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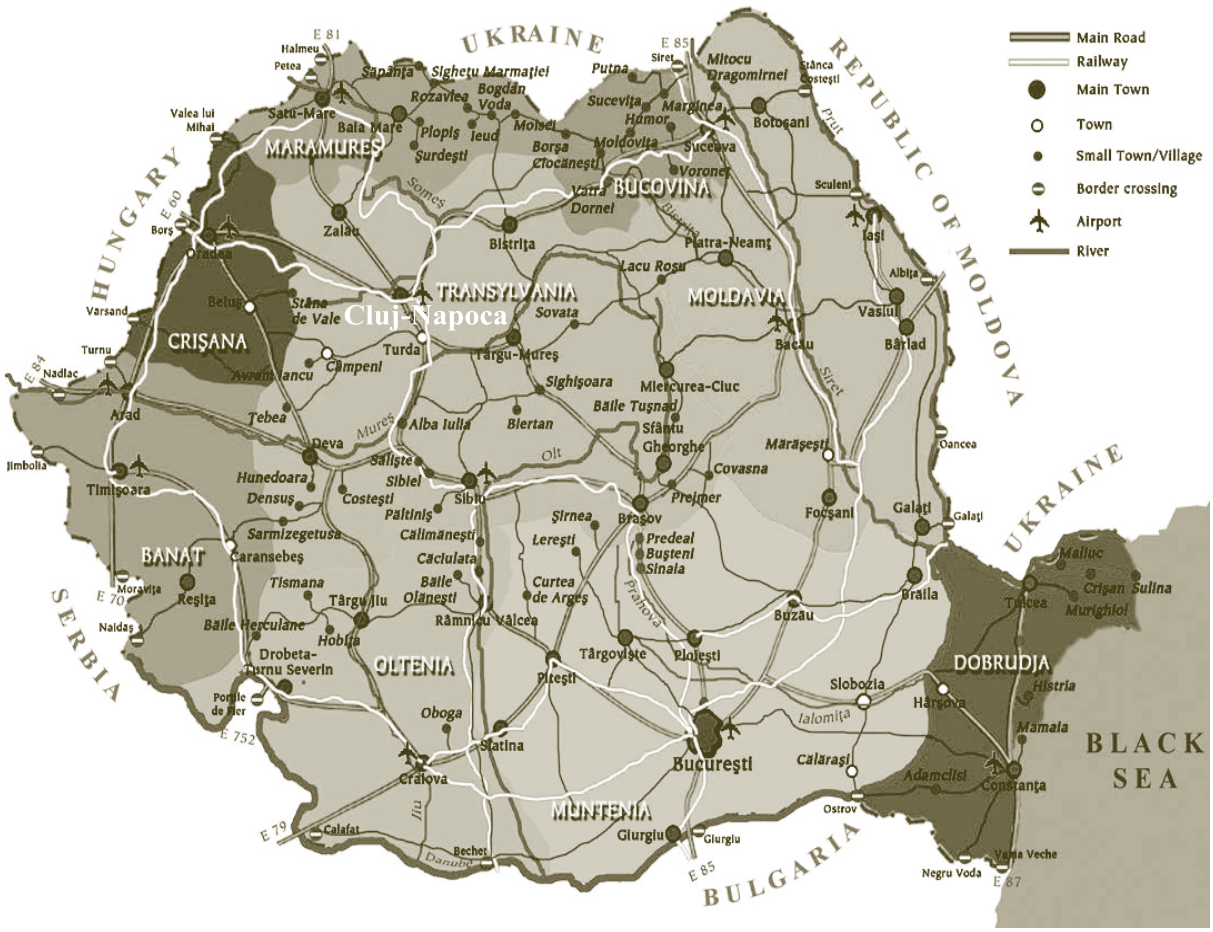

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THE RELIGIOUS STRUCTURE OF THE ROMANIAN POPULATION IN 2011 BY COUNTIES AND GEOGRAPHICAL-HISTORICAL PROVINCES

GR. P. POP[1], A. NIŢĂ[1]

ABSTRACT. – The Religious Structure of the Romanian Population in 2011 by Counties and Geographical-Historical Provinces. Our study addresses the issue of religion, which is one of the essential geo-demographic structures in the study of the Romanian population. We were motivated by the fact that it was not possible to study this issue in the period of 1948-1989 since censuses did not include data on religion. The situation of religion has become more visible and individualized only since the last decade of the last century and afterwards once with the censuses of 1992 and 2002 up to present day. More broadly, this study examines the key aspects of denominational structure of the Romanian population, based on the census conducted on 20 October 2011 at national level, data being provided by the National Institute of Statistics. Our research work consisted in the collection and processing of statistical data, subsequently synthesised in tables and graphical material (three tables and three figures). Table 1 provides key comparative data on the general religious structure of the Romanian population registered at the censuses in 2002 and 2011. Table 2 is the main source of information of this study, revealing the religious structure and territorial distribution of the Romanian population in the geographical - historical provinces and counties in 2011. Table 3 is a synthesis in which we present the total population at county and provinces level as absolute data (digits) and rates in case of the five main religious denominations (i.e. Orthodox, Roman Catholic, Reformed, Pentecostal and Greek-Catholic, the remaining religious denominations being grouped into the category of Other religions and Atheists. The research results are also highlighted by three charts and maps, allowing for the easy tracking of the subject as a whole and territorially, at county level and in the geographical-historical provinces. In a brief presentation of the topic addressed it can be emphasized that the Romanian population recorded at the census in 2011 was of 20,121,641 inhabitants, of which 81.04 % Christian Orthodox, 4.33% Roman-Catholic, 2.99% Protestant, 1.80% Greek-Catholic, and 0.75% Pentecostal. The other 16 denominations (Baptist, Seventh-Day Adventists, Muslim, Unitarian, Jehovah's Witnesses, Christian Evangelical, Christian of Old Rite, Lutheran Evangelical, Serbian Orthodox, Evangelical, Evangelical of Augustan Confession, Mosaic, Armenian, another religion, free of religion and atheists) hold only 2.83% of the population of our country. Approximately 6.26% of the population did not provide information on their religion (see tables 1, 2 and 3). Regarding the degree of representativeness of religious denominations in Romania, we conclude that the share of Orthodox religion population (81.04% of the 20,121,641 inhabitants of the country) expresses normality, given that on the one hand 6.26% of the registered population (1,259,739 persons) was included in the category of Unavailable Information, and on the other hand the difference of 12.7%

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(2,554,898 people) belongs to other 20 recorded religions, emphasizing that only the Roman-Catholic, Reformed and Pentecostal denominations registered a little over 1% (see table 1).

Keywords: *religious denomination, Orthodox, Roman-Catholic, Reformed, Geographical-Historical Provinces.*

1. INTRODUCTION

Ever since 1971, the first author of this study has addressed the issue of Geography of Population, the first component of human geography when he elaborated and published the paper "*Probleme de structura populației în Câmpia Crișurilor*".

The following year, in 1972, two other significant works: "*România. Geografie Economică*" and the series of "*Județele Patriei. Bihor County*" were made available to readers. The first book is an approach to the problems of development and territorial distribution of population, population dynamics and population structure (age, gender, social and professional backgrounds) in rural and urban areas and at national level. The second book describes the stages of inhabitation, development and continuity of settlements, population dynamics, distribution and structure (age, population activities, urban and rural population). We mention that if in the first case confessional structure (religion) was not approached, in the second case the national structure (ethnicity) was not addressed, as well, the lack of inclusion being the effect of the vision of the political system in the period 1948-1989.

From then on, the research on the geography of population has continued, Gr. P. Pop publishing up to 30 studies on a wide range of subjects, at different scales, such as: *The structure of population on age groups in Bihor County* (1973), *Population mobility in a village in the Someș Plateau* (1974), *Population in Bistra-Strei Corridor* (1986), *Issues of population in Bistrița and Gherla municipalities* (1987, 1990), *Potentiel et la structures géodemographiques dans le pays de Lăpuș* (1990), *The Bobâlna Valley, A Model of Geodemographic Evolution* (1995), *Model de involuție rurală. Satul Calna, județul Cluj* (1998) etc[2]. Another complex study, which included the analysis of demographic issues, is the volume elaborated and published by I. O. Berindei, Gr. P. Pop, Gh. Măhăra, Aurora Posea (1977) *„Câmpia Crișurilor Crișul Repede Țara Beiușului, Cercetări în Geografia României*". In this study, population is analysed from several perspectives, including historically and geographically, such as: population dynamics and territorial distribution, structure, geodemographic typology. Population was also subject of analysis in monographs, i.e. *Mănăstireni și Mănăștur Românesc. Satul sufletului meu* (2005), *Dej, Poarta Someșului* (2005), *Monografia comunei Țaga* (2008), and also in the series of *Județele Patriei* (1972) with *Județul Bihor,* and *Județele României* (2007) with *Județul Cluj*. One of the last studies worth mentioning is *Structurile (Calitatea) localităților comunei Țaga, județul Cluj, în perioada 1910-2002* (2008).

[2] Babeș-Bolyai University, Faculty of Geography, Cluj-Napoca, *Prof. dr. GRIGOR P. POP – la opt decenii de viață și activitate 1933-2013*, Cluj University Press, 2013, p. 35-52.

Starting with 1991, Gr. P. Pop has begun to elaborate and publish several studies on population at national level, once with the censuses in 1992, 2002 and 2011. In 1995, Pop Gr. in collaboration with Bodocan V. wrote a study on the religious structure of population entitled „*Ethnic and Religious Structure of the Rural Population of Cluj County, Rural Change in Romania",* registered as Occasional Paper, 33, p. 22-26, at Leicester University, Geography Department, Great Britain. What is worth mentioning is the fact that immediately after 1990, Gr. P. Pop has initiated and coordinated a series of doctoral theses on the subject of "Ethnicity, religious denomination and voting behaviour" researches territorially covering *Transylvania* (Bodocan V. 2001), *Banat* (Creţan R. 1998, 1999), *Crişana* and *Maramureş* (Ilieş Al. 1997, 1998), the first study being awarded with the Prize of the Romanian Academy. We therefore believe that, having our preoccupations in the field, we needed to elaborate a study on population in Romania with regard to the religious structure.

2. RELIGIOUS STRUCTURE OF THE ROMANIAN POPULATION AT THE CENSUS IN 2011

Having the poor circumstances under which the census in 2011 was conducted, its quality was highly contested both from the perspective of accuracy of the total number of population registered at national level and also from the perspective of accuracy of the number of persons on categories of religious denominations.

Therefore, aiming to reveal an integrative display of the subject under analysis, we logically tracked down the issues that particularize this type of study. First we presented the general population religious structure in Romania, and secondly we analysed each of the 23 types of religious structures that were identified and represented by a certain number of people registered at the census (see Table 1 and Table 2).

2. 1. General religious structure of the Romanian population

According to the census held in 2011, the total population in Romania was of 20,121,641 permanent inhabitants, with 1,559,333 (7.19%) persons less than in 2002 (21,680,974 inhabitants). However, some changes appear in terms of the number of confessions recorded in 2011 as compared to those at the 2002 census. Thus, we find new types of religious denominations registered, such as: Jehovah's Witnesses, Serbian Orthodox and Armenian. A certain percentage of population was included in the category of Unavailable information regarding religion. Also, the decrease in population number has led to relatively significant changes in the existing religious denominations in Romania: in the case of 13 of them there was a decrease in frequency in 2011 compared to 2002, the most significant of which were registered in the case of Orthodox (from 86.81% in 2002 to 81.02% in 2011) and in the category of other religions (from 0.41% to 0.15%). The decrease was also found in case of other religions as there was registered a lower number of Roman-Catholics (from 4.73% to 4.33%), Reformed (from 3.23% to 2.29%), Greek-Catholics (from 0.88% to 0.75%) etc.

Table 1

General religious structure of the Romanian population registered at the censuses in 2002 and 2011

	Religion	2002	%	2011	%
1	**Total resident population**	**21680974**	**100,00**	**20121641**	**100,00**
2	Orthodox	18817975	86.79	16307004	81.04
3	Roman-Catholic	1026429	4.73	870774	4.33
4	Reformed	701077	3.23	600932	2.99
5	Pentecostal	324462	1.50	362314	1.80
6	Greek-Catholic	191556	0.88	150593	0.75
7	Baptist	126639	0.58	112850	0.56
8	Seventh-Day Adventists	93670	0.43	80944	0.40
9	Muslim	67257	0.31	64337	0.32
10	Unitarian	66944	0.31	57686	0.29
11	Jehovah's Witnesses	0.00	0.00	49820	0.25
12	Christian Evangelical	44476	0.21	42495	0.21
13	Christian of Old Rite	38147	0.18	32558	0.16
14	Lutheran Evangelical	27112	0.13	20168	0.10
15	Serbian Orthodox	0.00	0.00	14385	0.07
16	Evangelical	18178	0.08	15514	0.08
17	Evangelical of Augustan Confession	8716	0.04	5399	0.03
18	Mosaic	6057	0.03	3519	0.02
19	Armenian	0.00	0.00	393	0.00
20	Other religion	89196	0.41	30557	0.15
21	Free of religion	12825	0.06	18917	0.09
22	Atheists	8524	0.04	20743	0.10
23	Unavailable information[3]	11734	0.05	1259739	6.26

When comparing data from the censuses taken in 2002 and 2011, we note an increase in the number of people declaring any of the following four religions: Pentecostals (from 1.50% to 1.80%), Muslims (from 0.31% to 0.32%), Free of religion (from 0.06% to 0.09%) and Atheists (from 0.04% to 0.10%) while the share remained unchanged in the cases of Christian Evangelical (0.21%) and Evangelical (0.08%).

2. 2. Structure and territorial distribution of religious denominations in Romania

The census conducted on October 20, 2011 recorded data on 22 categories of religions, starting with the *total resident population* and ending with *unavailable information* (see table 1). For the ease of analysis of the subject considered, the 22 positions were

[3] *Datele din anul 2002 sunt cuprinse sub denumirea de Religie nedeclarată.*

grouped as follows: each of the first five religions (*Orthodox, Roman Catholic, Protestant, Pentecostal and Greek Catholic*) represents a separate entity; the other 16 religions were grouped in the category of *Other religion* that includes the following: *Baptist, Seventh Day Adventist, Muslim, Unitarian, Jehovah's Witnesses, Evangelicals, Old Rite Christian, Evangelical Lutheran Church, Serbian Orthodox, Evangelical, Evangelical of Augustan Confession, Mosaic, Armenian, Other religion, Free of religion* and *Atheists*). The last category of analyzed data is the *unavailable information*.

2. 2. 1. The Orthodox Christian denomination

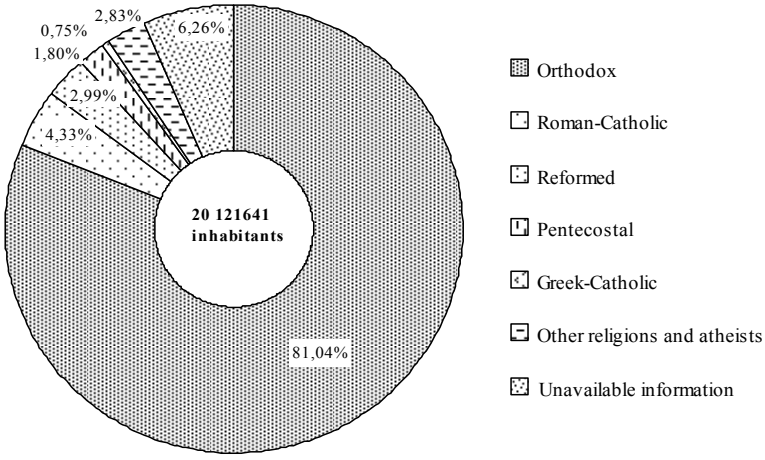

Fig. 1. Religious structure of the Romanian population, at the census in 2011.

It is by far the most representative religion at national level. In 2002 it registered 86.7% (18,817,975 adherents) out of the total population of 21,680,974 people, whereas in 2011 the rate decreased to 81.04% (16,307,004 adherents) out of a total population of 20,121,641 people). As compared to the national rate, the orthodox population registers different values when analysed from the territorial perspective. Thus, in case of historical-geographical provinces the largest share of orthodox population (93.96%) is registered in Oltenia and the smallest share (55.84%) in Crişana. The other provinces register the following shares: Muntenia (92.47%), Moldavia (85.76), Dobrogea (83.96%), Banat (73.20%), Transylvania (65.12%), Maramureş (62.99%) and Bucharest (84.31%) (see table 3).

