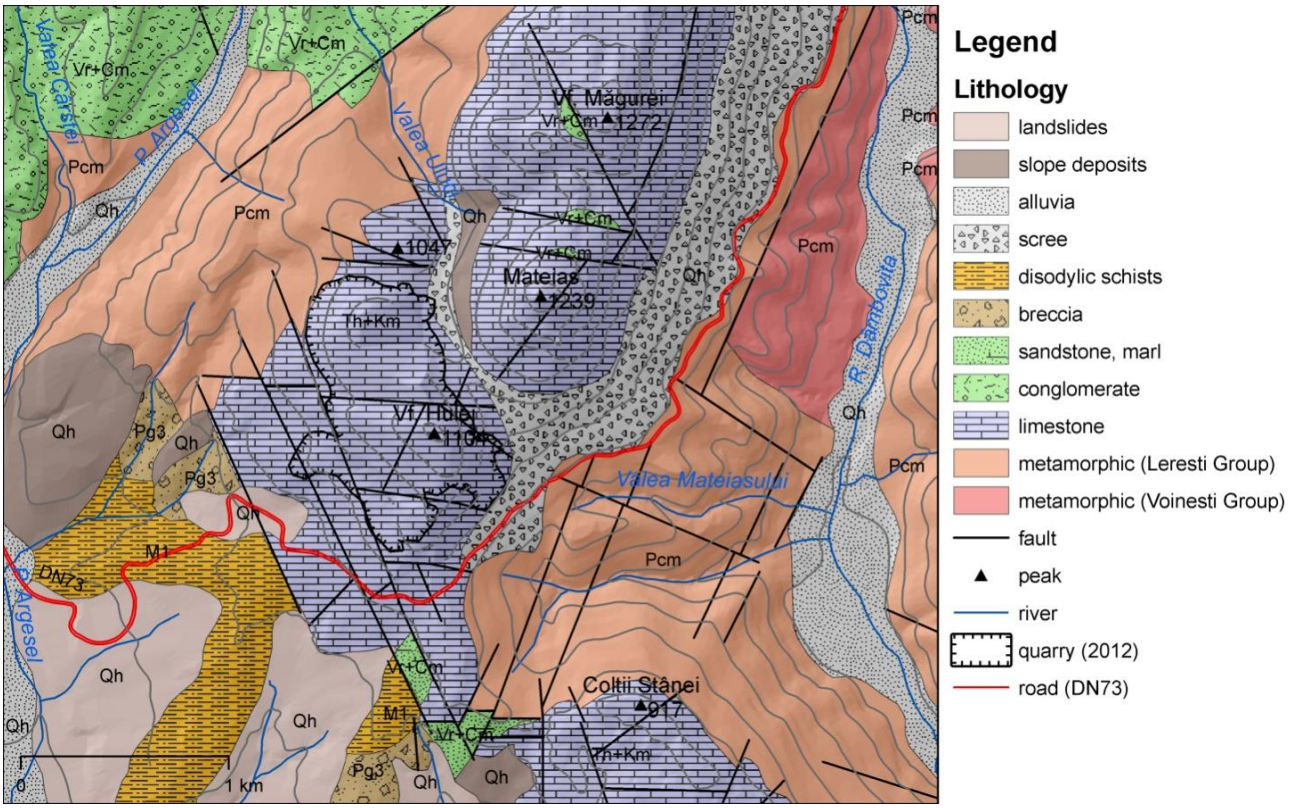

Fig. 2: Geology of Mount Mateiaș area (processing by L. Tîrlă after Ștefănescu et al., 1983). Significance of geological symbols: Pcm – Precambrian; Th+Km – Thitonian+Kimmeridgian; Vr+Cm – Vraconian+Cenomanian; Pg3 – Oligocene; M1 – Lower Miocene; Qh – Quaterny (Holocene)

The landscape, strategic and economic role of Mount Mateiaş

Apparently, the name of the mountain comes from Mateiaş, the adopted son of Matei Basarab (1632-1654), the ruler of Wallachia principality. Over the time, Mount Mateiaş has witnessed many events that left their imprint on Wallachia, and later on Romania (Cornățeanu, 1996). Thus, Mihai Viteazul, the artisan of the first union of the Romanian Principalities (1600), while waiting for the military support from Sigismund Bathory (prince of Transylvania) to fight the Ottomans who had invaded the country, withdrew his troops as far as Stoeneşti (a commune lying to the southeast of the Valea Mare-Pravăţ) and further to the Valea Mare Pravăţ. Here, he chose as strategic point the Mateiaş peak, orienting his cannons to the south, then attacking and repulsing the Turks who were advancing from the Dâmboviţa valley (Cornățeanu, 1996). At the outset of the 20th century, during World War I, Mount Mateiaş was the resistance point of the Romanian Army during the battle of Pravăţ, when thousands of soldiers died in the line of duty. The fighting in the area of Mateiaş and Căpitanu Mountains is part of what historian Nicolae Iorga used to call the *"mountain pass epic"* (Cornățeanu, 1996). In 1916, the prefect of Muscel stated that the Romanian army defended at Dragoslavele and Câmpulung "the sacred origins of the Romanian state", while Mateiaş was compared with a huge mountain of our past. Later on, Ferdinand the 1st *"King of Romania by the grace of god and by national will" awarded the "Mihai Viteazul" order to the 70th Infantry Regiment, "for the courage and enthusiasm of its soldiers (…) in the battles fought in 1916 in Dobrudja and north of Câmpulung (…), as well as for the fierce*

resistance (…) against the elite German troops that intended to pass through the Valea Pravățului and conquer Câmpulung City" (www.cjarges.ro). In the memory of the soldiers who perished in the war between 1927 and 1935, the authorities built, according to the project of architect Dimitrie Ionescu-Berechet, a mausoleum, which today is one of the most important sights of the Argeş County (Fig. 3). After 1980, the monument was completely restored and completed with a permanent exhibition dedicated to the battles fought in the area during the World War I.

Apart from its remarkable landscape and tourist value, Mount Mateiaş has also a significant eco-protective value in relation with the territories lying west and southwest of it (Câmpulung Depression). At the same time, it is important from the economic point of view, because the limestone reserves have been estimated to ensure production for about 100 years. Unfortunately, the quarrying activities will lead in the end to the disappearance of this isolated mountain. On a national level, Mount Mateiaş has been perceived differently: as a physiographic unit of strategic importance for the military defense plans; as landscape element with eco-protective and economic-productive role; as natural tourist sight; as fundamental economic resource for the development of local and regional economy; as factor with direct influence on the jobs of the adjacent territories; and as topographic unit with very active dynamics during the last 50 years, because of the brutal anthropogenic influence.

Fig. 3: The Mateiaș Mausoleum. A. Frontal view of the monument; B. Fissures and cracks caused by mining affecting the mausoleum basement (photos by L. Tîrlă, 2007 and G. Manea, 2014)

The aim of the study is to highlight the time-scale spatial extent of the Mateiaș quarry on the basis of the existent cartographic materials and orthorectified aerial photographs, and to estimate the local perception on landscape changes. The objectives of our approach are the following: showing, based on graphic and cartographic documents, the morphometric and morphographic changes that have occurred during the last 40 years; evaluating the perception of the population and local authorities on the viability of this economic activity. The results are meant to contribute to future studies in case of rehabilitation planning.

Research methodology

Data type. Two differently originated datasets were used within the study: mapping-based data revealing the change of spatial extent of the limestone quarry in Mount Mateiaș in 1979 to 2012, and the results of semi-structured interviews. Mapping-based data consisted in contour lines vectorized from the 1979 topographic map and polygon features representing the quarry area in 1979, 2005, 2009 and 2012. A *.hgt*-type file (SRTM3) was used to create the DEM as a basis for topography analysis in 2000.

Materials: 1979 topographic map of scale at 1:25,000 (courtesy of DTM, (MTD) - Military Topographic Division); 2005 and 2009 orthophotographs with resolution of 0.5 m (courtesy of ANCPI (NACREA) – National Agency for Cadaster and Real Estate Advertising); 2012 satellite imagery (courtesy of Digital Globe); suggestive photographs of environment degradation.

Methods. Basic methodology involved field surveys, digital mapping and processing, and interviewing. The changes in spatial extent and topography of the limestone quarry were surveyed and analyzed by digital mapping and calculations. The next steps were followed: 1. Digital mapping by GIS techniques, using ArcMap™; 2. DEM generating in Global Mapper™; 3. Raster processing and creating graph profiles in ArcMap.

Resolution of the SRTM-based DEM in 2000 is about 65x93 m (Fig. 4A), too low comparing to that of

the DEM created after interpolating the elevation values of the contour lines digitized on the 1979 topographic map, which is 5x5 m (Fig. 4C). To reduce the difference, we generated in Global Mapper contour lines of equal interval (10 m), used to create a DEM with the same resolution (5x5 m) as the 1979 DEM. The result is shown in Figure 4B, with noticeable differences in terrain smoothing. Though, the initial low-resolution grid could not be improved well-enough to reach the same accuracy as the 1979 grid, which had some consequences on the data precision in the 3D terrain model and profile.

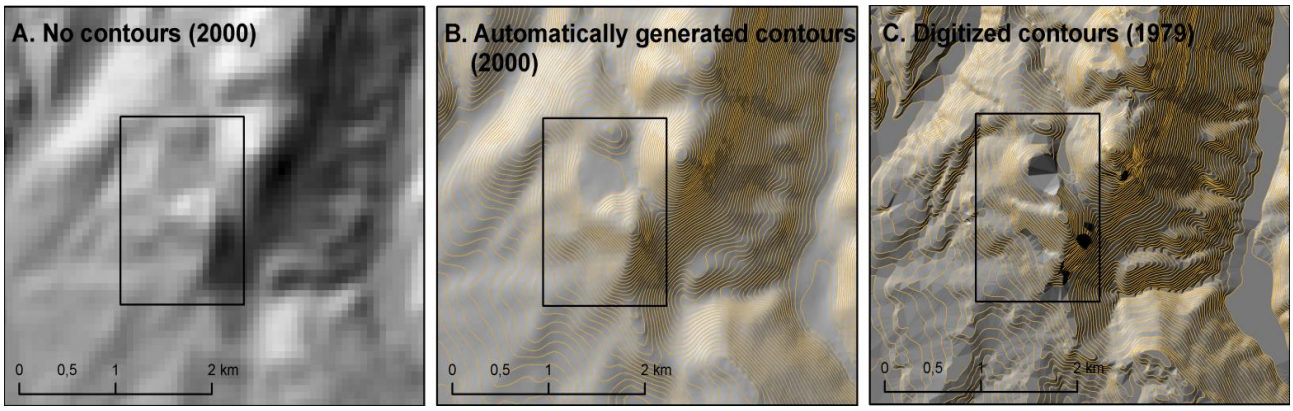

Fig. 4: Elevation data accuracy. A. 2000 topography, illustrated by a SRTM-based DEM (low resolution, unprocessed); B. 2000 topography, after processing the SRTM-based DEM (5x5 m resolution); C. 1979 topography, illustrated by a DEM obtained after digitizing and interpolating contours (5x5 m resolution)

The lack of recent large-scale cartographic materials (of a scale at minimum 1:25,000) hampered estimating the removed limestone and considering the volumetric values. Under the circumstances, we used information resulted from digital mapping of the quarry area – vector data and related attributes.

The assessment of the perception of population and local authorities concerning the environmental issues triggered by the limestone working in Mount Mateiaş was based on the survey method (semi-structured interview sub-type) applied face-to-face in April 2013 and written recorded. All respondents have orally accepted to use their answers and demographic data for research purpose. The advantage of this survey sub-type is that the interviewed person is allowed to express himself freely, unconstrained by prepared, and rigid questions. The order of the questions can be permanently changed, driven by the discussion flow. The adequate questions may be addressed in favorable moments, with good results. The interview guide included only six questions, in order to maintain itself within the limits of acceptability. The questions considered the following aspects: Mount Mateiaș notoriety among residents in Valea Mare-Pravăț; its importance to community; the resident's opinion on limestone quarrying and how long he believes it would be active; the resident's opinion on beginning the mining works in Mateiaș Peak; the consequences in case of the complete disappearing of Mount Mateiaș. All data obtained during the research were coded in Nvivo v 10, thus, every question became a „node". As the interview group comprised different people, they were coded as nodes, too using the following symbols: F1, F2 ... Fn for females and M1, M2... Mn for males having demographic characteristic attributes added. Thus, Nvivo software allows to manipulate data and organize them to research topics in order to analyze a great amount of data (Mihalca, 2013), to find patterns generated by queries such as the tree map and cluster analysis diagram.

Results

Assessment of the morphometric and morphographic alteration of the mountain unit

The analysis and processing of cartographic materials reveals that during the interval 1979-2012 the area of the quarries in the Mateiaș perimeter continuously grew (Fig. 5 and Table 1). The Soviet map from 1970 at scale 1:50,000 shows no topographic change yet, unlike the map from 1979, where a small quarry 'bites' from the northern part of Mount Hula. The DEM in 2000 shows a complete removal of this northern peak and a decrease in altitude by 150 m. Different short time-scale orthophotographs (2005, 2009 and 2012) depict the evolution of quarrying works from north towards south. Visible mining terraces appear on Mount Hula in 2005 (Fig. 6); it was almost completely removed until 2012.

At the same time, the volume of the removed bedrock proportionally grew, causing a decrease in elevation by about 150 m (from 1100 m in Hulei Peak to 950 at peripherals). Consequently, the cone-shaped Mount Mateiaș (1239 m) is now totally

exposed, and remains the only topographic barrier against the northeasterly turbulent air drafts in the Bran-Rucăr-Dragoslavele tectonic corridor.

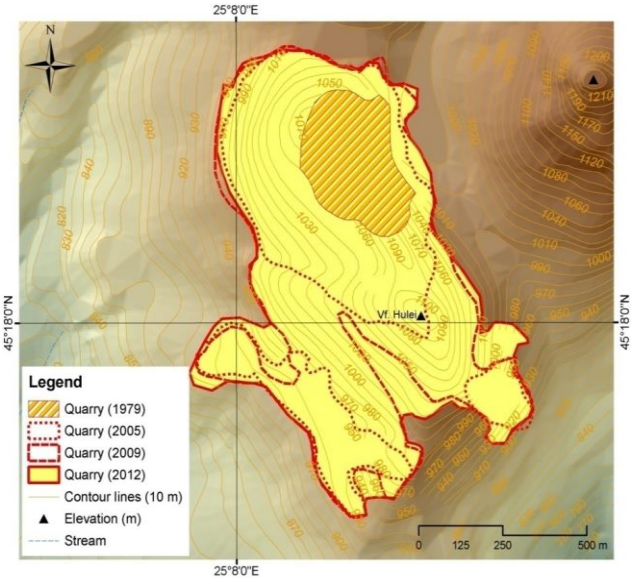

Fig. 5: Mount Mateiaș – Time-scale change of quarry extent

The quarrying site has generated a number of processes and phenomena that add to the negative impact on the environment, of which we can mention the following: massive defforestations, with direct impact on the intensification of mass wasting processes (collapses, torrential erosion etc.), pollution with settling dust (at present diminished due to the refurbishment of the Holcim Enterprise), and the degradation of the Mateiaş mausoleum (fissures, infiltrations) and the nearby buildings, because of the limestone exploitation blasts. One important step towards the rehabilitation planning has already been made by the mining company by planting a protective shelterwood of Scots pine (*Pinus sylvestris*) on the southern slope of Mount Mateiaș, under the Hulei Peak. This pine forest is meant to protect the European and national road (E577/DN73), and there with the Mateiaș Mausoleum against the direct negative effects of the quarrying works (Fig. 6).

The dramatic change of topography in 1979 to 2012 is also illustrated by the 3D models and topographic profile in Figure 7.

Table 1: Evolution of the quarry area

No.	*Year*	*Area (hectares)*
1	1979	9.54
2	2005	46.09
3	2009	65.70
4	2012	72.63

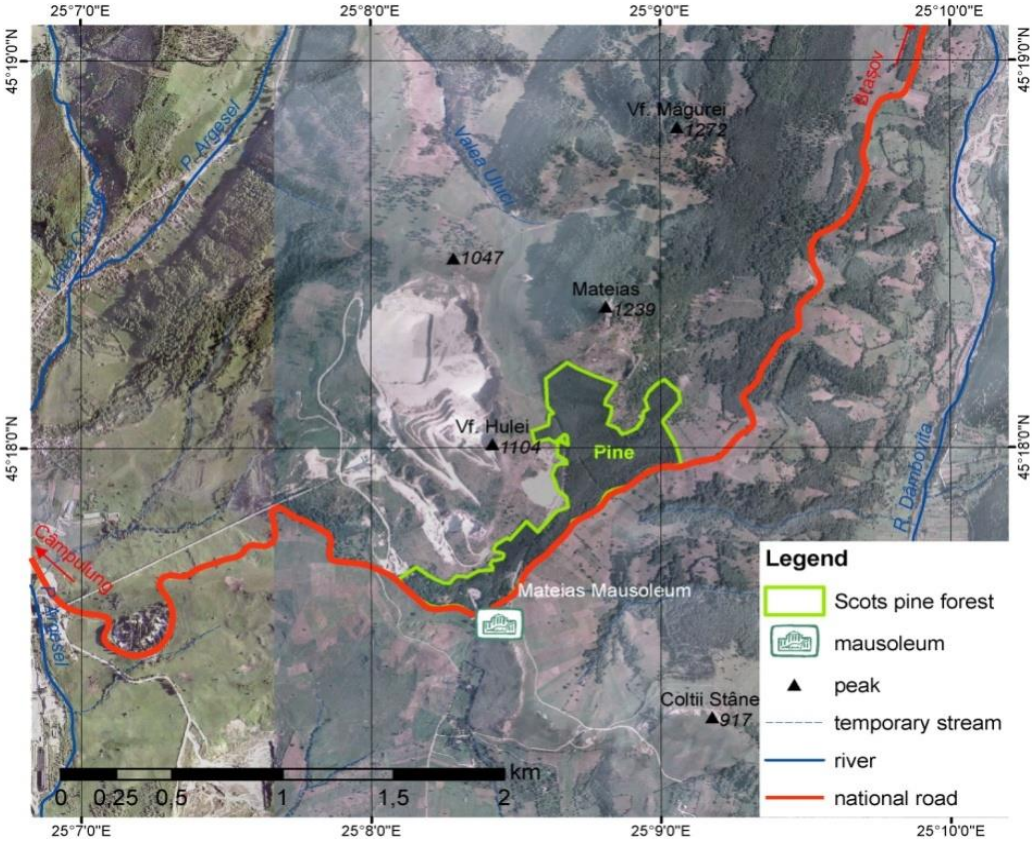

Fig. 6: Mateiaș quarry in 2005 (Source: orthophotograph, courtesy of ANCPI, 2005)

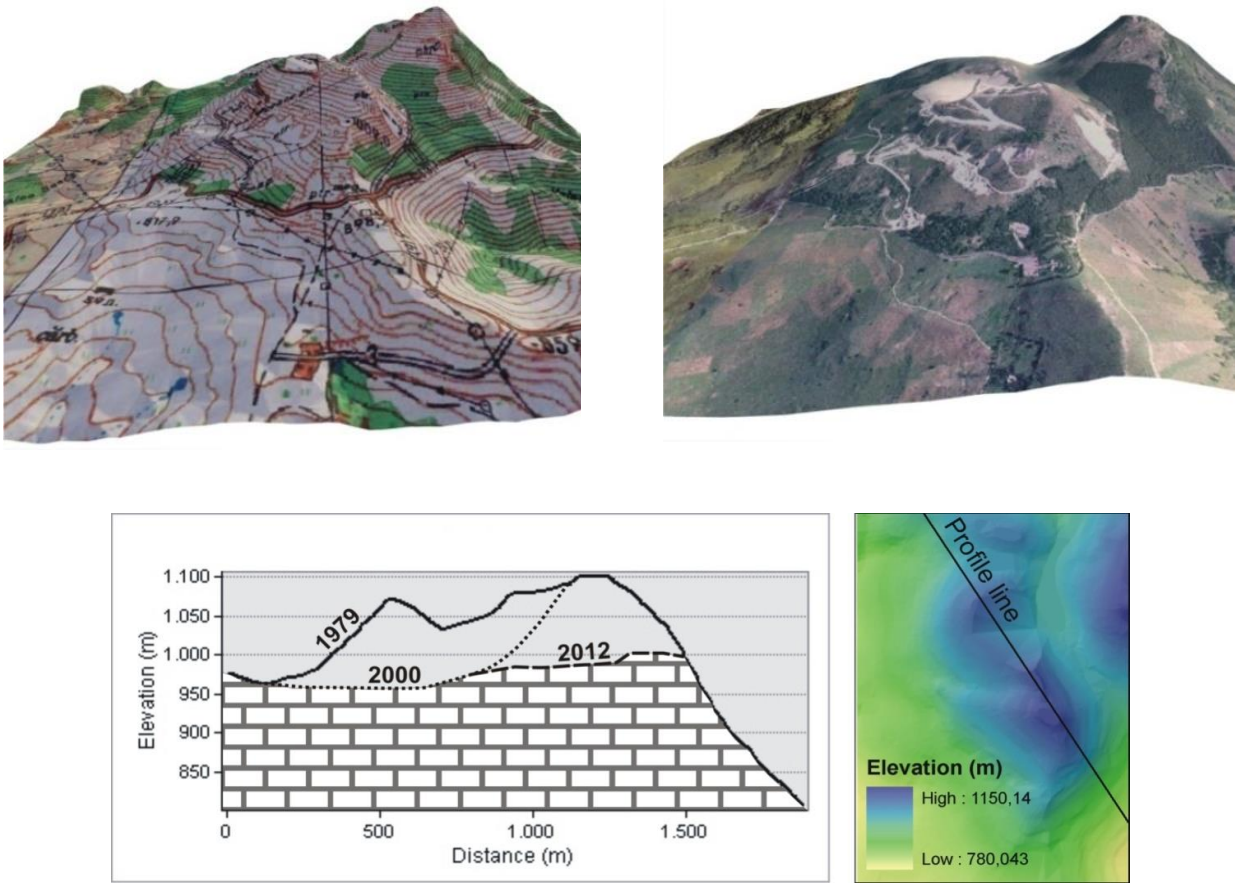

Fig. 7: Changes of the quarried area in 3D and topographic profile: A. 1979 topography, lateral view (northward); B. 2005 view (topographic map and orthophotograph draped on a 3D surface derived from a SRTM3 raster file). C. NW-SE profile of the Mount Mateiaș with topographic changes in 1979 to 2012

The perception of people and local authorities on the viability of the economic approach

The sample of interviewed persons is made of 15 local people, 40% females and 60% males, aged between 25 and 67 years old (Table 2). The provided answers enlightened us about the attitude of the local authorities and the inhabitants of the Valea Marea-Pravăţ commune with regard to the potential disappearance of Mount Mateiaş in the next 50 years. For all respondents, Mount Mateiaş is very well known, but only 40% of them recognize it as a landscape symbol of this area, while 60% appreciate its importance for building materials input and the jobs opportunities offered by the quarry and nearby Holcim Plant for local communities. Even they agree the necessity of jobs, 80% of respondents expressed worries about its disappearing in 50-100 years and pollution generated by specific works. Concerning the beginning of mining in Mateiaş Peak, 85% of respondents consider useful the banning of it, keeping the state of protection and conservation. Despite these divided answers, all respondents recognized the ecological impact of the quarry, the depletion of local resources, the temporal economic benefits, and destruction of its tourist attractiveness. Only one person knew that there are possibilities to recovery the landscape suggesting both revegetation and leisure infrastructure development.

Table 2: Respondents' profiles

No.	*Respondent*	*Age*	*Profession*
1	F1	60	Accountant
2	F2	50	Professor
3	F3	35	Professor
4	F4	26	Sociologist
5	F5	51	Biochemist
6	F6	67	Pensioner
7	M1	25	Student
8	M2	25	Freelancer
9	M3	35	Engineer
10	M4	67	Pensioner
11	M5	31	Economist
12	M6	58	Professor
13	M7	55	Engineer
14	M8	30	Professor
15	M9	57	Counselor

Analyzing the NVivo outputs, The Word Frequency Query shows that much attention is given to the

economic values ('limestone', 'materials', 'source', 'constructions') then those about the environment ('pollution', 'climate', 'disappear' etc.) (Fig. 9). The cluster analysis diagram reveals similarities of respondents' views that allow us to see that the authorities (M9) and the majority of people (F2, M4, M3, M7) form a cluster with rather similar views, while F6 and M8 put an accent on the economic importance toward the environment. There is also a third cluster, who thinks the environment is more important than economic benefits (Fig. 10). Thus, a contradiction between some of the respondents' views could be noticed, due the fact they want both benefits: environmental quality and economic needs.

In sum, they particularly emphasized the economic and social importance of the exploitation (the only profitable industrial activity in the area), the historical and strategic importance of Mount Mateiaș, as well as the possible risks of the complete disappearance of the mountain, the loss of the forests and the diminishing of its local climatic role.

Fig. 8: Mount Mateiaș quarry: a. general view; b. anthropogenic-triggered landform inversion (photos by G. Manea, 2012)

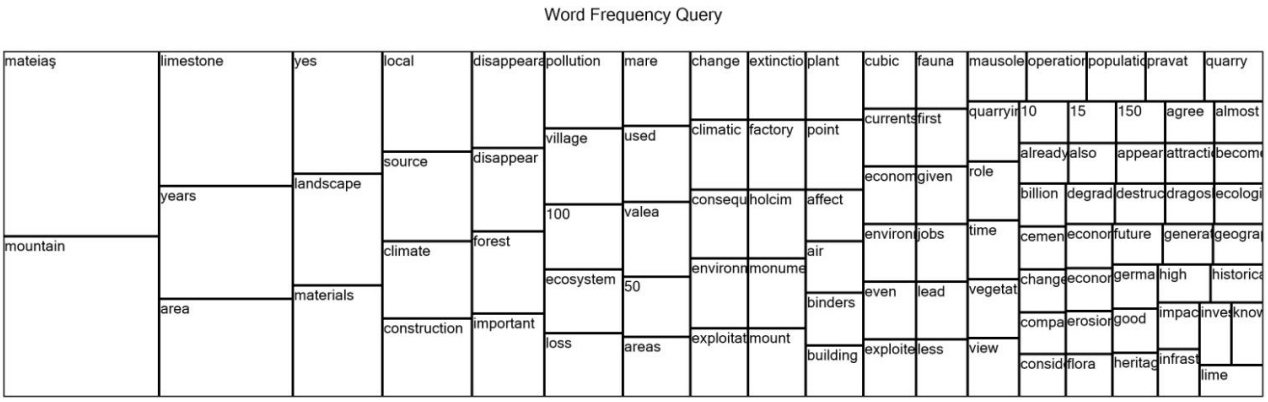

Fig. 9: Word Frequency Query Tree Map (extract from Nvivo v 10 output)

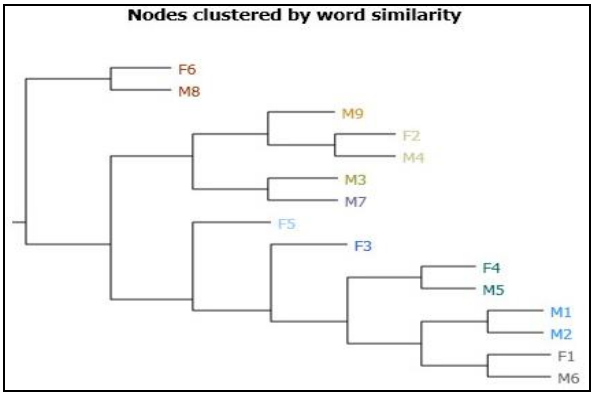

Fig. 10: Gender clustered by words similarity; M-male, F-female (extract from Nvivo 10 output)

Discussions

The present study does not claim to give solutions for solving the environmental issues derived from the discussed limestone quarry. The obtained preliminary results are relevant only by contributing on a database that could be used in further pre- and feasibility studies, required when implementing post-closure rehabilitation planning measures.

Although, according to the estimates, the quarry will close approximately in 50 years, the extent of the impact that Mount Mateiaș disappearance will have on the adjacent settlements should be anticipated at an early stage, so that to prepare

functional conversion scenarios for the rehabilitation of degraded lands.

From the input-data perspective, the study has some limitations: the area was digitized based on cartographic materials with unevenly distributed information, available only for certain years. The interval 1979-2005 is too large in comparison with 2005-2009 and 2009-2012, making it impossible to trace the evolution of the quarry at regular intervals.

The values of the quarry area in the input years were obtained by mapping techniques from the specified materials, so accuracy might not be as high as the technical data.

The results of the semi-structured interview are relevant, although the answers are not homogeneous, which emphasizes the different perception of the respondents with respect to limestone quarrying. The advantage of the interview in comparison with the questionnaire is that allows the operator to get a broader spectrum of information, opinions and comments, some of them really enlightening for the authors.

The analysis of the answers leads to the conclusion that, although aware of the quarry's aggression on the environment, the locals believe that immediate incomes obtained from limestone exploitation are much more important than the potential benefits they would have on medium and long term, if the quarry would close and economic reconversion of the area were implemented. This attitude reveals that for the local residents economic stability and immediate prosperity prevail over the environmental concerns, even if that means health risks and a worse quality of life.

The authors aim to achieve in perspective a thorough analysis of the civil society in the vicinity of the quarry, in order to identify people's opinion regarding the conservation of Mateiaş Peak (which so far escaped exploitation), as a symbol of the region and of the cultural-historical continuity of the human communities living around it.

The present study is intended to bridge the gap between the local authorities and the scientists, which can work together in the future for finding the best solutions in order to harmonize the economic interests with the necessity of protecting the environment.

Conclusion

The approximately 40 years of limestone exploitation have resulted in irreversible damage of Mount Mateiaş. The analysis and processing of cartographic materials reveals that during the interval 1979-2012 the area of the quarries in the Mateiaş perimeter continuously grew. The volume of the removed bedrock proportionally grew, causing a decrease in elevation by about 150 m (from 1100 m in Hulei Peak to 950 at peripherals). The contract concluded with the Swiss company Holcim, is unlikely to be cancelled in the near future, which means that large areas will continue to be mutilated by excavation. On medium term, at the current rate of exploitation, the Mount Mateiaş landscape will face an increasing dynamics, being continuously crushed by the machinery that excavates the limestone. Practically, the mooned landscape will become dominant; the fragmentation of natural environment will worsen, while the impact on the housing quality will definitely be negative. On the other hand, the interview survey reveals that the prosperity of local communities depends on limestone exploitation and processing, while the interest for environment protection comes second. Under the circumstances, the compromise solution can only be a rehabilitation program, meant to improve the degraded lands according to the models provided by the countries with experience in this respect (Italy, UK, Germany etc.).