At county level, considering the 41 counties and Bucharest municipality, there are significant discrepancies in accordance with the socio-historical evolution of our country. First we mention that the highest rate of orthodox population is registered in Călăraşi county (96.68% out of the total population of 306,691 people), whilst the smallest rate is registered in Harghita county (12.12% out of the total population of 310,867 people).

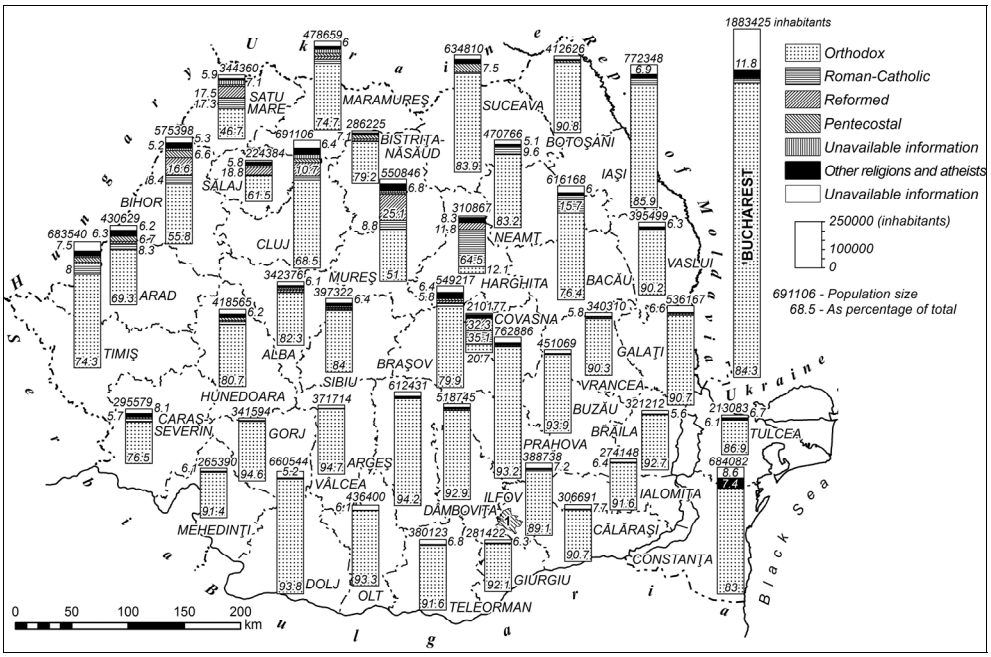

Fig. 2. Religious structure of the Romanian population, at the census in 2011, at county level (data regarding the seven categories displayed in table 3)

The high frequency rate of this religious denomination at national level emerges from the fact that 27 of the Romanian counties together with Bucharest municipality have shares **higher than 80%** and 18 of them have shares even **over 90%** (Botoşani, Galaţi, Vaslui and Vrancea in *Moldavia;* Argeş, Brăila, Buzău, Călăraşi, Dâmboviţa, Giurgiu, Ialomiţa, Prahova and Teleorman in *Muntenia*; Dolj, Gorj, Mehedinţi, Olt and Vâlcea in *Oltenia*), while 10 counties have about **80-90%** orthodox population (Alba, Hunedoara and Sibiu in *Transylvania*; Iaşi, Neamţ and Suceava in *Moldavia*; Constanţa and Tulcea in *Dobrogea* and Bucharest in *Muntenia.*

A share between **50 and 80%** of orthodox population is registered in the case of 11 counties (Bistriţa-Năsăud, Braşov, Cluj, Mureş and Sălaj in *Transylvania*, Bacău in *Moldavia*, Arad, Caraş-Severin and Timiş in Banat, Bihor in Crişana and Maramureş in Maramureş. The smallest shares of **20-50%** are registered in two Romanian counties (Covasna in Transylvania and Satu Mare in *Maramureş*) and a share **below 20%** is registered in Harghita County in *Transylvania*.

2. 2. 2. Roman-Catholic religious denomination

In 2002, this religious denomination was was declared by 4.73% of the Romanian citizens (1,026,429 people), whereas in 2011 the value decreased to 4.33% (870,774 inhabitants). The highest frequency (64.55%) is registered in Harghita county (200,663 adherents), and the lowest frequency (0.02%) in Teleorman county (84 people).

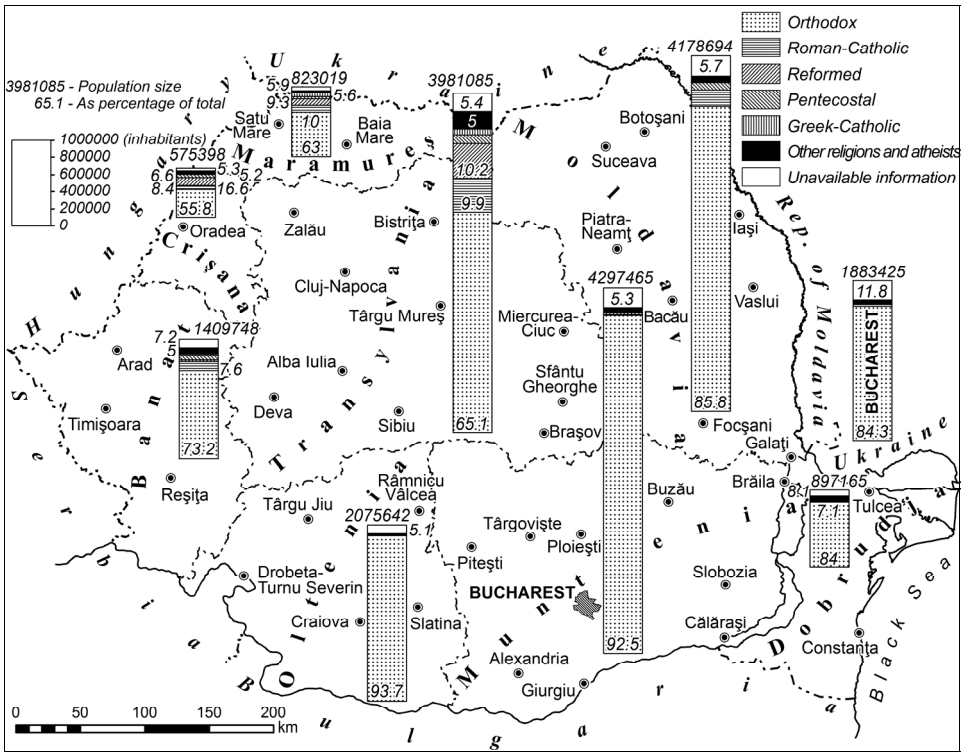

Fig. 3. Religious structure of the Romanian population, at the census in 2011, at regional level – geographical-historical provinces (data regarding the seven categories displayed in table 3)

At regional level the highest frequency, while conditioned by the presence of the Hungarian and partially of the German population, is registered in Maramureş, Transylvania, Crişana and Banat. In Maramureş there is a share of 10.00% Roman-Catholics (out of a total population of 518,403 people), while in Transylvania there is a share of 9.99% (out of 3,981,085 people). In Crişana we find 8.40% (out of 321,312 people), and in Banat 7.58% (out of 1,031,988 people). The share continuously decreases in case of the other provinces and Bucharest municipality, as follows: 4.68% in Moldavia, 0.48% in Dobrogea, 0.29% in Muntenia, 0.16% in Oltenia and 1.18% in Bucharest (see table 3).

We note the same situation of the Roman-Catholics at county level, being able to set four different classes of shares, as follows:

- class 1 - below 1%, in 16 of the Romanian counties (Alba, Botoşani, Galaţi, Constanţa, Tulcea, Argeş, Brăila, Buzău, Călăraşi, Dâmboviţa, Giurgiu, Prahova, Dolj, Gorj, Mehedinţi and Vâlcea);

- class 2 - 1-3%, in which case we find 8 territorial administrative units (Bistriţa-Năsăud, Sălaj, Sibiu, Suceava, Vaslui, Vrancea, Ilfov and Bucharest municipality);

- class 3 - 3-5%, registered in 5 counties (Braşov, Cluj, Hunedoara, Iaşi and Maramureş);

- ***class 4*** - ***over 5%,*** registered in 10 of the Romanian counties, namely Covasna (35.08%), Harghita (64.55), Mureş (8.21%), Bacău (15.66%), Neamţ (9.63%), Arad (8.27%), Caraş-Severin (5.66%), Timiş (7.98%), Bihor (8.40%) and Satu Mare (17.52%).

2. 2. 3. Reformed Denomination

With a number of 600,932 adherents in 2011, which represents 2.99% of the Romanian population, this religious denomination follows the same pattern of representation as the Roman-Catholic religion, yet with lower values. At regional level, from the centre towards the east of the country, we note the following situations of frequency: Transylvania (10.20%, 406.188 people), Moldavia (0.01%, 497 people), Dobrogea (0.02%, 171 people), Muntenia (0.01%, 557 people), Oltenia (0.01%, 249 people), Banat (1.43%, 20,140 people), Crişana (16.55%, 95,250 people) and Maramureş (9.31%, 76,589 people), to which we add Bucharest municipality (0.07%, 1,291 people).

After analysing the numbers registered at county level we were able to set four classes of values of frequency in case of reformed religion:

- class 1 – below 1%, in which category we find 26 of the counties and Bucharest municipality out of which only a few of them register values of more than 100 adherents, namely Bacău (116 people), Suceava (109 people), Constanţa (151 people), Prahova (132 people), Caraş-Severin (957 people) and Bucharest (1291 people);

- ***class 2 – 1-3%*** - registered in only 5 counties, namely Braşov (2.08%, 11,426 people), Hunedoara (1.85%, 7,730 people), Sibiu (1.46%, 5,800 people), Arad (2.28%, 9,372 people) and Timiş (1.37%, 9,372 people);

- ***class 3*** – ***3-5%,*** registered in only 3 counties, namely Alba (3.24%, 11,080 people), Bistriţa-Năsăud (4.08%, 11,675 people) and Maramureş (3.39%, 16,246 people).

- ***class 4*** – ***over 10%,*** the highest values of this religious denomination, being registered in 7 counties, located in the central and north-western part of Romania, namely Cluj (10.66%, 73,669 people), Covasna (32.5%, 67,791 people), Harghita (11.82%, 36,760 people), Mureş (25.08%, 138,129 people), Sălaj (18.77%, 42,128 people), Bihor (16.55%, 95,250 people) and Satu Mare (17.52%, 60,343 people).

2. 2. 4. Pentecostal Christian Denomination

This is one of the religions whose number of adherents increased over the period, from 324,462 in 2002 (1.50% out of 20,121,641 people) to 362,314 in 2011 (1.80%). Territorially, the highest values registered are found in the western part of Romania. From the perspective of geographical-historical provinces the data reveal differences in shares, as follows: Crişana (6.60%, 37,960 Pentecostals), Banat (4.54%, 63,995 Pentecostals), Maramureş (3.22%, 26,534 Pentecostals), followed by Transylvania (2.60%, 10,369 Pentecostals), Moldavia (2.12%, 88,441 Pentecostals), after which we notice a significant decrease down to below 1% in the south-east and south provinces, namely in Dobrogea (0.32%, 2,854 Pentecostals), Muntenia (0.62%, 26,595 Pentecostals) and Oltenia (0.35%, 7,196 Pentecostals).

At county level, we notice the following values:

- below 1% Pentecostals we find in Bucharest Municipality and in 19 of the 41 Romanian counties, mostly located in the provinces of Dobrogea, Muntenia and Oltenia, except for the counties of Harghita, Bacău, Iaşi and Neamţ, where we find a high number of Roman-Catholics. The lowest values are registered in Olt County (0.09%)

- values of **1-3% Pentecostals**, are registered in 12 counties, five of which are located in Transylvania (Alba, Braşov, Covasna, Mureş and Sibiu), four in Moldavia (Botoşani, Galaţi, Vaslui and Vrancea), two in Muntenia (Dâmboviţa and Ialomiţa) and one in Maramureş (Satu Mare);

- the frequency of **3-5%** Pentecostals is found in six counties, all of them being located in the central and western part of Romania (Cluj, Hunedoara, Sălaj, Caraş-Severin, Timiş and Maramureş);

- the highest frequency of this religious group, of **over 5%,** is registered in four counties, namely Bistriţa-Năsăud (7.08%, 20,257 Pentecostals), Suceava (7.53%, 47,773 Pentecostals), Arad (6.72%, 28,922 Pentecostals) and Bihor (6.60%, 37,960 Pentecostals).

2. 2. 5. Greek-Catholic religion

Without going into any details on the historical evolution of this religion, we just mention the fact that it was subject of pressure at the end of 17th century and the beginning of 18th century, when the provinces of Transylvania, Banat, Crişana and Maramureş were occupied by the Habsburg Empire. Then in 1948, it was brutally taken apart by the eastern imperial regime. This negative fact was solved once with the 1989 events, thus the United Romanian Church with Greek-Catholic Rome went back to the previous state as in 1948.

We note the fact that this religious group registered a decrease in number at national level, from 191,556 (0.88%) in 2002 to 150,593 (0.75%) in 2011. At the provinces level, we note that the highest shares are registered in the central and western part of Romania, namely in Maramureş (5.64%, 46,404 Greek-Catholics), Crişana (2.12%, 12,184 Greek-Catholics), Transylvania (1.76%, 69,925 Greek-Catholics) and Banat (1.02%, 14,347 Greek-Catholics), followed by the other provinces with very low values: Moldavia (0.05%, 1,969 Greek-Catholics), Dobrogea (0.03%, 294 Greek-Catholics), Muntenia (0.02%, 1,012 Greek-Catholics) and Oltenia (0.02%, 440 Greek-Catholics).

At a smaller territorial scale, we remark the lowest values registered in two counties of Muntenia province, namely Ialomiţa (0.00%, 11 people) and Teleorman (0.00%, 16 people), whilst the highest are registered in Satu Mare (7.13%, 24,568 Greek-Catholics) and Maramureş (4.56%, 21,836 Greek-Catholics). As a general overview of this religious group at county level we highlight three categories of shares, as follows:

- **below 1%**, in which category we find 31 counties and Bucharest municipality, the most representative being Braşov (0.62%, 3,401 Greek-Catholics), Covasna (0.11%, 241 Greek-Catholics), Harghita (0.17%, 516 Greek-Catholics), Hunedoara (0.86%, 3,260 Greek-Catholics), Suceava (0.18%, 1,155 Greek-Catholics), Arad (0.99%, 4,271 Greek-Catholics), Caraş-Severin (0.61%, 1,805 Greek-Catholics) and Bucharest Municipality (0.21%, 4,016 Greek-Catholics), followed by other 24 counties, all of them with small values and located mostly in the provinces of Moldavia, Dobrogea, Muntenia and Oltenia;

- shares of **1-2%** are registered in the case of only 3 counties, namely Bistrița-Năsăud (1.84%, 5,276 Greek-Catholics), Sibiu (1.92%, 7,612 Greek-Catholics) and Timiș (1.21%, 8,271 Greek-Catholics);

- the third class of values of territorial representation, of **over 2%** is found in 7 counties located in Transylvania, Crișana and Maramureș, namely Alba (2.71%, 9,294 Greek-Catholics), Cluj (3.35%, 23,164 Greek-Catholics), Mureș (2.01%, 11,077 Greek-Catholics), Sălaj (2.55%, 5,756 Greek-Catholics), Bihor (2.12%, 12,184 Greek-Catholics), Maramureș (4.56%, 21,836 Greek-Catholics) and Satu Mare (7.13%, 24,562 Greek-Catholics) (see table 3).

2. 2. 6. Other religions and Atheists

After the five main religious groups (Orthodox, Roman-Catholic, Reformed, Pentecostal, and Greek-Catholic) holding a share of 90.91% (18,291,617 people) out of the total Romanian population, we now present the other 16 religious groups (Baptist, Seventh-Day Adventists, Muslim, Unitarian, Jehovah's Witnesses, Christian Evangelical, Christian of Old Rite, Christian Evangelical synod - Presbyterian Denomination, Serbian Orthodox, Evangelical, Evangelical of Augustan Confession, Mosaic, Armenian, Another religion, Free religion, Atheists), whose frequencies barely reach 2.83% (570.285 adherents).

At the provinces level we find the following values registered for these religious groups: Dobrogea (7.08%, 63,491 persons), Crișana (5.18%, 29,815), Banat (5.03%, 70,930), Transylvania (5.02%, 199,848), Maramureș (2.91%, 23,932), Moldavia (1.70%, 71,098), Muntenia (1.32%, 56,873) and Oltenia (0.65%, 3,500 people).

At county level, the highest share was registered in Harghita county (8.35%, 25,960 people), while the lowest is found in Olt county (0.45%, 1,945 people). Between these limits we set several classes of shares (see table 3);

- **below 1%** (from 0.45% in Olt to 0.95% in Galați); this share is registered in nine of the Romanian counties (two in Moldavia, three in Muntenia and four in Oltenia);

-**1-2%** - 13 counties and Bucharest municipality recorded values between 1% and 2%. The lowest values we find in Brăila (1.09%) and the highest in Iași (1.97%), other five counties registering values in this class. They are located in Moldavia, eight in Muntenia[4] and one in Oltenia;

- 2-4% - characteristic to eight of the counties, from a minimum of 2.54% in Brăila, to a maximum of 3.92% in Timiș. Territorially, four of the counties are located in Transylvania, one in Moldavia, one in Banat and two in Maramureș;

- **over 4%** is registered in 11 counties, the lowest value of 4.87% (33,636 people) being recorded in Cluj and the highest, of 8.35% (25,960 people), in Harghita. In this case, six of these counties are located in Transylvania, two in Dobrogea, two in Banat and one in Crișana.

Furthermore, we present the 16 religious denominations by specifying the absolute values recorded due to low number of people included (see table 2).

[4] *Bucharest municipality is also included*

a) Baptist religious group recorded a share of 0.56% (112,850 people) in 2011, at national level. The highest number of Baptists we find in Banat (34,188), Transylvania (34,164) and Crişana (21,934), followed by the other provinces with values below 10,000 namely in Moldavia (6,720), Muntenia (3,879), Maramureş (4,031), Oltenia (3,172) and Dobrogea (1,417). Thus, this religious group is visibly more present in the central and western parts of Romania.

At county level, the lowest values are registered in Ialomiţa (93 Baptists) and the highest in Bihor (21.934 Baptists). On the whole, we note that 23 counties recorded values **up to 1,000** Baptists, being located, in Moldavia, Dobrogea, Muntenia and Oltenia, except for the counties of Covasna and Harghita; the next nine counties registered values **between 1,000 and 3,000** Baptists (Bistriţa-Năsăud, Braşov, Mureş, Botoşani, Constanţa, Mehedinţi, Maramureş, Satu Mare and Bucharest municipality; the third category of counties registered values **between 3,000 and 6,000** Baptists (Alba, Hunedoara, Sibiu and Suceava) and **over 6,000** Baptists in the counties of Cluj (7,139), Sălaj (8,293), Arad (14,700), Caraş-Severin (10,808), Timiş (8,680) and Bihor (21,934).

b) Seventh-Day Adventist religious group is represented by 80,944 people (0.40% of the Romanian population), at national level that is territorially distributed relatively proportionally with the size of geographical-historical provinces and counties. Thus, in case of provinces we note the following: Transylvania (21,328 people), Muntenia (20,812 people), Moldavia (15,520 people), Banat (7,059 people), Maramureş (4,314 people), Oltenia (4,252 people), Crişana (1,859 people) and Dobrogea (1,769 people).

At county level, we note the lowest values registered in Tulcea county (330 persons), and the highest in Mureş county (5,979), this county being the only one with values of over 5,000 people). Generally, we observe that 18 counties registered values **below 1,000** people, other 15 counties have values **between 1,000 and 3,000** persons, and 7 counties have **between 3,000 and 5,000** representatives of this denomination, namely: Cluj (3,433), Suceava (3,855), Dâmboviţa (4,194), Prahova (4,536), Teleorman (4,050), Arad (4,531) and Maramureş (3,451), and Bucharest municipality (4,051 persons).

c) Muslim religious group, with a share of 0.32% (64,337 people) at national level, is the religious denomination mainly present in the province of Dobrogea, with 72.38% (46,569 people), out of which 67.27% (43,279 persons) are located in Constanţa county and 5.11% (3,290) in Tulcea county. The other 27.62% of the people declaring this religion (17,768) are spread in the rest of the Romanian territory. **Below 100** people are registered in each of 18 counties, **between 100 and 400** people are registered in other 16 counties, followed by 3 counties that registered **between 500 and 1,000** people, namely Cluj (973), Iaşi (677) and Călăraşi (614). **Over 1,000** people declaring this religion are found in those two counties in Dobrogea Province, followed by Ilfov county (1,470), Timiş (1,117) and Bucharest municipality (9,037 Muslims).

d) Unitarian religion was declared by 0.29% (57,686 persons) of the total population at national level. Most of the representatives of this religious group (98.45%, 56,797 persons) are mainly concentrated in the central part of Romania, in Transylvania, in 5 counties, that are: Braşov (5,059), Cluj (7,094), Covasna (8,682), Harghita (21,023) and Mureş (12,200). Unitarian people register quite small numbers in the other provinces, as follows: Moldavia (26), Dobrogea (3), Muntenia (39), Oltenia (20), Banat (223), Crişana (280) and Maramureş (185) (see table 2).

Accordingly, at county level, besides the 5 already mentioned counties that together cumulate over 5,000 people, and other 3 counties that register values of over 500 people each, such as: Alba (1,492 Unitarians), Hunedoara (513) and Sibiu (633), the other counties are spread as follows: **more than 100** people are found in the counties of Timiş (137), Bihor (280), Satu Mare (115) and Bucharest municipality. In the case of counties included in the provinces of Moldavia, Dobrogea, Muntenia and Oltenia the number of Unitarians decrease down to 1-2 people (Botoşani, Galaţi, Vaslui, Tulcea, Călăraşi) or are even missing at all (Vrancea, Ialomiţa, Teleorman).

e) Jehovah's Witnesses religion was declared by 49,820 people, representing 0.25% of the Romanian population at national level (20,121.641 inhabitants). Their territorial distribution is rather disproportionate at national level. We note that, at the level of provinces, more than half of the people (53.12%) are living in Transylvania (26,716 persons), with high shares in Maramureş (19.67%, 9,801 Jehovah's witnesses) and in Moldavia (8.70%, 4,135 persons), followed by all the other provinces with significantly low values, as follows: Dobrogea (372 people), Muntenia (1,903), Oltenia (1,207), Banat (2,609), Crişana (1,289) and Bucharest municipality (1,794).

As for the territorial distribution at county level, we note the following situation:

- the lowest number of Jehovah's witnesses we find in Tulcea county (74), whilst the highest in Maramureş county (11.96%, 5,960 persons);

- **less than 200** people are registered in each of the 9 following counties: Neamţ, Brăila, Buzău, Călăraşi, Dâmboviţa, Giurgiu, Ialomiţa, Mehedinţi and Vâlcea);

- **between 200 and 500** people representing this religious denomination are registered in 14 counties;

- **between 500 and 800** people are registered in Iaşi county;

- **more than 800** people are registered in 17 counties**,** 10 of them included in Transylvania province, followed by Suceava, Arad, Timiş, Bihor, Maramureş, Satu Mare and Bucharest Municipality (see table 2).

f) Christian Evangelical religious group represents only 0.21% (42,495 people) of the total Romanian population. The representatives of this group are almost evenly distributed in the territory at the level of provinces, as follows: Moldavia (32.52% of their number, 13,833 people), Muntenia (29.62%, 12,589 people), Transylvania (22.64%, 9,621 people), Maramureş (1,354 people), Oltenia (1,257 people), Banat (1,166 people), Crişana (629 people) and Dobrogea (161 people).

The value ranking of this religious group at county level is rather difficult since the lowest value registered is of 21 persons in Ialomiţa County and it reaches 4,015 persons in Argeş County. Still, in order to reveal the territorial distribution we show the situation as follows:

- less than 200 people are registered in 9 counties, namely Covasna (80), Constanţa (102), Tulcea (59), Brăila (42), Ialomiţa (21), Mehedinţi (124), Olt (103), Vâlcea (85) and Caraş-Severin (176);

- **between 200-500**, are registered in 9 counties;

- **between 500-800** are registered in 10 counties;

- **more than 800 people**, are registered in 13 counties, namely: Alba (835), Braşov (2,360), Cluj (803), Mureş (1,060), Sibiu (2,440), Botoşani (1,875), Iaşi (3,784), Suceava (3,921), Vaslui (1,769), Argeş (4,015), Dâmboviţa (2,610), Prahova (3,689), Maramureş (815) and Bucharest Municipality (1,895).

g) Christian of Old Rite religious group has a share of 0.16% (32,558 people) out of the total Romanian population. At the provinces level, we note a concentration of 46.10% in Moldavia (15,010 people), a share of 35.63% in Dobrogea (11,601) and 6.97% in Muntenia (2,271). Their number decreases evidently in Transylvania (1,034), Oltenia (144), Banat (807), Crişana (117) and Maramureş (506).

At county level, the number of representatives starts from less than 3 persons in Olt county and goes up to 8,794 persons, in the case of Tulcea county. Attempting to deliver a general overview on this religious group, we set a few classes of values, as follows:

- up to 100 persons**,** values registered in 19 counties, 5 in Transylvania, 7 in Muntenia, all counties in Oltenia and 2 in Banat;

- between 100 and 400 persons, values registered in 10 counties, five of which in Transylvania, one in Moldavia, two in Muntenia, one in Crişana and another one in Maramureş;

- **between 400 and 700** persons**,** values registered in only 3 counties, namely Vrancea (608), Timiş (653) and Maramureş (477);

- **over 700** persons, values registered in 9 counties, 6 of which are located in Moldavia, namely Bacău (1,567 persons), Galaţi (735), Iaşi (3,561), Neamţ (4,012), Suceava (2,934) and Vaslui (1,205), followed by 2 in Dobrogea, namely Constanţa (2,807) and Tulcea (8.794) and one in Muntenia - Brăila county (1,546) and also Bucharest Municipality (1,067).

h) Evangelical Lutheran religion, with a share of 0.10% (only 20,168 of the Romanian population), is almost entirely concentrated in Transylvania, where we can find 75.33% of the representatives of this religious group (15,194 people) and in Banat, with a share of 18.50% (3,733 people). There are insignificant values registered in the other provinces, such as: Moldavia (99), Dobrogea (39), Muntenia (114), Crişana (310) and Maramureş (218).

Subsequently, at county level, there is a large gap between the lowest value registered in Călăraşi County (less than 3 people) and the highest value registered in Braşov (10,374). Overall, the registered values are low and they are distributed as follows:

- **up to 50** representatives - the case of 27 counties, one of which being located in Transylvania (Sălaj), all 8 counties in Moldavia, both counties in Dobrogea, all 10 counties in Muntenia, all 5 counties in Oltenia and one in Banat (Caraş-Severin);

- **between 100 and 300** representatives – the case of 6 counties, four of which in Transylvania and both counties in Maramureş;

- **between 300 and 600** representatives – the case of only 3 counties, namely Cluj (496), Timiş (339), Bihor (310) and Bucharest Municipality (415);

- **more than 600** representatives **–** the case of 5 counties**,** namely: Braşov (10,374), Covasna (851), Mureş (715), Sibiu (1,924), in Transylvania and Arad (3,351) in Banat.

i) Serbian Orthodox religion has a share of only 0.07% at national level (14,385 people out of the total population). The Serbian orthodox representatives are naturally located in the geographical-historical provinces in the south-west part of Romania, in Banat and Oltenia. In Banat we find a share of 79.27% (11,403 persons), while in Banat there is only 7.27% (1,046 persons) of their group, followed by Transylvania with 3.56% of the representatives (513 people). In the case of all other 5 provinces the values are decreasing, as follows: Moldavia (248), Dobrogea (279), Muntenia (331), Crișana (3) Maramureș (89).

At county level the situation of their territorial distribution is in accordance with that shown in the case of provinces. Thus, we reveal the situation on classes of values, as follows:

- **up to 50** representatives – the case of 28 counties, 7 of which being located in Transylvania (with less than 3 persons in Bistrița-Năsăud and Covasna), all 8 counties in Moldavia (with no representative in Suceava county), 8 counties in Muntenia (with no representatives in Buzău, and with less than 3 persons in Călărași), followed by 3 counties in Oltenia, one in Crișana (Bihor) and another one in Maramureș (Satu Mare);

- **between 50-100** representatives – the case of only 3 counties, namely Dâmbovița, Giurgiu, Maramureș;

- **between 100 and 150** – the case of 4 counties (Brașov, Mureș, Neamț and Dolj);

- **more than 150** Serbian Orthodox – values found in 6 counties, namely: Cluj (161), Constanţa (249), Mehedinţi (881), Arad (687), Caraș-Severin (3,948), Timiș (6,773) and Bucharest Municipality (415).

j) Evangelical religious group, consisting of 15,514 people, represents 0.08% of the population of Romania, being concentrated in two provinces, namely Transylvania (34.78%, 5,396 people) and Muntenia (36.09%, 5,600 people), followed by all other provinces with small values: Moldavia (878), Dobrogea (149), Oltenia (458), Banat (912), Crișana (142) and Maramureș (199).

At county level, the lowest values were registered in Tulcea county (less than 3 people), and the highest in Brașov (1,877 people), between these limits being able to identify the following situations:

- up to 100 representatives were registered in 12 counties, located in five of the eight provinces, namely Transylvania (Harghita), Moldavia (Botoșani, Galați, Suceava), Dobrogea (Tulcea), Muntenia (Brăila, Călărași, Ialomița, Teleorman), Oltenia (Olt, Vâlcea) and Maramureș (Maramureș county);

- between 100 and 300 representatives, from 20 counties located in all of the provinces (five in Transylvania, four in Moldavia, one in Dobrogea, three in Muntenia, three in Oltenia, two in Banat, one in Crișana and one in Maramureș);

- between **300 and 600** representatives were registered in only three counties – Alba (311), Neamț (433) and Timiș (514);

- over 600 representatives were registered in 6 counties, namely Brașov (1,877), Mureș (865), Sibiu (1.402), Argeș (1,529), Dâmbovița (1,709) and Prahova (1,508), together with Bucharest municipality (1,779).

k) Evangelical of Augustan Confession is a religious denomination declared by only 5,399 people at national level, which represents a share of 0.03% of the Romanian population, distributed in all 41 counties, and subsequently in all 8 geographical-historical provinces.

In accordance with the low values registered by this religion, the territorial distribution seems simpler, at the provinces level, the highest share of 7.61% being registered in Transylvania (4,190 people), followed by Moldavia (108), Dobrogea (25), Muntenia (266), Oltenia (41), Banat (335), Crişana (53) and Maramureş (29).

At county level, the smallest number of Augustans – up to 3 people is registered in Botoşani, Tulcea, Gorj and Olt, and the highest in Braşov (1,794 people). If we analyse the classes of values, we note the following: **less than 100** representatives – found in 31 counties, three of which are located in Transylvania, all eight in Moldavia, both counties in Dobrogea, nine of the 10 in Muntenia, all five in Oltenia, one in Banat and Crişana (Bihor – the only county in which this religion is represented) and both counties in Maramureş (Maramureş and Satu Mare); **between 100 and 200** Augustans are registered in only 7 counties (Alba, Bistriţa-Năsăud, Covasna, Hunedoara, Prahova, Arad and Timiş), and **over 300** Augustans we find in Braşov (1,794 persons), Mureş (491), Sibiu (1.246) and Bucharest municipality (351).

l) Mosaic religion is registered by only 0.02% of the total population (3.519 people). There are cases of counties in which we find only **up to 3 persons** practicing this religion, such as: Călăraşi, Dâmboviţa, Giurgiu, Ialomiţa and Teleorman (Muntenia province) and Gorj (Oltenia province), while the highest values are registered in Bucharest Municipality (1,459 persons).

At the provinces level, the highest values are registered in Moldavia (609), followed by Transylvania (476), Banat (400), Muntenia (192), Maramureş (157), Crişana (157), Oltenia (46) and Dobrogea (35 Mosaics).