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Author contribution

The authors of the study had the following contributions: bibliographic documentation, field activities and paper drafting were done by Gabriela Manea, Iuliana Vijulie and Adrian Tişcovschi; the processing of the interviews in QSR Nvivo and the translation of the final paper were performed by Elena Matei and Octavian Cocoş; computer mapping, data analysis and assistance with proofing were provided by Laura Tîrlă.

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Assessing long-term changes in forest cover in the South West Development Region. Romania

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Abstract

The paper is discussing the importance of assessing forest dynamics based on several statistical and cartographic supports considered to be the most representative for the last century. The selected maps are able to point out the forest cover changes for three time frames (1912-1971; 1971-1990; 1990-2006) related to the relevant multi-temporal statistical and cartographic data as well as historical events such as land reforms, political changes related to the transition to the intensive and extensive communist agriculture and the post-communist period strongly related to the decolectivisation and privatisation of agriculture leading to the emergence of new types of property, an excessive land fragmentation and deforestation (illegal logging). The authors are aiming to analyse land use conversion and forest covered areas dynamics in relation to the main socio-political and natural driving forces by means of GIS methods (binary change index and trend index) based on a series of significant cartographic documents and a large and complex geodatabase.

Keywords: *forest cover, land use change, GIS, South West Development Region, Romania*

Rezumat. Evaluarea schimbărilor pe termen lung a suprafeţelor acoperite cu pădure din Regiunea de Dezvoltare Sud-Vest Oltenia. România

Lucrarea urmăreşte importanţa evaluării dinamicii suprafeţelor acoperite de pădure pe baza mai multor date statistice şi cartografice considerate reprezentative pentru ultimii o sută de ani. Hărţile selectate sunt în măsură să evidenţieze schimbările survenite în dinamica suprafeţelor acoperite de pădure pentru trei intervale temporale semnificative (1912-1971; 1971-1990; 1990-2006). Alegerea acestor intervale a fost făcută în corelaţie cu datele statistice şi materiale cartografice multitemporale relevante, precum şi cu evenimentele istorice şi politice cum ar fi reformele funciare, schimbările politice legate de perioadele comunistă şi post-comunistă, de colectivizarea, decolectivizarea şi privatizarea agriculturii care au condus la apariţia unor noi tipuri de proprietate, o fragmentare excesivă a terenurilor şi despăduriri extinse (exploatarea forestieră ilegală), cu precădere în ultimii 20 de ani. Autorii şi-au propus să analizeze modificările utilizării terenurilor şi dinamica suprafeţelor acoperite de pădure în raport cu principalii factori socio-politici şi naturali cu ajutorul metodelor GIS (indicele schimbării binare şi indicele de tendinţă) şi pe baza unor documente cartografice relevante care le-au permis realizarea unei baze de date spaţiale complexe la nivelul Regiunii de Dezvoltare Sud-Vest Oltenia.

Cuvinte-cheie: *suprafaţă împădurită, shimbările utilizării terenurilor, GIS, Regiunea de Dezvoltare Sud-Vest, Romania*

Introduction

It is widely recognized that forest has always been considered a major natural resource having an essential role in maintaining both ecological equilibrium and integrity (Raet et al., 2008; Davedra, 2011), thus providing different ecosystem services for different environmental and societal sectors.

Over the last twenty years, the post-socialist Central and Eastern European countries have witnessed substantial restructuring processes facing the growing challenges of settlements expansion and associated environmental consequences in terms of land use/land cover changes, loss of natural vegetation, habitat fragmentation etc. (Kamal-Chaoui, 2009). Forest cover change involves a wide range of transformations involving deforestation, afforestation, reforestation and natural expansion of forests (Laze et al., 2010) strongly linked to the spatial and temporal variability of different natural, socio-economic and political drivers as well as their actors (Soler and Verburg, 2010).

In Romania, under the socio-economic and political changes brought about by the fall of the socialist regime, significant landscape transformations related to land use changes, mainly in terms of forest cover and forest fragmentation have occurred (Bălteanu and Popovici, 2004 and 2005; Kuemmerle et al., 2009; Popovici et al., 2013). Studies undertaken at national, regional and local level revealed the strong connection between these forest cover transformations and a series of driving forces of change which have evolved in connection with the shifting natural, socio-economic and political environment (Bălteanu et al., 2004; Bălteanu et al., 2005; Kuemmerle et al., 2009;

Dutcă and Abrudan, 2010; Marinescu et al., 2013; Pravalie et al., 2014 etc.).

The present research is dealing with the specific trends in land use changes within the last almost one hundred years which has determined significant changes, especially in favour of agricultural land, forest areas, and residential development.

Study-area

The South-West Development Region is located in the South-Western part of Romania, covering 12.3% (29,010 sq.km) of the national territory and 10.7% of its population (Fig. 1). The area is overlapping the main relief forms from the heights of the Southern Carpathians and Banat Mountains in the north and north-west to the hilly, plain regions and Danube floodplain in the centre and south (Bălteanu et al., 2006) displaying all biogeographical zones and belts of Romania. These environmental features explain the vast surface covered with forests, presently reduced to 29.8% (from up to 35% at the beginning of last century) explaining its spatial dynamics strongly linked with the natural and human-induced land use/land cover changes (deforestation, extreme weather events, urban sprawl etc.).

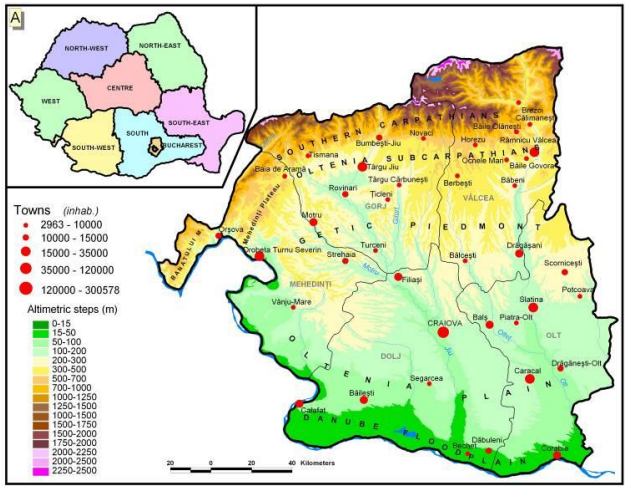

Fig. 1: The South-West Development Region

The South West Development Region mainly develops in the deciduous (nemoral) forest zone and the nemoral belt, which consists of two vegetation sub-belts: the sub-belt of durmast forests and mixed forests of durmast and beech and the sub-belt of forests of beech and beech associated with resinous species reaching altitudes of up to 1,200 m–1,600 m on the south-western slopes of the Southern Carpathians with a southern aspect and rather uniform distribution (Doniţă & Roman, 1976; Bălteanu et al., 2006). Therefore, in terms of forest structure, more than 85% of the study-area is covered by deciduous forests. At altitudes higher than 1,600 m the spruce forest (Picea abies) belt develops, its upper limit reaching the open ridges at approximately 1,700–1,800 m (1,850 m) in natural conditions. In the Southern Carpathians the spruce forest present a rather narrow strip-like distribution around the sub-Alpine belt, narrowing from east to west on the southern slopes of this chain, as compared to the rest of the Romanian Carpathian Chain (Bălteanu et al., 2006).

At NUTS 2 level, due to the qualitative and quantitative proprieties, resinous forests were, to a large extent, subject to forest withdrawal generally due to deforestation processes or degradation.

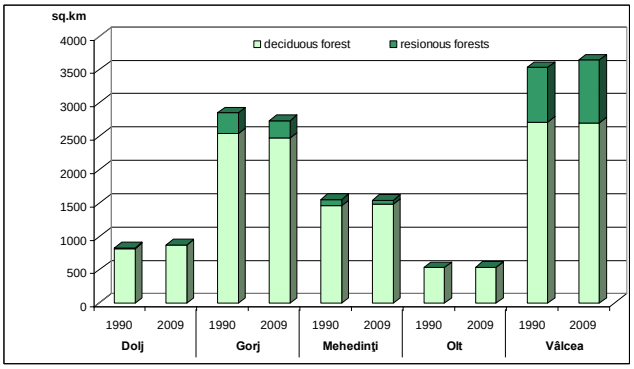

Fig. 2: The share of deciduous and resinous forests in the total forest found in the South West Development Region by County in 1990 and 2009, respectively

Source: National Forest Administration

Except Vâlcea County, which between 1990 and 2009 experienced afforestation processes (over 4%) the rest of the counties were subject to forest withdrawal. In the case of deciduous forests, the situation is more different. Dolj, Mehedinţi and Olt Counties had gain up to 8% forest area, while Gorj and Vâlcea Counties had lost up to -3% of the woodland (Fig. 2).

Methodology and data sources

Assessing forest cover changes based on historical maps in the study-area was undertaken using different data sources: statistical data, topographic maps, aerial photographs and satellite images. A special emphasis was put on spatial data through GIS processing and investigating the most relevant cartographical documents for the analysed period at various spatial scales.

Therefore, in order to retrace and analyse forest cover transformations over the last one hundred years in the South West Development Region, the authors used several historical maps in order to rebuild the forest cover based on different critical drivers of historical, social, political, economic nature: the land reforms, agricultural practices, the

afforestation programs etc.: topographic maps (Austrian Map, 1912 and Russian Map, 1971), scale 1:100,000 and Corine Land Cover - CLC - (EEA, 1990 and 2006), scale 1:100,000 (Table 1, Fig. 3).

The analysis was carried out using GIS-based methods and tools. After data extraction from both topographical maps and CLC database, the authors proceed to the calculation of surfaces for each analyzed element grouped into the following major categories: *forest and semi-natural areas* (forests, scrub and/or herbaceous vegetation associations, open spaces with little or no vegetation), *built-up areas* (urban fabric, industrial, commercial and transport units, mine, dump and construction sites and agricultural, non-agricultural vegetated areas), agricultural areas (arable land, permanent crops, pastures), *water bodies and wetlands*.

Table 1: The main cartographical resources used for the South-West Development Region

Year	Analysed time-frames	Data sources - topographic maps
1912	***T1 – T2*** *(1912 - 1971)*	*Scale 1:200 000, edition 1910-1912 (Austrian Map)*
1971		*Soviet map; Scale 1:100 000; edition 1971*
1990	***T2- T3*** *(1971 - 1990)*	*Corine Land Cover – CLC; Scale 1:100 000 (EEA, 1990)*
2006	***T3- T4*** *(1990 - 2006)*	*Corine Land Cover – CLC; Scale 1:100 000 (EEA, 2006)*

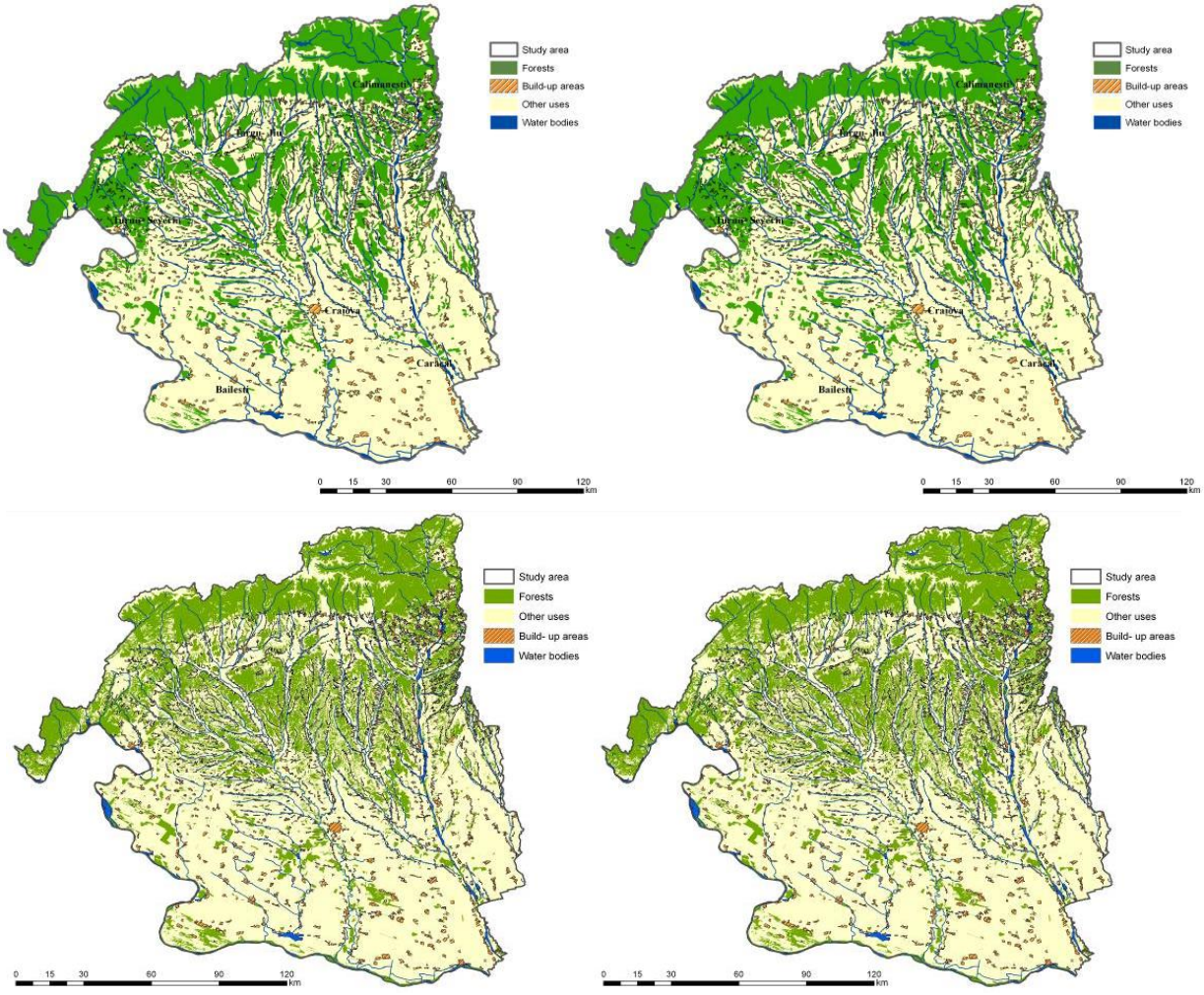

Fig. 3: Land use /land cover maps - 1912 (a), 1971 (b), 1990 (c) and 2006 (d)

Using the direct intersection method the authors were able to compute the changes of each element for the selected intervals: 1912-1971, 1971-1990, and 1990-2006. Based on the changed/unchanged ratio for each analyzed element, the authors computed two relevant landscape metrics: **binary change index (BCI)** and **trend index**. The **binary change index (BCI)** was calculated in order to identify the changes occurred at pixel level following the formula (Van Eetvelde and Kayhko, 2009; Pătru-Stupariu et al, 2009 and 2011; Stupariu et al., 2010; Van Eetvelde et al., 2012):

BCI = NCH – CH / NCH + CH (%)
NCH = unchanged
CH = changed

Moreover, another index used in order to point out the forest cover changes assumed from the mathematical analysis of elements pointing to their evolution trend – **trend index** using the following procedure (Van Eetvelde and Kayhko, 2009; Van Eetvelde et al., 2012):

$$\textbf{TREND} = \frac{\textbf{no. of changes/element}}{\textbf{total no. of changes}}$$

Additionally, the study was completed by statistical data (available at NUTS 5 and NUTS 2 level) supplied by National Institute of Statistics (Romanian Statistics Yearbooks, 1912-1989 and Tempo On-line database 1990-2011 https://statistici.insse.ro/shop/), as well as field surveys in the study area. In order to have a more accurate representation of the current assessment, the authors also took into consideration a wide range of qualitative and quantitative parameters (Raet et al., 2008) related to forest reserves, forest metrics, distribution patterns, health, legal status etc. based on data provided by the National Forest Administration.

Due to the unequal and sometimes incomplete information, the different mapping scales and the particular environmental features of the study-area, some adjustments to the database were undertaken.

Results and discussions

The main driving forces of spatial transformations are related to different *natural* (the main physico-geographical features, climate change-related impacts etc.), *demographic* (population growth, settlements expansion) and *political factors* (political decisions influenced the property status, type of exploitation etc.) which are directly responsible for land use change patterns (Bălteanu and Popovici, 2010; Grigorescu et al., 2012), thus triggering forest cover transformations.

Since the beginning of last century, several evolution periods with intense consequences in terms of land use/land cover changes had affected the Romanian territory. During the **1912-1971 interval**, most of the changes that occurred had affected mainly the forest cover within the study-area. As a consequence, out of the total forest covered area of more than 7,400 ha, over 35% were converted into other categories (mainly agricultural) in relation to two of the most important land reforms: *the 1918-1921 and the 1945 land reforms*. The first was enacted after the Greater Union of Romania in 1918, which brought about the expropriation of huge surfaces of state property which were fragmented and distributed to peasants, thus creating a certain balance between former and new owners and leading to increased social stability. The second land reform, enforced after the Second World War, liquidated the property of great landowners, and prefigured the transition to the socialist regime characterised by the centralised ownership, collectivisation and state farms (Bălteanu et al., 2004; Bălteanu et al., 2006; Popovici et al., 2013).

Significant land use changes occurred during the *communist period (1948-1989)* which had brought in the liquidation of the property of big landowners and the establishment of the centralized state-controlled property (collectivisation) and of large state farms. The socio-economic development recorded radical changes throughout two major transition periods: the 1950–1960/1962 period that marked the passage from the capitalist economy to the highly centralized plan-based communist system and the 1950-1989 interval when Romania, like other Central-European communist countries, choose for an extensive industrialization (Dumitrescu, 2008).

In relation to these socio-political changes, for the analysed period (1912-1971), significant conversions of the forest covered areas into other land use categories took place. According to the **binary change index**, in the study-area the changes were mainly registered in favour of agricultural land (over 32% of the forest covered area was transformed into agricultural). Smaller percents were converted to water bodies (0.57 %) and built-up areas (0.5 %). The rest of about 67% maintained its original use (Fig. 4).

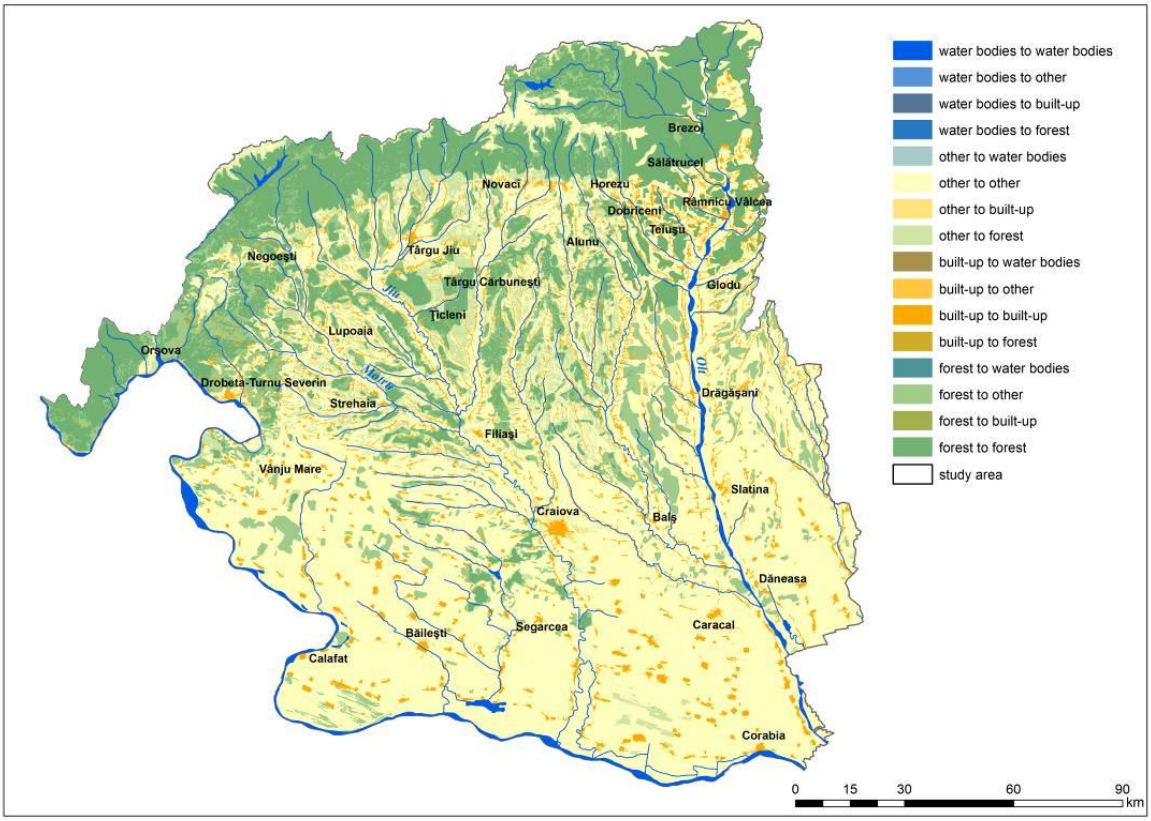

Fig. 4: Land use changes over the 1912-1971 period in the South-West Development Region

The land use changes triggered by the political and socio-economical transformations brought about by the communist period had continued during the next **analysed interval (1971-1990)** in relation to the enhancement of a centralised extensive agriculture, having a significant effect on the forest cover, as well. As a result, over 26% of the water bodies were converted to agricultural areas, especially in the Danube Floodplain area with the aim of extending the agricultural area within the Lower Danube Plain. Moreover, in line with this trend of excessive development of agriculture, woodland areas, too suffered transformations, especially the floodplain forests with different species of *Salix, Populus, Fraxinus angustifolia and Quercus robur*. Almost 20% of the forest covered areas were transformed to agricultural areas, mainly in the plain and plateau/tableland relief units (Fig. 5).

On the other hand, some areas were afforested in order to provide proper infrastructure for agriculture (i.e. forest belts) or for flood control in the Danube floodplain or along the main rivers (i.e. river embankments, protection forests etc.), process which slightly continued after 1990.

Generally, the expansion of the forest area was primarily related to natural regeneration (in the mountainous and the Subcarpathians regions), especially from woodland-shrub to forest categories. Secondly, artificial reforestation (after logging or calamities) took place on smaller areas, directly connected to financial sources. The costs were covered from the state budget and the Land Reclamation Fund destined to such actions (http://mmediu.ro/file/17.11.2010_Programul-National-Impadurire.pdf) and by non-reimbursable European funds dedicated to the tree-planting. Additionally, Measure 3.5 of the SAPARD Programme (Special Accession Program for Agriculture and Rural Development) stipulated the funding of afforestation projects; in 2009, Measure 221 of the National Rural Development Programme had in view the First Afforestation of Agricultural Lands (Popovici et al., 2013). Thus, over the analysed interval, over 14% of the agricultural areas and 15% of the water covered areas were converted to woodland. Overall within the study-area, over the 1989-2009 period, 118.31 sq.m of land (state property) were afforested. Dolj County ranked first as the largest afforested large administrative unit both related to the flood management embankments in the Danube Floodplain and the agricultural betterment works on the sandy dunes from the Southern Oltenia Plain.

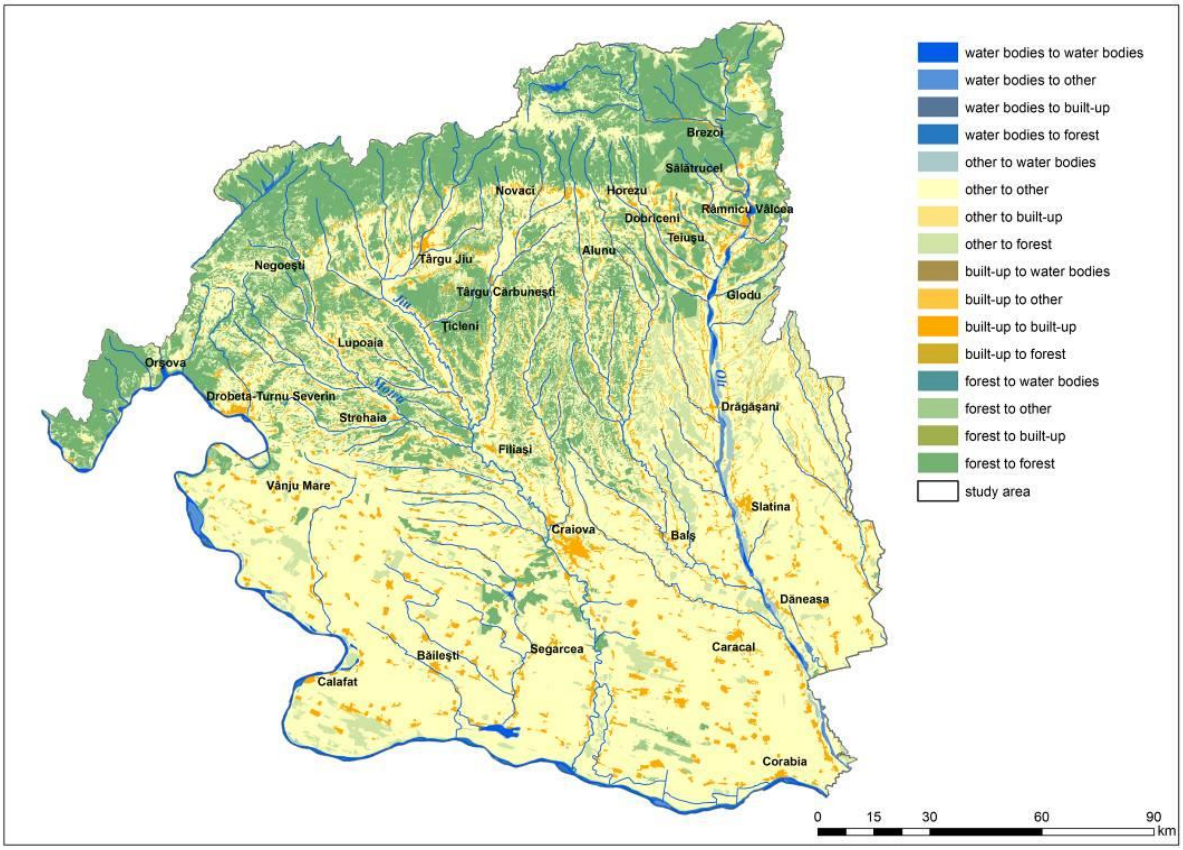

Fig. 5: Land use changes over the 1971-1990 period in the South-West Development Region

The fall of the communist regime (December, 1989) marked the beginning of a new and extremely dynamic period - **the post-communist (1990-to-date)** – which brought about, as major general outline, the transition from a centralised economic system to the market economy. These changes triggered restructuring processes in all fields of activity, leading to a certain dynamics of the land use/land cover categories, including the forest found (Fig. 6).

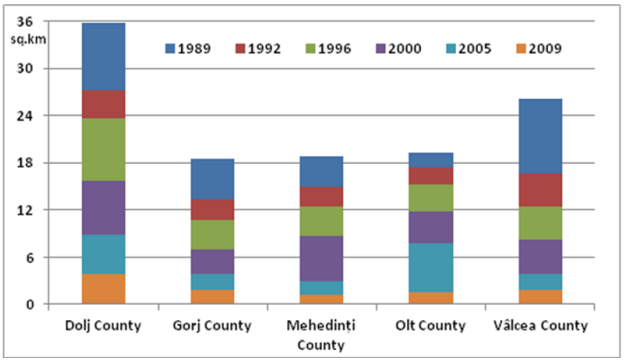

Fig. 6: Afforestation process (sq.km) at NUTS 2 level in the South-West Development Region

Souce: National Forest Administration

The first stage of this period, the so-called *transition period* (1990-2000) set in motion the transition from state property to private ownership through the decollectivisation and privatisation processes, the so-called "land laws" (Geografia României, vol. V, 2005). The related changes determined structural relocations of the different land use categories, thus seriously affecting the forest fund by means of important "land laws" such as *Law No 18/1991 and the additional laws (169/1997, 1/2000)*. These legislative papers had in view to reconstitute the right to ownership of collective farm members, their successors and other categories of persons through privatisation and decollectivisation processes (Bălteanu et al., 2004; Bălteanu et al., 2005).

The second stage – *the post-transition period* (2000-to-date) – involves a new rage of territorial changes and transformations related to Romania's preparation to join the European Union (2007), including complete implementation of the EU environmental and agricultural policies, determining important changes related to land use and, particularly, forest dynamics.

The patterns of change which have characterised the last analysed period had triggered rather difficult to trace statistically land use changes (including forest) due to the increased land fragmentation, agricultural land abandonment, afforestation plans and, not least, the limitations and uncertainties triggered by the CORINE Land Cover database

(minimum mapping area – 25 ha). However, overall, more than 3% of the water bodies were converted to agricultural land, 2% of agricultural areas to woodland and almost 5% of agricultural land and forest covered areas to water bodies. On the other hand, almost 5% of the water bodies, agricultural land and built-up areas were transformed into forest covered areas due to afforestaion actions or natural regeneration (Fig. 7).

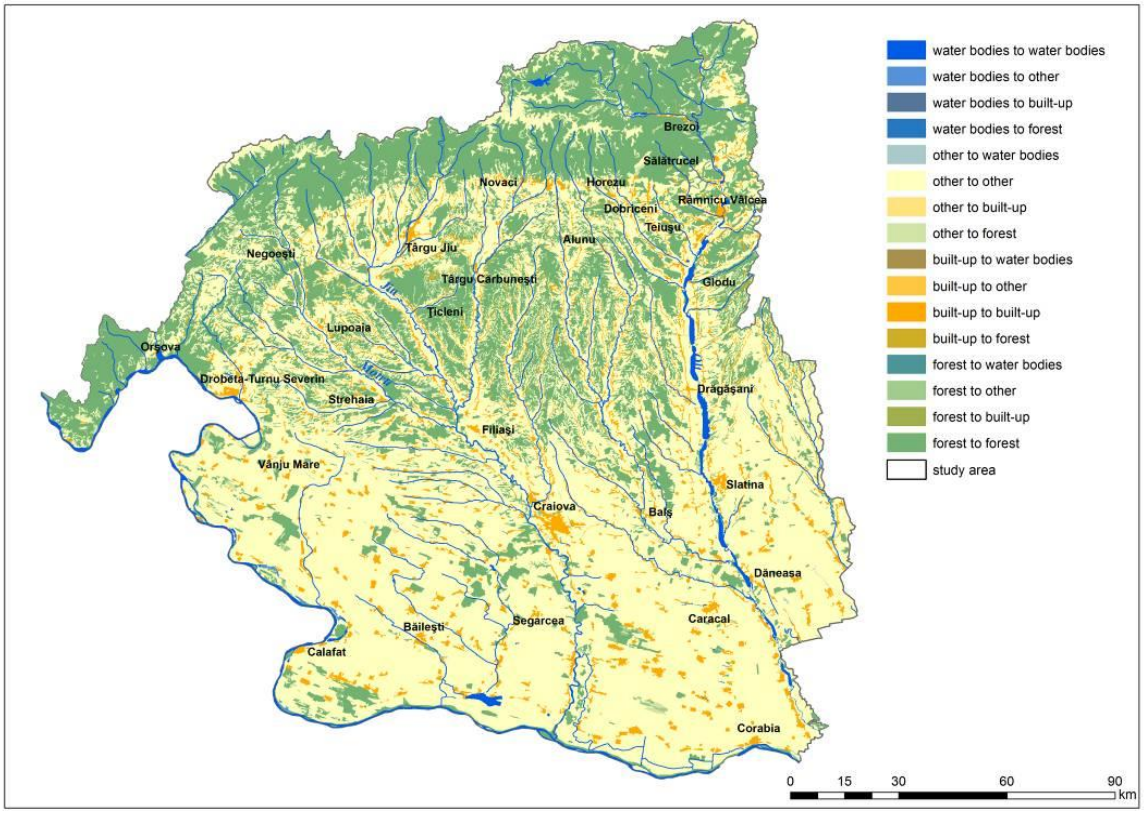

Fig. 7: Land use changes over the 1990-2006 period in the South-West Development Region

After 2000, in relation to Romania's pre-accession to European Union, the arable area tended to increase, while the vine-and-fruit-tree areas continued to drop, especially in the hilly plateau and Subcarpathian areas. It is within this context when mountain forests and protection belts from plain and tableland areas were systematically illegally logged, thus affecting land quality and triggering extreme weather phenomena (Popovici et al., 2013; Dragotă et al., 2011; Bălteanu et al., 2013). Furthermore, the urban sprawl process (mainly sub-urbanization) expands, tending to evolve into large sub-urban areas in the surroundings of large towns, thus leading to significant land use conversions.'