At county level, we reveal the following classes of values:

- up to 50 Mosaics **–** in the case of 25 counties, six of which are located in Transylvania, two in Moldavia, both counties in Dobrogea, nine in Muntenia, all five in Oltenia and one in Banat;

- between 50 and 100 Mosaics, situation recorded in 11 counties, three of which located in Transylvania, five in Moldavia, one in Muntenia and both counties in Maramureş;

- **between 100 and 150** Mosaics**,** values registered in only two counties, namely Arad (132) and Bihor (145);

- more than 150 Mosaics**,** values found in three counties, namely Cluj (171), Iaşi (257) and Timiş (232), and also Bucharest Municipality (1,459).

m) Armenian religion is the last nominated religion at the census in 2011, at the national level being recorded a number of 393 people practicing this religion and territorially spread in all provinces, as follows: Transylvania (160), Moldavia (44), Dobrogea (29), Muntenia (29), Oltenia (2), Banat (9), Crişana (10) and Maramureş (2), and in Bucharest Municipality (108).

Accordingly, at the county level the values registered are very low, 38 counties recording **less than 20** people of Armenian religion, eight of which recording up to 3 persons (Alba, Iaşi, Vrancea, Călăraşi, Vâlcea, Arad, Maramureş and Satu Mare), whereas in the case of 15 counties there are no representatives of this religion (Bistriţa-Năsăud, Hunedoara, Sălaj, Vaslui, Buzău, Dâmboviţa, Giurgiu, Ialomiţa, Prahova, Teleorman, Dolj, Gorj, Mehedinţi, Olt and Caraş-Severin).

n) Other religion, a separate category of data, representing about 0.15% of the total population of 20,121,641 of Romania (30,557 persons), people that do not belong to any of the 18 above mentioned religious groups, and being territorially distributed all over the country. Overall, in accordance with the social and historical evolution, the census in 2011 reveals the following distribution of this religious group at the provinces level: Transylvania 29.98% (9,162 persons), Moldavia 29.40% (8,984), Dobrogea 1.19% (363), Muntenia 5.76% (1,761), Oltenia 1.13% (344), Banat 11.22% (3,428), Crişana 4.60% (1,405) and Maramureş 4.25% (1,298). At county level, we can show the following particularities in the values registered:

- the lowest absolute value, of 24 people declaring another religion, was recorded in Teleorman county (Muntenia province), and the highest, of 5,580 people, in Suceava county (this counts for 18.26% out of the total group declaring Other religion);
- **up to 200** people **–** values registered in 20 counties (5 in Moldavia, 1 in Dobrogea, 9 in Muntenia and all 5 counties in Oltenia);
- between **200 and 600** people **–** values registered in 9 counties, namely Alba, Bistriţa-Năsăud, Covasna, Harghita, Sălaj and Sibiu (Transylvania), Constanţa (Dobrogea), Caraş-Severin (Banat) and Satu Mare (Maramureş);
- **between 600 and 1,000** people – are found in only 4 counties, namely Hunedoara (Transylvania), Ilfov (Muntenia), Arad (Banat) and Maramureş (Maramureş);
- **over 1,000 people**, values recorded in 8 counties, as follows: Braşov, Cluj, Mureş (Transylvania), Iaşi, Neamţ, Suceava (Moldavia), Timiş (Banat), Bihor (Crişana), and Bucharest Municipality.

o) Free of religion, is a category of data representing about 0.09% of the national population in 2011 (18,917 persons). The territorial distribution at the level of provinces reveals the following shares: Transylvania (46.33%, 8,764 persons), Moldavia (7.59%, 1,436), Dobrogea (0.87%, 165), Muntenia (7.83%, 1,481), Oltenia (2.00%, 380), Banat (8.63%, 1,633), Crişana (4.81%, 909) and Maramureş (8.06%, 1,146 persons declaring Free of religion).

At county level, the number of people is distributed, as follows:

- the lowest number of people free of religion (24 people) is recorded in Giurgiu county, and the highest number (2,201) in Mureş county and Bucharest municipality (3,003);
- up to **100** persons are registered in the case of 13 counties (2 in Moldavia, 1 in Dobrogea, 5 in Muntenia and all 5 in Oltenia);
- **between 100 and 300** persons are registered in the case of other 13 counties (2 in Transylvania, 4 in Moldavia, 1 in Dobrogea, 4 in Muntenia and 1 in Banat);

- **between 300-500** persons are registered in only 4 counties, namely Sibiu (Transylvania), Iaşi, Suceava (Moldavia) and Prahova (Muntenia);

- **over 500** persons we find in 12 counties, six of which being located in Transylvania, namely Alba (646), Braşov (1,045), Cluj (2,011), Covasna (794), Harghita (655), Hunedoara (586) and Mureş (2,201), 2 in Banat, namely Arad (562) and Timiş (846), 1 in Crişana, namely Bihor (909) and both counties in Maramureş, namely Maramureş (641) and Satu Mare (505 persons), and also Bucharest Municipality (3,003).

p) Atheists represent 0.10%, of the total Romanian population in 2011 (20,743 persons). Their territorial distribution at provinces level reveals the following shares and values: Transylvania (21.96%, 4,555 persons out of the total number of Atheists), Moldavia (10.33%, 2,144), Dobrogea (2.48%, 515), Muntenia (10.53%, 2,184), Oltenia (2.53%, 525), Banat (8.31%, 1,723), Crişana (2.54%, 528) and Maramureş (2.42%, 502).

We decided on four classes of values to reveal their distribution at county level, mentioning the lowest value of 42 persons in Olt County, and the highest in Cluj County, of 1,854 persons, along with the value of 8,067 Atheists (38.90%) registered in Bucharest municipality. Having these, we present the following situation of atheists:

- **up to 100** Atheists are recorded in 11 counties (2 in Transylvania, 3 in Moldavia, 1 in Dobrogea, 3 in Moldavia and 1 in Oltenia);

- **between 100 and 300** persons are recorded in the case of 15 counties (3 in Transylvania, 3 in Moldavia, 4 in Muntenia, 3 in Oltenia, 1 in Banat and 1 in Maramureş);

- between 300 and 500 persons are recorded in the case of 9 counties, namely Hunedoara, Mureş, Sibiu (in Transylvania), Galaţi (Moldavia), Constanţa (Dobrogea), Argeş, Ilfov (Muntenia), Arad (Banat) and Maramureş (in Maramureş);

- **over 500 Atheists** are recorded in 6 counties, including the largest urban centres in Romania, namely Braşov (885 persons), Cluj (1,854), Iaşi (896), Prahova (556), Timiş (1,125) and Bihor (528), and Bucharest Municipality (8,067 Atheists).

r) Unavailable information. This category of data was for the first time introduced as a choice in carrying out the procedures of registration at the census in 2011. And the reason was the high number of Romanian emigrants from whom it was not possible to get this information. Thus, corresponding to a number of 1,259,739 persons, this category of data holds a share of 6.26% out of the 20,121,641 Romanian citizens.

People recorded under this category are distributed differently at the provinces level, as follows: Transylvania (213,680 persons, 16.96% out of the total registered), Moldavia (237,255, 18.83%), Dobrogea (72,808, 5.78%), Muntenia (226,212, 17.96%), Oltenia (106,750, 8.48%), Banat (101,455, 8.05%), Crişana (30,527, 3.42%) and Maramureş (48,843, 3.88%).

At county level, the lowest number of people included in this category of data was recorded in Covasna county (6,433 persons), while the highest value was registered in Constanţa (58,494 persons). Also, we should note that 17.63% of the Unavailable Information was registered in Bucharest Municipality (222,212 persons).

Overall, at county level, we could group the unavailable data into four classes of values, as follows:

- less than 15,000 people, values registered in 6 counties, namely Bistriţa-Năsăud, Covasna, Harghita and Sălaj (Transylvania), Tulcea (Dobrogea) and Gorj (Oltenia);

- **between 15,000 and 30,000** persons, values registered in 25 counties, 4 of which in Transylvania (out of 10), 5 in Moldavia (out of 8), 9 in Muntenia (out of 10), 3 in Oltenia (out of 5), 2 in Banat (out of 3) and 2 in Maramureş (out of 2);

- between **30,000 and 45,000** persons, values registered in 6 counties, namely Braşov (34,989), Cluj (43,996), Bacău (36,783), Galaţi (35,246), Prahova (31,310), Dolj (34,455) and Bihor (30,527);

- **more than 45,000** persons are registered in the case of 3 counties, obviously more urbanized in Romania, namely Iaşi (53,412), Constanţa (58,494) and Timiş (50,964), and also Bucharest municipality, with 222,212 persons.

3. CONCLUSION

Our study is focused on the religious structure of the Romanian population as recorded at the census in 2011 and we aimed to highlight the major aspects with a view to the territorial distribution at county and regional level.

We believe that our contribution is significant since there have been few studies on the religious structure the reason lying in the lack of information in the censuses held in the period between 1948 and 1990. Then, starting with 1992, the content of the census improved, including data on gender, age, ethnicity, mother tongue, religion, active population, households, etc. The same and improved data were subsequently registered at the 2002 and 2011 censuses.

We processed the statistical data provided by the National Institute of Statistics and we synthesized them in four tables, one chart and two maps. We conclude by presenting the data in table 4.

Table 4

General religious structure at the level of geographical-historical provinces in Romania, in 2011[5]

Geographical-Historical Provinces	Orthodox	Roman-Catholic	Reformed	Pentecostal	Greek-Catholic	Other religions and atheists	Unavailable information
Transylvania	65.12	9.93	10.20	2.60	1.76	5.02	5.37
Moldavia	85.76	4.68	0.01	2.12	0.05	1.70	5.68
Dobrudja	83.96	0.48	0.02	0.32	0.03	7.08	5.12
Muntenia	91.60	0.29	0.01	0.62	0.02	1.32	5.26
Oltenia	93.66	0.16	0.01	0.35	0.02	0.65	5.14
Banat	73.20	7.58	1.43	4.54	1.02	5.03	7.20
Crişana	55.84	8.40	16.53	6.60	2.12	5.18	5.31
Maramureş	62.99	10.00	9.31	3.22	5.64	2.91	5.93
Bucureşti	84.31	1.18	0.07	0.27	0.21	2.16	11.80

[5] *Data extracted from Table 3.*

By presenting the data in table 4 we conclude that there are numerous religions in Romania and they are differently distributed territorially, when comparing the provinces in the central and western part of Romania (Transylvania, Banat, Crişana and Maramureş) with the four provinces in the east, south and south-east (Moldova, Dobrogea, Muntenia and Oltenia), fact resulted from the historical rule of the first four regions by the western neighbours, yet without influencing the majority orthodox native population.

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SPONTANEOUS POTENTIAL INVESTIGATIONS IN SEMENIC MOUNTAINS

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ABSTRACT.- Spontaneous Potential Investigations in Semenic Mountains. The use of geophysical methods such as that of Spontaneous Potential (***SP***) to investigate areas where the geomorphological processes occur, has the role to identify less visible processes as for example subcutaneous erosion or piping, subsoil water drainage and finding specific spatial differences of these processes. Comparative study of these sites allows correlation between geomorphological factors, soil and climate, but also to observe the evolution of subsurface erosion or underground water infiltration over time. During this investigation a series of mesh grids have been made in areas with different characteristics (lithology, pedology, slope, exposition, etc.) at different time periods in order to spot and analyse the change in data in the chosen sites, various conditions given. Values expressed in millivolts (***mV***) obtained by the Spontaneous Potential method have been put into an algorithm for interpolation looking to yield a pattern of values of what is happening in the soil during that period of time. Thus, in the autumn, the investigation site at the nivation niche Baia Vulturilor, returned values of between -22.6 mV and 65.6 mV, while in spring in the same site, values were within the range of -14.4 mV / 30.1 mV. On the other hand, on the site of the cryopediment under the Semenic peak, in the spring, return values ranged from -40.4 mV and -1.1 mV. A particular case is that of the glacis near Piatra Goznei peak; in this area anthropogenic electricity influences on soil can be found. Based on some models a trend of water movement in the soil could be established, this depending heavily on the amount of precipitation infiltration, local lithology, depth of soil and their structure, and evapotranspiration process. Water movement in the soil may be a correlation with sediment movement in soil horizons and instability manifested on the slopes.

Keywords: *spontaneous potential, piping, subsoil water drainage, nivation niche, cryopediment, Semenic Mountains.*

1. INTRODUCTION

Self potential, or spontaneous potential (SP), is a naturally occurring electric potential difference in the soils and geological substratum and is determined by two processes involving the movement of ions, streaming potential and electrochemical potential. The self-potential (SP) methods are, hovever, among the oldest of all geophysical methods, and they involve the measurement of the electric potential at a set of measurement points called self-potential station (Revil, Jardani, 2013).

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In the literature we find studies of the relations between the geomorphological component and the hydrological characteristics, the latter being the one that is registered by the Spontaneous Potential method, in this case.

The water infiltrated into the soil contributes to the formation of landslides (Naudet, 2008; Chambers *et al*., 2011; Hattori *et al*., 2011; Revil, Jardani, 2013), modeling of the karst relief (Jardani *et al*., 2006), and of the relief partially saturated with water (Jugnot, Linde, 2013). All of these can be monitored through geophysical investigation methods. Another component that can be analyzed is the anthropogenic landforms (Price *et al*., 2011). The structures of earth dams are frequently studied using this type of method (Boleve *et al*., 2011; Minsley *et al*., 2011; Rinehart *et al*., 2012) and the fluvial geomorphology (Onu, Opara, 2012).

These are just some of the aspects of geomorphology that can be monitored by the Spontaneous Potential method, this analysis depends both on the answer of the mechanical action of the water (Straface *et al*., 2011) and on the chemical reactions that can cause electric current into ground (Gu, 2013).

The Self- Potential (SP) method is a non-intrusive method and provides an image of what is happening at a time in the undersoil (Revil, Jardani, 2013). The method itself has been used since 1830 for determining subsoil resources (Fox quoted by Roudsari, Beitollahi, 2013) and relies on recording the values of the movement of the water in porous spaces (Jardani, 2007; Boleve e*t al.,* 2011). It has direct applications of fluid flow in soil mapping, identification of natural or man-made cracks in dams made of earth (Wishart *et al*., 2009; Moore *et al*., 2011; Boleve *et al*., 2011), mineral resources (Guerrero, 2004), analyze characteristics of the hydrothermal areas (Colangelo *et al*., 2006; Singarinbum *et al*., 2012) and other related fields.

Spontaneous Potential method can be approached also in mathematical manner, with studies such as those of Mehanee (2014): "*An efficient regularized inversion approach for self-exploration potential on interpretation of hours using a mix of logarithmic and non-logarithmic model parameters*". Straface, De Biase (2013) or Roudsari and Beitollahi (2013), these are just some of the recent studies on this topic. Physical-chemical approach method was performed by Revil *et al*. (2009) in "*Ionic Contribution to the self-potential signals associated with a redox front*", Peksen *et al*. (2011): "*Application of particle swarm optimization on self-potential data*", Boleve A. (2009) or Linde N. *et al*. (2007) with "*Estimation of the water table throughout the catchment using self-potential and piezometric time in a Bayesian framework*."

All these works have helped to create a solid basis of this method, proving the validity of how it is perceived in the SP geophysical method. Although in Romania there are currently not many such works, the results obtained by external researchers can still be correlated with a local geophysical environment to implement this method optimally. We can therefore use this technique to highlight the fluid mobility processes existing in the landforms and finally reveal some characteristics of geological substratum and geomorphological structures. In the Romanian geomorphology the Spontaneous Potential method was applied for the first time on the periglacial earth hummock of Muntele Mic in October 2011[2].

[2] Urdea, P. (2011), Spontaneous potential in periglacial geomorphology researches, International Scientific Conference *„Geographical research trends in the European space''*, West University of Timişoara,Timişoara 13-15.05.2011.

An important aspect is the quantification of results obtained by this method, so to have a more complete picture of what takes place in the ground, there is a need for continuous structures. This can be achieved by interpolating the values obtained in the field, and as interpolation methods can be used Radial Basis Functions (Buhmann, 2000, 2003; Bullinaria, 2004; Morse, 2005; ArcGIS 10.1 Help), Kriging with its many variants (Kleijnen, 2011; Hengl *et al*., 2008; ArcGIS 10.1 Help) or Inverse distance Weighted (Lu and Wong, 2008; Miller, 2005; ArcGIS 10.1 Help), can be used as interpolation methods, each presenting some advantages and disadvantages.

The main **purpose** of our study is the analysis and interpretation of data derived from measurements made in different sites. The **objectives** of this study are the evaluation of the values acquired through Spontaneous Potential method in the mountainous landforms and analyze their temporal evolution.