Overall, at NUTS 2 level, the largest forest logging were experienced during the 1992-2000 period following the restitution laws which led to significant forest cover withdrawn, in a certain extent related to illegal logging from the state forest (Fig. 8).

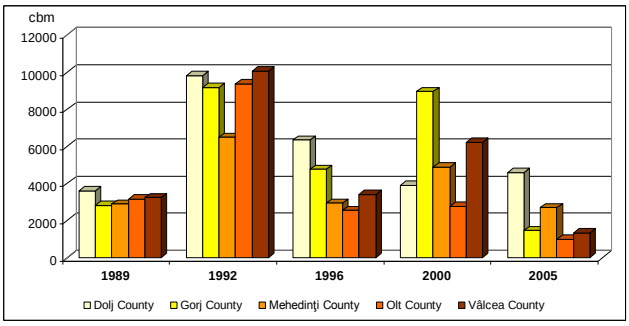

Fig. 8: Illegal logging from the state forest at NUTS 2 level in the South-West Development Region

Source: National Forest Administration

The **trend index**, seen as the number of changes undertaken at pixel level (from one category to another) against the total number of changes, reveal that, generally, the largest amount of transformations took place with respect to water bodies, especially during the 1971-1990 and 1990-2006 intervals, mainly related to flood control management works along the Olt and Jiu Rivers and along the Danube Floodplain. Significant changes

were registered in the built-up areas (with the highest peak in the last analysed interval due to urbanisation and suburbanisation processes) and agricultural areas (over the 1971-1990 and 1990-2006 periods in relation to extensive/intensive agriculture, land abandonment, agricultural land fragmentation etc.) categories (Fig. 9).

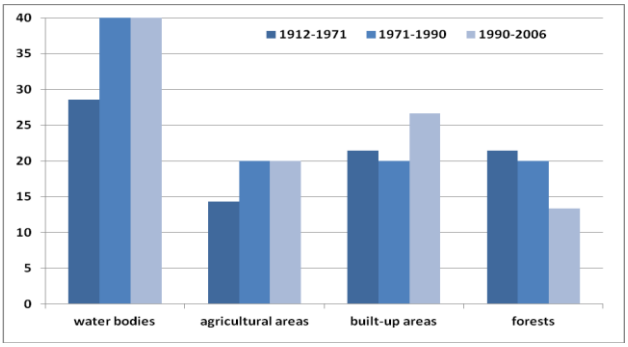

Fig. 9: Trend index for the main land use categories in the South-West Development Region

In line with these changes related to the main land use/land cover categories, the forest covered areas also experienced significant transformations triggered or induced by the above mentioned land conversations. Therefore, as compared to the other changes, forest covered areas register a decreasing trend during the analysed time frames from over 20 index values in the first interval (1912-1971) to less than 15 index values in the last analysed interval (1990-2006) due to the intense and diverse land use transformation related to agriculture and urbanization. The largest share of forest covered related changes were largely linked to agricultural land use, especially during the first and second analysed intervals, and secondly to built-up areas (mainly during the 1912-1971 time frame) and water bodies (particularly during the 1971-1990 period). In the South West Development Region, the areas the most affected by these processes ranged from rather scattered surfaces in the hilly-plateau areas of the Getic Piedmont and Subcarpathians to more compact areas in the mountain regions of the Southern Carpathians.

Conclusion

The analysis undertaken within the current study was focused on the three major intervals with the aim of underling the forest cover transformations in and from three main land use categories: agricultural land, built-up areas and water bodies. The binary change index revealed more significantly the transformations into agricultural land use category mainly during the 1912-1971 interval and constantly decreasing after 1971-up-to date. These conversions were connected to the consequences of land laws (1918-1921 and 1945 land reforms), of different political and economical changes related to extensification and intensification of agriculture. As a result, lower transformations were registered from forest covered to water bodies or built-up area categories (Fig. 10).

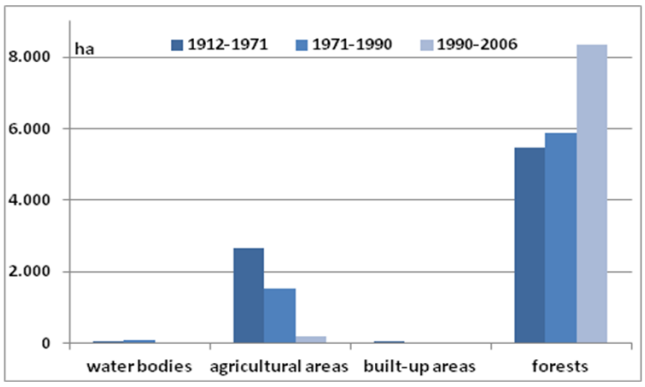

Fig. 10: Forest cover conversion over the 1912-1971, 1971-1990 and 1990-2006 intervals in the South-West Development Region

In line with these conversions, overall, the forest covered area decreased over the 1912-1971 period and steadily increased after 1971, especially after 1990 in relation to extended afforestation actions which took place in the Danube Floodplain, Oltenia Plain, degraded land from the hilly and mountain areas etc. At NUTS 2 level (1990-2009), forest cover dynamics was rather uneven in the study-area mainly related to the physical-geographical conditions which characterise each administrative unit. Dolj County was the most affected by forest withdrawal due to extensive logging of woodland in the plain area, especially with respect to the acacia tree plantations (Fig. 11, Fig. 12).

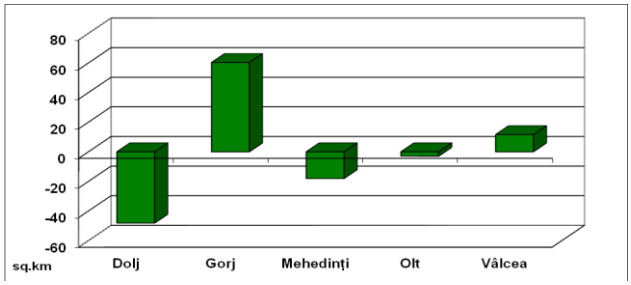

Fig. 11: Forest cover dynamics at NUTS 2 level (1990-2009) in the South-West Development Region

Source: National Forest Administration

Over the last analysed period, the forest fund structure witnessed slight changes, shrinking in the counties situated in the central and southern part (Dolj, Mehedinţi and Olt) and slowly extending in the northern counties (Gorj and Vâlcea) overlapping hilly and mountain areas.

Fig. 12: Accacia forest affected by drought on sandy fields (a) and by sand dunes in Oltenia Plain (b)

The assessment of land use dynamics with an emphasis on forest covered areas is a necessary process in the evaluation of landscape dynamics, ecosystem's balance in terms of structure and functions, land quality etc. The related effects could sum up to several environmental disturbances related to land and soil degradation, intensification of extreme weather events (aridity and drought phenomena, blizzards, hail storms etc.), habitat fragmentation, biodiversity loss, shifting forest limit in the mountain regions etc. Assuming measures to prevent uncontrolled forest cover change especially in the vulnerable regions such as drought prone or flood exposed areas should be coupled with additionally management and conservation measures in order to provide sustainable use of woodland in the study-area.

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The role of Şarlota Park (Timiş County) in the colonisation of a new mammalian species - Fallow Deer (Dama dama L., 1758) in Romania

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Abstract

Şarlota Park, located in Lipova Plateau, was founded between 1902 and 1904 at a distance of 42 km from the town of Timişoara. The aim was to create a hunting park, populated mainly with Fallow Deer. The first specimens, originating from the Habsburg Empire, were brought in animal trucks, colonised in the years 1904-1907, Şarlota railway station dating from 1896. As the species population grew to over 600 individuals, in the early 1950s specialists decided to have a number of specimens captured annually and colonise them in all of Romania`s provinces that offered similar environmental conditions. The animals were carried to the new sites in animal trucks and lorries. The captures (about 1,000 individuals) were made over 1942-1977, mostly between 1954 and 1970. The 73 transports resulted in the formation of 49 new populations of this species in Romania. It was the most outstanding action taken by the Romanian authorities to expand the area of a mammalian species.

Keywords: *Şarlota park, Fallow Deer, colonisation, Romania*

Rezumat. Rolul Parcului Şarlota (judeţul Timiş), în colonizarea unei noi specii de mamifere – Cerbul Lopătar (Dama dama L., 1758), în România

Parcul Şarlota a fost constituit în intervalul 1902-1904 în Podişul Lipovei, la 42 km de Timişoara. Destinaţia lui a fost şi este aceea de parc de vânat, specia principală fiind cerbul lopătar. Primele exemplare au fost aduse aici în intervalul 1904-1907 din fostul Imperiu Habsburgic în vagoane speciale, gara Şarlota existând din anul 1896. Sporind populaţia speciei la peste 600 de exemplare, s-a hotărât la începutul anilor `50 ai secolului trecut ca, anual, să se captureze indivizi pentru a fi colonizaţi în alte regiuni cu condiţii naturale similare, din toate provinciile României. Transportul acestora spre noile locuri de populare s-a făcut cu vagoane de tren şi autocamioane. Capturile (circa 1000 exemplare) s-au realizat în intervalul 1942-1977, cele mai multe între 1954 şi 1970. Astfel, cele 73 transporturi realizate au dus la constituirea a 49 de noi populaţii ale acestei specii pe teritoriul României. A fost cea mai semnificativă acţiune realizată de autorităţi, în România, pentru extinderea arealului unei specii de mamifer.

Cuvinte-cheie: *Parcul Şarlota, cerb lopătar, colonizare, România*

Introduction

The Fallow Deer is a mammal colonised in Romania, the first specimens having been brought in from Central Europe and placed in enclosed parks - Şarlota (Timiş County), Fiac (Arad County), Cetariu-Pucioasa and Balc (Bihor County) - created before the First World War. Of all these parks, Şarlota is the largest.

A representative site for the Fallow Deer in Romania is Şarlota Park (Bogda Commune), situated 42 km north-east of Timişoara town, verging on Arad County. The Romanian name of this Park derives from Charlotenburg, a neighbouring village (Fig. 1).

Şarlota Hunting Park, established by Count Siegfried von Wimphen between 1902 and 1904 on 1,194.8 ha, was populated with Fallow Deer. Currently, the Park is named « Fallow Deer Hunting Complex » and covers 1,206.9 hectares (forests – 1092.9 ha, crops to feed the game – 109.1 ha, small lake – 0.7 ha, other grounds – 4.2 ha).

The Park lies in the west of the Lipova Plateau. It extends from north to south (6 km) and from east to west (3 km). The altitude ranges between 132 m in the north (Beregsău Floodplain) and 274 m in the east (Fântâna Seacă Hill); 38% of the overall surface-area lies at 132-200 m alt. and 62% at 200-274 m alt. The annual mean temperature is of 10.8°C (in Timişoara), the quantity of precipitation reaching 606.2 mm (at Maşloc). The Park is crossed by the Hamoş Brook (a lefthandside tributary of the Beregsău) along 4.3 km. The main stands are Quercus cerris (59%), Quercus frainetto (23%), Quercus petraea (5%) and Carpinus betulus (5%).

Fig. 1: Entrance on Charlotenburg village territory, where Şarlota Park lies

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The present length of the enclosure (zinked wire net, 2 m high) is of 18.2 km. There are 11 acces gates wide of 5 m and 6 entrence doors, double ladder over the fence, for the staff. The Park has 5 food storehouses, 13 feeders, 80 saltings and 21 drinking places.

Research Methods

The present synthesis is based on field investigations into various Fallow Deer populations in Romania, as well as the consultation of a comprehensive documentary material identified in the archives of several forestry and hunting institutions; information was also obtained from foresters, hunters or locals.

Colonisations of Specimens Captured from Şarlota Park

During the Second World War, a few individuals were captured from Şarota Park and colonised in Reşca Forest (Olt County).

After 1950, the idea was to populate also other lowland forests of Romania. The first concrete actions to this effect were taken in 1954; in 1962, a task-plan to expand the colonisation of game, included also the Fallow Deer (Duda, 1967).

The Park was populated with Fallow Deer, originating from the former Habsburg Empire, between 1904 -1905, and occasionally in the years 1906-1907. The aim was to increase its population.

In 1905, the Park numbered 48 Fallow Deer specimens, 250 in 1929, 445 in 1938, 620-660 in 1954-1968 and over 850 individuals in 1977, an effective similar to the current one (Fig. 2).

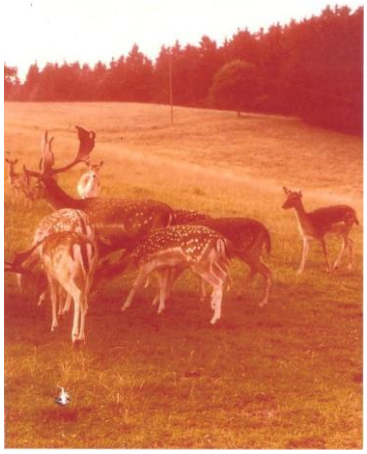

Fig. 2: A group of Fallow Deer in Şarlota Park

In 1954, there were 15 deer traps, but only one was still functional in 1968. In 1978, three trap enclosures, made of wire and acacia wood, did exist but only two were still in place in 1988.

Between 1942 and 1977 nearly 1,000 Fallow Deer were captured from Şarlota Park and sent to 29 counties (Fig. 3) of Romania (73 transports : by rail truck and lorry, in special boxes, at distances of 204-995 km and 55-482 km, respectively).

The animals were caught mostly in February (from the forests of Creţeşti, Mărgineni, Niculiţel, Bratovoeşti, Tismana, Dâlga, Chevereş and Papiu Ilarian) and March (from the regions of Fântâna Mare, Deduleşti, Seaca, Perişor, Pădureni, Hodoş, Lapiş and Iezeru Ighiel).

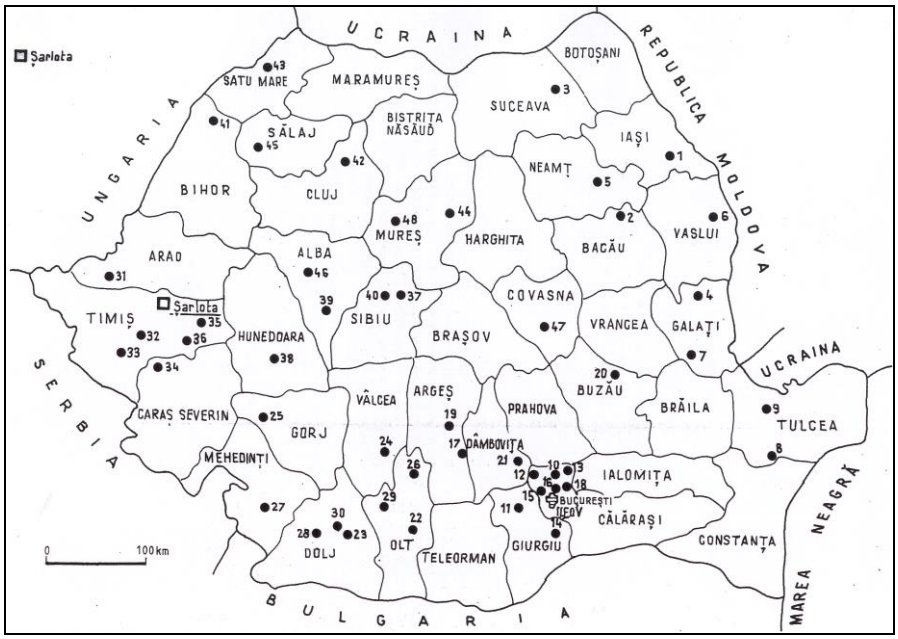

Figure 1: Sites in Romania colonised with Fallow Deer captured in Şarlota Park. Map figures: 1. Poieni; 2. Iteşti-Gârleni; 3. Pătrăuţi; 4. Adam; 5. Mărgineni; 6. Creţeşti; 7. Hanu Conachi; 8. Fântâna Mare; 9. Niculiţel; 10. Snagov Park; 11. Bolintin; 12. Buriaş; 13. Balta Neagră; 14. Comana; 15. Râioasa; 16. Băneasa Park; 17. Mozacu; 18. Brânzeasca; 19. Micești; 20. Deduleşti; 21. Bolovani; 22. Reşca; 23. Bratovoeşti; 24. Dobruşa; 25. Tismana; 26. Seaca; 27. Punghina-Pătulele; 28. Perişor; 29. Izvoru; 30. Dâlga. 31. Sânpetru German; 32. Chevereş; 33. Pădureni; 34. Ersig. 35. Margina; 36. Drinova-Tapia; 37. Valchid; 38. Haţeg; 39. Pianu; 40. Hodoş; 41. Cetariu; 42. Livada; 43. Noroieni; 44. Gurghiu; 45. Lapiş; 46. Iezeru Ighiel; 47. Reci; 48. Papiu Ilarian.

In this way, 49 new population nuclei were created in the following counties: 12 in Transylvania, 12 in Muntenia, 9 in Oltenia, 7 in Moldavia, 7 in Banat and 2 in Dobrogea. Today 21 of them are extinct (Table 1).

Table 1: Population sites in Romania of Fallow Deer captured in Şarlota Park

No.	Captured in	No. of specimens	Population site	Distance (km)
1	1942	5	Reşca (Olt County)	445
2	1950	A few	Snagov Park (Ilfov County)	590
3	1954	18	Balta Neagră (Ilfov County)*	604
4	1955	10	Poieni (Iaşi County)*	995
5	1955	18	Bolintin (Giurgiu County)	586
6	1955	15	Buriaş (Ilfov County)	596
7	1955	13	Comana (Giurgiu County)*	600
8	1955	7	Râioasa (Ilfov County)*	575
9	1955	18	Reşca (Olt County)	445
10	1955-1956	20	Iteşti-Gârleni (Bacău County)*	856
11	1956	22 (2 transports)	Pătrăuţi (Suceava County)	633
12	1956	17	Reşca (Olt County)	445
13	1956	10	Valchid (Sibiu County)*	307
14	1956	18	Haţeg (Hunedoara County)*	200
15	1957	16	Pianu (Alba County)	204
16	1957	18	Haţeg (Hunedoara County)*	200
17	1957	8	Valchid (Sibiu County)*	307
18	1957	18	Adam (Galaţi County)	850
19	1957	3	Băneasa-Bucarest Park*	560
20	1957	33	Mozacu (Argeş County)	514
21	1958	19	Fântâna Mare (Tulcea County)	880
22	1958	17	Niculiţel (Tulcea County)*	930
23	1958	18	Hodoş (Sibiu County)*	310
24	11 February 1959	8	Bratovoeşti (Dolj County)	400
25	25 February 1959	7	Bratovoeşti (Dolj County)	400
26	1959-1960	16	Cetariu (Bihor County)	228
27	1960	13	Adam (Galaţi County)	850
28	1960	A few	Brânzeasca (Ilfov County)*	593
29	1961	11	Dobruşa (Vâlcea County)	440
30	1962	10	Tismana (Gorj County)	310
31	1962	10	Mărgineni (Neamţ County)	947
32	1962	50	Creţeşti (Vaslui County)*	936
33	1962	15	Hanu Conachi (Galaţi County)	790
34	1962	18	Râioasa (Ilfov County)*	575
35	1962	14	Livada (Cluj County)*	361
36	1963	16	Noroieni (Satu Mare County)	325
37	1963	4	Livada (Cluj County)*	361
38	1963	8	Sânpetru German (Arad County)	85
39	1964	15	Mărgineni (Neamţ County)	947
40	1964	20	Bolintin (Giurgiu County)	586
41	1964	12	Seaca (Olt County)	482
42	1964	11	Seaca (Olt County)	482
43	1964	14	Tismana (Gorj County)	310
44	1964-1965	20	Comana (Giurgiu County)*	600
45	1965	20	Punghina-Pătulele (Mehedinţi County)*	290
46	1966	16	Perişor (Dolj County)*	450
47	1966	2	Izvoru (Olt County)	415
48	1966	20	Gurghiu (Mureş County)*	400
49	1967	18	Punghina-Pătulele (Mehedinţi County)*	290
50	1967	20	Perişor (Dolj County)*	450
51	1967	6	Micești (Argeş County)*	520
52	1968	2	Fântâna Mare (Tulcea County)	880
53	1968	18	Dâlga (Dolj County)	400
54	1968	10	Chevereş (Timiş County)	65
55	1968	25	Pădureni (Timiş County)	55
56	1968	7	Lapiş (Sălaj County)	320
57	1968	7	Iezeru Ighiel (Alba County)*	235
58	1969	24	Deduleşti (Buzău County)	770
59	1970	14	Ersig (Caraş-Severin County)	80
60	1970	35 (2 transports)	Reci (Covasna County)	455
61	1973	22	Margina (Timiş County)*	155
62	1974	6	Izvoru (Olt County)	415
63	1975	11	Izvoru (Olt County)	415
64	1976	10 (2 transports)	Bolovani (Dâmboviţa County)	570
65	1976	20	Tapia (Timiş County)*	90
66	1976	18	Papiu Ilarian (Mureş County)	330
67	1977	29	Drinova (Timiş County)*	100

** Populations extinct today*

In brief, the situation looked as follows:
a) Moldavia: 173 individuals were colonized between 1955-1964, and most of them (75) were transported in 1962. There were 10 transports by train at distances of 623-980 km. The boxes were carried from terminal railway stations to colonization sites by cart, truck or sledge (10-27 km), two transports to each of the following sites - Pătrăuţi (Suceava County), Adam (Galaţi County) and Mărgineni (Neamţ County). Seven population nuclei were formed; three of them are currently extinct. Population batches consisted of 7-50 individuals. The species still exists in three counties: Galaţi, Neamţ and Suceava;
b) Dobrogea: 36 individuals colonised in 1958 by two rail transports at distances of 850-900 km. The boxes were carried from terminal railway stations to colonisation sites by truck (30 km). Two population nuclei were formed; one of them is currently extinct. Population batches consisted of 17-19 individuals. The species still exists in Tulcea County;
c) Muntenia: 205 individuals colonised between 1950-1976, most of them (71) were brought in 1955 by train or lorry (16 transports) at distances of 480-750 km. The boxes were carried from terminal railway stations to colonisation sites by lorry (15-44 km). There were two transports to each of the following sites - Bolintin and Comana (Giurgiu County) and Râioasa (Ilfov County). Out of the 12 population nuclei created there, 6 are extinct today. Population batches consisted of 3-33 individuals. The species still exists in 5 counties: Argeş, Buzău, Dâmboviţa, Giurgiu and Ilfov;
d) Oltenia: 224 individuals colonised between 1942-1975, most of them (38) having been transported in 1967. There were 18 transports by train and lorry at distances of 280-445 km and 290-482 km, respectively. The boxes were carried from terminal railway stations to colonisation sites by lorry (20-35 km). Two transports to each of the following sites - Bratovoeşti and Perişor (Dolj County), Seaca (Olt County), Tismana (Gorj County) and Punghina-Pătulele (Mehedinţi County), and three transports each to Reşca and Izvoru (Olt County). Out of the nine population nuclei, two are currently extinct. Population batches consisted of 2-20 individuals. The species still exists in four counties: Dolj, Gorj, Olt and Vâlcea;
e) Banat: 76 individuals colonised between 1963-1977, most of them (35) having been transported in 1968. There were 6 transports by lorry at distances of 55-155 km. Six population nuclei were formed, two of them are currently extinct. Population batches consisted of 5-25 individuals. The species still exists in three counties: Arad, Caraş-Severin and Timiş;
f) Transylvania: 225 individuals colonised between 1956-1976, most of them (42) having been transported in 1957. There were 16 transports by train and truck at distances of 201-303 km and 200-455 km, respectively. The boxes were carried from terminal railway stations to colonisation sites by lorry and cart (3-7 km). There were two transports to each of the following sites - Reci (Covasna County), Valchid (Sibiu County), Haţeg (Hunedoara County) and Livada (Cluj County). Twelve population nuclei, were formed six of them are currently extinct. Population batches consisted of 4-20 individuals. The species still exists in six counties: Alba, Bihor, Covasna, Mureş, Satu Mare and Sălaj.

Conclusion

Most of the Fallow Deer populations colonised in various parts of Romania originated from Şarlota Park.

The Fallow Deer started being colonised during the Second World War, but the action got momentum under communism. The animals were transported in coated boxes sized to the animals standing or lying postures. In many sites destined to colonisation, enclosures used to be built for the animals to get accommodated; in other sites, they would be released directly into the wild.

In the interval spanning the years 1942-1977, about 1,000 individuals originating from Şarlota Park were being colonised. All of the country`s provinces were being populated, yet particularly those in Transylvania (225) and Oltenia (224), the fewest specimens being colonised in Dobrogea (38). The distance between population sites is of 55-995 km from the Şarlota Park.

The period chosen for this operation was mostly February and March. Out of the 49 new populations thus obtained, 21 are extinct today. Most colonisations (7) took place in 1955, the largest number of colonised animals (117) was in 1962.

Colonised batches included between 2 and 50 individuals.

So, Şarlota Park was an onstanding site in the "chronology" of man-related enlargement of the Fallow Deer area in Romania.

In Romania, there are 5,000 Fallow Deer specimens (Ministry of Environment data). These specimens are naturalised, an assertion sustained by two arguments: the species reproduces in the new sites, and has fully integrated where introduced.

The Fallow Deer population is affected by two restrictive factors: 1) poaching (which got momentum over the past few decades) and 2) intenser circulation of people and vehicles after 1991, when land was being restituted to former owners, a situation that reduced the quiet needed by big mammals.

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Globalisation and Urban Spatial Reconversion. Case-Study: Commercial Services in Romania

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Abstract

The ever-growing concentration of income in the capital-city and in major towns has encouraged the development of a series of specialized products and services and the opening of commercial units. The only limit to this type of localization seems to be the continuous social segregation which restricts demand and creates preferential segments of users. New types of urban-rural polarisation are created, directly proportional to the social and cultural segregation and polarisation that condition the Romanian urban system's capacity to absorb globalizing fluxes. Thus, strong financial segregation among the urban population in the wake of restructuring industrial activities restricts the penetration of globalizing fluxes. Even if the products of the consumerist culture are intensely penetrating at local level, yet the population's access to them is still limited. Global culture tends to combine with endemic culture, grafted on poverty, deteriorating the quality of life and stimulating urban subculture and organised crime. Financial investments constitute the basis of the spatial distribution of commercial investments. The outlet market potential is the decisive factor for commercial investments, that is chains of stores usually set up by transnational companies. The establishment and diffusion of these commercial units in the territory is closely correlated with the location of banks, dependent on the income-based spatial segregation of the population. Thus, big commercial units are more frequently found in large cities with macro-regional polarisation functions and a positive economic dynamic that ensures the presence of an outlet market competitive enough both financially and quantitatively, so as to guarantee that the investment is profitable. On the other hand, the east/west financial segregation existing in Romania directly reflects segregated localisation of commercial investments which are placed mostly in Bucharest and the large cities from the central and western regions of the country – Transylvania, Banat and Crişana.

Keywords: *globalisation, global consumerist goods, urban systems, urban spatial reconversion, services, functional diversification, commercial investments, location, Romania, Bucharest*

Rezumat. Globalizare şi reconversia spaţiului urban. Studiu ce caz: Serviciile comerciale în România

Concentrarea tot mai mare a veniturilor populaţiei în capitală şi în oraşele mari a determinat dezvoltarea de produse şi servicii specializate, precum şi localizarea de unităţi comerciale. Acest tip de localizare pare însă să fie condiţionat de segregarea socială tot mai evidentă, prin limitarea cererilor şi conturarea unor segmente preferenţiale de beneficiari. Astfel s-au evidenţiat noi tipuri de externalităţi urban-rural, direct proporţionale cu segregarea socială şi culturală, externalităţi ce condiţionează capacitatea de absorbţie a fluxurilor globalizante la nivelul sistemului urban românesc. Astfel, puternica segregare financiară care există în rândul populaţiei urbane, ca urmare a restructurării activităţilor industriale, determină limitarea pătrunderii fluxurilor globalizante. Chiar dacă la nivel local produsele culturii de consum au un potenţial ridicat de penetrare, accesul populaţiei la acestea continuă să fie limitat. Cultura globală tinde astfel să se combine cu o cultură endemică, grefată pe sărăcie, cea ce contribuie la degradarea calităţii vieţii şi favorizează apariţia subculturilor urbane şi a criminalităţii organizate. Investiţiile financiare reprezintă astfel premisa localizării celor comerciale. Potenţialul pieţei de desfacere constituie factorul determinant pentru amplasarea de investiţii comerciale, reprezentate de obicei prin lanţuri de magazine înfiinţate de companii transnaţionale. Amplasarea şi extinderea în teritoriu a acestor unităţi comerciale este strâns corelată cu localizarea unităţilor bancare, dependentă la rândul său de segregarea spaţială a populaţiei în funcţie de nivelul veniturilor obţinute. Astfel, cea mai mare frecvenţă a unităţilor comerciale mari este în marile oraşe, centre de polarizare cu funcţii macro-regionale, cu o dinamică economică pozitivă, ce pot asigura o piaţă de desfacere suficient de competitivă, atât din punct de vedere financiar cât şi al cantităţii de mărfuri operate, asigurând astfel profitabilitatea investiţiei. Pe de altă parte, segregarea financiară est/vest se reflectă direct proporţional şi în segregarea localizării investiţiilor comerciale, acestea fiind amplasate mai ales în Bucureşti şi în marile oraşe din regiunile centrale şi vestice – Transilvania, Banat şi Crişana.