2. RESEARCH AREA

Semenic Mountains are the highest unit of the Banat Mountains, reaching 1447 m in Piatra Goznei Peak. One of the features that provide a unique identity to these mountains, even to the highest part of them, is the wide deployment of the peneplains. The upper surface was identified and named Semenic by Emm. de Martonne (de Martonne, 1924). This author believes that the physiognomy of this erosion platform is identical to Borăscu platform, but at a lower altitude (*„…la physionomie de la platform du Semenic est bien celle de la platform Boresco à un niveau inférieur"*; de Martonne, 1924, p. 154).

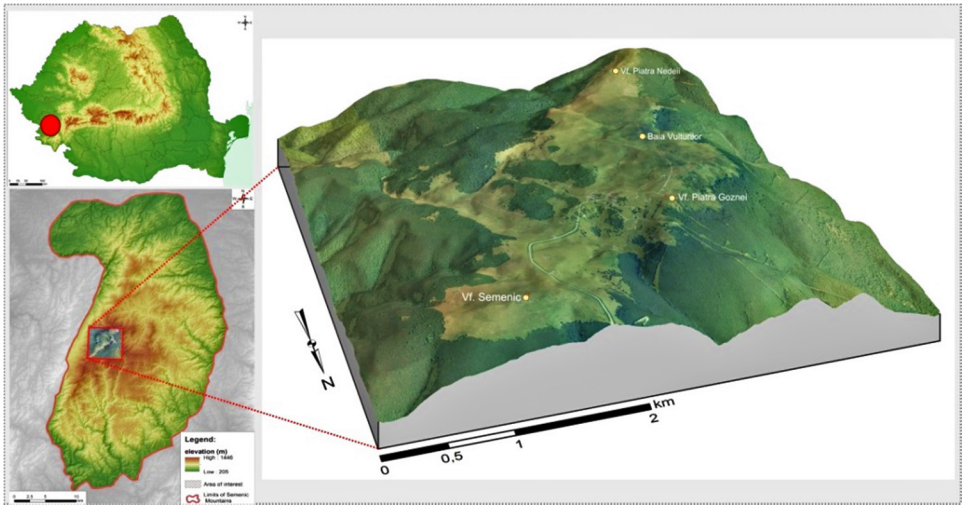

Fig. 1. Location of the research area.

The detailed geomorphological elements are represented by many periglacial landforms, with an evolution connected to the current weather conditions. The long period of time that snow persists contributes to the emergence of specific crionival landforms.

Semenic plateau, above 1400 m a.s.l., is dominated by residual peaks of monadnock type, the most important ones being Semenic peak (1446 m), Piatra Goznei peak (1447 m) and Piatra Nedeii peak (1437 m) (fig. 1).

The Spontaneous Potential investigations were made in Semenic plateau, in the central west side of Semenic Mountains (fig. 1), at altitudes above 1350 m, in three distinct areas: the nivation niche near Baia Vulturilor spring, a section of cryopediment developed under the Semenic peak and a portion of glacis near Piatra Goznei peak, close to the television tower.

Semenic Mountains are made of intensely metamorphosed crystalline schists, predominantly those meso-metamorphosed and the epimetamorphic ones, part of the Lotru Series of the Getic Nappe, which are quite limited to the central region. In Piatra Goznei, Semenic and Piatra Nedeii peak area, sinorogenic granitoides rocks can be observed. Semenic peak consists of micaschists, biotite paragneiss, nodular gneisses and migmatites, while Piatra Goznei peak has in its composition micaschists, granites, granodiorites and lenticular migmatites (Savu, Maier, 1976).

The geomorphologycal landscape is dominated by Semenic leveled peneplain - with low landform energy. Because of this, in the central plateau and beyond, have formed raised bogs, water drainage being reduced. The residual peak Semenic, Piatra Goznei and the Piatra Nedeii peak are surrounded by cryopediments (fig. 2). Also landforms such as glacis and nivation niches are to be found here.

Fig. 2. Cryopediment around Semenic Peak.

On Semenic plateau, one finds many **soil types** grouped into certain categories so that pre-podzols are in the upper part. They are divergently arranged around the higher areas. Flat surfaces are composed of histosols due to the accumulation of liquid and solid precipitation and insignificant runoff. Besides the predominant soil types, there are associations of districambosoils, podzols and lithosols having a sandy loam texture[3].

Each type of soil characteristic influences the SP values obtained, and this case is an example of the nival niches pedology.

From the **hydrological** point of view, Semenic plateau is drained by many rivulets, in some areas forming small periglacial lakes during periods of snow melting and significant rainfall. In the center of the plateau bogs are formed due to weather conditions and local morphology.

[3] Romanian soil map 1: 200,000, 1989

The **climatic conditions** are influenced by the western winds. The annual average temperatures is around 1.5°C, rainfall exceeds 1400 mm, with heavy snow[4]. Precipitation has a significant role because the streaming potential study takes into account the movement of particles entrained by water in the soil, but must take into account several other parameters.

The subalpine **vegetation type** is found at altitudes above 1350 m, local conditions (precipitation, temperature, circulation of air masses) contributing to the appearance of the mountain meadows with *Carex curvula, Poa media* and *Festuca* and isolated patches of shrubs (*Vaccinium myrtillus; Vaccinium vitis - idaea*). In the marginal zone of the Semenic plateau there are spruce and beech forest patches, and swamps with peat moss (*Sphagnum*) are characteristic to the areas with poor or difficult drainage. These characteristics influence the Spontaneous Potential values received by water absorption from the soil by the root system and transport to the canopy. The mixed arrangement of these species contributes to the diversification of characteristics exerted on the soil and rock layer in some cases.

As we mention, cryopediments are present around the peaks, the result of erosion occuring due the periglacial conditions on a surface with solifluction and slope drains, transporting the debris fragments resulted outside the area (Iannicelli, 2010). Environmental conditions during glacial periods significantly influence the formation mechanism of the cryopediments, being influenced by the lithological structure, slope, vegetation coverage, the presence of permafrost, type and amount of precipitation (Czudek, Demek, 1971; Vandenberghe, Czudek, 2008). As for other landforms, the glacis are described as concave surfaces of various sizes, whose slope is running from the edges towards the inside (Garcia – Tortosa *et al.,* 2011). There can be found the pedological material erosion in the marginal zone and sedimentation thereof in the central part, a result of the action of water drainage. Although the size is reduced, we can still observe the local trend, but due to anthropogenic influence exerted by the television tower nearby, there were abnormalities of electricity in the soil, imposing filtering the signal (Crespy *et al*., 2008).

Another landform associated with the periglacial slope processes found in the Semenic plateau and which showed interest was the nivation niche from Baia Vulturilor, identified since 1922 by Emm. de Martonne („*Les depressions tourbeusses où l'on trouve meme de petit lacs à la localité appelée Adlerbad, ont l'apparence de cirques embryonnaires, et indiquent qu'il y a eu là, pendant la periode glaciaire function de névés temporaries*"; de Martonne, 1924, p 153). These landforms are formed at the base of slopes where they accumulate more snow; it is maintained for a longer time period, and due to frost acting on detaching fragments from slopes due to temperature differences (Gerrard, 1990). The rock fragments accumulate where the snow is discontinuous, and between the origin slope and the fragments layer an asymmetrical excavation is formed in the soil retaining water for a longer time.

Because this area of investigation is integrated in the "Semenic–Cheile Caraşului National Park" protected area, for studies on specific aspects of soil, it requires the use of non-invasive methods. Such a method is the Spontaneous Potential with insignificant impact on the ground. Although the literature mentions the complementary use of geophysical methods for higher accuracy, such as the use of electrical and electromagnetic methods, for this study, the Spontaneous Potential method was chosen as the study technique.

[4] Annual Report on the state of the environment in Region 5 West in 2010

2.1. Investigation on the characteristics of the sites

The first set of measurements was conducted on 10.11.2011, investigations being carried out on that date in two sites of the grid type. Grid 1 was conducted in the nivation niche near Baia Vulturilor spring (fig. 3).

At that date soil moisture was lower due to the lack of precipitation during autumn, but due to the high altitude, vegetation moisture content was increased. That day, visibility was low due to dense fog and the temperature was low also. It has sides of 30 m, and the points from which the data were obtained has a frequency of 5 m. The fixed electrode has been set at about 2.5 m from the upper edge of the profile, in the middle of it.

Fig. 3. Baia Vulturilor nivation niche site.

The second grid was conducted on the southeastern slope of the Piatra Goznei peak, close to the TV tower, about 130 m from it (Fig. 4).

Just like in the first place, the edges of the profile were about 30 m, with a frequency of the sampling points of 5 m.

Due to human conditionings that we will present later, in the framework of the second phase of measurements (19.05.2012), we have not made a grid near the TV tower, but only in the nival niche Baia Vulturilor, in the same sample points, and on the cryopediment situated on the SW side of Semenic peak. Within this site, a grid with sides of 30 m in width and 45 m in length was made.

Fig. 4. Piatra Goznei site.

3. SPONTANEOUS POTENTIAL METHOD

Spontaneous Potential method is a method of non-invasive geophysical survey that allows obtaining values of the electric potential of the soil as a result of the interaction between chemical, physical and biological properties of the generator agents (Revil, Jardani, 2013). Knowledge of internal mechanisms that generate this natural electricity leads to a better interpretation of the results obtained, so that the process will be presented in the following.

Spontaneous Potential is defined by Jardani as "*passive measure in the surface or drilling of the natural electrical potential distribution created by polarization mechanisms of the electric cargoes in porous media (streaming potential linked to water flow, consistent with redox phenomena*" (Jardani, 2007, p. 46).

It is accepted that the mechanisms generating a potential difference are:

• electro-diffusion phenomena: in which the difference in mobility of ions in a given environment and the existence of a salinity gradient created by the electrical potential difference is called the diffusion potential (Maineult, 2004; Jardani, 2007);

• oxidation-reduction phenomena: where oxidation reactions and reduction produces electrons that can be mobilized because of the redox potential;

• electrothermal phenomena: this differential ion diffusion under the influence of a thermal gradient of pore water is contributing to power generation;

• streaming potential phenomena: they involve moving of the excess electric charge near the mineral surface under the influence of the fluid movement into the soil pore system.

The fluid movement in the pores of the soil or weathered rocks, contributes to the existence of the mobile ions movement and when the contact between colloids and the mobile part of the mineral layer is free, this detach helping to create a convection current and the other side, called conduction current. The associated potential conduction current is the one that can be measured at ground level (Moore *et al*., 2011).

Generation of current from streaming potential due to the electric interaction of the fluid and minerals depends largely on the factors existing at a point, but knowledge of their internal mechanisms can lead to a proper correlation between the internal and external environment. Due to the shaping in the soil of the processes through which current generates streaming potential, the pedological material characteristics are influenced by many factors (geology, plant associations, climatic influences, soil moisture, geomorphometry). Spontaneous Potential values obtained have influenced each other by many factors. Besides, streaming potential itself is associated with a range of parameters that influence the positive or negative values recorded. Jardani (2007) identified the following two sources as being responsible for producing noise:

- the magnetotelluric induction: where temporal variations of magnetic field induce electric telluric currents, and the frequency can be identified at the level of the sidereal day; if there are irregular and rapid variations (within one hour), this may be due to thunderstorms; in the case where investigations are to be carried out for a period of time less than a day, it can disregard this noise source;

- the bioelectric potential: may occur due to the transfer of chemicals between biotic factors and may influence the SP by generating an electric current induced in the ground; its effect is well highlighted in forests, meadows and pastures, which drains water through plant roots from the soil and helps to create an additional electric potential. To avoid this source of noise, measurements should be performed away from the root system and use the bentonite for stabilization of the moisture in the sample points.

According to the company producing SDEC electrodes (electrodes used in this study[5]) the ratio temperature /electro-infiltration current is 0.21 mV / °C, so that during

[5] *http://www.sdec-france.com/soil-science-equipment-sensor-pms9000.html*

the day, thermal amplitude should be considered and should offset final values. A difference of 10°C is considered to be responsible for SP amplitude values of about 2 mV, which should be corrected (Jardani *et al*., 2009).

In addition to the listed sources of noise, changes in the values of SP are also influenced by the effect of the pH with alkaline as it is, the values recorded are larger-scale negative (Ishido, Mizutani, 1981, cited by Guichet 2002). Rock mineralogy also imposes certain issues, depending on their composition yielding electro-infiltration differentiated values. The influence of permeability is equally important, as well as partial saturation of the electrolyte and electrical conductivity of the soil (Darnet, 2003). The knowledge of these parameters allows an objective distinction between power sources themselves and those that are redundant and contribute to a misinterpretation of results.

4. DATA ACQUISITION

Spontaneous Potential investigations were carried out using non-polarized electrodes connected to a voltmeter (fig. 5).

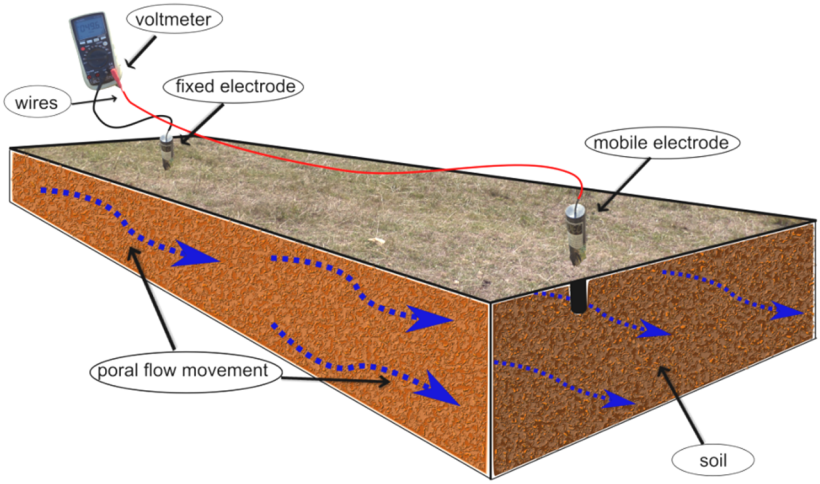

Fig. 5. Spontaneous potential acquisition values.

A non-polarized electrode is made of a metal in contact with a saline solution (Revil, Jardani, 2013). In this case electrodes Petiau Pb/Cl_2 are used: one used as a fixed electrode, placed outside the investigation site, and a second electrode as a mobile electrode, moved at different sample points in the field.

At the point where the fixed electrode is placed, for better conductivity, bentonite mixed with water is inserted, and to avoid reducing the salinity of the pore water due to evapotranspiration results by the analyst soil ripped to break up, a saline solution is applied (Revil, Jardani, 2013).

A VoltcraftVC850 digitalmultimeter was used, which allows the recording of the voltage of the electric current in the range of 0.1 mV– 1000V, thereby providing very accurate values. In addition to recording Spontaneous Potential values expressed here in millivolts (mV), the instruments may be used for the acquisition of soil temperature values or the intensity and frequency of the electric current in the ground.

4.1. The interpolation of values obtained using Self Potential method

The next step of the data acquisition has been to use them in such a way as to allow continuous analysis of the values obtained in the grids made. The objective was to obtain patterns of subcutaneous erosion and penetration of water into the soil. This operation was performed by integrating these values in the interpolation methods implemented in the software ArcMap 10.1, allowing the realization of the whole process of preprocessing, and exporting the resulting data. For this purpose, one can use other programs such as Surfer or SAGA. In ArcMap 10.1 several methods of interpolation were implemented, as deterministic, such as Inverse Distance Weighting, Global Polynomial Interpolation, Radial Basis Functions and Local Polynomial interpolation as well as stochastic called geostatistical methods[6].

However, in both types of interpolation methods, they are interpolations that return results that take into account the values previously entered, there is a crossover between the output and the sample values, called exact methods, and interpolation simulating results based on baseline applying a smoothing over them, called inexact methods. However, we briefly introduce most interpolation methods that are implemented in ArcMap program.

The interpolation method that was suitable for this study was ***Radial Basis Function***. In this method, the resulting surface must pass through every sample, the spaces between the points are constructed based on variables chosen by the analyst as: Thin-plate spline, Spline with tension, Multiquadric function, Completely regularized spline and Inverse multiquadric function. The latter function returning in a much smaller prediction error as compared with the other[7], and, on the other hand, the advantage of this method of interpolation is that it shows to be more flexible and more automatic than Kriging functions. The variables available are much fewer, but still provide a measure of accuracy.