Cuvinte-cheie: *globalizare, produse ale culturii globale de consum, sisteme urbane, reconversia spaţiului urban, servicii, diversificare funcţională, investiţii comerciale, localizare, România, Bucureşti.*

Aim and methods

The economic market potential is a major decisive factor in the placement of big commercial investments, whether it is a commercial centre like a mall, that gathers together a variety of supermarkets, that is, a chain of stores usually set up by transnational companies (Dunning, 1993).

The logic behind the establishment and dissemination of these commercial units in the territory is closely correlated with the location of financial services, depending on the spatial segregation of the population based on income levels (Kralj & Marki, 2007). In this context, the paper analyses localisation strategies and the dispersion factors of financial and commercial

services in the Romanian urban system and particularly in its capital-city.

The methods used were both deductive and inductive.

Gglobalisation and the diversification of services in Romania

Globalisation and the urban systems

The downfall of the communist system in Central and Eastern Europe and the abolishment of ideological barriers has created the premises for closer globalizing links within the urban systems from this part of Europe (Robertson, 1993; McFarlane, 2006).

On the line of former experience as COMECON members, the first half of the 1990s witnessed, after the dissolution of that organisation, a rise in the volume of trade exchanges, of imports in particular; services and investments were aimed at developing small and medium-sized enterprises (Wackermann et al., 1997).

Towns acted as nuclei, polarising and re-directing fluxes in the territory. However, development, as it were, could not compensate for the industrial decline and its demographic and especially social consequences (Featherstone, 1990, 1995; Friedman, 1994). After over fifty years of forced industrialisation drive associated with hypertrophic development, the Romanian urban system (Fig. 1) has been experiencing a radical transformation, basically de-urbanisation both as regards town population and town quality, its functional attributes undergoing substantial changes (Holm, 1997).

Thus industry, which was the main factor of urbanisation for almost all of Romania's towns, has been overcome by the tertiary sector, a phenomenon specific to large cities, the capital and the regional metropolises strengthening their co-ordinating positions in the territory (Ianoş & Tălângă, 1994; Ianoş et al., 2000; Knox & Marston, 2001).

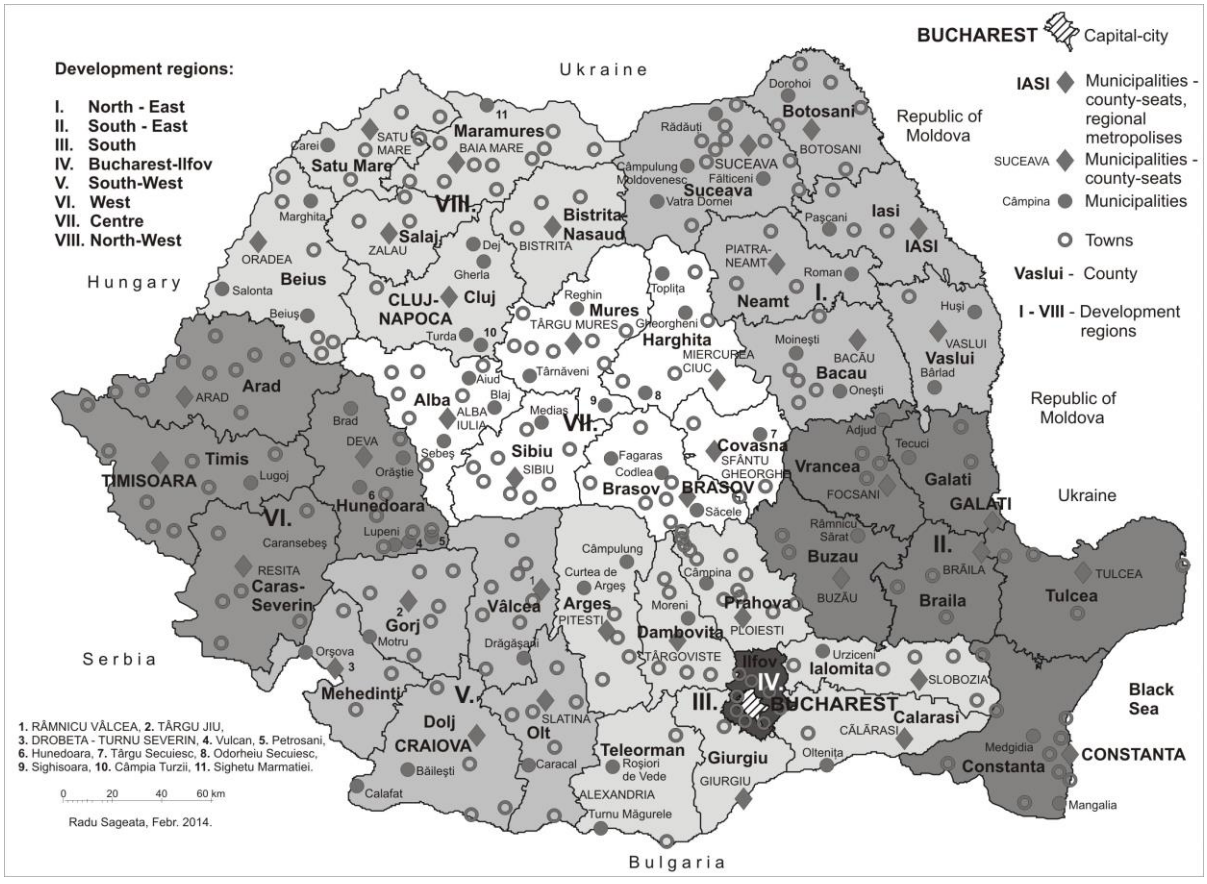

Fig. 1: The Romanian urban network *(Source: Radu Săgeată)*

Cosmopolitan cities

Large cities tend to assume the attributes of cosmopolitan cities due to greater ethnical diversity, the development of specialist services and the large-scale assimilation of global consumerist goods (Bonnet, 2000), basically products and services which go beyond geo-cultural spaces (Sassen, 1991; De Lotto, 2008).

Foods and fashion items have the strongest impact on the population. The settlement in Romania of Arab, Turkish or Chinese nationals

engaged in trading, or in small industrial businesses, the presence of foreign citizens who have come to study here, of the personnel of diplomatic missions, of multinational firms or NGOs has diversified the services sector (Chinese, Lebanese, Italian or Greek restaurants; French or German bakeries; African, Indian or Latin-American artisanal shops, etc.) (Fig. 2) (King, 1990; Fall, 1998).

Their localisation within commercial centres (malls and supermarkets) explains the importance of these units for the local diffusion of the products of global consumerist culture (Claval, 1995).

Fig. 2: Globalisation of food services in Romania. ***left - Chinese restaurant in Bucharest; right - Lebanese fast-food in Timişoara (Photo: Radu Săgeată)***

Financial and commercial segregation of the urban space in Romania. Case-studies

The logic behind the establishment and diffusion in the territory of commercial units closely correlates with the location of financial services according to spatial, income-based segregation of the population. Bank services were oriented mainly to cities, especially those placed in developed regions (the capital and the counties from Banat and Transylvania). An exception is CEC Bank, the only bank having a large network developed also in the rural areas (Săgeată & Guran, 2007). At national level, there are two strategies for bank location. Some banks were set up in the Capital and spread to the rest of the cities, while others, founded in the large urban settlements of Transylvania and the western regions of Romania (Cluj-Napoca, Sibiu, Târgu Mureş, Arad, etc.), used Bucharest as a relocation core (Fig. 3). Thus, large commercial units frequently opened up in large cities with macro-regional polarising functions and a positive economic dynamics that ensured an outlet market, competitive enough in terms of financial and quantitative attributes, so as to guarantee profitability. On the other hand, investments in towns that are at the base of the urban hierarchy materialised in supermarkets, but if towns have below 30,000 inhabitants they are considered unprofitable.

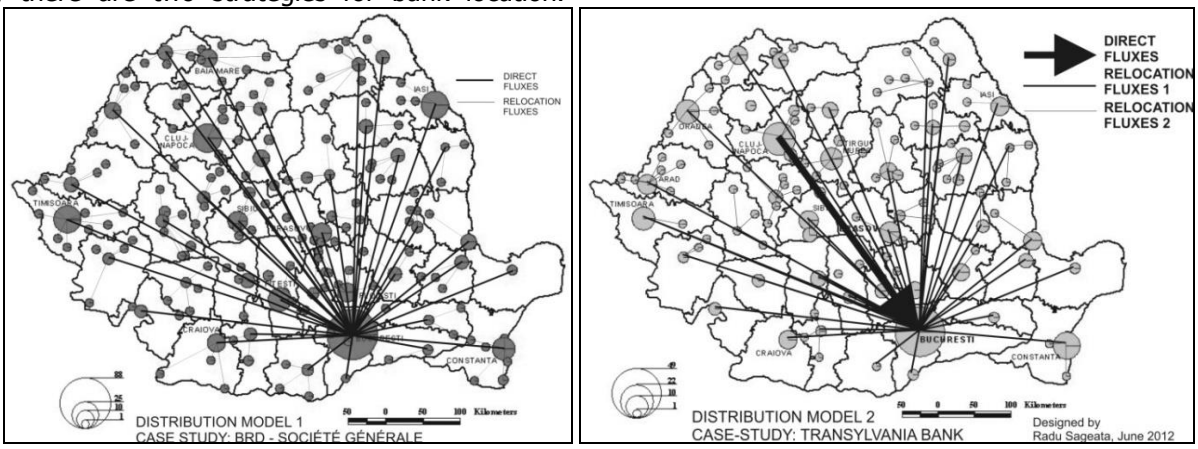

Fig. 3: Distribution models of financial services in Romania. ***left - Distribution model 1: Case-study: BRD-Société Générale; right - Distribution model 2: Transylvania Bank (Source: Radu Săgeată)***

Positive segregation exists in Bucharest, in some counties from Transylvania, Banat and in Constanţa County, strictly correlating with the polarisation of incomes; negative segregation exists within the counties from the eastern and south-eastern parts of Romania. Thus, according to a study made by the market research company *MEMRB Retail Tracking Services* in October 2006 and October 2007, the counties most likely to be targeted for the expansion of such commercial lines were Sibiu, Constanţa and

Mureş, while Botoşani, Tulcea, Teleorman and Buzău, featured almost exclusively traditional trading.

The same pyramidal distribution observed in the case of financial investments holds also for commercial units, provided that the extent of the investment is directly proportional to the size of the respective town (Bonneville et al., 1992). The east/west financial segregation in Romania, mirrors the development of commercial services, this type of investment being drawn mainly by Bucharest and the large cities from Transylvania and Banat. Thus, the largest *malls* and supermarkets are situated mostly in Bucharest and in the western metropolises of Romania: Timişoara, Arad and Oradea (Săgeată, 2009-a, Săgeată et al., 2010 & 2011).

The social impact of commercial investments is worth-considering. The concept of "mall" goes beyond a strictly commercial function, being associated with luxury and fashion: one goes to a mall to see new trends, socialise, make acquaintances with a certain segment of the population (Jarvis et al., 2001). Therefore, financial segregation combines with social segregation, both being embodied in commercial segregation, and malls are the best way to express it. Not surprisingly, in some commercial centres, shopping and business facilities are associated with social facilities (e.g. *Julius Mall* in Timişoara has a register office and a chapel) (Fig. 4).

Besides fashion clothes, cosmetics, accessories and household appliances shops, malls include also fast-food restaurants, coffee shops, multiplex cinemas, casinos and games, intended to disseminate global consumerist goods within the Romanian urban society. The social function of malls in the built-up area is visible in the number of visitors to the twelve Bucharest malls.

Fig. 4: "Julius Mall" in Timişoara, the big shopping centre in the West of Romania *(Photo: Radu Săgeată)*

On the other hand, building some of these commercial centres implies special works to improve the infrastructure, e.g. the construction of *Trident Plaza* in Constanţa requires the consolidation of the city's sea cliffs area; other special works imply the rehabilitation and integration of certain historical buildings into the respective commercial centres - e.g. the former water tower in Bucharest will become part of the *Bricostore-Orhideea Shopping Center* (Fig. 5), or the former slaughter-house in Timişoara will become part of the future *Civis Center*).

Fig. 5: "Bricostore-Orhideea" in Bucharest, and the former water tower *(Photo: Radu Săgeată)*

The development and modernisation of trading services is one of the main components of the tertiary sector in Romania. The process has gained in importance after 2000; according to available data, only 6% of the consumer goods were sold through store chains in 2000, 27% in 2005 and 50% in 2010. The dynamics of this process is due to Romania ranking on the eights place on the preferential trade list of investors, Russia and the Czech Republic heading the list (Ciobanu et al., 2009). At the same time, the global character of this process is given by the specific consumer goods found in commercial centres and by over 90% of the modern trade network belonging to international store chains.

With the concentration of incomes in the Capital and in the large cities, commodity markets, or specialist services units, ended up in big commercial complexes. Their localisations are seemingly the result of increasing *social segregation*, tending to limit the area in which this type of goods and services are likely to be spread, because demand rests with a specific segment of users.

Hence, a new type of urban-rural polarisations, directly proportional to social and cultural segregation, is dependent upon the capacity of the Romanian urban system to absorb the globalizing fluxes. The severe financial disparities, affecting the urban population in the wake of industrial restructuring, filter the penetration of globalizing fluxes. At local level, although the items produced by the culture of consumption are somehow easily penetrating, they are not very accessible. Thus, the combination of global culture with endemic lack of culture grafted on poverty

is a fertile ground for the recrudescence of urban sub-culture and organised crime.

Strategies of placing commercial investments in Romania

Spatially, two types of distribution seem to emerge: one going from Bucharest to the major cities (e.g. *Cora*, *Carrefour*, *Metro*, *Auchan* etc.) and a second one from the cities located in the west of the country, especially Timişoara and Cluj-Napoca (e.g. *Selgros*, *Spar*, *Profi*, *Real* etc.).

There is also spatial complementariness: some companies (*Profi*, *Spar*) prefer Bucharest and the major cities from Transylvania, others opt mostly for the Extracarpathian area (*Proges, Mini Max Discount* etc.). Most malls built in Bucharest (*Bucharest Mall, Plaza Romania Mall, City Mall* and *Liberty Center)* have been raised on the site of the unfinished buildings of former food complexes (mockingly, people used to call them "hunger circuses"), whose construction had begun in the 1980s in convergence areas of population flows, subsequently contributing to the development of their neighborhoods (Fig. 6).

The next investments had in view either empty spaces on the outskirts of the city (*Carrefour* and *Metro Militari*, *Cora Pantelimon*), using the rail-and-road infrastructure existing at the margin of Bucharest, or the sites of former industrial units later demolished (e.g. *Cora Lujerului*, built on the site of a dairy factory, could use *Cotroceni* railway station), similarly, *AFI Cotroceni* situated on the premises of the former *UMEB* plant, had the advantage of a railway infrastructure (Fig. 7).

Fig. 6: Shopping centres located on the sites of former food complexes that started being built before 1990. *left – "City Mall" in Bucharest; right - "Plaza Romania" in Bucharest (Photo: Radu Săgeată)*

Fig. 7: Shopping centres located on the sites of demolished industrial units. *left - "Cora Lujerului" in Bucharest; right - "AFI Cotroceni" in Bucharest (Photo: Radu Săgeată)*

In many situations, big commercial investments were preferentially located in the administrative territories of certain communes situated in the periurban areas of big cities, where real-estate prices are lower. It is the case of supermarkets such as *Real* Timişoara-South (in Giroc commune); *Real* Timişoara-East (in Ghiroda commune); *Real* Suceava (in Schela commune); *Selgros* Târgu Mureş (in Ernei commune); *Selgros* Bucureşti-Pantelimon (in Pantelimon town); *Carrefour* Piteşti (in Blejoi commune); *Dedeman* Constanţa (in Agigea commune); *Dedeman* Brăila (in Baldovineşti commune to serve both Galaţi and Brăila cities); *Dedeman* Roman (in Cordun commune); *Dedeman* Piatra Neamţ (in Dumbrava Roşie commune); *Praktiker* Bacău (in Nicolae Bălcescu commune); *Praktiker* Piteşti (in Bradu commune), etc.

Advantageous locations have led in time to the development of commercial parks: *Băneasa* outside Bucharest on DN1 highway to Ploieşti; *Militari* in Bucharest, on A1 motorway to Piteşti and *Dragonul-Roşu* on the highway to Voluntari-Urziceni. A similar commercial park is scheduled to develop in Bucharest in the *Lujerului-Cotroceni* area and

encompass also *Cora Lujerului* supermarket, *Plaza Romania* and *AFI Cotroceni* malls; European Retail Park in *Selimbar residential area* (Sibiu) (Fig. 8), and similar parks outside Târgu Mureş, Deva, Botoşani, Arad, Brăila, etc.

Fig. 8: "European Retail Park" in Selimbăr residential area (Sibiu) *(Photo: Radu Săgeată)*

Student campuses are considered potential markets for commercial complexes. *Carrefour* Orhideea, placed in the close vicinity of the student campuses *Grozăveşti* and *Regie*, is a typical example of such a strategy (Fig. 9). *Iulius Mall* in Iaşi and *Iulius Mall* in Cluj-Napoca, located in Gheorgheni district, near the campus of the University of Economic Sciences, follow the same location logic, in other cases entertainment is complementary to shopping.

Fig. 9: "Carrefour Orhideea" located in the vicinity of student campuses (Bucharest) *(Photo: Radu Săgeată)*

Other establishments, having in view the same complementariness, combine tourist services with residential environments: *Eliana* Mall in Braşov situated in Bartolomeu commercial district, on the the tourist route to Bran resort; *City Park* on the outskirts of Constanţa (*Tabăcăriei* area), on the road to Mamaia sea-side resort. Another location strategy is to modernise the large commercial units built before 1989 (the so-called universal stores) and turn them into malls (Fig. 10).

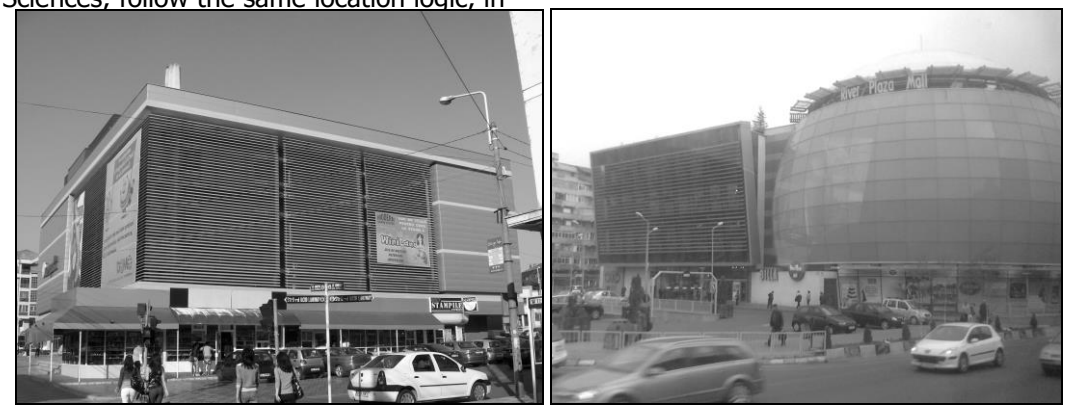

Fig. 10: Modernised old shopping centres. *left – Winmarkt Shopping Center in Galaţi; right – River Plaza Mall in Râmnicu Vâlcea (Photo: Radu Săgeată)*

A typical example of such a strategy is *Unirea* stores in Bucharest, which was extended and updated into what is now *Unirea Shopping Center*, with a *Carrefour* supermarket developing in its proximity. In the proximity of other commercial investments, usually from the same country, but with a strictly specialist offer, some supermarket chains have been attracted.

The supermarkets of *Bricostore* (French chain) localised in the proximity of *Carrefour* supermarkets (Bucharest-Orhideea, Bucharest-Băneasa, Arad, Constanţa, Focşani, Ploieşti, Suceava, etc.), or *Auchan* (in Piteşti); the supermarkets of *Praktiker* (German chain) in partnership with those of *Metro* chain (Bucharest-Militari, Bucharest-Băneasa, Arad, Constanţa, Piteşti, Ploieşti, etc.); the *Obi* chain sited in the proximity of *Real* chain (Bucharest – Berceni District, Bucharest – Pallady Avenue, Arad, Oradea, etc.). Other supermarkets in the neighbourhood of malls: *Cora Sun Plaza* (Bucharest – Berceni district); *Auchan* Cluj-Napoca, *Auchan* Suceava and *Auchan* Timişoara (near *Iulius Mall Shopping Center*); *Carrefour-Lotus* Oradea (near *Lotus Shopping Center*); *Carrefour-Era* (Iaşi & Oradea – near *Era Shopping Center*); *Carrefour - Polus* Cluj-Napoca (in *Polus Shopping Center*); *Cora* Constanţa (near the *City Park Mall*); *Real* Cotroceni Bucharest (in *AFI*

Palace Shopping Center); *Cora* Baia Mare (near *Gold Plaza Mall*), etc.

Ethnical neominorities and commercial investments

An extremely hypertrophic Capital compared to the other regional metropolises in Romania (Cluj-Napoca, Iaşi, Timişoara, Constanţa, Braşov, Craiova etc.), and its rather remote spatial location from other big cities in Central – South East Europe (Budapest, Kiev, Odessa, Athens or Istanbul) explains why Bucharest can act as an intra-continental city with polarisation functions. In this way, it can better take in globalizing fluxes and accommodate more rapidly to the attributes of a cosmopolitan city (Săgeată, 2009-c).

In 2010, Bucharest numbered about 20,000 foreigners, who chose to group into zones by ethnic criteria, thereby contributing to socio-spatial segregation within the city. It was not by chance that the Chinese gathered in the Obor-Colentina-Voluntari zone, given that their businesses were linked to commercial activities there; for similar reasons the Arabs opted for the Militari area and Grozăveşti-Regie student campus area where they did business (Fig. 11).

Fig. 11: "Sir" – Arab commercial investment in Militari residential area (Bucharest) *(Photo: Radu Săgeată)*

The majority are located in the centre of the city, but also in the centre of residential zones, becoming nuclei that relocate globalizing fluxes inside the urban through commercial activities discharged in the big vegetable markets and in supermarkets. They add specific culinary elements to Bucharest's cultural landscape, but also an original toponymy and symbolistics which tends increasingly to enter the autochthonous cultural heritage. The Chinese Dragon, the green of Islam, the Indian orange, or the Lebanon cedar are only a few of the symbols visible in the city landscape; words like tavern, pub, pizza, paprika, shaorma, croissant, hot dog, or hamburger have already entered the Romanian vocabulary. The Islamic veil, or elements of the traditional Indian or Japanese garment are quite commonly seen, no longer surprising anyone. In addition, one finds traditional elements of architecture specific to various cultures, strikingly obvious in the built-up area, creating in Bucharest that "cosmopolitan landscape" characteristic of the big metropolis.

The economic-financial crisis has a powerful impact on trade investments, the market being oversaturated and people's purchasing power fairly low, especially in Bucharest. Thus, shortage of investors made some projects be abandoned (*Oltenia Mall* in Craiova, *Galleria Shopping* Center in Bucharest, *Siret Plaza* and *Euromall* in Galaţi, *Three Galleria* in Buzău, etc.), postponed or their destination changed to offices buildings, e.g. Axa Shopping Center in Iaşi, while some supermarkets (*Pic* chain - in Brăila, Oradea and Călăraşi, *Spar* in Târgu Mureş) have been closed down.

Case-study: Bucharest

Bucharest was the first Romanian city in which malls were set up. The *Bucharest Mall* (initial trade area 37,000 m^2) was opened on September 10, 1999. Situated in *Vitan* residential district, in a dismantled urban area, this mall would rapidly become a point of convergence in the city. As a result, it was enlarged up to 99,000 m^2 in 2003 and 2007, housing 140 stores, most of them subsidiaries of international companies sales units. In 2004, the same investor opened the second mall in the west of Bucharest, between *Militari* and *Drumul Taberei* residential districts. This investment, called *Plaza Romania*, was intended to be the largest commercial centre of its kind, with a built-up area of 104,000 m2 profiled on shopping (over 150 stores), fast-food, entertainment and business (Fig. 6 - right).

However, its supremacy was short-lived: in 2005, the largest mall at the time was commissioned in Timişoara, a cross-border convergence point of the Danube-Criş-Mureş-Tisa Euroregion; two years later another complex was opened in Cluj-Napoca (Nov. 10, 2007). The same developer opened up *Julius Mall* in Suceava (September, 2008), overall area 132,000 m^2 (out of which 67,500 m^2 built-up spaces and 45,000 m^2 for rent and 150 shops). It was the biggest unit of its kind in Moldavia, and a regional convergence point for the counties of Suceava, Botoşani and Neamţ, as well as for the cross-border area with Ukraine and the Republic of Moldova. One year later, on October 29, 2009, the *AFI Palace Cotroceni* (214,000 m^2), investor the *AFI Europe*, Israeli Group (Fig. 7 - right), was commissioned. The construction, raised on the site of a former factory, houses 300 shops and the *Real* supermarket, the largest skating-rink and karting track built inside a commercial centre, an escalade wall, a bicycle track, a lake for small electric boats, play-grounds for children, a cinema-hall with 20 screens, the first

IMAX (3D) in Romania, two casinos, an exhibition hall and many more attractions. Forthcoming is the construction of four offices buildings (cca. 12,000 m^2) and a 4-star hotel. The same consortium has scheduled two projects for the near future: in Ploieşti (*AFI Palace* Ploieşti) and in Bucharest's Bucureştii Noi district (*AFI* Bucureşti).

In February 2010, another mall – *Sun Plaza* (210,000 m^2, out of which 80,000 m^2, commercial area) was added to the network. It is a 200-million euro-worth investment which houses 150 shops, coffee bars and *Cora* supermarket. However, in the conditions of the present economic-financial crisis its profitability is put in question, because the southern city districts (Ferentari and Rahova) are inhabited by lower-income people, have social problems and, moreover, it has to compete with similar structures recently commissioned (*City Mall* – Fig. 6 – left, *Grand Arena* and *Liberty Center*). However, these drawbacks might be compensated for by locating *Sun Plaza* in a convergence area of population fluxes (The South Square) with access to the underground network through a subterranean passage.

In the northern part of Bucharest stands *Băneasa Fashion Center* (85,000 m2 rentable area, basically twice that of *Plaza Romania* or of *Bucharest Mall*), with over 220 stores, opened on April 18, 2008. It is part of the *Băneasa Shopping* City complex, a commercial area of supermarkets (*Metro, Carrefour, Bricostore and IKEA*) with a total built-up area of 250,000 m2. It offers modern shopping, entertainment and business facilities. Its location was chosen because of transport facilities: *Băneasa* and *Otopeni* airports, *Băneasa* railway station and prospectively a heliport. *Băneasa Shopping City* holds a singular position as the district it lies in has the highest GDP per capita, remarkable demographic growth and a flourishing built-up area. This mall alone brought 45 new international brands in the Romanian market (Fig. 12).

Fig. 12: Shopping centres in Bucharest *(Source: Radu Săgeată)*

Conclusion

Malls and supermarkets in Romania, main types of location (Săgeată, 2008; 2009-b; 2010):

- On the site of former food complexes that started being built before 1990 (mainly in Bucharest), but were later abandoned: *Bucharest Mall*, *Plaza Romania* (Fig. 6-right), *City Mall* (Fig. 6-left) and *Liberty Center*. Scheduled to be built in the unfinished structure of what was to be the "Radio House" is *Dâmbovița Center*;
- In the proximity of existing large shopping centres forming together commercial and business parks (chains of supermarkets: *Carrefour, Cora, Auchan, Praktiker, Bricostore, Obi,* etc.);
- On the site of dismantled industrial units: *AFI Cotroceni* (*UMEB Plant*) (Fig. 7-right); *Sema Park* (*Semănătoarea* Plant); *Atrium Center* Cluj-Napoca (*Someşul* Knitwear Mills); *Craiova Mall* (*IRA* Factory); *Plaza Center* Timişoara (*Modern* Footwear Factory); *Civis Center* Timişoara (formerly a *slaughter house*); *Korona* Braşov (*Fartec* Factory); *Gold Plaza* Baia Mare or *Cora Lujerului* in Bucharest (demolished dairy factories) (Fig. 7-left);
- On the major highways, at the city margin: *Commercial Park Băneasa*, on DN 1 Bucharest-Ploieşti, *Militari Commercial Park* on A1 Bucharest-Piteşti, *Dragonul Roşu* on Bucharest-Urziceni Highway; *Euromall Piteşti* on A1 Piteşti-Bucharest; *Şelimbăr-Sibiu Commercial Park* on the highway to Timişoara and Bucharest (Fig. 8); *Constanţa South-Agigea*, on the road to Mangalia; *West Gate* and *Oltenia Mall* in Craiova on the roads to Filiaşi and Malu Mare, respectively; *Perla Shopping Center* in Ploieşti on DN1; *Galleria* in Suceava on the road to Fălticeni; *Plaza Center* in Timişoara on the road to Lugoj; *Plaza Center* in Hunedoara on the road to Deva; *Silver Mall* in Vaslui, in the north of the town, on the road to Iaşi; *Real* and *Obi Pallady* Bucharest on A 2 Constanţa - Bucharest motorway, etc.;
- On the outskirts of towns, on the road to tourist zones: *Eliana Mall* in Braşov, on the road to Bran-Moeciu, and *Mega Mall* on the road to Predeal; *City Park Mall* in Constanţa in *Tăbăcăriei* district, on the road to Mamaia sea-side resort, etc.;
- In the proximity of student campuses: *Iulius Mall* in Cluj-Napoca, *Iulius Mall* in Iaşi, *Crizantema Mall* in Târgovişte, *Carrefour Orhideea* in Bucharest (Fig. 9), etc.;
- On the site of former stadiums: *Mercury* in Arad (*Strungul* Stadium);
- In central areas, using local urban polarising cores: *Alba Mall* in Alba Iulia, *Bistriţa Mall* in Bistriţa, *Forum Center* in Piatra Neamţ, *Grand Mall* and Atrium Center in Satu Mare, *Aktiv Plaza* in Zalău, *Winmarkt Central Mall* in Vaslui, *River Plaza* in Râmnicu Vâlcea (Fig. 10-right), *Grand Center* in Sinaia;
- On the site of universal stores overhauled and turned into malls: *Unirea Shopping Center* in Bucharest, *Tomis Mall* in Constanţa, *Mureş Mall* in Târgu Mureş, *Moldova Mall* in Iaşi, *Winmarkt Shopping Center* in Galaţi (Fig. 10 - left), *Maramureş Shopping Center* in Baia Mare, etc.;
- In the proximity of parks associated with recreation and other functions (trade, business): *Park Lake Plaza* under construction near *Titan* Park, or *Galleria* Bucharest (still a project because no investors have come forward) in *Plumbuita* Park.

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The pattern of demografic changes in Craiova and its peripheries - causal or catalytic agent in the urban growth?

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Abstract

The paper analyses the demographic structure of Craiova and its neighbouring area, taking into consideration the suburbanization process and the strong demographic decline that followed after 1990. The demographic potential is the inner driving force of the urban and represents a decisive factor for the territorial changes that the contemporary post-communist town is facing in the context of an ever-increasing mobility and transformations of the core-periphery relationships.

Keywords: *Craiova, geodemographic resources, urban growth, demographic decline, suburbanization.*

Rezumat. Tiparul schimbărilor demografice în Craiova şi periferiile sale – agent cauzal sau catalizator în creşterea urbană?

Articolul pune în evidenţă analiza demografică structurală a municipiului Craiova şi a zonei sale adiacente, în contextul suburbanizării şi al declinului demografic pronunţat de după 1990. Potenţialul demografic exprimă forţa motrice internă a urbanului şi reprezintă un factor decisiv în cadrul transformărilor teritoriale pe care le traversează oraşul post-comunist contemporan în contextul mobilităţii crescânde şi a schimbării raporturilor centru-periferie.

Cuvinte-cheie: *Craiova, resurse geodemografice, creştere urbană, declin demografic, suburbanizare.*

Introduction

Well-known and influencial studies on urban structure to explain urban growth were posited by the Chicago School scholars; the process of urban expansion was explained based on differentiation of land uses and competition among those uses in models of internal organization, in terms of the invasion and succession of one zone (predominant land use) into the next outer zone adjacent to it, with physical expansion of the city as a result (Johnson et al., 2009, Warf, 2006).

A clear picture of a settlement's demographic potential is very important since the analysis of its diachronic evolution, together with the changes of the economic dynamics are the main factors that trigger urban growth and transformations of the relationships that will exist between the town and its hinterland (Suditu et. al., 2010, p. 81).

Meanwhile, demographic changes are one of the major inner forces needed for restructuring and transformation of the urban system components and of the relationships between them, with a multiple impact upon the inner urban organization and the spatial development of the town towards the rural area. Thus, 'the population, which through its characteristics, creates a tipical social environment, influences not only the economic activities by the quantity and quality of the work force, the human settlements following the population increase and the demands for a particular way of life, leading to their spreading and upgrading, but also the behaviour of human communities as a result of the training and education level' (Ianoş, 2000, p. 23).

Geographical setting

Craiova holds a good position in the national urban system and has a leading role at a regional level, as its demographic potential, together with the status of town of first rank, increase pole and headquarters of the South-Western Development Region prove it, polarizing the entire region. Craiova is situated almost in the center of the region (Fig. 1), halfway between the Carpathians and the Danube, at the crossroads of the main communication lines; hence, good accessibility and connectivity.

Along time, Craiova has maintained its rank within the national urban hierarchy as well as its role of the most influent centre within Oltenia. From this point of view, along the 20th century and the beginning of the 21st century, at national level Craiova has always been among the top ten towns of the country (Table 1), not only because of its administrative functions (county seat, oblast or region), but also because, just like other medieval towns, Craiova remained the main urban centre of a Romanian province, which ensured it a privileged regional position (Popescu, 2009).

At regional level, Craiova had a very stable position, testifying for a significant hierarchic innercy as a result of the few small and medium-sized towns, less competitive centres in the monocentric urban system of Oltenia (Table 2). The rank of Craiova town has a linear trend, compared with the other county seats in Oltenia. Still, the primacy index

(Voiculescu, 2004, p. 147) for Craiova and the next town has always been higher than 2.3.

The urban growth and the dynamic formation of the town periphery have been fundamentally influenced by the demographic vitality and predominantly rural regional context, Craiova's regional role and the development of road transports.

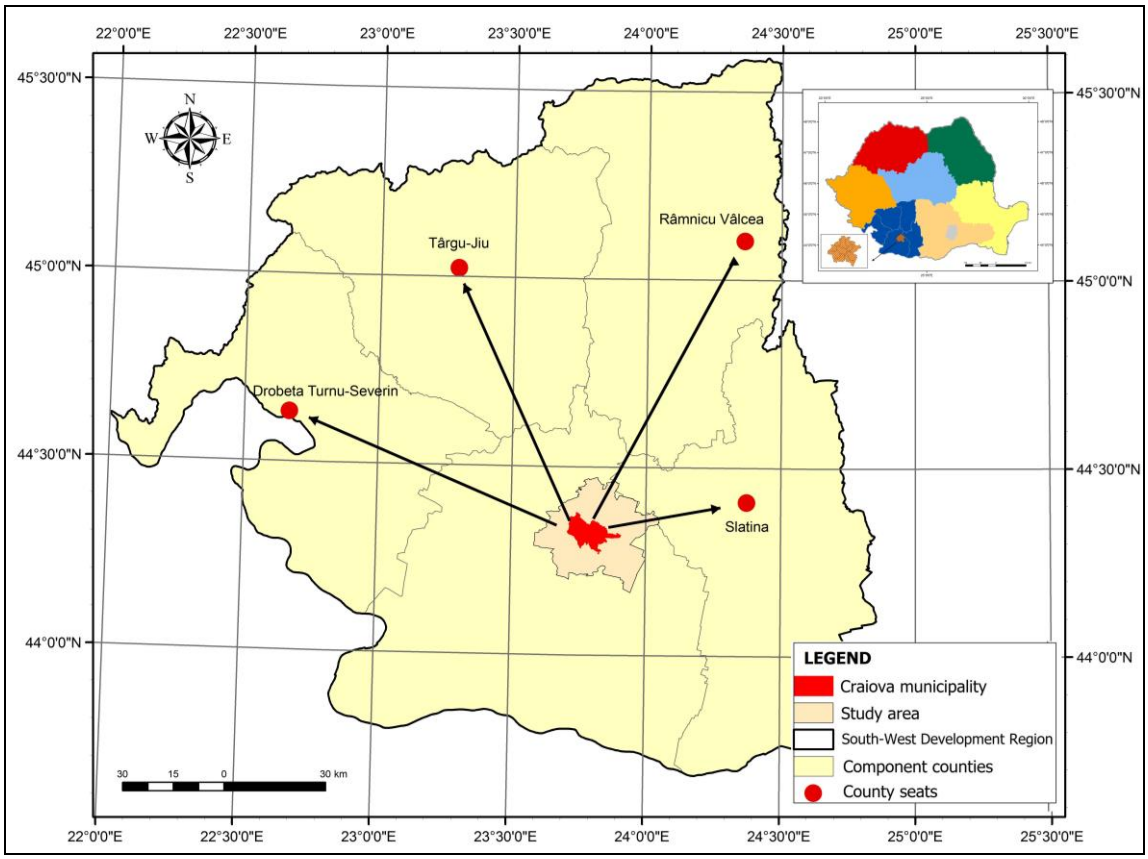

Fig. 1: Geographical setting

Table 1: Craiova in the national urban system

Rank	29.XII.1930	21.II.1956	15.III.1966	5.I.1977	7.I.1992	18.III.2002	20.X.2011
1	Bucureşti 639,040	Bucureşti 1,236 905	Bucureşti 1,365 885	Bucureşti 1,820 829	Bucureşti 2,067 545	Bucureşti 1,926 334	Bucureşti 1,883 425
2	Chişinău 114,896	Cluj-Napoca 154,762	Cluj-Napoca 185,786	Timişoara 271,927	Constanţa 350,581	Iaşi 320,888	Timişoara 319,279
3	Cernăuţi 112,427	Timişoara 142,251	Timişoara 174,388	Iaşi 269,464	Iaşi 344,425	Cluj-Napoca 317,953	Iaşi 290,422
4	Iaşi 102,872	Stalin* 123,882	Braşov 163,348	Cluj-Napoca 266,473	Timişoara 334,115	Timişoara 317,660	Cluj-Napoca 324,576
5	Cluj-Napoca 100,844	Ploieşti 114,560	Iaşi 160,889	Braşov 260,577	Cluj-Napoca 328,602	Constanţa 310,471	Constanţa 283,872
6	Galaţi 100,611	Iaşi 112,989	Galaţi 151,349	Constanţa 260,331	Galaţi 326,141	Galaţi 302,810	Craiova 269,506
7	Timişoara 91,580	Arad 106,457	Constanţa 150,436	Galaţi 244,021	Braşov 323,736	Craiova 302,601	
8	Ploieşti 79,149	Brăila 102,491	Craiova 148,821	Craiova 226,212	Craiova 303,959		
9	Brăila 68,347	Constanţa 99,690					
10	Craiova 63,215	Oradea 99,007					
11		Craiova 96,929					

(Data source: Romania statistical yearbooks, Population Census)

* nowadays Braşov

Table 2: Craiova's rank in the regional urban system

Year	Craiova			Râmnicu-Vâlcea		Drobeta Turnu-Severin		Târgu-Jiu		Slatina	
	R	S	Ip	R	S	R	S	R	S	R	S
1859	1	21,521	5.88	4	3,160	5	2,925	2	3,661	3	3,534
1899	1	45,579	2.31	4	7,288	2	19,753	5	6,718	3	8,150
1912	1	56,023	2.37	3	13,588	2	23,643	4	12,907	5	10,316
1930	1	63,215	2.99	3	15,648	2	21,107	4	13,030	5	11,243
1941	1	77,051	2.40	3	15,653	2	32,040	4	14,435	5	13,918
1948	1	84,574	2.70	4	17,238	2	31,296	3	17,698	5	13,136
1956	1	96,929	2.98	4	18,984	2	32,486	3	19,618	5	13,381
1966	1	148,821	3.28	4	23,880	2	45,394	3	30,837	5	19,267
1977	1	226,212	2.95	3	66,321	2	76,686	4	63,506	5	44,892
1992	1	303,959	2.64	3	113,624	2	115,259	4	98,238	5	85,168
2002	1	302,601	2.81	2	107,7263	3	104,557	4	96,562	5	79,171
2011	1	269,506	2.73	2	98,776	3	92,617	4	82,504	5	70,293

(Data source: Romania statistical yearbooks, Population Census)
R-rank, S-size, Ip-index of primacy

Thus, regarding the spatial concentric development, there exists a suburban ring that includes the present periphery of the town (the inner periphery): Făcăi, Mofleni, Popoveni, Şimnicul de Jos, Cernele, Cernele de Sus, Izvoru Rece, Rovine 2, and an outer ring that includes the neighbouring periurban area, the outer periphery or emerging periphery: Breasta, Bucovăţ, Cârcea, Coşoveni, Ghercești, Işalniţa, Pieleşti, Podari, Şimnicu de Sus (Şoşea, 2013, p. 191). The study points to their potential to influence the town dynamics, by highlighting the pattern of the natural dynamics and population mobility, focusing on the data provided by the last population censuses.

Population dynamics

Craiova has witnessed a relatively constant increase of population, with some variations: as a result of the two world wars, the population number changed very little during the first half of the 20th century; there was a significant increase following the decree from 1966 (that was targeted towards raising the birth rate by banishing all contraceptive means) and the positive migratory increase triggered by the strong industrialization process the town faced during the communist period. This episode was followed by a significant decline of the population number that all the post-communist towns had to face during the transition period.

The general ascending trend is the result of the consolidated function as major regional pole of the town, its administrative, economic and cultural functions. Thus, Craiova concentrated more and more population within the county, the share of the population from Dolj County that lived in Craiova increasing from 21.5% in 1966 to 2011.

During this period, Craiova witness a population increase of 91.8%, while the neighbouring communes faced a negative increase, varying from -49.3% as it was the case at Coşoveni, to -12.8% at bucovat (Table 3). Still, we must notice two different periods, with antagonic trends: from 1966 to 1990, the population generally increased (higher levels between 1966 and 1977), and the period after 1990, with a strong population decline, except for the communes where the suburbanization process was more intense: Podari, Şimnicu de Sus, Pieleşti, Bresta, Cârcea.

Most of the neighbouring communes are large rural settlements (2,000-6,000 inhabitants) (as ranged by Erdeli&Cucu, 2007), only two communes (Ghercești and Mischii) having between 1,000 and 2,000 inhabitants, while there is only one very large commune, Podari, exceeding 6,000 inhabitants. Most of the settlements have a regressive demographic regime during the 1966-2011 period (Table 3, Fig. 2), their population decreasing with up to 49.3% as it was the case of Coşoveni, except for Breasta (+11.2%), Podari (+15.2%) and Craiova (+91.8%). If at the beginning of the analyzed period, a demographic gain is generally registered, following 1977, there was a net loss in all the settlements. After 2002, two settlements (Coşoveni and Malu Mare) register a strong demographic loss, other two (Işalniţa and Pieleşti) have no significant variations, while increases are registered in just three communes (Podari, Breasta and Cârcea), as a result of the urban activities spreading towards the periphery and suburbanization process.

The causes for these demographic patterns are much more profound and represent the result of the territorial-administrative changes that occurred after 1968, divisions of the territory of some of the settlements (Coşoveni commune for instance was split in 2004 into tow communes: Coşoveni and Cârcea), as well as of the demographic structures of the neighbouring settlements that were more or less industrialized and the externalization of the towns activities and suburbanization process after 1990.

Table 3: Population dynamics between 1966 and 2011

	1966-1977		1977-1992		1992-2002		2002-2011		1966-2011	
	R_i	R_{air}	R_i	R_{air}	R_i	R_{air}	R_i	R_{air}	R_i	R_{air}
Breasta	12.9	1.0	-8.8	109.1	2.5	0.3	5.2	0.6	11.1	1.19
Bucovăţ	10.5	0.8	-21	124.7	-4.4	-0.5	4.4	0.5	-12.8	-1.52
Cârcea	-	-	-	-	-	-	19.5*	-	-	-
Coşoveni	4.3	0.4	-21.5	125.5	-5.7	-0.6	-34.3	-4.6	-49.3	-7.27
Craiova	30.1	2.2	49	68.8	0.2	0	-1.3	-0.2	91.8	7.51
Ghercești	2.3	0.2	-33.3	146.2	-9.9	-1.0	-5.8	-0.7	-42.1	-5.90
Işalniţa	-25.5	-2.4	-5.8	105.8	-5.1	-0.5	-0.5	-0.1	-33.8	-4.48
Malu Mare	6.3	0.5	-18.8	121.7	-2.1	-0.2	-27.4	-3.5	-38.7	-5.30
Mischii	-0.7	-0.1	-36	152.0	-18.5	-2.0	-1.4	-0.2	-49	-7.21
Pieleşti	6.4	0.5	-24.5	130.2	-9.4	-1.0	1	0.1	-26.4	-3.35
Podari	10.5	0.8	-4.4	104.4	2.1	0.2	6.9	0.7	15.2	1.59
Şimnicu de Sus	6.7	0.5	-29.3	138.5	-3.3	-0.3	6.9	0.8	-22	-2.73

(Data source: Romania statistical yearbooks, Population Census)
R_i - increase rate during the entire period, R_{air} - average annual increase rate
* 2004 (since it has its own administration) – 2011

The demographic patterns (Fig. 2) highlight on the one hand, contradictory demographic dynamics following the disrupting factors (Bucovăţ, Şimnicu de Sus, Pieleşti, Işalniţa, Breasta), and on the other hand the importance of the local factors. It is the typical case of Mischii and Ghercești, northwards from Craiova, lying in the southern part of the Olteţ Piedmont, and area with fewer natural resources and weak economic diversification, which are clearly mirrored by their demographic decline. Şimnicu de Sus, although being located in the north, too, had the advantage of an elongated spreading, along the Amaradia valley and an important communication line, unlike the other two located on the piedmont hills.

Population dynamics reflects the major social and economic changes and testifies for the negative increase of Craiova and surrounding settlements population.

The birth rate picked during 1967-1968, as a result of the restrictive measures taken by the communist government, 4 out of 12 communes registering birth rates higher than 30 live births/ 1,000 inhabitants: Breasta, Bucovăţ, Coşoveni, Şimnicu de Sus. Still, the legislation influencing births and fertility during a short period of time, this index having ever lower values, which dropped following the end of the communist period and liberalization of modern contraceptive means and abortions. This period marked the end of the demographic transition and, more important, poor life standard, increasing unemployment rate, higher social mobility, higher cost incurred by having a child, and not least, the influence of the Western European model.

Işalniţa, Şimnicu de Sus, Ghercești stand out due to very low birth rates (less than 6‰), while Coşoveni, Malu Mare and Breasta exceed 10‰ (Fig. 3), as a result of the population age structure, the influence of the typical rural family model and less diversified economy.

Death rates were higher during the post-communist period in all the analysed settlements, testifying for an ever stronger disequilibrium of the age structure, population ageing being a common phenomenon for all the surrounding rural settlements. Compared to Craiova, that registered 8.8‰ in 2010, the highest death rates were registered at Ghercești and Şimnicu de Sus, the two communes from the northern part, that face the greatest negative increase (-12‰).

The diachronic and synchronic evolutions highlight an obvious gap between Craiova and neighbouring villages: higher birth rates in the villages compared to the town, age structure, share of female fertile population, education level, tradition influence, women's role and not least, migrations.

Migrations

Unlike other towns in Romania, Craiova did not show a very powerful attraction, the number of population that came from more than 100 km being quite low. Thus, in 1966, almost half of the dwellers in Craiova were born in the settlements within 50 km distance to the town, and a third from the villages located at 50-100 km away (Popescu, 2008, p. 145). Still, the rural exodus played its part for the population increase that Craiova registered during the 70s and the 80s, despite the restrictive measures taken by the government to stop migration flows towards the big towns. According to the data gathered at the population census from 1992, only 48% of the population from Dolj towns was born in the same town, while 30% and 11.7%, respectively, was born in the rural settlements from the same, or other county (CNS, 1994).

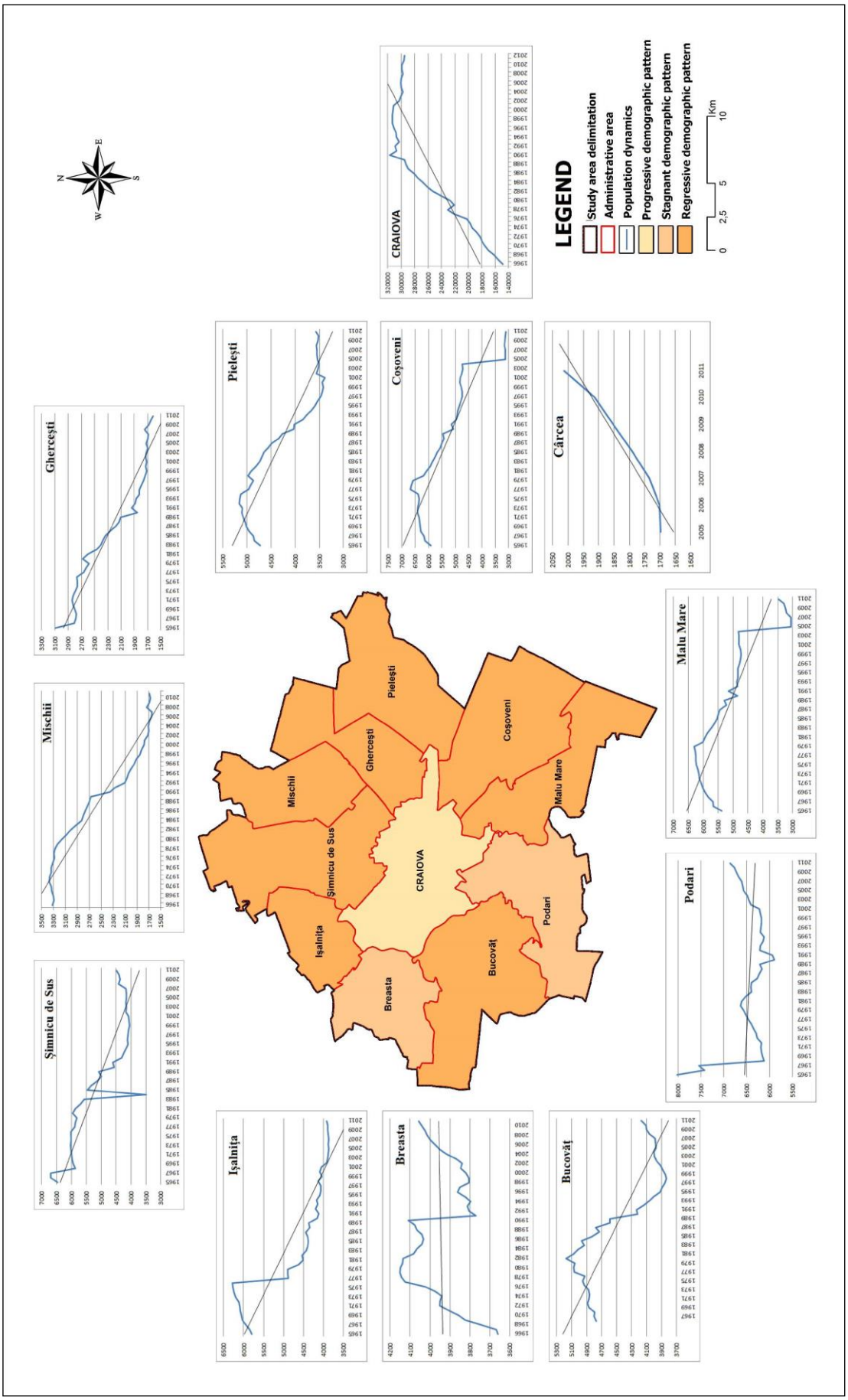

Fig. 2: Population dynamics in Craiova and its peripheries between 1966 and 2011

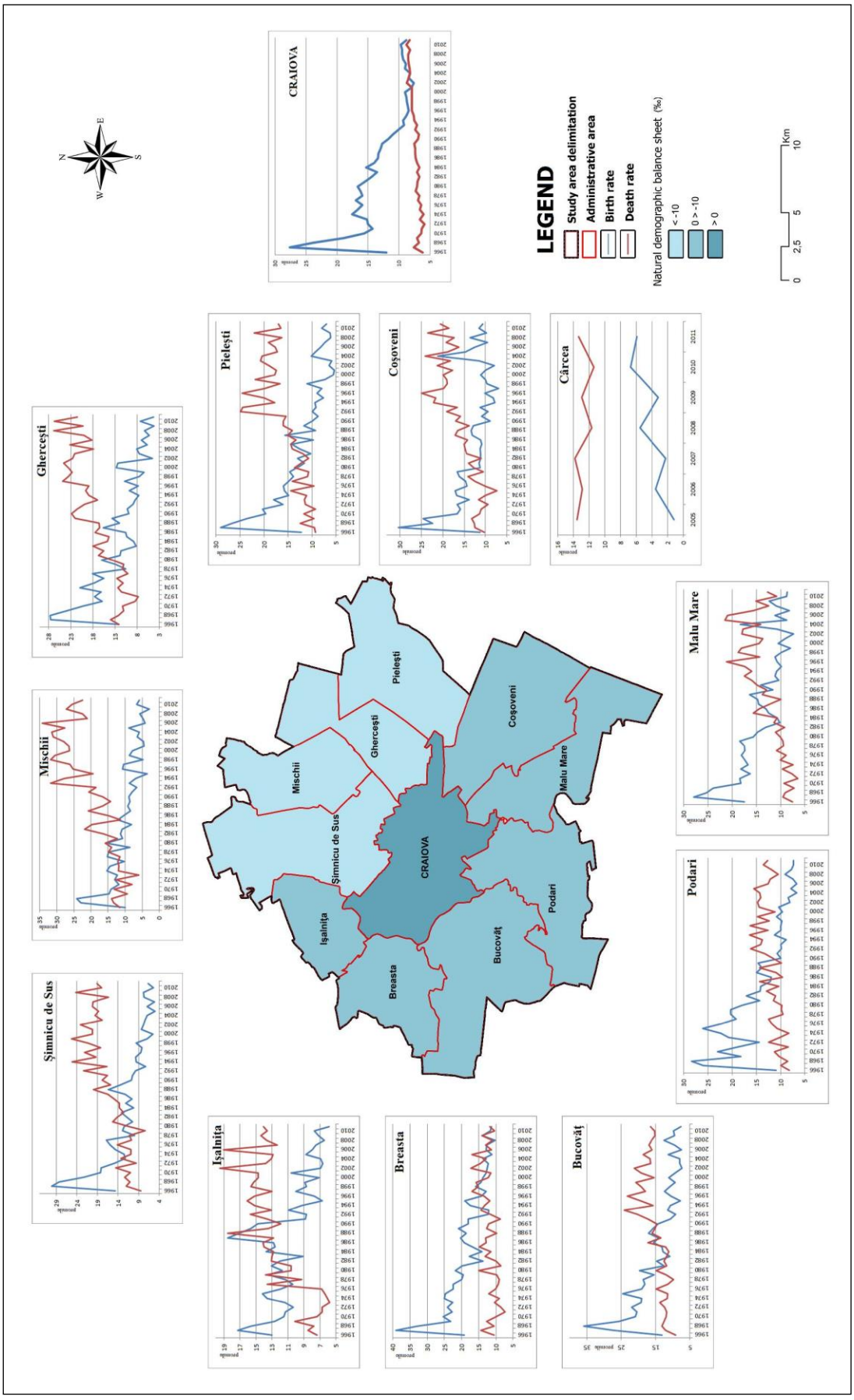

Fig. 3: Birth and death rates between 1966 and 2011

The highest migration rates peaked at 5,000 – 7,000 persons, i.e. 25-30‰ and were registered during the 1977-1983; still, Craiova had the lowest immigration rate compared to the other county seats in the region (Popescu, 2009), but just like all the big towns from the communist period, had a considerable number of weekly or seasonal commuters (up to 10,000 persons, including students) (Ianoş, 1993).

It is worth mentioning the situation from 1990, when there were no restrictions regarding migration, when Craiova registered the highest immigration rate (117‰), while the neighbouring communes had negative rates, the share of persons that flocked to the city being considerably higher than that of the persons that choose to move to villages (Fig. 4). Actually, there was an official recognition and registration of the population that dwelled de facto in the town before 1989, many of them coming from the neighbouring settlements. The migration boom from 1990 was triggered by the fact that persons from all the age groups migrated, with an increase of the family groups compared to individual migrations (Rotariu&Mezei, 1999, p. 18).

After 1998, there is a general trend of inverse migrations, most of the surrounding settlements registering a positive migratory increase following the return migration (as a result of the difficult economic conditions in towns and retrocession of agricultural lands beginning with 1992). Craiova is the only settlement within the study area that constantly registered a negative migration rate after 1998, due to the bankruptcy of industry and outmigration. Consequently, the free market succeeded to accomplish what the communist administration had failed (Kupiszewski et.al., 1997).

Now, the communes neighbouring Craiova have the lowest migration rates within the county, only 5 to 7% of their population registered at 2011 census being temporarily or for a long period absent from home, compared to some communes and towns within the southern part of Dolj county, where 15 to 25% of the population was absent from home (Licurici&Popescu, 2013). Thus, even in the communes registering the highest number of temporarily absent persons, their share in the total population is very low (Bucovăţ 2.4%, Malu Mare 1.9%), with less than 3%, except for Podari (5.8%). the proportion of those absent for a long period is a bit higher: Işalniţa 4.7%, Pieleşti 4%, Malu Mare 3.7%, Craiova 3.3%.

The general demographic balance highlights the latent demographic crisis of the demographic system, pointing to a significant disequilibrium between inputs and outputs (natural and migratory ones) and the emergence of new factors and mechanisms (Gheţău, 2007).

In order to better understand the mechanisms that triggered the demographic changes, we used the classification proposed by Webb (1966). Thus, for 2011, most of the communes (5) have population increase due to net in-migration (D class) and other 3 communes register a population decrease (E class) (although there is net in-migration, there is a greater natural decrease), while no communes are found in B and C classes (Table 4).

Table 4: The Webb classification of demographic regimes

Year	Craiova	Râmnicu-Vâlcea	Drobeta Turnu-Severin	Târgu-Jiu	Slatina
A	Population increase	Natural increase (NI)	Net out-migration		-
B	Population increase	Natural increase	Net In-Migration	NI›NIM	-
C	Population increase	Natural increase	Net In-Migration	NI‹NIM	-
D	Population increase	Natural Decrease (ND)	Net In-Migration		Breasta, Cârcea, Mischii, Şimnicul de Sus, Podari, Işalniţa, Pieleşti, Malu Mare
E	Population decrease	Natural Decrease	Net In-Migration		Bucovăţ, Coşoveni, Ghercești
F	Population decrease	Natural Decrease	Net out-migration	ND‹NOM	-
G	Population decrease	Natural Decrease	Net out-migration	ND›NOM	-
H	Population decrease	Natural increase	Net out-migration		Craiova

Kupiszewski et al., 1991, pg. 32

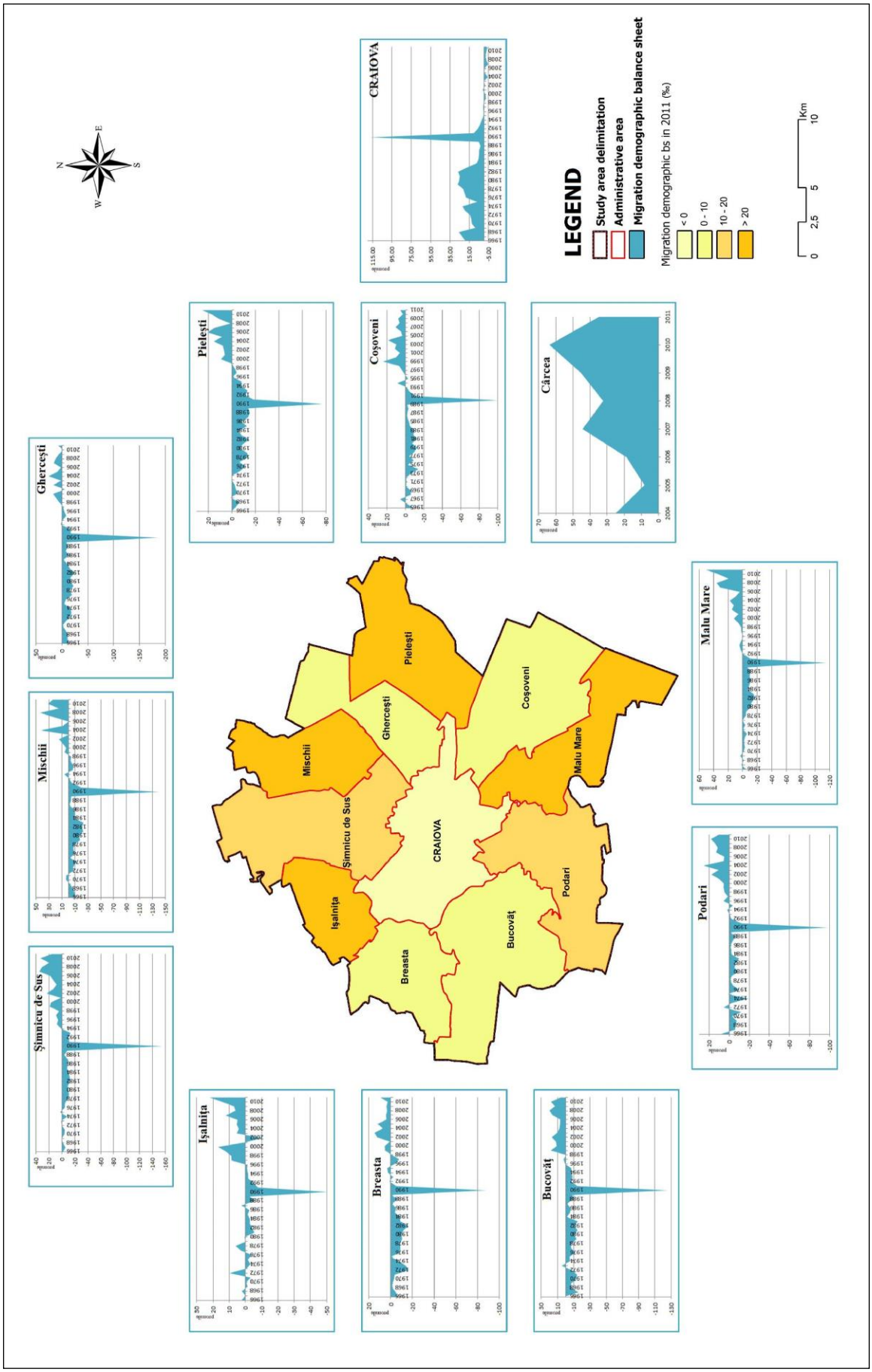

Fig. 4: Migration rate for Craiova and its peripheries between 1966 and 2011

Conclusion

A complex analysis of human resources is highly necessary in order to fully understand the characteristics of human settlements. The demographic dynamics (together with the population age structure), points to the town vitality and offers a genuine perspective on the evolution of the human factor and its potential to influence the urban development one way or another.