When the number of samples is higher, the results are more in line with reality, making it a relative smoothing compared with Inverse Distance Weighted interpolation method. Low quality outcomes are returned if the differences between inserted points are high, favoring a high degree of uncertainty. The method was used in this study because of the favorable response to all data sets compared to other models that returning the artifacts for some integrated datasets.

Another interpolation method that has the potential to use is ***Inverse Distance Weighted***, being a deterministic method, accurate, relying on the idea that the more things are close, then they should be similar. This method generates values around the sample

[6] A quick tour of Geostatistical Analyst ArcMap 10.1
[7] ArcGis 10.1 Help

point, giving high weight areas in the immediate vicinity, and low weights to those distant, thus helping to create a map composed of concentric circles. Within a dataset, weights corresponding to sample values will decrease in importance as they are farther from the point of origin. The weight is set so as to yield a reduced root mean squared prediction error (RMSPE), statistically calculated in the module at the stage of cross validation. The result is sensitive to the presence of clusters and outliers and it does not appear as a viable model due to the lack of integration standard error of prediction.

A third ***Kriging*** method is used as part of geostatistical interpolation methods. It is an interpolator that can be exact or inexact by measurement error models and exploratory tendency (local or global). It is flexible and helps graphically investigate the autocorrelation and cross correlation. Kriging method uses statistical models to return a variety of surfaces including predictions of surface result, predictions of standard errors, probability and quantile. The flexibility of the models requires an active involvement of the analyst, which reduces the objectivity of the final results. There are several types of Kriging interpolation - Ordinary Kriging is the most common, others are Simple Kriging and Universal Kriging. Ordinary Kriging is characterized by flexibility and means that using a constant average is acceptable and this is used for data showing trends.

A fourth method of interpolation that can return satisfactory results is ***Empirical Bayesian Kriging***. This works by automating some parameters in their calculation segmentation processes, the input data set and the integration of simulations. These parameters must be set manually in other Kriging models. It is based on the Kriging interpolation method, reducing uncertainty estimation of these mivariogram by additional semivariogram of simulated input data.

Empirical Bayesian Kriging performs local models based on a subset of data originally inserted. Due to non-integration of uncertainty in the algorithm, other methods of this class underestimate the standard errors of prediction. Among the advantages of this method, one can include the need for a minimum contribution of the analyst in setting the model variables, the standard errors of prediction are more accurate as the other Kriging methods and lends itself much better than normal Kriging models for the analysis of small data sets. Simultaneously, the disadvantages faced are related to high processing time simulations and return a raster, and that log transformation Empirical (based only on positive values) is sensitive to isolated values.

4.2. Definition of parameters used in the interpolation

Radial Basis Functions is a method in which there are some parameters that must be defined to obtain a mean square error (RMS) as low (table 1). However, it must set the same parameters for all data sets to reduce the influence of the human factor, although in some cases custom settings are imposed. These parameters were determined by testing multiple combinations.

In Geostatistical Analyst module, after selecting the data set and the values that were to be used in the "Method Properties", the parameters to be presented were introduced.

Table 1.

Comparison of mean square error interpolation models for data used for interpolation in the Baia Vulturilor site 19/05/2012

Function	RMS
Completely Regularized Spline	8.513
Spline with Tension	8.510
Multiquadric	8.694
Inverse Multiquadric	8.450
Thin Plate Spline	9.070

Among the features used, Inverse Multiquadric returned the lowest mean square error. When the tool is selected, the tool of choice of a parameter appears acting as a weight and is directly influenced by the selected function and the characteristics of the data set.

Then follows the method of searching of the neighbors and it returns intermediate values. We chose standard type of neighbors, in order not to influence their search, with a choice of minimum and maximum number of neighbors considered. The maximum number of neighbors is the total number of values that are taken into account in the application position. In this case, there is a total of 10 points selected distance to be used at a time, while the minimum was set to 5 (fig. 6).

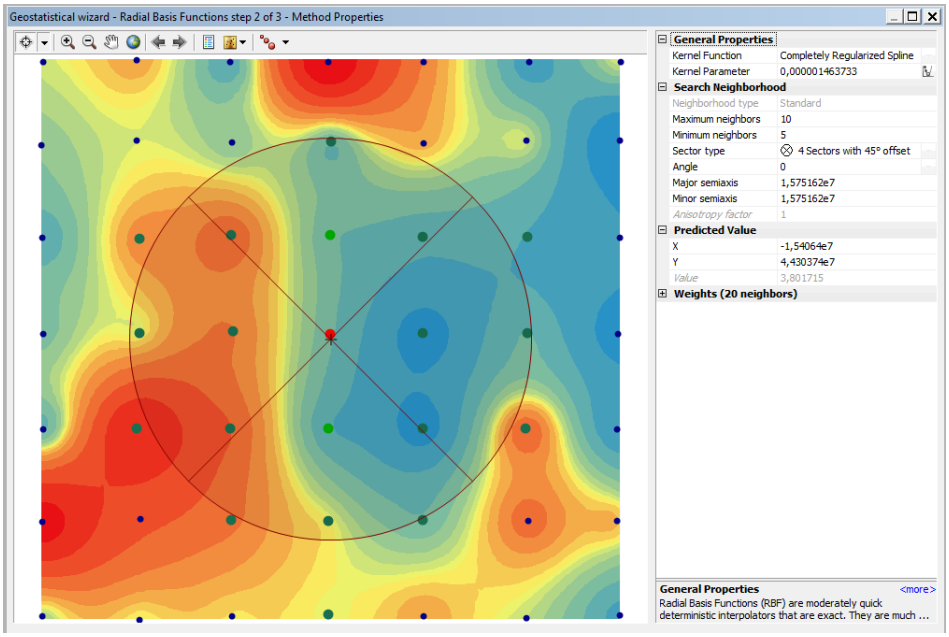

Fig. 6. The implementation of interpolation method in ArcMap 10.1 program

The next step is to choose the type of search of the sector. The amounts can be taken out in a simple circle or one segmented into four sectors, four sectors with an angle of 45° or eight sectors. Each of these different settings affects the final result, but should be kept in mind that these settings should be implemented in each of the data sets, so by their own choice have obtained maximum value for each set.

These are the parameters that could be influenced by this method of interpolation, other features: semi-axis major and minor semi-axis is influenced by the dataset, and the anisotropy could not intervene, conventionally the assigned value is set to 1.

4.3. Comparison of raster types of grading results

After obtaining raster representations of Spontaneous Potential values resulting from the application of interpolation methods, the question is how this structure is classified. Each classification method is implemented in the software ArcMap 10.1. Methods found in other programs have certain characteristics that may influence the graphical representation obtained. Adopting a classification of the raster structure to the detriment of representation unclassified has the advantage of emphasizing certain features that exist in the resulting model but one must carefully choose the method used.

A classification method is implemented using intervals: "***Equal Interval***" and, as known, it involves splitting the value interval in an equal number of classes, number defined by the analyst and is easy to analyze[8]. Disadvantages of this method occur when values are grouped and several elements can appear in a class and very little in another.

Another method exists and has been used in the graphical representation of the results of this study; this is the classification of geometric intervals "***Geometrical Interval***" called "smart quantile". It is a method used for continuous data visualization and data representation folds well, while not having a normal distribution. The method was designed for use in asymmetric histogram data where similar values may appear. The algorithm creates these geometric intervals by reducing the square of an element of a class. The Spontaneous Potential values are similar and they do not necessarily have to be next to each other and smoothing of these values is not necessarily relevant, as these singular values can transmit distinct characteristics of the situation in the ground. The method is used to view the predictions of surface, the distribution of the values but its role is not to identify the values of the isolated space.

A third method used is that of classification through ***quantiles***, where it is assumed that each class contains the same number of elements. This fits in situations where data are distributed. Elements are grouped in a predefined number of classes.

The classification method "***Natural Breaks***" is based on the integration of values in natural groups by combining similar values into different classes or features classes. It is used to represent values that do not normally occur on the histogram; however the method is limited to a single set of data whilst putting the problem of choosing the number of classes due to a wide distribution[9].

[8] *http://individual.utoronto.ca/lackner/ggr272/DataClassificationMethods.pdf*
[9] *http://individual.utoronto.ca/lackner/ggr272/DataClassificationMethods.pdf*

A final method of classification is the ***standard deviation***, and is used to see the variation from the mean data. For this purpose, it calculates the average and standard deviation and class division is based on the values obtained. If one uses only standard deviation the number of classes resulted is 6, and when using only half the standard deviation, the number of classes increases to 12.

At last we will integrate specific elements of a map and its export.

5. RESULTS

Within the investigation sites, spontaneous electrical potential of an area at a time was analyzed when the frequency of rainfall was lower as well as after a period with significant amounts of precipitation both solid and liquid. In winter 2011 and spring 2012, the snow cover on Semenic plateau persisted until May with a significant thickness, so that the amount of meltwater in the soil was considerable in the second stage of investigation.

5.1. Baia Vulturilor nivation niche

The areas with low values (shades of green areas) are areas with a fluid mobility in the soil layer (fig. 7), while the southern part of the grid is characterized by the slope decrease. The existence of concave relief microforms covered with a significant layer of soil and peat material over time are probable, but still directing water flow. The evolution of the current values depended on the local morphology of the soil and climatic situation at a given time. Thus, one can see significant changes between the two periods in which measurements were made. The SP values were amplified in this case by increasing the movement of water caused by increased rainfall and local topography that allows drainage to the SW grid.

Evolution of SP values (mV) and amplitude for the nivation niche Baia Vulturilor differ from one climate period to another period, in the sense that, for example, the first column of the grid, on 10.11.2011, oscillations are strongly amplified with a maximum of 56.7 mV and a minimum of -0.5 mV, compared to the same line, but on 19.05.2012 with a maximum of 30.1 mV and 10.8 mV minimum. The lack of precipitation contributed to significant fluctuations in the soil layer by decreasing the mobility of chemical elements and forcing them as their movement depends on kinetic energy. High values suggest immobility of the soil colloids in terms of slope and low fluid mobility.

In general, there is a difference between the two periods, at least at the top of the grid, meaning that values of the East-West axis present oscillations that vary from one period to another. This can be explained by reference to the slope which was established as the area of investigation, the first registration point being on the side with higher altitude than the last point of the column. Fluid mobility will therefore be more active on this orientation, SP values retaining a certain uniformity.

In the nivation niche, from row 3 and column 5, graphs of values obtained in two separate periods begin to have relatively similar trends. From this cyclical evolution, it

may emerge that non saturated surface (topsoil) of the median - lower grid-like values keep the SP in different climatic periods. Natural drainage in this area remains constant, influencing compliance and particle mobility.

The values presented, in addition to a similar evolution chart, form a similarity between the values obtained, as their amplitude varies only minimally from one case to another with a maximum of 20.9 mV in 10.11.2011 and 27.1 mV in 19.05.2012 for point 3 in both cases and a minimum of -15.9 mV on 10.11.2011 for point 5 and -14.4 mV on 19.05.2012 to section 6 of the row 4.

One notices that in the case of the column 7 values are quite small the first time and now there are two positive peaks in the second period. This last set of values is totally negative marking there is a constant fluid flow that involves chemicals continuous systems. It should be mentioned that there is a small creek in the neighborhood, which can provide a constant wetting of the soil, or at least wet periods, the remaining time can operate in the lower vegetation layer even at low levels.

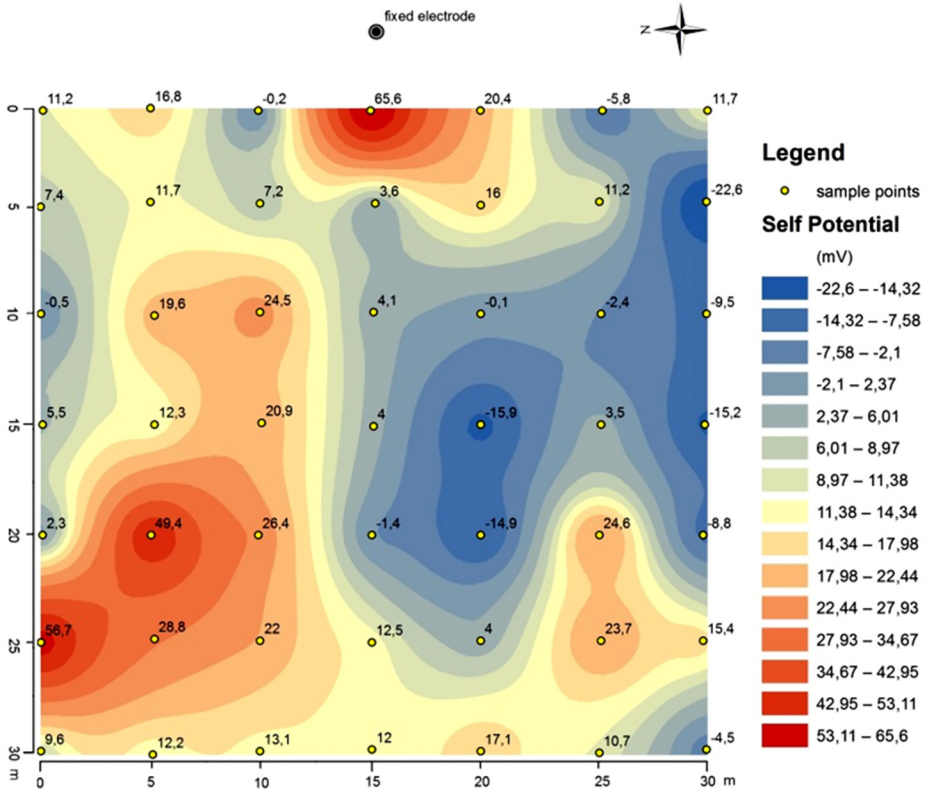

Fig. 7. SP pattern – 10.11.2011 on Baia Vulturilor nivation niche.

Although the difference in height between the North and South side of the grid is reduced to the level of the second period of investigation (fig. 8), leveling values, between 10 mV and 30 mV of Spontaneous Potential in the northern part of the grid are noticeable. If on 10.11.2011 in this part of the grid, there are two values of more than 45 mV, with a maximum of 65.6 mV on the upper side of the investigation site, this time the resulting values are more homogeneous. This is due to the large volume of water in the soil that contributes to its saturation and reduces the water movement in the soil in the northeastern section, forcing it to move to the lower area, this area being the closest to Baia Vulturilor spring. The north-west retains similar characteristics which assert the existence of a concave geological irregularity covered by soil layer that stops water moving to areas with lower slope, while the soil might be deeper to the South, encouraging water circulation.

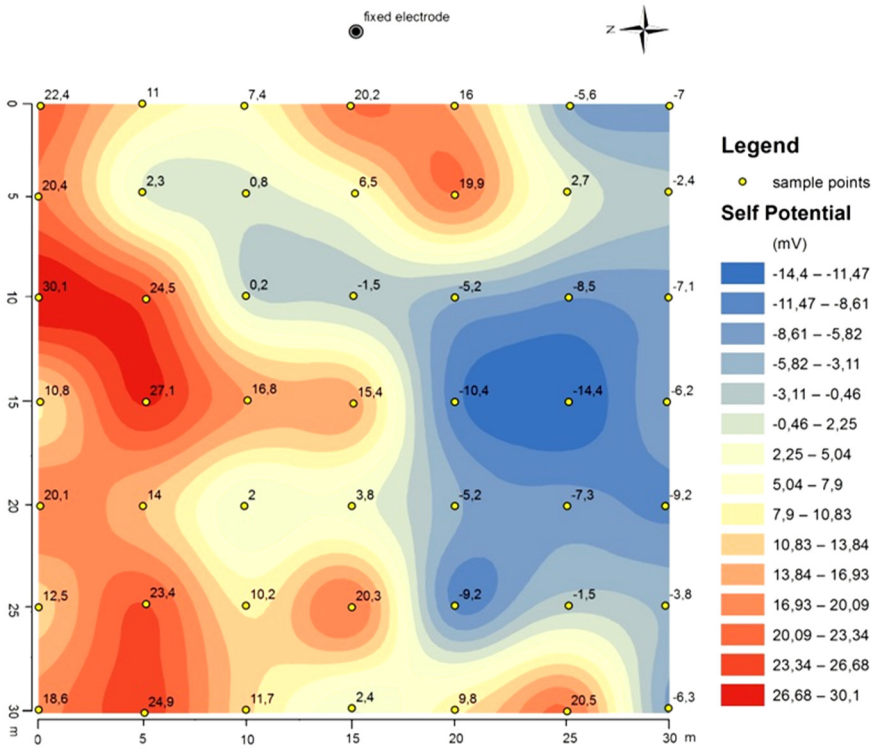

Fig. 8. SP pattern – 19.05.2012 on Baia Vulturilor nivation niche.