Craiova and its peripheries are witnessing significant demographic changes, following several unfavourable demographic mechanisms: considerable decrease of birth rates, below the death rate, demographic ageing process with severe economic and social effects. Unfortunately, the negative trend of population dynamics and the demographic characteristics will continue, at least in the near future.

As a result of the lower number of inhabitants and strong dependency to the center, the suburban communes as well as those neighbouring the town witness significant oscillations, being more vulnerable from the demographic point of view than the town itself. This is a proof of spatial inequalities related to the rural area, local resources that were not properly capitalized and, not least, the relationships between the polarizing town and its peripheries.

The study concludes that for Craiova municipality, the urban growth and suburbanization phenomenon testify for changes of the territorial relations with the neighbouring rural communes, as well as changes in the lifestyle and consumption models rather than a population increase.

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Tourist events in Serbian part of Banat

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Abstract

In this paper tourist events organized in the area of Serbian Banat are studied. They represent the base for initial development of tourism, but also some other economic activities in this underdeveloped region. Those events are mostly based on tradition, folklore and customs (ethnographic by type) and agricultural production (fairs, exhibitions). However, there are also a number of multicultural events (artistic, ethnographic and religious events), based on fact that this space is multiethnic in character. In Serbian part of Banat, in 2013, about 416 traditional tourist events were organized.

Keywords: *tourist events, tourism, Banat*

Rezumat. Evenimente cu rol turistic in Banatul Sârbesc

Lucrarea analizează evenimentele cu rol turistic din Banatul Sârbesc. Aceste evenimente reprezintă baza pentru dezvoltarea inițială a turismului, precum și activități economice considerabile pentru această zonă subdezvoltată. Ele sunt legate în primul rând de tradiții, folclor și obiceiuri (etnografie), precum și de practicile și producțiile agricole (targuri, expoziții). Totuși, există mai multe evenimente cu caracter artistic, etnografic și religios, ținând cont de mozaicul etnic al acestui spațiu. În Banatul Sârbesc, în anul 2013, au fost organizate 416 evenimente cu rol turistic.

Cuvinte-cheie: *evenimente cu rol turistic, turism, Banat*

Introduction

Events, starting from the last decade of 20th and first decade of 21st century, became the important development tool for local communities and regions. They are regarded as a possibility to gain some strategic advantages and bring a number of economical, social and ecological goals. The role and impact of events in tourism field is well documented. Their role in enhancing the competitiveness of destination on tourism market is more and more evident. Moreover, because of the increase of competitiveness between tourist destinations, organizing events and development of event tourism became an important activity. As tourism is regarded as one of the fastest growing industries today, within tourism sector, events became more and more significant elements of tourist offer (Erfurt, Johnsen, 2003). In scientific literature in Serbia and abroad, different terminology for this type of tourism (manifestations, events, festivals, parliaments, etc.) is used (Getz, 1997; 2008; Bjeljac, 2006; Cudny, 2013).

Different terms are used based on geographical area and domination of language among different nations. In accordance with this, in areas with dominant Germanic group of languages (England, Germany, Scandinavian countries, USA) terms event and festival are used, while in other countries (with Latin and Slavic language base - Italy, France, Spain, Romania, Serbia, Bulgaria, Russia, etc.) the term manifestation is more popular.

In Serbia, in particular, event tourism, as economically prosperous type of tourist offer, become significant in first decade of 21st century. It was defined for the first time in some strategic national documents, such as Tourism development strategy of Republic of Serbia (2006). In this document, this segment of tourism offer is seen as a great market potential. "In Serbia a great number of traditional events, local manifestations, festivals, celebrations, parliaments, etc. is organized. Beside their popularity on domestic market, some of these events have a potential to be placed on international market, where they already gained some positive reputation" (Strategy 2006). According to different sources, about 2,500 tourist events are organized, annually in Serbia (www. vodič kroz manifestacije.com/kalendar manifestacija; www.vojvodinaonline.com/events). The organization of such a great number of events should contribute to the come-back and repositioning of Serbia on international tourist market, by increasing the level of competitiveness and creation of stronger base for marketing activities.

Serbian Banat has numerous and various natural and anthropogenic resources which are important for the development of tourism. However, in this sense, the rich cultural-historic heritage of Banat has special value, which is presented through multiculturalism, different customs, folklore, music and gastronomy (Bjeljac, Ćurčić, 2008, 2010; Obradović, 2009). Event tourism is one of the leading types of tourist offer in this part of Serbia (Bjeljac, 2001; Obradović, 2009). The aim of this work is to conduct the categorization and classification of tourist events in the Serbian part of Banat.

Historical overview

The oldest tourist event in Serbia was organized in Banat region - Flower Carnival in Bela Crkva, which was initiated in 1852, and held continuously since 1911 (Bjeljac, 2010; Stojanović, 2010). Zrenjanin as District center, in 1769 gained the right to organize two fairs per year, and later, another two such events, marking each annual season with a great fair. The first fair in Debeljača was held in 1873, while the first wine exhibition in Vršac was organized in 1857, in a tavern named Kod dva ključa". Before World War II, in Vršac, celebrations of the grape harvest, the so called "Veinleze fest" were held every year.

„Under the supervision of Lazar Janoš, the owner of villa Kaštel in Ečka, from 1793 to 1809, in the park in front of his villa, foil fencing tournaments were held. In those tournaments the best fencers from Austria and Hungary took part. Moreover, there was a parallel contest for ladies in archery, horse riding and hunting. Here, from 1870 to 1891, beside balls and concerts, some events that included horse races of the most famous stables from Austria-Hungarian monarchy took place. Some contests for girls were also organized, particularly in knitting and sewing (Bjeljac, 2010). In 1889, Ečka village was the host of the Conference of the South-Hungarian Association of Teachers, and in 1892 the host of the Conference dedicated to the necessity of the removal of the existing and construction of a new bridge over Begej river". Since 1910, in Grebenac village, Carnival on celebration of Candelmas (The Meeting) is organized, which Romanian people have taken from Germans. Carnivals in Kruščica and Vračev Gaj villages date from the same period (Bjeljac, 2010, Marjanović, 2003/2004).

Geographical distribution

On the territory of Banat, in 2013, there were organized 419 traditional tourist events in 16 municipalities (38,98% of the total number of events in AP Vojvodina, 16,76% of total number of events in Serbia) (www.vojvodinaonline.com/events; www.manifestacije.com). The greatest numbers of events take place in the municipalities of Pančevo, Zrenjanin, Kikinda, Kovačica and Novi Bečej (table 1). If the distribution of events according to settlements is observed, most of the events are held in: Pančevo (67), Zrenjanin (36), Kikinda and Vršac (18 each), Novi Kneževac and Novo Miloševo (16 each), Kovin (15), Novi Bečej (12), Kovačica (9), Dolovo (8), Uzdin, Debeljača and Deliblato (7 each), Debeljača (6), Gudurica, Opovo, Bela Crkva and Omoljica (5), Ivanovo, Jaša Tomić, Starčevo and Torak (4).

Classification of tourist events

With the goal of determining which of these 419 traditional events have a tourism potential and prerequisite to become the main motive for tourist visitation, their classification and categorization is needed. Based on complex and detailed analysis, the basic classification of tourist events can be made. The classification was based on geographic and economic group of criteria (Getz, 1997, 2008; Carlson et al., 2000; Goldblat 2000; Du Cross 2000; Bjeljac, 2006; Hadžić, Bjeljac, 2006; Bjeljac, 2007; Bjeljac, Brankov, 2008; Bjeljac, Ćurčić, 2010) (Al cited in Bjeljac, 2010).

Table 1: Events in Serbian Banat, by municipalities

Municipalities	Num. of events
Pančevo	110
Zrenjanin	45
Kikinda	29
Novi Bečej	28
Kovačica	29
Novi Kneževac	27
Vršac	26
Kovin	27
Žitište	22
Bela Crkva	12
Sečanj	17
Alibunar	13
Nova Crnja	9
Plandište	10
Opovo	8
Čoka	7
Total	419

Source: www.vojvodinaonline.com

DATA AND METODS

Geographical group of criteria

Geographical group of criteria include: program content, origin of visitors and participants, traditionalism (continuity of the event), rank, location, transport accessibility and connectivity, season and timing, artistic value, number of accompanying events, satisfaction levels of visitors and organizers (Bjeljac, 2006, 2007). The geographical group of criteria has 0-5 grade scale.

The definition and distribution according to the content of events has been the research theme of a significant number of scientists (Ožegović, 1977; Ritchie, Yangzhou, 1987; Getz, 1991, 1997, 2008; Jovičić, 1992; Nicholls et al., 1992; Avramovski, 1996; Jago, Show, 1998; Arcodia, Alastair, 2000; Aitken, 2002; Goldblat, 2002; Bowdin et. al., 2001; Bjeljac, 2006, 2010; Gibson, Stewart 2009, Quinn, 2010) ; Cudny, 2013).

Within Serbian territory, the classification given by Bjeljac is widely used (2006, 2010). According to the main content, events are classified on artistic, ethnographic, economic, scientific-vocational, religious, sport, political-historical, entertaining, tourist-promoting and children events. This classification, in March 2011, was officially accepted by the Tourist Event Organizers Association established within the

Council for Tourism and Hospitality by Chamber of Commerce and Industry of Serbia.

Economic group of criteria

The economic group of criteria includes: the influence of capital investments, ecological, economic, media and political influences, as well as stakeholder relations and cooperation with tourist organizations (Goldblatt, 2000; Bjeljac, 2006; Bjeljac, Brankov, 2008; Bjeljac, Ćurčić, 2010; Ćurčić et al., 2008). All criteria are respected before and after the event took place, with scale ranging from 0 to 4 points.

DISCUSSIONS

Geographical group of criteria applied on events organized in the Serbian Banat

In the area of the Serbian Banat, based on the classification by program content, there stand out: 132 artistic (31.50%), 67 economic (15.99%), 31 ethnographic (7.40%), 52 entertaining (12.41%), 62 sport (14.80%), 22 religious (5.25%), 12 political-historical (2.86%), 34 children's (8.11%) , 4 scientific(0.95%) and 3 tourism promoting events (0.73%).

Table 2: The oldest events in Banat

Event	Place	years
Flower festival	Bela Crkva	103
Festival of the professional theaters in Vojvodina	Zrenjanin	63
Kovačica's October"	Kovačica	60
Artistic Colony	Ečka	57
Festival of Romanian music and folklore in Vojvodina,	Uzdin[1]	53
Lipar evenings – Đura Jakšić Days	Srpska Crnja	53
Grape Harvest	Vršac	53
Music festival of Vojvodina's children	Novi Bečej	52
Festival of Romanian poetry "Roads of Spice"	Uzdin	51
International art colony of scout painters "Palette	Uzdin	46
Artistic colony "Delibato sand"	Deliblato, Pančevo	45
Fishing contest "Tamiš"	Pančevo	
Regional contest of orators "Poet of my nation"	Sečanj	45
Festival of documentary films ,,Village life", ŽISEL	Omoljica	43
Theatre days of Romanians in Vojvodina[2]		43
Artistic Salon	Pančevo	42
Parliament of the beekeepers *"Delibato sand*	Deliblato	42

Source: Bjeljac (2010); www.vojvodinaonline.com

Traditionalism of the event was another criteria, based on the continuity of organization. Traditional events are those that have continuous sequence of at least five years of being held, with determined date and location of the event (Bjeljac, Ćurčić, 2008, 2010)[3]. Expansion of event tourism in Serbia, but also in Banat region, started at the end of the first decade of 21st century. The oldest events in Banat are presented in table 2.

According to the *rank, goals and content of the program,* in the Banat area, the events can be classified as local, regional (zonal), national and international. Regarding the criteria for determining the rank, the geographical origin and number of visitors and participants was considered[4]; there predominate events of local rank (181 events or 43.20%), then regional (164, or 39.14%), national (52, or 12.41%) and international (22 events or 5.25%). Among international events in this region stand out: Festival of popular music "The youth sings", "Roads of Spice" ("Drumuri de spice"), International Symposium "Famous Banat people – A step towards Europe" (Uzdin), Carnival, Festival of author comic-book "Grr", Artistic colony "Delibato sand", Competition of chamber ensembles of wind instruments, Festival of under-water movie and photography (Pančevo), Artistic colony (Ečka); Folklore festival "Vršački venac", Chest tournament "Memorial of Bora Kostić" (Vršac), Symposium of sculpture "Terra", Festival of national orchestra "Fenok" (Kikinda), "Strongman" wrestling contest (Novi Kozarci); Festival of accordionists (Novi Kneževac); Meetings of the writers from the border in Sečanj and Timisoara; Festival of the chorus "Cantemus", Junior tournament in wrestling "Darko Nišavić" (Zrenjanin), etc.

Some events of regional rank are also very important. In particular, it is about events organized by Romanian, Czech and Slovak minorities that live in this part of Serbian Banat. As participants or guests to these events, a great number of people from Romania, Slovakia, Czech Republic, Bulgaria etc., gather here. Such events are: Days of Vasko Popa, Children's festival of Romanian folk music and folklore in Vršac, Translation workshop "Zoltan Čuka" in Plandište, Romanian Days in Kovin, "Kovačica's October", "Maško's Days", Festival of Slovak theaters of Vojvodina in Kovačica, Festival of Vojvodina Romanian's music and folklore, Theater Days of Vojvodina Romanians, Orator contest "Buna

1 Every year in other settlement with Romanian population in Vojvodina and every fifth year in Uzdin (Kovačica).

2 Every year in other setlement with Romanian population in Vojvodina

3 Score is determined by 0-5 grade scale. Less then 4 years long tradition gets 0 points; 5-10 years - 1 point; 11-20 years – 2 points; 21 – 30 years – 3 points; 31-40 years – 4 points: over 40 years – 5 points.

4 Score is determined by 0-5 grade scale. Originating from the same municipality of the event – 0 points, neighboring municipalities – 1 point, from the same region – 2, from the same country – 3, from neighboring countries – 4, from other countries – 5.

Vestire" Uzdin (Kovačica), Festival of humor and satire, Winter Christmas customs "Torak" (Žitište), Symposium ,,Banat history and multiculturalism" in Rešita (Romania) and Zrenjanin (Serbia).[5]

Location of the event refers to the place or places where the event is organized. This criterion shows the connection of the event with anthropogenic-geographic and natural-geographic tourist resources. Criteria show the distance of the event location from the tourist attractive sites (Allen, 2000; Bjeljac 2006, 2008; Bjeljac, Ćurčić, 2008; 2010; Ćurčić et al., 2008)[6]. On the territory of Serbian Banat, among the natural-geographic resources that represent important tourist destinations, according to du Cros evaluation model (Bjeljac & Lovic 2012; Bjeljac et al., 2013), stand out: Vršac mountains, Delibato sands, Slano Kopovo, Stari Begej-Carska Bara, lakes Okanj and Rusanda, and Tisa river. Among anthropogenic tourist values most attractive are: old town nucleus of Vršac, Pančevo, Zrenjanin and Kikinda, the remains of medieval monument such as a Chatedral in Arača, Vršac tower, monasteries Mesić and Vojlovica, villas "castles" in Ečka, Srpska Crnja, Plandište, old mills, windmills, watermills and farms "salaš", artificial lakes in Bela Crkva, etc. (Bjeljac, 2001; Bjeljac, Pandžić, 2005; Bjeljac, Nikitović, 2005; Obradović, 2009). In Belo Blato village (Zrenjanin), there is one ethno-house that represents folk house-building skills of a multicultural population (Slovaks, Serbs, Bulgarians and Hungarians). In the village of Torak (Žitište) there is an ethno-house representing folk architecture of the Romanian minority. In Kovačica village there is also an ethno-house, representing the folk architecture of Slovak nation of Vojvodina. Moreover, local Slovaks from Kovačica have achieved the world fame with their tradition of naive painting[7] (Todorović, Bjeljac, 2009). On these locations, that have certain attractive assets, 73 tourist events take place. In line with these criteria, there is also the accessibility and traffic connectivity of the location to the main tourist distribution centers. If we consider Novi Sad, Subotica, Szeged and Timisoara, as a main distribution centers in this region, it can be stated that the Serbian part of Banat is in half-day and one-day gravitation zone, which is considered to be a positive aspect.

Time and duration of the event is a criterion that shows the connections between event organization and free-time of the visitors (Bjeljac 2006; Bjeljac, Ćurčić 2007, 2010). Duration of the event is usually from one to three days, but there are also events that last for a week, a month or during the whole year. Time and place of the events are usually inter-connected. It is of crucial importance to determinate the part of the year in which it takes place – main season, pre-season, post-season or a holiday time, especially if they take place in tourist attractive destinations. Events are held throughout the year, but mostly in summertime (164, or 39.14%) and springtime (137, or 32.70%).

Number of visitors (table 3) *and participants*[8] is the criteria appropriated for showing the visitation extent and use of tourist offer programs (Bjeljac, 2006). This criterion is also in causal connection with the rating of the event, the time and location on which it is held. Type of people, target market, is another factor that has an influence on the event (O'Toole, 2005).

Table 3: Number of visitors

Event	Place	Number
Bear Days	Zrenjanin	300,000
Bacon fest	Kačarevo	150,000
The Assumption Days	Novi Bečej	100,000
Grape Harvest festival	Vršac	80,000
International Carnival	Pančevo	50,000
Pumpkin Days	Kikinda	20,000
Folklore festival ,,Vršački venac"	Vršac	15,000

Source: Data from tourist organizations

Cantemus International chorus festival, Bear days in Zrenjanin, "Kovačica's October", "Lipar Days", Days of Miroslav Antić and Theatre festival ŽISEL gather several thousands of visitors each year (Bjeljac, 2010). Festival of the professional theaters in Vojvodina, International Carnival (Pančevo), ,Vršački venac 'Folklore festival , Grape harvest (Vršac) (figure 1), Festival of Slovak theaters of Vojvodina (Kovačica), Festival of Vojvodina Romanians' music and folklore and Theater Days of Vojvodina Romanian's, have several hundred to several thousand participants.

5 The proclaimed goal of all minority organizations is gathering, developing and deepening of interconnections of the community members, as well as the preservation and cultivation of national identity, traditions, native language, culture, customs, folklore etc. This way, although few in number, many ethnic groups have recently succeeded to renew some of their traditional practices, but have also introduced some new customs, often with a ethnic symbolism. In particular this applies to collective events that in addition to their basic function of connecting community members, empowerment and cohesion of the community, have another goal – promoting the parent-state culture in the wider space (Pavlović, 2012).

6 Scoring is made based on the distance of the event location from the tourist attractions (less then 1 km = 5 points; from 2 to 10km = 4 points; 11 to 20km=3 points; 21 to 30km=2 points; 31 to 40 km = 1 point, and over 40 km = 0 points.

7 In 2013, naive art as a skill is inscribed into the national register of intangible cultural heritage of Serbia.

8 Grade scales: Visitation: less than 500 visitors = 0 points, 501-1,000 visitors = 1; 1,001 – 5,000 visitors = 2; 5,001 - 10,000 = 3; 10,001 – 20,000 = 4; over 2,000 visitors = 5; Participation: Less than 10 = 0; 11 - 50 = 1; 51 – 100 = 2; 101 – 500 = 3; 501 – 1,000 = 4; over 1,000 = 5.

Figure 1: Grape harvest festival, Vršac
Source: www.manifestacije.com

The n*umber of additional events* shows the variety and attractiveness of the program which places the event in tourist offer of the destination (Bjeljac, 2006). Content (program) of the event and additional programs with entertaining, educational, cultural, religious, and other contents, are made in order to enrich the main program and make it more appealing to the visitors.

As additional programs, there often appear various exhibits (artistic works, photography, crafts, agricultural machinery, etc.), book promotions, performances, theatrical shows, presentation of traditional dishes (gastronomy), sports contests, professional lectures, and similar (table 4)[9].

Table 4: Number of additional events

Event	Place	Number
Beer Days	Zrenjanin	14
Museum's Night[10]		13
Kovačica's October	Kovačica	11
Bacon fest	Kačarevo	11
Days of European Heritage[11]	Zrenjanin, Vršac, Kikinda, Pančevo	7
Festival of documentary film, Vilage life- ŽISEL	Omoljica	6
Regional festival of Alternative culture REFRACT[12]	Pančevo, Zrenjanin, Belgrade	6
The Assumption Days	Novi Bečej	6
Festival of author comedy-book "GRR"	Pančevo,	5
Lipar Nights – Djura Jakšić Days	Srpska Crnja	5

Source: data from the organizers

Organizers, as criteria, are used in order to determine the goals of event organization. As organizers we recognize local governments, NGO's and professional organizations, cultural institutions, sports associations and clubs, tourism organizations and others. This criterion is important in economic sense as well. Defined as "stakeholders", several different interest-groups that take part in the organization of the event are included.

The satisfaction of the visitors and participants with the event is a very important criterion for the evaluation of the success of the event. Factors that have the greatest impact on the quality evaluation are: ambiance, tourist attractions, quality of the event offer, relation of the local community towards the visitors and vice versa, and other (Hadžić, Bjeljac, 2006)[13] According to previous research (Bjeljac, 2010), visitors are usually satisfied with the events they visit, but certain aspects of the organization bother them, as well as some specific parts of the program. Some of the complaints include: fair type of the events, inadequate sanitary facilities, lack of parking places etc. (Bjeljac, Brankov, 2010).

Artistic value includes scoring the ambience, design elements in creation of tourist product, cultural significance, robustness and quality of program (Du Cross, 2000; Hadžić, 2005; Bjeljac et al., 2013). Ranking of the events presented in this study is conducted based on Du Cros model of evaluation. The model was slightly modified for the purposes of this particular case. Some indicators were derived from the original model: ambiance; well-known beyond local community; significant national symbol; evocative place; distinguished from nearby assets, appealing to special needs; association with culture; number of attractive assets in the area; as well as its historical, social, scientific and educational value; rareness; investment potential and stakeholder involvement [14]. Depending on the type of the event, artistic value of the event differs. The overall grade of artistic events is mostly - 5, children's events – 4, ethnographic – 3 points and other events get 2 or 1 point.

Economic group of criteria applied on events organized in Serbian Banat

Capital investments show the development levels regarding the overall infrastructure. It determinate the extent to which the organization of events contributes to the development of infrastructure and

9 Scale: 0 programs (only main program) = 0 points, 1 to 3 = 1; 4 to 6 = 2; 7 to 9 = 3; 10 to 12 = 4 and over 12 = 5 points.

10 At the same time in 8 setlements in Banat: Bela Crkva, Idvor, Kikinda, Novi Bečej, Novo Miloševo, Pančevo, Vršac and Zrenjanin

11 At the same time in 4 setlements: Kikinda, Pančevo, Vršac and Zrenjanin

12 At the same time in 3 setlements

13 It is measured by the survey conducted among visitors and participants of the event. Each indicator is graded from 0 to 5, and then average grade is given, which determinate the satisfaction level of the visitors.

14 Each indicator is graded from 0 to 5, and average grade is derived based on the result of all mentioned indicators.

other capital projects in town or region (Goldblatt, 2000; Bjeljac, 2006; Bjeljac, Ćurčić, 2010;). For most of the events, only "cosmetic" changes are made (partial repairs of objects and spaces where the event is held, placing asphalt of small parts of roads etc). The single exception is "Kovačica's October", where because of the need for exhibition of artistic works, the Gallery and Ethno-house were built.

An ecological criterion is connected to the protection levels concerning the natural environment. It shows the ways in which the event makes impact on the local environment of the region (focusing on all its positive and negative sides), practically and educationally (Bjeljac, 2006a). This criterion is particularly obvious in Movie festival "Village life" ŽISEL[15].

Media – promotion impact is a criteria relating to the representation of events in printed and electronic mass media, as well as promotional activities in markets and fairs. The goal is to determine how media and promotional activities contribute to the visitation and popularity of the event. The Assumption Days (Novi Bečej), Grape Harvest (Vršac), Beer Days (Zrenjanin), Bacon fest in Kačarevo, Pumpkin Days in Kikinda enjoyed high levels of media promotion.

Social-political impact refers to the impact of the current political situation in the country on maintaining the organization of the event. Tourism events in recent years have become more political in nature, in the sense that they offer quality national and regional legacy, in terms of their perceptions of quality of living standards (Bjeljac, 2006).

Economic impact is related to the direct and indirect financial gain of the event (budget revenue, income from ticket sales, etc.). Economic impacts of events in Serbia can not be foreseen, because there is no defined legislation which could accurately track revenue from events. Moreover, the organizers have no obligation to display their income, because current fiscal laws do not demand it, especially if they are registered within NGO sector. The only events that have ticket sales and some profits from the sales of souvenirs, products, the exhibits and the like, can be evaluated in terms of economic impact.

Stakeholder relations include the impact of all stakeholders in the organization of events. Their role in the planning process and maintenance of the event is extremely important. They determinate the developments of tourism, putting in focus the need for mutual cooperation between institutions and agencies that organize the event. "Creating a relationship between the partners at the destination shall cause the exchange of information, exchange of goods and services, as well as mutual understanding, which gives a personal dimension to relations between the partners. Collaboration provides some framework for making strategic decisions relevant to the development of tourism in the destination. Establishing a high degree of interdependence, relations among the partners can become drivers of activity in the field of control of resources and creation of new resources" (Hadžić, 2005). *C*losely related to this criterion, there is the *cooperation between organizers and tourism organizations, tour operators and travel agencies.* This criterion was separated in order to determine the impact tourism organizations have during the organization of an event (whether they appear as sole organizers, co-organizers, or just perform promotional activities and give accommodation and transport services).

Tourist evaluation of events in Banat

In Serbia and in Banat region likewise, practically there is no adequate categorization and classification of the events. Within the economic group of criteria, it can be seen that governmental institutions finance events without a clear criterion, which is not the case in other countries (USA, Australia, New Zealand, Canada, South-Africa, Great Britain, and EU states). In these states, there is a licensing process for organizers of tourist events (event agencies), some events and even some aspects of the events. For example, in South African Republic, there are regulations for licensing the large events, with over 2,000 visitors. Here, special attention is set on those elements that have great risks, such as large number of visitors, food and beverage, extreme sports, transportation etc. Event industry sector includes the events different in sizes and types, from wedding organizations, exhibits, sport contests, entertainment to mega events. Companies that organize events can be independent, as well as parts of international companies. Unlike many industrial sectors, the event industry is very fluid, dynamic and involves a number of individuals involved in organizing and planning of the event. There are some suggestions to form a professional body, which would be the certification body related to setting of standards that would be similar to the industrial standards. This professional body should be made up of leading professionals in the field of event management (O'Toole, 2008).

By using the defined geographical and economical groups of criteria, three categories of events with tourist attractive potentials can be determined:

1. In the first category, events that represent the independent tourist attractions are classified.

15 With specific themes based on village life, architecture, old and new in micro-space of the village living (www.zaprokul.org.rs)

2. In the second category, events that are significant, additional element of the tourist offer of destination are listed.
3. The third category includes events that take place in underdeveloped regions of Serbia, and have only local significance.

When the highest values of all indicators of the economic groups and geographic criteria are calculated, the sum of 116 points is established. In order for an event to be ranked in the first category, it must score 97 or more points; for the second category a sum raging from 73 to 96 points and the third category includes those events that score less than 73 points.

Regarding the criteria of categorization of tourist events (Bjeljac 2010, Bjeljac, Brankov, 2008; Bjeljac, Ćurčić, 2008), tourist attractive events are considered the following: Grape Harvest in Vršac (108 points) and Beer Days in Zrenjanin (105 points). Other evens with great potentials also include the Bacon Fest in Kačarevo (94 points), Folklore festival "Vršački Venac" (88), "Kovačica's October" (75), Parliament of Beekeepers "Delibato Sand" and International Carnival in Pančevo (74), Artistic Colony Ečka (72), Artistic Colony "Delibato Sand" (69), "Lipar Nights – Djura's Days" (67), „Gander Fest" in Mokrin (63), The Assumption Days (61), ŽISEL in Omoljica (59) and Flower Carnival in Bela Crkva (58 points).

Conclusions

Based on the conducted research, it can be stated that some individual events in the Serbian part of Banat have a great potential. Thanks to their long tradition, the attractiveness of the program and good ambiance, as well as the development of their own image, they represent a significant segment of the tourist offer of Serbia. Moreover, they are an extremely important element in the development of selective forms of tourism in Serbia (especially in complementing rural and cultural tourist offer).

For tourist events that are held in Banat area, promotion should be focused on the domestic market. Promotion should increase the interest of the audience of tourist segments from urban areas, in particular Belgrade, Novi Sad, Subotica, Zrenjanin, Pančevo. However, these events also attract some foreign tourist, mainly from Hungary, Romania, Slovakia, Czech Republic and Austria. The final goal of these events is placing themselves on international markets, in particular, Great Britain, German, Italian and French tourist markets. Certain events, growing beyond national boundaries with prominence on the international market, positively differentiate themselves and become a recognized tourist brand. Their attractive power is growing and the economic effects, triggered by the event itself, rapidly increase revenues from tourism. This is of essential importance for the events that take place in towns (Pančevo, Zrenjanin, Kikinda, Vršac), but also for those organized in rural areas.

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Development and use of public space – the case of Saint Stephen square of Szeged

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Abstract

Public space development has got an increasing role in the urban development movements. These parts of the city were always important in history and today they are more and more often analyzed in scientific researches. In the Western countries (mainly in North America and Western Europe) public space development is highly detailed and really longsighted. In Hungary this kind of method started to be used later and has not been so sophisticated and matured yet. This paper presents the development of Saint Stephen square of Szeged, Hungary. Besides the development, it also presents what kind of methods are appropriate for analyzing a square. Saint Stephen square is a good example to illustrate the changes related to the rehabilitation because it has been a degraded but popular place and after the development it has become a really attractive but not so lively square. Its main characteristic was a flea market, which gave the essence to it, but after the renewal it has become much smaller; due to some other changes, it could no longer function as before. This movement caused the biggest impairment of the place and some other negative changes also emerged.

Keywords: *public space, activity mapping, discourse analysis, square renewal, public market*

Rezumat. Dezvoltarea şi utilizarea spaţiului public – cazul pieţei Sf. Ştefan, Szeged

Dezvoltarea spaţiilor publice a devenit din ce în ce mai importantă în cadrul curentelor de dezvoltare urbană. Aceste părţi ale oraşelor au jucat mereu un rol important de-a lungul istoriei, devenind în prezent o temă abordată de tot mai mulţi cercetători. In statele occidentale (cu deosebire America de Nord şi Europa de Vest), modul în care se dezvoltă spaţiile publice este supus unei analize foarte detaliate. În Ungaria, aceste analize au început să fie întreprinse mult mai târziu, nefiind atât de amănunţite. Această lucrare prezintă dezvoltarea pieţei Sf. Ştefan din Szeged, precum şi principalele metode ce se pretează pentru analiza unui astfel de spaţiu. Piaţa Sf. Ştefan este un bun exemplu pentru a ilustra modificările legate de lucrările de realibilare, întrucât era un loc degradat, dar totuşi foarte popular, iar după aceste lucrări a devenit foarte atractiv, dar mai puţin frecventat. Această piaţă a apărut ca un târg de vechituri, ceea ce i-a conferit anumite caracteristici, după renovare devenind însă mult mai restrânsă, si cu trăsături total diferite. Acestă schimbare a constituit un prejudiciu major, atrăgând după sine şi alte consecinţe negative.

Cuvinte-cheie: *spaţiu public, cartarea activităţilor, analiza discursurilor, reînoirea pieţei, piaţă publică*

Introduction

During the last few decades the renewal of public spaces has got an increasing emphasis within the urban development processes in the Western countries. In the last few years projects like this have begun in Hungary, too. The foreign experiences highlight the practice of making the "appropriate" public spaces based on the approach that every concerned actor can have an opinion about the development. In Western Europe and Northern America, developments based on public participation come true and redound success in many cases. In Hungary with a few exceptions mainly construction oriented developments are typical and the primary aim is often to finish the project as soon as possible. Consequently the preservation and further development of functions get limited attention. Hereby during a given public space development the earlier well-functioning function may be lost so, the role of public space may change.

The current research examines how could the Saint Stephen square integrate in the urban space after the development, how the use of space has changed and how could the users benefit from the newly created functions. A local public market was the strongest feature of the square before the development, but this function has been reduced so much that the market has disappeared by now. Basically, this justified the choice of the square in the research. Conflicts occurring in the media refer to the fact that the users evaluate the market's disappearance as a negative change. Beside the earlier results and the relevant literature background, the method of participant observation and media- and discourse analysis was used. The results of the research show that the change of functions induced revulsions form the users and the modes of use of the square changed too. The square that was earlier colorful and often visited is now deserted and this change has brought about other negative consequences like weakening of the public safety. This analysis presents the first results of an ongoing research.

Method

First, the literature on public space was reviewed to determine the main characteristics of these parts of the cities and to have a usable definition.

Besides the processing of foreign and Hungarian literature it is indispensable within the research of

public spaces to overview the connecting development documents. Valuable information can be got with media analysis too. The articles that appear in the printed and electronic press and were connected to the given public space were analyzed, as well as the forum comments related to it during the discourse analysis. What can be gleaned well from this is how the contributors - who are interested in the topic - evaluate the given news or occurrence and if a conflict occurs, what kind of conflict it is.

Although before the empiric research it seemed that the method of the questionnaire survey can be used well in this kind of research of public spaces some difficulties emerged during the research, so we used different methods for now. The dilemma of sampling was one of the difficulties. In the case of a particular public space, the actual users and experts of the square should be inquired and asked to fill in the questionnaires; however there might be many people in the square who just walk there and do not even live in the city or if still, they do not know the square so much that their answers would be valuable. In addition, relying on a previous study, another difficulty also arises. The willingness to respond was very low and the use of space is influenced by seasonal circumstances. During the survey related to public space developments, problems like availability of data, especially for budget information and the documentation of projects is not user friendly. This was no different in the case of Saint Stephen square either.

For the examination of public space development, it recommended to interview a variety of actors, but this has not been fully completed yet (Steinar, 2005). Traversing the square, photographic documentation and participant observation is one of the most appropriate methods in order to map the space use patterns. All three of these methods were used, however a more detailed overview should be made of the participant observation. During this, I stayed in the square for certain period of time and I made notes of what I saw and what happened. There were observed the square users' external features, behavior patterns, the use, quantity and condition of field marks. The observations were done to add up to a weekday and a weekend day. In certain phase of the day, a few hours were spent in the square and then, another day a different phase was chosen so as not to overlap the observation sections. Overall one weekday and one weekend day was observed from 6 am to 9 pm; however, in the future it is necessary to extend the period of observation in order to show subsequent activity of all kinds and the fullest possible picture of the square. During the time spent there, the so called behavior mapping sheets (Fig. 1) were filled in.

Activity mapping datasheet

Field name:
Observer's name:
Date:
Period:

Group	Gender		Age						Activity														Notes
	Man	Woman	0-6	7-18	19-34	35-50	51-65	65-	Cross over	Reading	Picnicing	Bycycling	Walking	Chatting	Doing a sport	Looking-round	Eating&drinking	Walking with a dog	Sitting	Meeting	Sunbathing	Shopping	
1																							
2																							
3																							
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17																							
18																							
19																							
20																							
All																							

Fig. 1: The activity mapping datasheet that was used during the participant observations
Source: Edited by the author based on Madden, 2005

On this datasheet, there were marked precisely the square user individuals' and groups' gender and age and a serial number was given to them. The schematic map of the square (Fig.2.) was also drawn and the serial numbers form the data sheets were marked on it, so that to see later on where a certain activity was done.

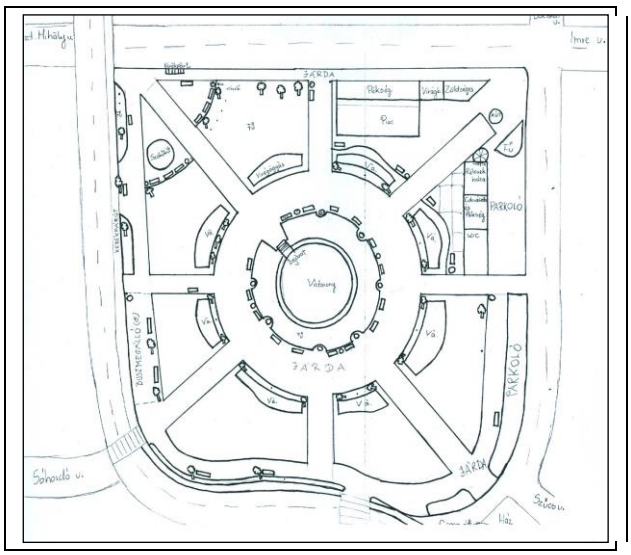

Fig. 2: The schematic map of the Saint Stephen square. Edited by Katalin Vedrédi

Thus, it outlined which part of the square was more intensively used during different time of the day, which field marks were used and how and what the typical methods of space use were. The evaluation of data was in excel table (Letenyei, 2006, Madden, 2005).

Importance of public spaces

A detailed understanding of various interpretations of public space literature is recommended before presentation the research work and results. Researching and examining public spaces have been done in many ways so it would be difficult to do a full review. For the purpose of his study, the significance of public spaces is especially important, showing why it is needed to pay particular attention to them in urban development actions. But before this, it is important to formulate what the paper means by public space. Numerous literature precedents were analyzed and combined with the author's empiric experiences, and afterwards synthesized as: public spaces are those spaces that are accessible to all; privatized by none; used by the local population and people from other parts of the city for meeting and recreation (Gehl, J. – Matan, A. 2009); that have functions; many kind of activities available; where different social groups come to contact; that is easily accessible and have some kind of community spirit (Mitchell, 2003, Szíjártó, 2010, Udvarhelyi, 2010, Wessely, 2010).

Within this, there were set aside community spaces that were identified by the following factors: community spaces are public spaces where people gather and may hold social and cultural events, that is rich in functions (trade, transport, cultural etc.), becomes a meeting place, and that strengthens the urban identity, democracy and the sense of common belonging (Madden, 2005). Considering the specific characteristics and potential of Saint Stephen square of Szeged, it could become a successful community space.

Both foreign and Hungarian literature covers the everyday life significance of public spaces besides the conceptual examining (Goheen, 1998). This significance has been reported since humans have gathered into settlements. Public spaces have always played a central role in the development and history of settlements and have always changed together with the surrounding urban space. Today in the age of globalization they are still able to interpret the social and economic activities like any time in history and therefore they deserve a competent and careful treatment (Feraboli, 2007).

With the ongoing transformation of cities, it is necessary to rethink the role of public spaces. Their development gains an ever increasing role within urban development because in accordance with the contemporary way of life, the importance and roles of public spaces have been extended too. Besides the city's basic functional and operational factors, other needs appear, such as tourism, recreational and community needs or even the humans' intent to express themselves (Varga, 2003). Accordingly the modern development projects should be carried along comprehensive social, economic, environmental and architectural concepts (Low& Smith2013).

There are many opportunities in public space development, but these are not always exploited in the Hungarian projects. Urban public spaces may have tourist potential, as city life can smarten up in a successful public space. They affect the local community's state, situation and assessment as public spaces are venues of the city where city residents have an opportunity to interact, where a variety of people and information concentrate and come in contact with each other. Public spaces are one of the most representative areas of identity, having a communication importance. The ideal public spaces are multicultural spaces where everyone feels like home regardless of their religious and ethnic affiliation (Malone, 2002). Public spaces reflect the condition of the city and also have an impact to it. During some developments many stakeholders' attention may be aroused as a keynote element of the project (Udvarhelyi, 2010, Wessely, 2010, Tamás&Kovács-Andor, 2009, Boros& Garamhegyi 2009).

Characteristics, significance and roles of public markets

Regarding the theme of the study, it is worth to do a tangent overview about the importance, roles and characteristics of public markets because the square analyzed in this paper had a well-functioning market. The Hungarian market word (piac) comes from the Italian "piazza" word. As the name suggests, markets were held in the settlement's main square. They played a significant role even in the ancient times and this significance was maintained in the Middle Ages too as the name of some settlements refers to it (e.g. Szombathely, Iaşi). Markets primarily fulfilled economic and commercial roles although in many places, especially in the Mediterranean region, they had a community role too. The former markets' imprints can be clearly seen in some settlements' present morphology. As they were mainly located in the heart of the cities or villages around the church these places have developed into public spaces. In Budapest, Kálvin square was once a coal market and in Szeged Klauzál square was a milk and bread market. Saint Stephen square was a wheat market and after the grain crisis, the smaller market started to function which has recently been developed within the square development (Balassa – Ortutay, 1980).

The markets as well as public spaces have had an important role since the formation of ancient cities. They still can have a number of positive effects on the city and on their direct environment. These factors should be considered briefly. Markets have such a complex nature, having a social, economic and cultural significance. A well-functioning public market may be the city's heart and soul that offers space for different activities. Markets, even if they are not open every day they are able to provide the local businesses' operation and may keep the local population's intent to shop there. In addition, markets fill up public spaces and their surroundings with life and encourage visitors to spend there more time and money both on the market and in the neighboring services.

There are several types of markets such as open air markets (flea-market, craft market and rural market), markets or fairs functioning only on certain days; there are also market halls and whole market districts (O'Neil, 2012). Despite the effects of the globalization to the commercial sphere, public markets are still enjoying a renaissance. The Institution of Project for Public spaces in the United States of America is researching public spaces and public markets. Researchers there carried on a survey and came to the conclusion that people like markets for various reasons. The Project for Public Spaces' (hereafter PPS) studies showed that the most frequently cited reason was the experience of going to a market. The effects and experiences that affect customers may be various. While shopping on a market, there is a chance to meet one another and to exchange ideas, views. In addition, markets have many attractive factors like spontaneous conversations and wild variety of stimuli that effect on the costumers senses. Mainly these factors influence the functioning of markets and stimulate people to return again and again. These elements – social relationships, experience of spontaneity – however do not create themselves. The condition of successful public markets (as well as in the case of public spaces) is the careful planning, and sustainable business management. PPS has studied markets all over the world and observed the classic factors as the conditions of successful spaces. Based on the results, it can be stated that what makes a market successful is the same as in the case of public spaces.

"Much can be learned about what make places great by observing successful markets – and vice versa."

PPS developed the theory of "power of ten". This states that there are ten focus points needed to be taken into account for making successful public space. Places that have the "power of ten" are able to create and provide appropriate experiences for everyday users. In the present paper, two out of the ten key factors are essential to discuss: the right location and the right public space.

The right location is easily noticeable and visible, accessible and memorable. People can see and walk through the place easily, the parking is well-organized and there are restaurants and other services in the neighborhood. They are centrally located, where assembling of people is natural, that is neutral regarding its users, so the market's area is available for all regardless of gender, age or ethnic origin. The scale of the place is also important so with the right size and right position it may be able to attract customers.

The right public space where a market can function properly should be like an oasis within the urban texture and it should provide a good feeling when entering. There ought to be a possibility for visitors to sit down, chat, eat, drink and relax. Good public space is well maintained and there are several shaded places which are important in all seasons. It should have things to look at and art is appearing too because these things can create aesthetical binding to the square. There are some rules, but it is not too formal. The feeling of welcome is important when entering the place. One of the most important elements is the flexibility of the square, that it is able to adapt to the users and maintain much kind of activities (O'Neil, 2012)

Before the development, one of the most striking elements of Saint Stephen square was the market which was not evaluated properly by the policy-makers. Thus, the market got much smaller role in the new square that has now completely lost its ability to function. Besides the results of the research, it is important to examine the square from the perspective of the above mentioned key elements.

The development of the Saint Stephen square

The issues related to public space development are presented through the case of a square renewal in Szeged. Szeged is located in South-East Hungary, near the Romanian and Serbian borders. The town has about 170,000 residents and after the change of regimes a lot of new forces started to form the inner spatial processes of the town (Boros –et al. 2006).

The Saint Stephen square is located outside Szeged's city center, it is at about five or ten minutes' walk from it, and it is definitely a less frequented place (Fig. 3). The main characteristics are the building of the water tower and the commercial functioning area in the corner which was intended to be the new market (Fig. 4).

The development begun in 2005 and finished in 2007, although later on there were still some smaller changes. In the framework of the square reconstruction, the water tower was also renewed inside and outside. A new arrangement was developed which represent the city's boulevard and avenue structure and it also refers to the paraphrase of "Szeged the city of the sunshine". New green areas were established, some trees were planted too, a fountain and a drinking fountain, several benches and dustbins were placed to the square and it was enriched with some artistic creations, too.

Although the formal market's regeneration is the most interesting element of the renewal, most of the conflicts were caused by this. The main goals of this renewal were to increase the public satisfaction, to preserve and present the city's values and traditions and to increase the number of tourists' arrivals. The effects were meant to increase the city's touristic attractiveness and improve local businesses' profitability and help them to crate new jobs as well (Szeged Megyei Jogú Város Integrált Városfejlesztési Stratégiája 2008 és Szeged Megyei Jogú Város Akcióterületi Terve (2007-2009, Boros 2009).

Two main groups of problems emerged related to the development. One was the above mentioned market renewal and the other was the one-sided decision making. These two topics will be presented in the following part of the chapter.

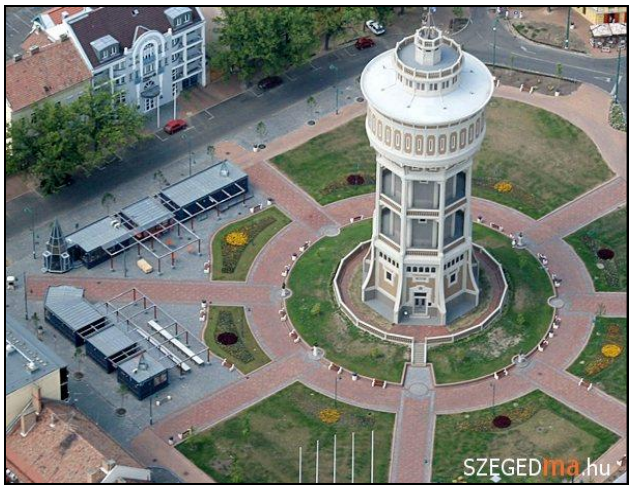

Fig. 3: The new Saint Stephen square in Szeged

Source: www.szegedma.hu

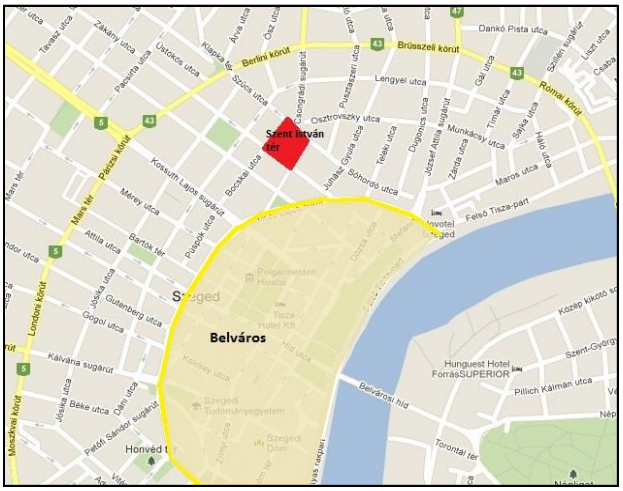

Fig. 4: Saint Stephen square after the development

Source: edited by Katalin Vedrédi based on googlemaps

Besides the water-tower, the most striking characteristics of the square was the flea-market before the conversion, which occupied nearly half of the square's area (Fig.5.) Although the look of the square was not too impressive, people who knew the old market said that it had a special atmosphere and it made the place cheerful, lively and sparkling. The city government aimed to reach the touristic goals by the square's market renewal. Despite this, the market has got placed in the corner on a 3 meters per10 meters area, which is very small compared to its previous size (Fig. 5). In addition, a few new stalls were housed in the same corner where such goods were intended to offer to tourists. The reduction of the market size and function may be evaluated as a negative process and the critics of the square users also support this view. The critics were analyzed using the method of discourse analysis.

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The other issue concerning the square renewal was that the development was mainly concentrating on the external factors and the design instead of the f use of the market. The square has not been measured to its earlier form and the human factor and functions got a less important role. It is also revealed in the critics that the public consultation lost during the development. People who care about the fate of the square formulated many comments in connection with it.

Fig. 5: The size of the market in Saint Stephen square before and after the development

Source: www.szegedma.hu and www.pixelfoto.hu

Conflicts and problems related to the renewal of Saint Stephen square in Szeged

The results of the discourse analysis

A variety of methods are possible in a public space examination. Besides the analysis of the documents related to the square and the development, it is worth to review the historical antecedents and, if relevant, the current printed and electronic media entries. In the empirical part of the research it may be useful to make interviews and do a questionnaire survey, visit the place and document the events as a participating observer. In this research, some of these methods were used, trying to describe the best possible picture about Saint Stephen square. In the theoretical part, there was examined the background of the development, the development documents and a media- and discourse analysis.

Discourse analysis is an excellent method to examine media publications not just in themselves but in a broader context, while taking into account other factors that occurred when the text was formatting. In doing so, the investigator does not capture certain statements from the text but considers the whole text overall as a macro-structure. Moreover, it is important that the texts that appear in the press have a hidden, implicit content. This means that the author does not provide some information directly and does not mention them in detail, but only suggests (Jakusné Harnos, 2002).

In order to examine the changes of the market, articles in the electronic press and I reviewed and the related forum comments as well were searched for. The political-sounding comments were eliminated, keeping only those that were clearly linked to the market. It became apparent that the majority of the comments are negative. The entries that classified the square were selected, distinguishing the positive and negative ones. Out of 42 comments, 33 judged adversely one factor of the square, while only 9 were positive. The various criticisms were grouped into issues so it turned out that mainly the following themes generated dispositions: the aesthetic elements of the square, the quality of landmarks, the neglect of market functions and the way of the plan and development. Most of the contributors had a negative assessment of the new expatriate market stalls, they liked neither their quality, nor the appearance. Several comments support the view that the blue stalls do not fit into the square's atmosphere.

"I have never seen such ugly stalls"[1]

However, most people criticized the size and functioning of the market. In the course of the participant observation, it became obvious that the market area is too small and it was not even working during the monitoring period. There is no information at all in the square about the opening times either. The merchants in the market revolted shortly after the opening alluding to the bad circumstances, the lack of customers and high rental fees. In the last few years there were several attempts to revive the market. In June 2011, there was an attempt to reopen it as a bio market, then, in 2012, the rental fees were reduced by fifty percent. The following forum comments reflect the various views well:

*„This market is the smallest one in Middle-Europe, 10 meters*10 meters!"*

„The 10 meters size market is a joke!"

„…it would be an exaggeration to call this 10 meters size area as a market…"

"I haven't really seen any customers there!"

"I walked there today, there was no merchant at all…"

„Much more people visited the earlier market. I think during the development, the customers went to other markets and shops…"

„When I moved to Szeged in 1983 the Saint Stephen square's market was a lively and cozy market."[1]

Based on the citizens' opinions, one reason of the failure of the square and market is the inappropriate promotion. The previously described ten criteria of successful public spaces and markets included the factor of "appropriate promotion" too. Thus, the market and square should be promoted by a variety of events and advertisements in the surrounding area and within the city. Based on the observations in the case of Saint Stephen square, it was clearly shown that if there is an event that attracts tourists (like Hungaricum festival), then the square's circulation increases too. The water tower is sometimes open and it can be visited and it functions as a lookout tower and exhibition hall. During the observation period, the tower was open several times and on these days the circulation of the square increased a little. The dreariness of the square is partly caused by the lack of advertising which also reflected in the results of the discourse analysis.

„The infrastructure is good, a little propaganda would be needed and there would be surely more customer and merchant too."

"The merchants should also be given some discount and advertise the market around the square!"[1]

However, quite a few comments mentioned that the planning and development process of the square was not in such a way as they think it would have been appropriate.

„…It is not composed as the old masters would say."

„Everything is needed to be handled on its own place and needed to adjust to its earlier existence."

"One thing is sure, the square is dead, empty and has no functions."

"It is bleak, lifeless and consists of ugly blue booths"[1]

Based on the comments above, we may conclude that the writers of the forum entries think that the role of the market was not properly estimated before the planning. Besides the necessary negative critics, there are some laudatory critics, too. They all refer to the fact that the square is much nicer than before and the change and innovation should be evaluated. The square was rundown, derogatory and worn before the development, so compared to that the present condition is very impressive.

„The square is really nice…"

„I think that the square is beautiful."

The square is beautiful, the kiosks are ok, and there will be vendors and costumers too sooner or later."

„I don't really regret the Saint Stephen square before the development"[1]

This chapter of the study demonstrates that the development of the Saint Stephen square was definitely a controversial case. Almost all urban activities appear in the press but not all of these induce conflicts and disagreements like this one. Discourse analysis confirms the assumption that the square really has elements that provoke dilemma and conflict between square users. This may occur at all public space developments because it would be difficult or maybe impossible to carry out a change that affects more stakeholders and that should be agreed by all parties. Disputes like this may even be constructive as well, as they point out the strengths and weaknesses of the development; however, after the handover there is not much possibility for adjustments. For further investigations of problems in relation to Saint Stephen square, participant observation was approached.

The results of the participant observation

The results of the fieldwork are consistent with those of the discourse analysis. The spatial characteristics of the square using habits have been outlined from the behavior mapping, i.e. from the marks made on the map. The observations also showed which part or parts of the square are more used than others.

The periodical characteristics of the square have been outlined well. Considering a weekday in the early morning hours the grocery, bakery and flower shop have a bigger turnover than in the rest of the day. Apparently, there is a high pedestrian traffic through the square, most probably because the younger generation makes for work and school, while they stop to buy some breakfast. There are remarkably many pensioners in the area, some of them take the dog for a walk, but almost all of them go to the stalls to buy something. After the morning bustle, the square becomes lonelier and mainly new mothers, retired people and older people with dogs appear. As the observation occurred in summer, there are very few square users around the meridian time which may be due to the weather conditions. In the afternoon, when the tower casts a shadow the flow increases in the square. More people come and go and the mostly static activity occurs this time

(i.e. all in which people do not move). People sit, read, meet in the afternoon and every day in the same time a group come together with their dogs and gather in the same part of the square. During this period the dynamic activities become more common too, as many people walk around, look-round, kids run around. Since a section of the city's bike rout crosses the square, there are a lot of bicyclists, but most of them just ride through the square. In addition, in the South-East corner of the square there is a trolleybus stop so there are more people because of this too. In the early evening hours, when the summer heat decreases, more pensioners visit the place. Some of them come with their usual package so they bring a pillow which they can sit on, something to drink and eat and some reading material, but some of them come just for chatting. In the evening the square becomes empty and after dark the younger ages occupy it. They gather in groups and then they move on or settle in the square and listen to music, talk, have fun. Overall considering a weekday, the intensity of use of space culminates in the morning and the late-afternoon, early evening period.

Considering a weekend day, the intensity of the use of space seems to be more balanced. People come and go all day, but there are much more family and group activities. During the observation period, several times foreign tourists show up too and on the days the tower was opened. Consequently, more people visited the square but after they went up to the tower they left the square too. Many visitors noticed the possibility to go up only when they arrived to the square. As the admission fee is cheap, almost everyone takes advantage of the opportunity, only a few people stayed down while the rest of the family went in. The flow of the square increases noticeably when there is a program in the city center. The reason is partly the fact that the square is at about five or ten minutes walk from the Széchenyi square, where most of the city's festivals and programs are held.

During the participant observation, the various activities were marked on the map of the square. For every observation period, a new map was used to mark the period it referred to. When these maps were overlaid, the so called hot-spots emerged - areas that are much more frequently used than others. This gave a clear picture that the south-eastern half of the square is more visited and more attractive (Fig. 6). The hot-spots are marked with red circles on the figure 6.

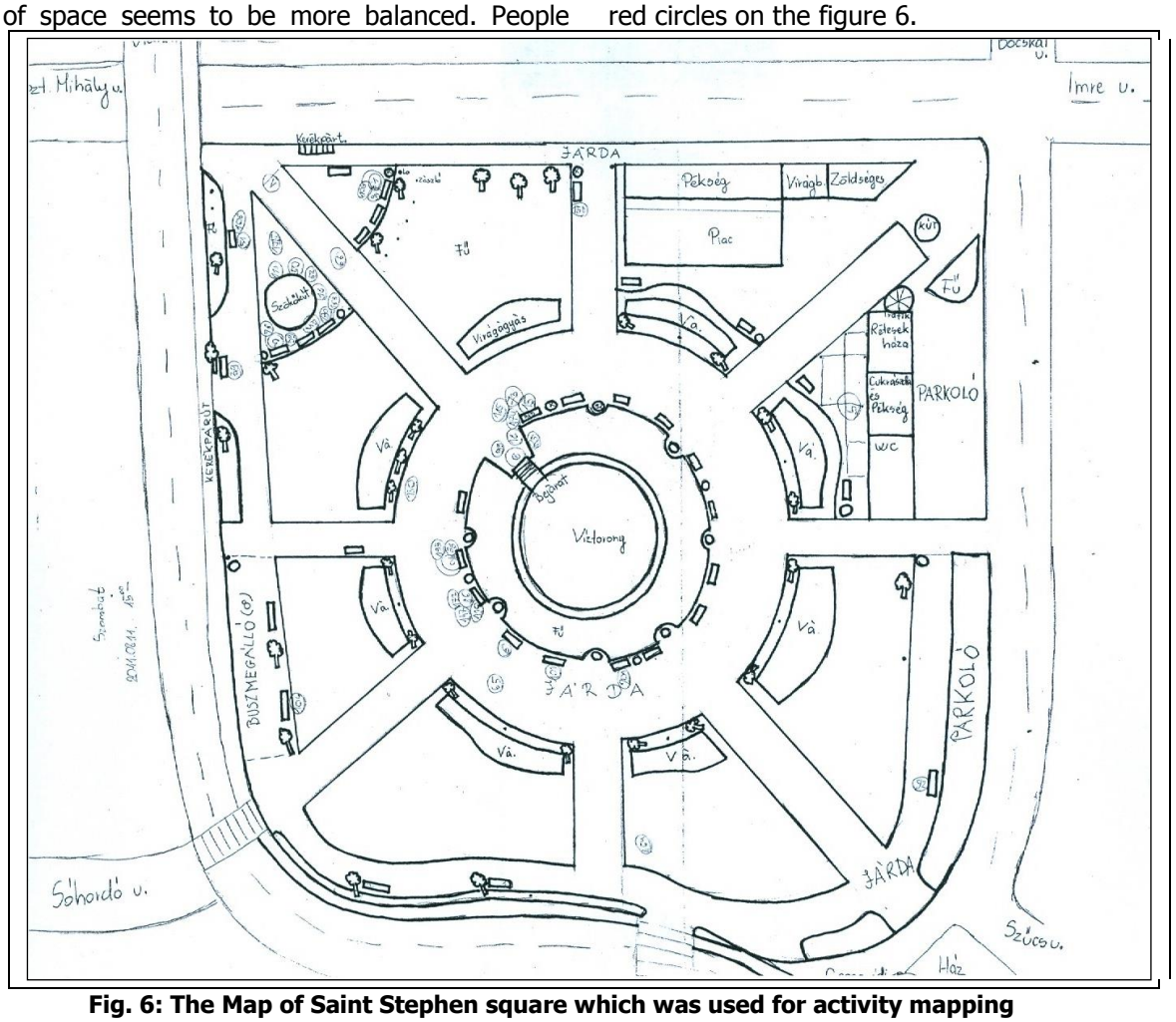

Fig. 6: The Map of Saint Stephen square which was used for activity mapping

Source: edited by Katalin Vedrédi

It is important to note that there is a permanent group of homeless people on Saint Stephen square who were continuously residing on a certain part of the square and they were sleeping, drinking, eating and chatting there. They were just in the other half of the square in the north-west, which includes the market area as well. Under the observations, they never came in contact with any square users at all. Only the litter left behind refers to their presence, but this is specific only on the part of the square where they reside. By the way there are sufficient numbers of dustbins on the area so littering is not typical at all.