It is also possible to monitor the development of Spontaneous Potential values on graphs made by both rows and columns. These graphs allow observing the changes that occur in a single column or row allowing detailed assessment of how the current distribution in the soil evolve, caused by infiltration and evaporation. One notices the existence of the features that can outline a specific way of evolving in different periods and their behaviour.

5.2. The glacis of the Piatra Goznei peak

Another area examined was the glacis near the TV tower on Piatra Goznei peak, but because of electrical interference emitted by the tower, the returned values were strongly influenced. The values resulting from the measurements were very high (fig. 9) compared to those derived from measurements of Baia Vulturilor on the same day. The distortion of SP values obtained obstruct the formation of an image on this area, but even so, we can still deduce general electric character of the area concerned. Higher values are located in the center of the grid while lower intensity values are located peripherally. From this analysis, it may result that there is a radial fluid movement from the center to the periphery.

To demonstrate the influence of electric current emitted by TV tower at other area measurement, we conducted a profile in the same area where we made previous measurements. This time we have not considered the recorded electric voltage, but the frequency of electricity found in soil. Thus we obtained a value of 50 Hz, a frequency that is used throughout Europe. This demonstrates the existence of a power of artificial origin within this site. For this reason we gave up the second set of measurements, which are not conclusive. Data columns are more uneven, but in almost all cases you can view a fall in the south - west grid graphs and convexity in the middle. Even if they try to correct the values by eliminating the electricity mathematically, its action has influenced not only receiving incorrect values , but amplified its power.

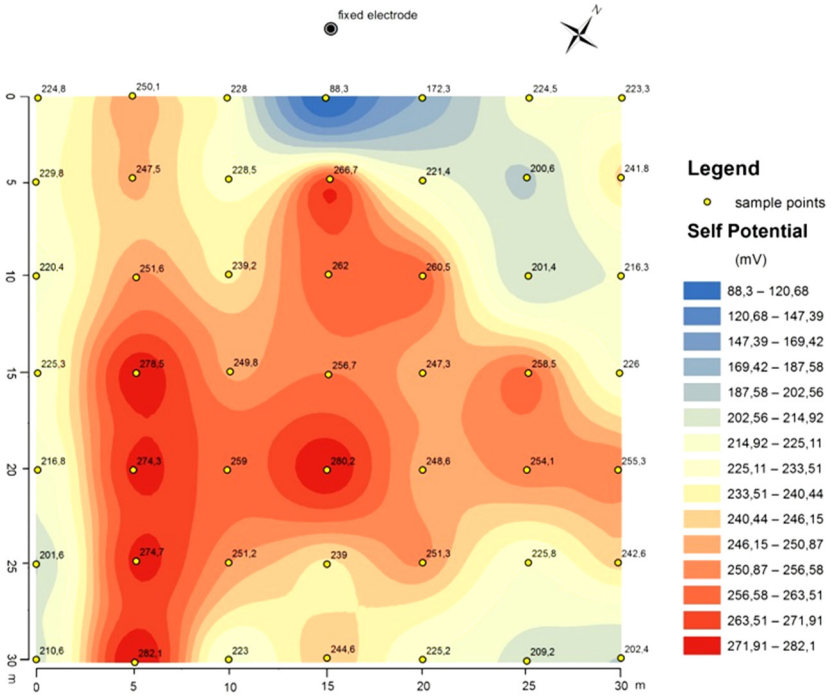

Fig. 9. SP pattern – 10.11.2011on the Piatra Goznei Glacis.

However, the distorted values can be recorded overlapping a compact lithologic body, analyzing the layout of the respective SP values, knowing that certain minerals such as pyrite or quartzite contributes in the return of the high SP values.

Because of the influence of anthropogenic environment, in order not to receive a set of wrong values, we decided to move the study site near Semenic peak.

5.3. The cryopediment developed close to Semenic peak

If the electric anthropogenic influences are reduced or even nonexistent, the SP values may be associated to real situation in the field. With this site, although no comparative investigations of other climatic periods were made, in this set of measurements we found only negative values (minimum is -40.28 mV), which is associated with particularly southern slope gradient and geologic substrate, which can confirm some theories.

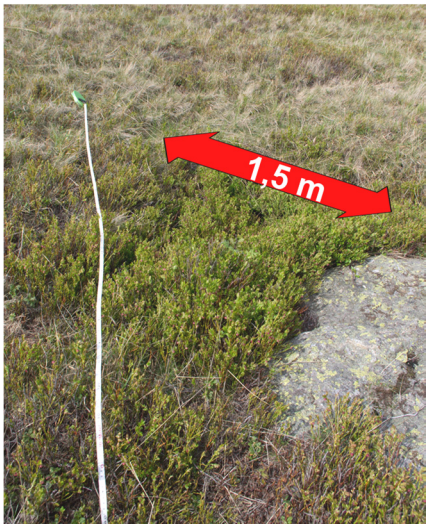

Fig. 10. Ploughingblock in the cryopediment under Semenic peak.

In this case (fig. 10), it can be generally seen that values increase from the upper portion (NE) to the bottom (SW) which means that once the slope decreases and the fluid flow rate in the soil decreases, this is associated with the increase or decrease of the current values in the soil.

The problem is that things are not so simple; the lithology of this area was affected, though on a smaller scale, the presence of cryopedimentation processes, which was visible on the low inclined surfaces surrounding the peaks of Semenic plateau, and the existence of rock fragments radially arranged around the peaks, making part of their structure at some point.

From the representation made, one may see that the areas with shades of blue have lower values of SP, which may correspond to areas with rock fragments, a ploughing block, that are carried along with the soil layer to the edge of the slope.

In the cavities behind these blocks (fig. 11) that moved parallel to the slope, the water infiltration acts simultaneously with the gravity and the slope gradient in the process of that rock slide, and snow accumulates in them in winter. In larger spaces, blueberry bushes grow; the advantage of high humidity, the slope being oriented SW, solar radiation reception is significant, contributing to the evaporation of water from soil.

If the connection between the elements presented and those of the ground is viable, through this method of investigation, differences in the constitution of the cryopediments by a relatively simple and cheap method could be detected.

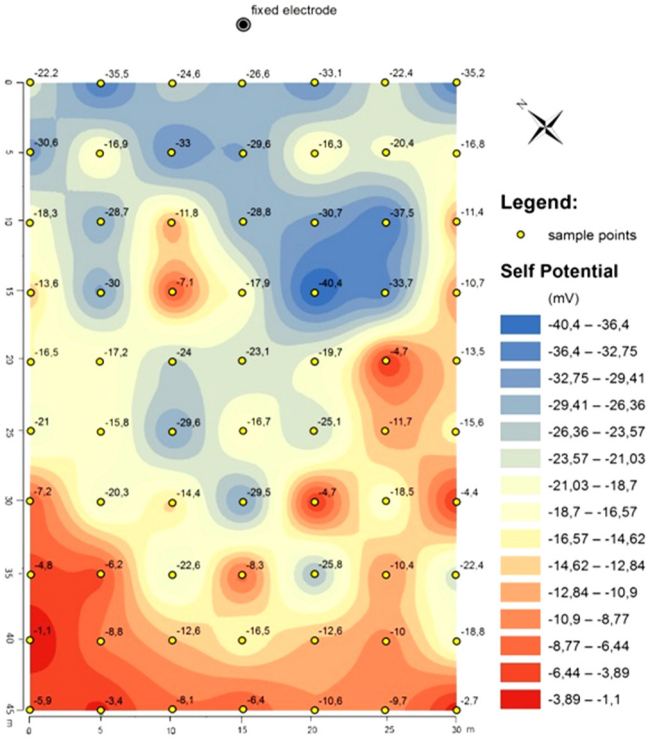

Fig. 11. SP pattern – 19.05.2012. Cryopediment near the Semenic peak.

From the evolution of current values in the soil one can view the increase of SP values from point 1 to point 10 of the columns, suggesting a more pronounced movement of ions combined with higher slope and a drop to the bottom of this report. In general, the values of rows vary according to the geological substrate characteristics which conditions the movement of fragments to the bottom of the slope.

Their variation shows a minimum in the center, but may have more negative peaks in those areas where there is a strong underground infiltration of fluid flow, an infiltration conditioned by the rock layer. Taking into account the not too sharp slope, 16-20°, with a movement towards the bottom of the soil layer, in a long period of time, the movement influenced by rock fragments in place, it can result that the soil layer cannot be very deep.

Examination of figure 10 can punctually identify areas where water can infiltrate in the underground, which may be associated with voids formed behind rocks sliding, enclosing a significant amount of rainfall, which will eventually enter in the basement.

The lower part of the grid returned higher SP values (-12.6 mV / -1.1 mV) compared to the upper zone (-40.4 mV / -33 mV) because this area have a lower slope which contributes to the fluid stability and reduces fluid flow mobility and not involving particles leads to the generation of electro-infiltration potential.

The South-East grid presents a band made up of high values , which climbs to the top of the grid, the draining fluid flow of movement within the grid, and can be associated with a concave rock layer in the portion of soil layer with a lower depth. Instead, the first row of the grid is formed only by low values (between -35.2 mV /-22.2 mV) of Spontaneous Potential, being the part that takes most of the fluid flow recorded.

The values were negative, suggesting fluid dynamics. It must be taken into account that the profile has been achieved after a period with significant precipitation, but in this way, the values highlighted aspects of soil layer. For a better understanding, however, a comparison between two different climatic episodes is required.

5. CONCLUSIONS

The evolution of the current values depended on the local morphology of the soil and climatic situation at a given time. Thus, significant changes between the two periods in which measurements were made can be seen. The values of SP are amplified in the case of increasing the circulation of water generated by increasing the amount of precipitation and local topography that allow water drainage.

For an overview, it is important to use geophysical methods of investigation simultaneously, allowing detailed knowledge of variables that contribute to influencing the values returned.

In these investigations through Spontaneous Potential method, we have emphasized on how water infiltration and movement of water on the geometry of gridsmade in relief developed on crystalline schists, there being some individualized microform specific of this landscape. In fact this is a subcutaneous geomorphological process defined as pipping.

One should consider also the rainfall infiltrated into the soil because Semenic plateau investigations were conducted in the first phase in a period without precipitation and afterwards these investigations resumed after the snow melted. On the Semenic plateau grids were made in nivation niches, glacises or cryopediments surfaces. The general area was characterized by a sustained fluid movement but have a linear distribution character field.

The anthropogenic influence of the natural electric flux puts some problems because its intensity increases, as was the case in the area near the Piatra Goznei peak TV tower. To avoid this problem, in case of investigations of this kind in areas with metal poles or underground power network, before the start of the study one must check the existence of a stable frequency of the electric current.

Although the method itself is quite simple, it can provide valuable information for solving certain environmental problems not only in terms of low cost and high efficiency. It is a noninvasive method, which is important since Semenic plateau investigations were conducted in an area that is part of a national park.

Using this method has the advantage of using a low budget and in less time outlining the characteristics of the subsoil, but for a true validation a second investigation is recommended.

Comparative studies using this method require knowledge of soil moisture in an accurate measurement, soil characteristics and climate issues for a correlation as close to the real situation in the field.

Many factors causing influences of any kind imposed a detail of their knowledge, but also the technique used in some circumstances contributed to the generation of artifacts, especially related cables which convey electricity between electrodes and voltmeter. Therefore, noise (natural or anthropogenic sources) can cause problems, so it must be removed both by mathematical methods and by avoiding certain aspects of the natural environment, not least through the proper use of equipment. However, these problems have been corrected, some influences such as those caused by the thermal amplitude of the day or those induced by vegetation can be deduced and corrected.

Further different geographical environments can be approached, each with its peculiarities and for their detailed analysis, they should be investigated in real time by using multiple electrodes so that they will return values from prescribed intervals revealing some features in detail.

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SNOW AVALANCHE ACTIVITY IN PARÂNG SKI AREA REVEALED BY TREE-RINGS

F. MESEŞAN[1], O. POP[1], IONELA GEORGIANA GAVRILĂ[1]

ABSTRACT. - Snow Avalanche Activity in Parâng Ski Area Revealed by Tree-Rings. Snow avalanches hold favorable conditions to manifest in Parâng Mountains but only one event is historically known, without destructive impact upon infrastructure or fatalities and this region wasn't yet the object of avalanche research. The existing ski infrastructure of Parâng resort located in the west of Parâng Mountains is proposed to be extended in the steep slopes of subalpine area. Field evidence pinpoints that these steep slopes were affected by snow avalanches in the past. In this study we analyzed 11 stem discs and 31 increment cores extracted from 22 spruces (*Picea abies (L.) Karst*) impacted by avalanches, in order to obtain more information about past avalanches activity. Using the dendrogeomorphological approach we found 13 avalanche events that occurred along Scărița avalanche path, since 1935 until 2012, nine of them produced in the last 20 years. The tree-rings data inferred an intense snow avalanche activity along this avalanche path. This study not only calls for more research in the study area but also proves that snow avalanches could constitute an important restrictive factor for the tourism infrastructure and related activities in the area. It must be taken into consideration by the future extension of tourism infrastructure.

Keywords: *snow avalanche, Parâng Mountains, dendrogeomorphology, ski area.*

1. INTRODUCTION

Snow avalanches are common geomorphic processes in alpine and subalpine areas of Carpathians. In these areas, they have a severe impact upon all human activities and existing infrastructure. The railways, the roads, the backcountry recreation areas, the sky areas and even the recreation and public areas can be affected by snow avalanches (Muntán E. *et al*., 2010, Jamieson and Stethem, 2002). In Romanian Carpathians almost every winter some people are being caught by snow avalanches. Since 2004 until 2007, every year more than 20 victims of snow avalanches were recorded (Milan and Flueraru, 2007).

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Parâng Mountains belong to Southern Carpathians, having the maximum altitude in Parângul Mare Peak (2519 m a.s.l.).The geology is dominated by crystalline schists, due to whom the relief is characterized by steep slopes. Between 1400 – 1700 m the average annual temperature is around 2-3^{O}C and the total precipitation about 1000-1200 mm/year. Coniferous belt extents roughly at mentioned altitudes, being dominated by spruce (*Picea abies)* forests. Above 1800 m the average annual temperature drops below 2^{O}C and the average rainfall reach 1200 mm/year, allowing the development of alpine shrubs and alpine grassland (Oancea *et al*., 1987). Crests and steep slopes in these subalpine areas are prone to snow accumulation and avalanche release.

In Carpathians, the tourism infrastructure consisting in ski resorts and hiking trails is sometimes located within areas prone to avalanche activity (Voiculescu and Onaca, 2013). In Parâng Mountains an important ski resort is present on the western slopes of Parângul Mic peak. The ski resort benefits from an ample development project for ski area extension, currently under implementation by Petroșani local council (Agentia pentru Protectia Mediului Hunedoara, 2011). The project aims, among other things, to prolong the existing ski tracks with twelve new ski tracks (12.66 km length) that will reach Parângul Mic Peak (2074 m) and to build three ski lifts that will reach Badea Peak (1935 m) and Piatra Peak (2084 m).

In the historical archives there is a lack mentions about the avalanche activity. Moreover, in this ski area, the snow avalanches were not studied previously. Only one avalanche event is known to have occurred in the 1996-1997 winter and recorded by forestry archives. At that time, large forest areas were affected by the avalanche on the NE slopes of Parângul Mic peak and the timber was extracted in order to clean the area. No destructive avalanche impact on tourism infrastructure is known in this area, but the avalanche activity is supposed to have a restrictive impact upon the future development of the tourism infrastructure.

The dendrogeomorphological approach proved its scientific value for studying the frequency and magnitude of past snow avalanches. It was successfully used in other mountain areas, such as Rocky Mountains (Potter, 1969; Rayback, 1998; Butler and Malanson, 1985; Reardon *et al*., 2008….), Gaspé Peninsula (Dubé *et al*., 2004; Germain *et al*., 2005; Germain *et al*., 2009) Alps Mountains (Schönenberger, 1978; Bebi *et al*., 2009; Corona *et al*., 2010; Garavaglia and Pelfini, 2011), Pyrenees Mountains (Molina *et al*., 2004), Iceland (Decaulne *et al*., 2013). Only few studies addressed to this topic were realized until now in the Romanian Carpathians (Voiculescu, 2005; Simea, 2012; Meseșan, 2013).