The maps also showed that one focal point of the area is the fountain. The benches around it are almost always occupied, especially if there are children between the visitors. The fountain is an important element of the square which slightly offsets the lack of shadows, which is otherwise a big problem of the area. During the observation period, there was noticed several times that in certain periods of the day there are hardly any shaded area and only the tower gives a little shadow which includes one or two benches (Fig. 7).

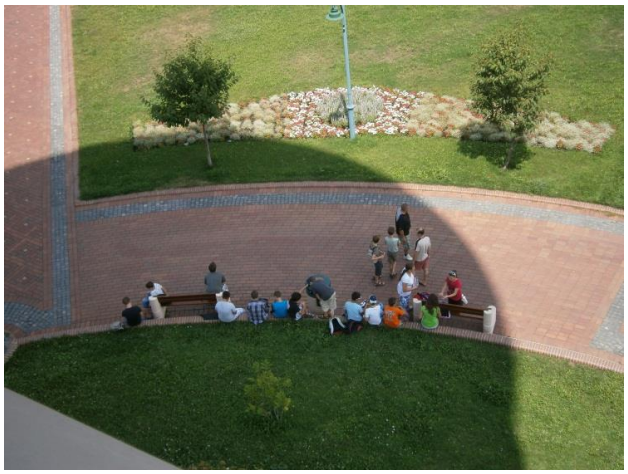

Fig. 7: Shade by the water tower
Source: the author's own photo

Partly this may be the reason why the average time spent in the square is very short. The weather conditions might have influenced the results, so in the future a milder season shall be included in the observations also.

With the method of participant observation it is easier to explore the life and characteristics of a public space and to gain an insight to the modes of the use habits. Moreover it is easier to find out that the critics related to the place are right or not. For example, during the discourse analysis there was noticed that in some comments there were references to the very poor quality of the solid surface of the area. When I was there I examined it and recorded by photo documentation that the stone cubes were turned out in many places (Fig. 8).

Fig. 8: Photos of poor quality of the cube stones in the square *Source: the author's own photo*

Moreover, several photos of the square and the activities were taken. These can confirm the statements based on the observations.

Overall, based on the experiences, it can be stated that this method can be used well for mapping a public space and exploring its life. It is necessary to note every moment and activity even those that do not seem important, because later during the evaluating work, those aspects may also make sense and get a meaning.

Based on the participant observation, it was found that the supposition that the square is not working as well as the decision makers planned is right. Many problems occur that make the place more unsuccessful than before, but it is also important to note that the development and renewal was necessary. The square is much more aesthetic than earlier, but its functions do not operate as they should.

Conclusion

This study has intended to present how important public spaces are to people and how essential is to examine the working, functions and needs of a place before doing any change.

Saint Stephen square had a strong character that made it attractive although its aesthetical trait was not satisfying. The market had always belonged to the square and the decision makers recognized it too, even they aimed to give new functions to it (like attracting tourist). However, something failed because the market is not working at all today. Square users who commented to electronic articles think that there would be many possibilities to fix the problem. It seems that political decisions are sometimes driven by aims that show what the given party did in that mandate.

Based on the successes of Western countries' method for developing public spaces, there are

many ways to measure a place's characteristics. For example go to the square, sit down for a while and watch how people use the terrain features, how they act and what they do, how long they stay there. This may reveal many things and participant observation can give answers.

In the case of Saint Stephen square, more observations are needed to get sophisticated results and to give proposals in connection with further development movements. However, the results so far reveal that the square is very impressive and local people and people from other parts of the city like it. They go there with pleasure, but they do not stay too much because it is empty and there is nothing to do.

Public markets are a very important feature of cities and they are able to attract people from the city and tourists as well if they work well. A market can give life to a square and can strengthen the businesses in the neighborhood as well. The market of Saint Stephen square was the only one in the downtown, so it may have a more important role that others.

Public spaces and public markets together can make people gather and make the surrounding of the place more successful. This is why it would be essential to analyze Saint Stephen square's status well and do some further dispatches because they are needed based on this research.

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The impact of the community development on electoral turnout in rural areas at the parliamentary elections (2008), Romania

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Abstract

In the countries with a consolidated democracy, but also in post-communist Romania, the turnout has experienced a downward evolution. The difference lies in the fact that while in Western European countries the turnout is higher as the economic and educational level is higher, in Romanian during the last general elections (2008), the turnout was higher in rural areas (traditionally more precariously from the economic and educational point of view than the urban areas). In this way, the article strives to identify to what extent there is a causal relationship between the development index of the rural localities and the turnout, the descriptive statistics highlighting a relevant aspect: there is a higher turnout in the less developed counties than in the developed ones.

Keywords: *general election, turnout, Romania, development*

Rezumat. Impactul dezvoltării comunităţii asupra prezenţei la vot în zonele rurale la alegerile parlamentare (2008), România

În statele cu o democraţie consolidată, dar şi în România post-comunistă, prezenţa la vot este din ce în ce mai puţin numeroasă. Există însă şi o diferenţă considerabilă: în timp ce în statele vest-europene, prezenţa la vot creşte o dată cu nivelul de educaţie, în România, la ultimele alegeri generale (2008), prezenţa la vot a fost mai mare în zonele rurale (care sunt, prin tradiţie, mai precare din punct de vedere economic şi educaţional decât zonele urbane). Astfel, articolul încearcă să identifice în ce măsură există o legătură cauzală între indicele de dezvoltare a localităţilor rurale şi prezenţa la vot, statistica descriptivă ilustrând un aspect important: în judeţele mai puţin dezvoltate, prezenţa la vot este mai mare decât în judeţele dezvoltate.

Cuvinte-cheie: *alegeri generale, prezenţă la vot, România, dezvoltare*

Introduction

Starting from the theory which states that citizens would abstain from voting, if they acted rationally (Downs, 2009), in spite of the fact that the chances to influence the final elections score are almost null, many proves have been shown for the perfect citizen who is interested by the electoral process.

Some voters consider that voting is a civic action and a duty of every citizen of a democratic society (Johnston and Pattie, 2006), others believe that belonging to a group of interests constitute a sufficient motivation for voting (in accordance with this assertion, when a voter rationalizes he does not start from the premise "will my vote count in the final result?", but rather from the question "will my vote count in the interests' group I belong to?" – Franklin, 2004). Others authors explain that the turn out of the electorate and its affinity for one party or other, from an anthropological point of view, the vote being considered "the central element of a rite, and from this perspective, "the vast majority of voters does not use a scientific reasoning to attend the game because then few individuals would participate in the game if they were aware of the probability of winning" (Guyonnet, 1994; Comşa, 2004).

However, a simple record shows that, both in countries with strong democracy and in those with new one, a part of the voting citizens gives up this right anyway (Johnston and Pattie, 2006; Gray and Caul, 2000; Norris, 2002). At the general elections in 2001, in Great Britain, the turnout was of 59 per cent, the lowest level of attending since 1918: the number of those abstain their voting right was higher than of those who voted for the winning party (Johnston and Pattie, 2006). We also meet this last case in post-communist Romania, where the voting turnout had a descendent trend, from a high percentage in 1990 (86.20 per cent, in 2008, the pro cent was quite low (39.20 per cent), practically, in less than 20 years, more than half of the voters have chosen not to vote any longer.

The low turnout at the general elections in 2008 made John Gledhill (2009) state that the low level of the voting citizens should not be a worrisome matter as "a low turnout is a normal although regrettable, result of the advanced democracies, and since Romania has become an advanced democracy it has to face this disease of growing up". How can we explain this low turnout in consolidated democracies? The explanation of the above mentioned author as

"the experienced voters in the advanced democracies understand that it is quite unlikely that the individual vote to influence the final result, one vote is ultimately just a drop in a huge electoral ocean", and even more "since there is no direct benefit from the electoral process, many citizens would rather go to a bar or take a walk in a park, than to enter the voting booth" (Gledhill, 2009) is quite often quoted. Given under the circumstances of extensively debates upon the paradox of the theory of the rational election, a simple proof for non-participation would be that, although it is rational for the citizens to abstain from voting, a significant part of them still vote, although as it was observed, its number has been constantly decreasing lately.

On the other hand, opposed to what Gledhill has noted concerning the Romanian turnout, we find J. K. Galbraith's statement. Analyzing the American contemporary society, Galbraith (1992) has identified two types of communities that live in the same country, but experience different standards of living, as the logical consequence of the market economy. One of the communities comprises those benefiting upon the market capitalism, whose life has been comfortable, the living standard has had a permanent growth trend, and accordingly they are deeply concerned with preserving their current state (status quo). On the other hand, we notice a large group including those who loose on the market economy. Here we have the paupers, the unemployed and the workers. As the parties are looking to get as many votes to win the election, they will pay attention to the opinion of the influential people; hence the policies adopted will be in accordance with the aspirations of the upper classes: low taxes, limiting the public expenditure (including wages). And in this way the interests of the paupers are neglected and as a result the turnout will be different on the two compartments of the superimposed social classes; particularly the turnout in the lower classes of society would be in a continuous decline. Moreover, the policies implemented by the parties will be focused on the upper classes, the problem of those economically disadvantaged be left aside "here is the modern political dialectics, in a highly concise form. It is about an unequal competition: the rich and prosperous have money and they count. And they vote. And the paupers, concerning for tomorrow – although in large number – most of them, unfortunately, do not vote. There is democracy, but there is a democracy of the wealthy people and that not in small measure" (Galbraith, 1997).

There have been brought numerous other substantiations for non-participation and concerning the non-voters. Crewe (2002) has distinguished four different categories:

a) apathetic non-voters, i.e. those who have no knowledge or interest in politics;

b) those who believe that there is no certainty that the politicians and governments address their problems;

c) those who are indifferent and are not interested in the result of the elections and the party that will win;

d) those that see no difference in the result of the elections.

Referring strictly to the Western area, it is undeniable the fact that the turnout is higher among the wealthy and educated classes compared to the participation among lower income and poorly educated citizens (Johnston and Pattie, 2006; Clarke et al., 2004; Almond and Verba, 1996; Leighley and Nagler, 1992; Lipset, 1983). At the elections from 2004, in Romania, the survey showed that the proportion of the voters was higher "among men, middle-aged, better educated, wealthy persons and employers" and that of non-voters was higher among women, younger or older people, less educated and low income persons, unemployed/ housewives" (Bobârnac and Comşa, 2005). The general elections from 2008 suggest a shift of paradigm: the turnout in rural areas was higher than in the urban environment (see table 1), major urban centres, such as Braşov, Timişoara, Cluj Napoca and Constanţa had a reduced turnout and less educated and poor population voted in a proportion greater than the educated and better-off classes (Alexandru et al., 2009).

In this context, taking into account the above mentioned, the main purpose of this article is to test if there is a significant/relevant interrelationship between the turnout and the development index of the commune at the general election in 2008 (Chamber of Deputies). If in 2008, in the rural localities the turnout (as percentage) was higher than in the urban ones, is there a certain correlation between the development index of the commune and the political participation inferred, meaning that the turnout is higher in rural areas, which are economically poorer compared to others economically pre-eminent? Were the differences significant at the regional and counties level, regarding the different degree of development in the historical Romanian provinces? How big are the turnout variations depending on the selected rural areas? These are the questions that our research aims to provide a response to.

Method

The present analysis is structured by two major variables, which are the development index of the communes (encoded here in IDC) and the turnout in the selected rural areas. These two variables will be correlated at various levels of analysis: the general one (correlation across the whole level of the

selected units), regional and categories of development level.

From the perspective of the sample we have to specify from the very beginning that at the level of counties and communes, we have chosen a representative one in a statistical sense, the research units have been randomly chosen. The article is built in three stages in order to answer the questions of the research treated by the present study. Therefore, it can fundamentally be catalogued as a multistage purposive sample (Quinn Patton, 2001).

In the first stage of sampling, we grouped all the 41 counties of the country in three regions that provide flexibility and efficiency in managing data and that surprise the most important regional and historical characteristics of them.

The three regions selected are Moldova, Transylvania and Wallachia. Under the generic name of Wallachia, we have also included the two historical provinces, Oltenia and Dobrudja, and when we mention here Transylvania we have also incorporated into it Banat, Crişana and the historical Maramureş. We have chosen this approach for several reasons. On the one hand, Oltenia and Wallachia had similar history since the 13th century and until the Union in 1859, as for Transylvania (here being included Crişana and Maramureş) and Banat they have followed different historical paths than the regions previously mentioned, their history between 1250 and 1918 been linked to that of Hungary and Austria-Hungary (Chirot, 2002). On the other hand, Dobrudja, although it has been a Romanian province for a relatively short time (since 1878), later on, the intense process of ethnicization has radically changed the region, encompassing it to the southern area, the ethnic transformation of the Moldova between the Danube and the Black Sea having a great impact on the electoral behaviour, even in the interwar period Dobrudja and Romania had a similar electoral behaviour (Giugăl, 2011). Therefore, we mean to define these three mentioned regions not in the sense of their strict term base size, but rather their spatiality which obviously involves a certain similarity in the historical evolution.

In the second stage, we have selected for each historical region, according to IDC county media (correlated with the population), three counties: a county with a low IDC, one with a medium IDC and in the end, one with a high IDC. On this criterion we have selected from Transylvania Maramureş, Hunedoara and Timiş counties; from Wallachia Teleorman, Gorj and Ilfov, and, finally, from Moldova Vaslui, Neamţ and Galaţi. We have chosen these counties concerning the intensity of cases (in our case – of IDC) and we consider that these cases provide representativeness for each historical region and each development category.

Fig. 1: Regional divisions and counties

Note: I – counties with a low IDC; II – counties with a medium IDC; III - counties with a high IDC

In the third stage of sample formation, the counties selected in the second stage have been reviewed in light of the questions sought, on the one hand, all localities in the assembly, on the other hand, the top 5 communes and last 5 ones from each county (according to IDC). The main reason for this latter selection was to observe if there can be noticed important differences between them or, conversely, the distinctions are dimmed at this level of bivariate analysis.

This sampling has certain advantages: I) it provides a comprehensive analysis upon selected counties; II) it ensures a degree of representativeness per region and per category of development; III) it enables comparisons between countries, regions and categories of development; IV) it provides the opportunity to in depth study for certain deviant localities. It also has its weak points: the cut regions were not balanced, the difference between Wallachia and Moldova is quite high from this point of view; the medium index (IDC) at the county level and the level of development in the selected regions is different, so that Maramureş has a medium IDC of 50, which makes it a weak developed county in the region of Transylvania, but places it on the same place with Galati which is the most developed county in Moldova.

The statistical instruments that we have used are the bivariate correlation and Pearson index, on the one hand, and the descriptive statistics on the other hand. The electoral data at the parliamentary elections (Chamber of Deputies) in 2008 are at the level of administrative territorial unit (locality) and they have been published by the National Institute of Statistics (INS) and the Permanent Electoral Authority (AEP).

The development index of the commune represents the indicator on which the counties and communes of the sample were selected. It is built by a team of National Institute of Statistics (INS)/School of Sociology, University of Bucharest and it measures the degree of the development of each commune, based on a set of 10 indicators grouped into four main dimensions: housing infrastructure, local financial resources, population health and household goods measured based on the number of cars per thousand inhabitants (Sandu et al., 2009). Most of the calculated values are arranged on an interval between 20 and 100, but these values are not per cents but scores in a series with the average of 50 and standard deviation of 14, but which could take values from 0 to infinity.

This type of measuring poverty/development is characteristic to the local communities, not to the individual or family's level and involves not just aggregation for home consumption but also goods, services and public consumption at the level of communes. Therefore, it is focused on the community, not on the family or individual. Transferring this approach at the level of our study, we can state that electoral turnout is an individual act mediated by the development of the community and therefore the turnout is understood in the context of the community. Moreover, since IDC has as its main predictor the stock of education (Sandu et al., 2009) it can be considered that the electoral turnout is indirectly linked to education.

Results and Discussion

In 1990, at the first elections in the post-Communist period, it was registered the highest rate of the turnout (86.20 per cent). From this beginning point, the turnout has steadily dropped, with a steady period at the ballots in 1992 and 1996 (76.29 and 76.01 per cent, respectively) – see the table below.

On the other hand, the dynamics of the turnout on urban/rural distinction has followed the same downward trend (see table 1), with only one important difference. In 1996, under the conditions of high rate of the turnout, in urban areas there has been a higher turnout than in the rural areas (77.3 per cent compared to 74.5 per cent). After this electoral moment, at the ballots in 2000 and 2004, the proportion of voters has declined by about 10 percentage points, and the rural-urban distinction was relatively balanced. The parliamentary elections in 2008 is looming as a turning point in the post-December 1989 history of Romanian electoral, on the one hand due to drastic decrease of the turnout from 58.51 per cent at the election in 2004 to the unassuming per cent of 39.20 in 2008 (the biggest difference from one election to another, basically less than half of what was registered in 1990) and on the other hand, by inverting the report of the turnout, with a significant difference of 8 percentage points in favour of the rural areas (43.9 per cent compared with 35.7 per cent).

Table 1: Turnout (%) in urban and rural areas at Romanian general elections (Chamber of Deputies)

	1996	2000	2004	2008
Urban	77,3	65,7	58,1	35,7
Rural	74,5	64,8	59,0	43,9
Urban – Rural	2,8	0,9	–0,9	–8,2

Source: Alexandru et al.2009

At all levels of the selected analysis, respectively the regional and counties' ones, categories of development, the turnout in rural areas was higher than in the urban areas, except for Ilfov County. At the region level, there can be distinguished two spaces (Wallachia and Moldova) with a difference of urban-rural of 11.10, and respectively of 13.39 per

cent, a higher rate than the national average and Transylvania with a rate under the national one (5.54 per cent compared to 8.20 per cent – the national average).

The counties selected on the base of development categories of the rural settlements also present important distinctions. On the one hand, an obvious difference was registered between the counties with developed rural settlements and those with underdeveloped ones, meaning that the turnout in the rural areas was vastly higher than that in the urban areas fromTeleorman and Vaslui counties, compared to the category of developed counties, Ilfov (higher turnout in the urban area) and Timiş (a small urban-rural difference of 5.83 per cent). Significant differences were registered among the category of the medium developed counties, with a minimum turnout between urban and rural in Neamţ (of 2.61 per cent) and a maximum turnout in Hunedoara (of 10.61 per cent) (table 1).

This general perspective on the turnout between regions and counties indicates an essential aspect: the turnout for parliamentary elections in 2008 was much higher in rural areas in counties with a precarious economic situation (Teleorman, Vaslui) compared to those situated at the top of rural development in selected regions (Timiş and Ilfov).

Turning to the particular situation of Romania, if we admit that rural areas are more precarious from the economic and social point of view compared to the urban settlements and taking into account the two electoral realities at the parliamentary elections in 2008, on the one hand, the low turnout (below 50 per cent), and on the other hand, the superiority of rural turnout in comparison with the urban one, it makes sense to ask ourselves if there is a significant correlation between the development index of rural localities from all the nine selected countries (606 communes as a total), and the turnout concerning the important aspect that the Romanian electoral logic is quite the opposite to the Western one, because the turnout is higher in the disadvantaged economic settlements (rural areas). On the other hand, we admit that this high turnout in the rural areas at the parliamentary elections in 2008 can be just pure random and not a clear peculiarity of Romanian space.

The correlation between IDC and turnout at the level of these 606 units analyzed is negative and very low (fig. 1). Following the correlation it can be said that the relationship between the level of development of one commune and the turnout in that commune is almost non-existent. This very weak link leads to the conclusion that if a commune is more developed, then its turnout is lower.

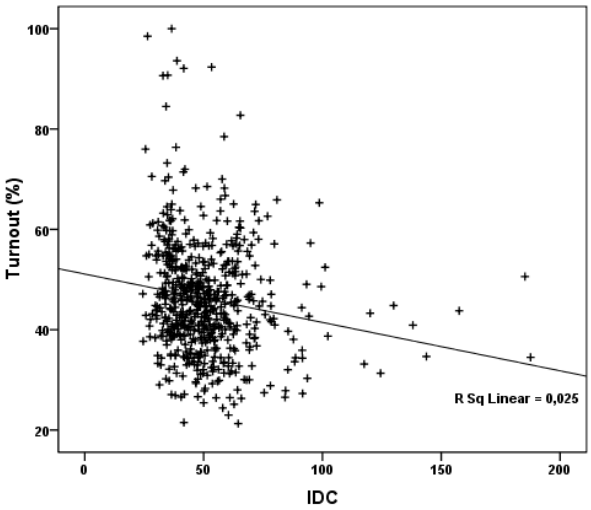

Fig. 2: IDC and turnout, 2008

Considering the historical regions, the most significant connection between the variables can be found in Wallachia, where there is a negative correlation of –309, but still, it is a weak one, which means that only 10 per cent of the turnout in 2008 can be explained through the development index of the community (table 2). In the same time, we should notice that Transylvania is the only region with a positive correlation, although insignificant. At the level of development categories, it is worth noticing the positive correlation between variables in the category of the medium developed counties, where the electoral turnout is higher as the local development is higher (table 2).

Table 2: Correlation coefficients between IDC and turnout

	NAT	MOL	MUN	TR	D	MD	SD	GL	NT	VS	IF	GJ	TR	TM	HD	MM
Pearson	–.158	–.167	–.309	.008	–.122	.195	–.107	–.423	–.421	–.090	–.348	–.019	–.174	–.206	.309	.244
R^2	.024	.027	.095	-	.028	.039	.011	.179	.177	.008	.121	-	.030	.042	.095	.059

Note: NAT – national; MOL – Moldova; MUN – Wallachia; TR – Transylvania; HD – high development counties; MD – medium development counties; LD – low development counties; GL – Galaţi; NT – Neamţ; VS – Vaslui; IF – Ilfov; GJ – Gorj; TR – Teleorman; TM – Timiş; HD – Hunedoara; MM – Maramureş.

Source: National Institute of Statistics (INS); D. Sandu et al. (2009) Dezvoltarea comunelor din România. Bucureşti

At county level, the strongest correlations we encounter in Galaţi and Neamţ, where there is a negative, inverse correlation, and where an index of higher development means a lower turnout. These are the only cases where the (inconspicuous too) correlation between IDC and the turnout has some relevance (approximately 18 per cent of the turnout could be explained by IDC) (table 2, fig. 3 and 4).

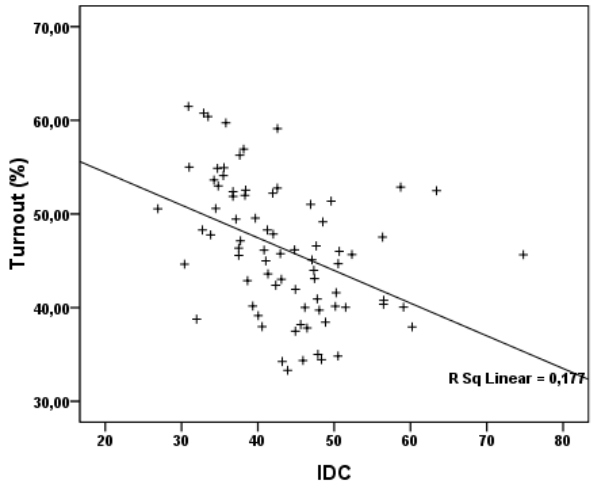

Fig. 3: IDC and turnout in Neamţ county, 2008

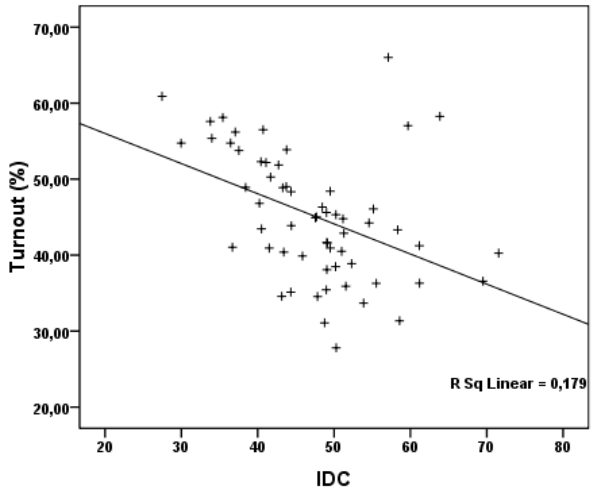

Fig. 4: IDC and turnout in Galaţi county, 2008

In Maramureş and Hunedoara counties, the correlation is positive, which means that here the development would lead to a higher turnout. These relations are much more interesting as the first two (Neamţ and Galaţi) are part of Moldova and the other (Maramureş, Hunedoara) of Transylvania. It is also interesting the meaning of the correlation between development and turnout in most developed countries – Timiş and Ilfov, where the development has a reducing effect upon the turnout. However, the correlation between IDC and turnout remains a very low one, but the meaning of the correlation can provide important information. The correlation is negative in Wallachia and Moldova, but also in the developed counties such as Timiş, Ilfov and Galaţi, and therefore the development of the community has a reducing effect upon the electoral turnout in the poorest areas and in wealthy areas from the IDC point of view. On the other hand, the turnout is higher as the development of the community is higher for the Transylvanian counties Hunedoara and Maramureş. For the county with the highest turnout at the rural level – Teleorman, the correlation is very weak, suggesting that the turnout is similar in the localities with a very different levels of development (cases of Siliştea-Gumeşti and Peretu, where the IDC was low, respectively high and the turnout high, over 90 per cent, but also localities with a medium IDC, where the turnout was as high as in the others, the case of commune Fântânele with 100 per cent. These special situations can only be explained through a detailed case research.

In this situation, in the absence of a significant coefficient of correlation, can we state that the higher turnout in rural areas at the last general elections in Romania cannot be associated with community development index (IDC)? We might say so, if we judge in the general context in which to include all the selected localities at regional and county level; this conclusion might support multiple faces if we filter all statistic data used and we refer to the first 5 localities and the last 5 from the point of view of development. In this context, we observe that in most of the cases the correlation index of Pearson between IDC and turnout gets negative – a relationship inversely proportional between the turnout and IDC (table 3), sometimes with significant statistical values in Galaţi, Ilfov and Timiş counties. This specific situation, given by the extreme values (the highest and the lowest developed 5 localities in each of the analysed county), indicates a peculiarity of the Romanian space (if we compare it with the electoral dynamics in western European space): in the highest developed counties in our study (Galaţi, Ilfov and Timiş), the development index of the communes has a strong reductive effect upon the turnout. This statistical correlation is far more significant if we take into to account the highest and the lowest developed 5 localities in each of the counties mentioned above. This is why a county which is weaker economically (Teleorman) had a greater turnout (50.7 per cent) than a more developed county, such as Timiş (31.5 per cent) – table 3. More even, Teleorman county was the most imbalanced in terms of the voting range in rural areas, the difference between the maximum turnout rate (100 per cent) and minimum (38,73 per cent) is of 61.27 per cent. In Teleorman and Vaslui counties from the south and east of the country, with a

development index far much lower than in Galaţi, Ilfov or Timiş, the correlation between IDC and the turnout is extremely weak, which make us believe that other indicators should be taken into account in order to provide a better clarification of the electoral behavior.

Table 3: Correlation coefficients between IDC and turnout [a]

	NAT	MOL	MUN	TR	D	MD	SD	GL	NT	VS	IF	GJ	TR	TM	HD	MM
Pearson	–.430	–.297	–.527	–.127	–.710	.412	–.551	–.788	–.277	–.208	–.509	309	–.105	–.508	.302	.218
R^2	.184	.088	.327	.016	.504	.169	.303	.621	.076	.043	.259	.094	.011	.257	.090	.047

[a]Were taken into account the turnout and IDC values in ten localities (first 5 and the last 5 as development).
Note: NAT – national; MOL – Moldova; MUN – Wallachia; TR – Transylvania; HD – high development counties; MD – medium development counties; LD – low development counties; GL – Galaţi; NT – Neamţ; VS – Vaslui; IF – Ilfov; GJ – Gorj; TR – Teleorman; TM – Timiş; HD – Hunedoara; MM – Maramureş.

Source: National Institute of Statistics (INS); D. Sandu et al. (2009) Dezvoltarea comunelor din România. Bucureşti

Conclusion

In the post-communist Romania, at the general election in 2008, was registered the lowest turnout in its electoral history (39.20 per cent). If we follow Key, Jr. and other researchers' in the field of social sciences judgement, we should really concern with such a turnout.

V. O. Key, Jr. (1958) affirmed that when the turnout is weak, this leads to Governmental under-representation of social and economic disadvantaged classes, which subsequently will implement it through a poor cohesion and loyalty to the democratic system as a whole (in one form or another it's about the same argumentation used by Galbraith in The Culture of Contentment). It wasn't quite precise specified in Key, Jr.'s statement, if low turnout is the effect of under-representation of poor economic and social classes or rather under-representation of the disadvantaged categories generates a low turnout. Other claims were made in order to strengthen the following assertion: a low turnout, as well as a very large one, can be translated by a democratic impasse (F. Wilson, 1936; H. Tingsten, 1937; M. Lipset, 1983).

A democratic impasse or not, at 2008 parliamentary election was registered a higher turnout in the rural areas than in the urban ones. This difference rural/urban is higher in the poor counties and is lower in the developed ones. In the same time, it is higher in Wallachia and Moldova than in Transylvania.

This way, we notice a different electoral behavior in Romania compared to the countries with consolidated democracies, where the turnout is higher among the communities with a greater level of development. In this framework, our research question, if there is a correlation between the turnout and the development index, is quite legitimate.

The level of the community development has a very weak effect upon the turnout, but several remarks can be made: in counties with a higher IDC the reducing effect is higher than in the poor ones. On the other hand, the positive correlation between IDC and turnout noticed in two counties in Transylvania (Maramureş and Hunedoara), albeit a small one and insignificant, from the statistical point of view, indicates the difference in electoral behaviour in terms of turnout, on the one hand between the centre and west of the country (the development has a positive effect upon the turnout), and on the other hand, between the south and east of the country (reverse correlation between development and turnout).

Although in the less developed counties (Teleorman, Vaslui) the bivariate analysis does not indicate an interaction between IDC and turnout, however, in both counties it is registered the biggest difference between the turnout in rural areas and urban (18.20 per cent and 12.18 per cent). These issues create the perspective of a further complementary analysis: micro analyses focused on commune or small groups of localities which could provide clues concerning the client relations in local partisan politics. By saying that we take into account the fact that the client networks controlling the vote do not represent an unique fact in political behaviour, such mechanisms being present in the western areas as well (Piattoni, 2001; Finner, 1970), but also in autochthonous politics, both in the interwar period (Dogan, 1999; Ivan, 1933), as in the post-Communist period as well (Olteanu, 2011; Ciobanu and Olteanu, 2011).

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