In an attempt to check if trees from Parângul Mic area recorded in their rings the past avalanche activity, we analyzed 42 samples (11 stem discs and 31 increment cores) gathered from 22 Norway spruces (*Picea abies (L.) Karst*) located in the upper part of Scărița valley avalanche path (fig. 1).

Usually, the dendrogeomorphological studies of past avalanches are based on a larger number of samples. Corona et al. (2012) suggest that a sample size of approximately 100 trees is required to obtain avalanche reconstruction in an avalanche path. In this study we don't aim to accomplish avalanche reconstruction along the entire mentioned avalanche path, but only to test if trees in this area are suitable for a further dendrogeomorphic reconstruction.

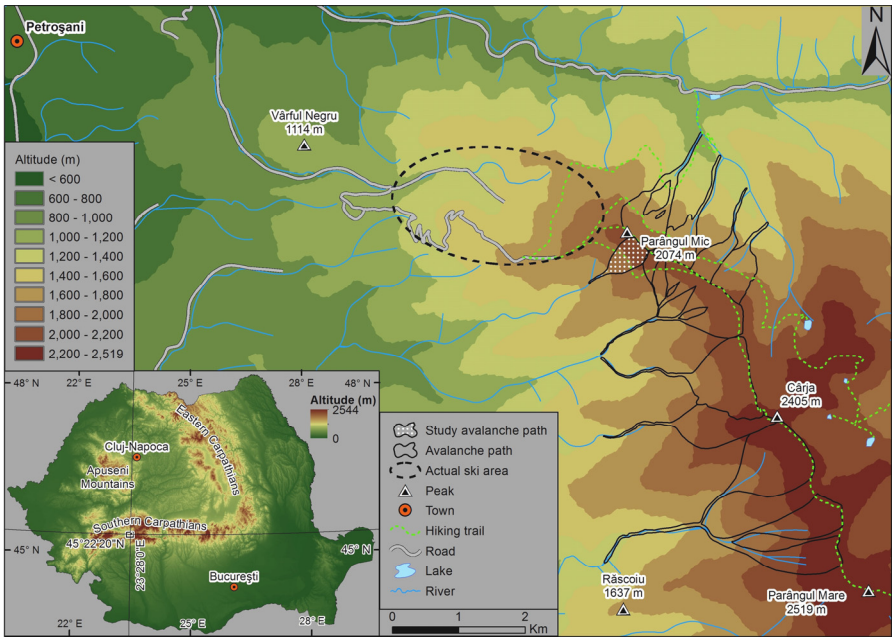

Fig. 1. Study area location

2. MATERIALS AND METHODS

The occurrence of geomorphic processes, including snow avalanches, may disturb the trees located in the area affected. The most important disturbances left by snow avalanches in trees are stem tilting, scars, tree decapitation, broken branches (Butler and Savyer, 2008; Stoffel and Bollschweiler, 2009a; Luckman, 2010). Correlated with those disturbances, the trees record in their internal structure the effects of the mechanical impact by developing growth anomalies, such as tangential rows of traumatic resin ducts, compression wood, growth suppression (Wilford, 2005; Stoffel and Bollschweiler, 2009a). They are stored in the annual ring(s) formed after the impact and represent a reliable natural archive suitable for reconstructing past avalanche activity with annual resolution (Stoffel *et al*., 2010).

The tangential rows of traumatic resin ducts are formed in coniferous trees after insect or fungal attack, fire damage or mechanical wounding (Bollschweiler *et al*. 2008). As a defensive mechanism, the tree develops a network of resin ducts that lead the resin to the place where wounding occurred (Nagy *et al*., 2000).

The compression wood is formed as a consequence of stem tilting induced by the exerting of a pressure upslope like in the case of an avalanche. In order to regain its vertical position, the coniferous trees produce downslope cells with thicker walls that will make the rings darker and larger than normally (Warensjö, 2003; Stoffel and Bollschweiler, 2009a). In the case of avalanches impact, the compression wood anomalies usually last many years, even more than 10, depending on the severity of the impact.

The growth suppression consists in one or more annual rings narrower than the previous. It affects the entire ring(s) if the tree was decapitated or only a portion (usually upslope) if the roots were partially damaged. In this case, the water and nutrients supply is reduced in the affected side of the tree (Stoffel and Corona, 2104).

The scars are the result of a strong mechanical impact that destroys a portion of the bark and the below layers of wood. In time, the tree will grow more intensely from the edge of the injury in order to close it (Stoffel and Bollschweiler, 2009a).

The first step in our research was to analyze the cartographic material available and to choose an avalanche path where the trees show external disturbances related to past snow avalanche activity. For the present study, we selected an avalanche path located on Scărița valley, which is included in the existing development projects of future ski infrastructure extension (fig. 2).

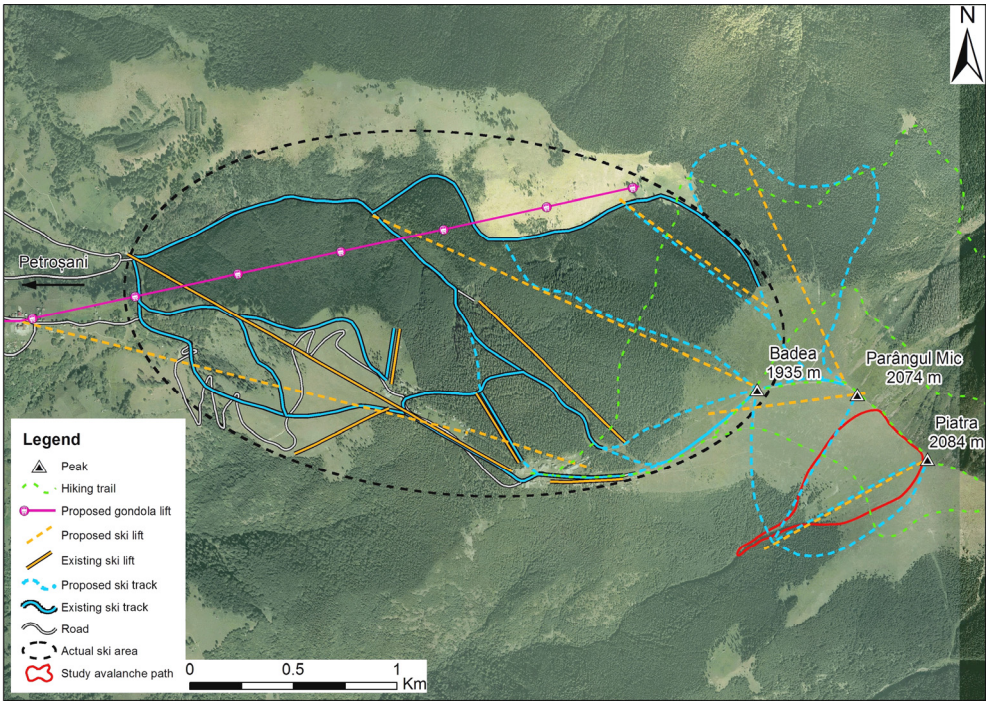

Fig. 2. Existing and proposed tourism infrastructure in the study area

During the field campaign (summer 2014), the trees located in the upper part of the avalanche path were visually analyzed and those showing severe disturbances as a consequence of past avalanche impact were sampled. Eleven trees were sampled using Pressler borers and 2-4 increment cores were extracted from each tree. Other eleven trees were sampled using a saw in order to extract a stem disc from every tree.

The sampling method was adapted according to the tree disturbance. The core sampling orientation was described by Stoffel (2005): A – left, B – right, C – upslope, D – downslope. The trees with tilted stems were sampled at the height of the maximum curvature of the stem. Two increment cores were extracted form tilted trees, one upslope (C) and another one downslope (D) (Bollschweiler *et al*., 2007; Corona *et al*., 2010).

From the trees presenting scars, a core was extracted next to the scar (Stoffel and Bollschweiler, 2008; Stoffel *et al*., 2010) and another core was extracted from the oposite part of the trunk or downslope. The decapitated trees were sampled few centimeters below the decapitation level and two cores were extracted, one upslope and another one downslope. In the case of the sawed trees, a stem disc was cut at the mentioned level.

The increment cores were glued on wood supports. The samples (discs and increment cores) were then air dried and sanded using abrasive belts (80, 240, 360 grit), in order to show clearly the anatomical details. Later, the annual rings were counted in every sample and marked with a pencil as Phipps (1985) recommends (one point for the years finished with „0", two points for the years finished with „50" and three points for the years finished with „00").

For ring-width measurements we used the LINTAB 5 system that includes a binocular microscope and a mobile table, connected to a computer with TSAPWin Professional 0.55 software (Rinntech, 2006).

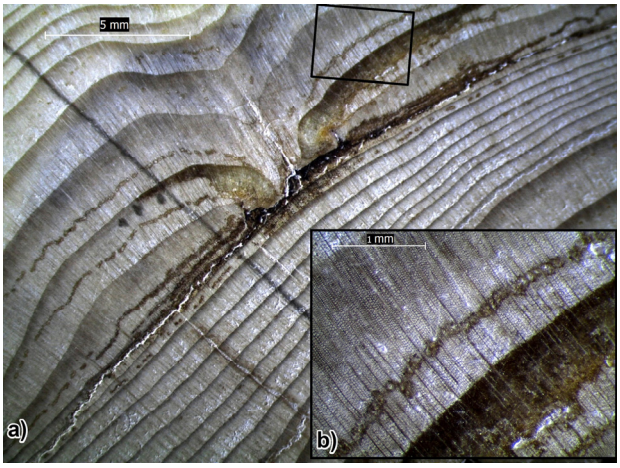

Fig. 3. a) Closed scar produced in 1999 associated with tangential rows of traumatic resin ducts; **b)** detail of the ring with tangential row of traumatic resin ducts formed in reaction to mechanical impact of snow on the tree stem

One growth curve vas obtained for each increment core. The discs were measured on 4 directions (A, B, C, D) obtaining 4 growth curves for each disc. All growth anomalies identified were also noted. The growth curves were cross-dated by checking visually the pointer years (Schweingruber, 1996). The years when at least 2 trees with grow anomalies were considered as avalanche event years. An exception was made for the year 1935 when only one of the sampled trees was alive, but its growth anomalies clearly indicate an avalanche event occurred in that year.

RESULTS AND DISCUSSIONS

The analysis of the 22 trees sampled along Scărița avalanche path revealed a minimum of 13 avalanche events occured between 1935 and 2013: 1934-1935, 1986-1987, 1988-1989, 1990-1991, 1994-1995, 1996-1997, 1998-1999, 2002-2003, 2003-2004, 2004-2005, 2007-2008, 2009-2010, 2011-2012.

This avalanche activity reconstituted using tree-rings records represents a minimum frequency (Reardon *et al*., 2008; Luckman, 2010; Corona *et al*., 2012). There may have been more avalanches that were not recorded in the sampled trees.

The centralization of the growth anomalies allowed us to make a comparison between the information provided by the increment cores and those sampled by stem discs (fig. 6). This comparison show that the discs contain more information than the increment cores and point out more avalanche events. Also, the discs provide more diverse information than the cores. For one event, on the stem disc one may easily identify all the mentioned anomalies: tangential rows of traumatic resin ducts (fig. 3b), compression wood (fig. 4), growth suppression (fig. 4), scars (fig.3a), because it allows the investigation of the entire circumference of the ring.

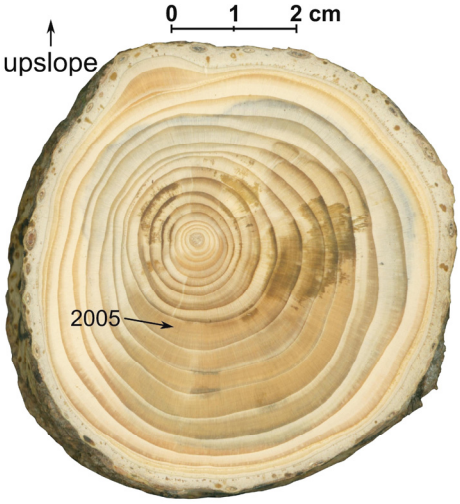

Fig. 4. Compression wood sequence downslope 2005-2009 and growth suppression upslope 2005-2006

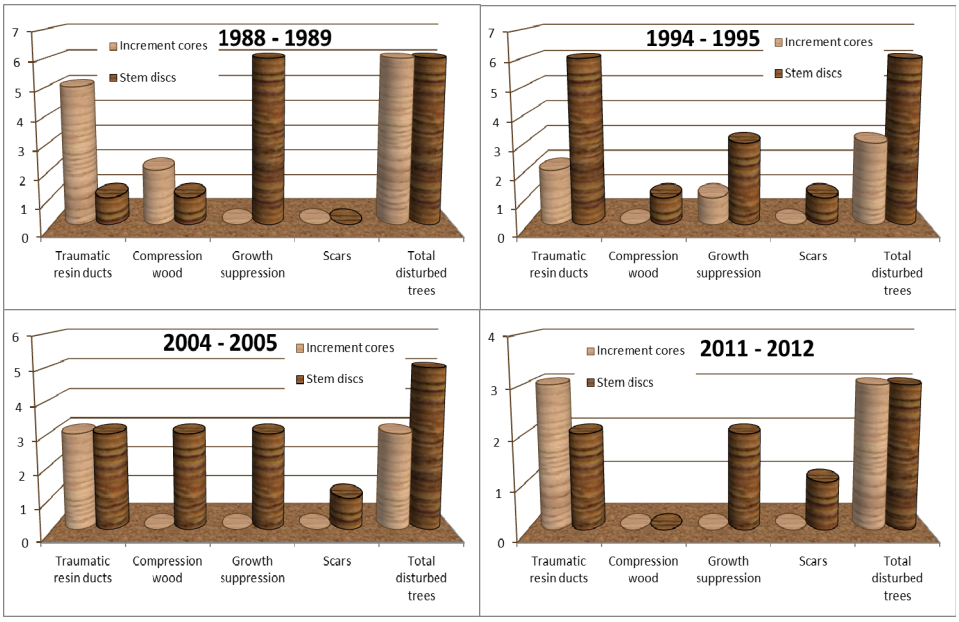

Fig. 5. Comparison between the number of gowth anomalies identified in the trees sampled by increment cores and stem discs for several winters when avalanches occured

Instead, the increment cores present more often traumatic resin ducts, compression wood and/or growth suppression reactions and just accidentally scars, because only a small part of the ring is available for analysis. Moreover, the reaction type found in increment cores strongly depends on sampling technique.

The increment cores are easier to prepare for analysis because they get dried quicker than stem discs. The most important disadvantage of stem discs extraction is that it represents a destructive sampling technique, causing the death of the tree, excepting the case when below the sampling level alive branches remain and could renew the axial growth. The increment cores extraction removes this drawback leaving the tree unharmed (Stokes, 1996).

In our study area, the snow avalanche impact on the tourism infrastructure is not a destructive one but a restrictive one. In the case of Parâng ski area there was not yet severe damages on the tourism infrastructure caused by avalanches, as it happened in other areas of the Carpathians (Moțoiu, 2008; Munteanu *et al*., 2012). Instead, we were able to identify an intense avalanche activity that was not previously known in the area.

It is expected that the expanding of tourism infrastructure resulting from all the development projects will attract a lot of skiers in the ski resort and will allow them to reach very easy Parângul Mic Peak or Piatra Peak in order to ski downslope. Is well known that *„the popularization of extreme sports impels more and more people to trespass out of the marked boundaries of the ski slopes",* in order to practice free ride snow sports (Arlettaz *et al*., 2007). In this context, *„some skiers and snowboarders at ski areas now seek out extreme terrain"* (Jamieson and Stethem, 2002). Such terrain will be found near by the two peaks, above tree line, in the starting and track zones of the avalanche paths and therefore the uninformed skiers will risk triggering more snow avalanches that commonly occur under natural conditions.

As described in the development project, one of the proposed ski lifts will link the Scărița area with Piatra Peak area, expecting to have the transport capacity of 1200 persons per hour. In addition, other 4 ski tracks will arrive at its base. They will be built as far as 80% of their surface on alpine grassland and they will pass through the Scărița avalanche path. The development project contains only two measures for avalanche release prevention:

a) installation of coastal fences and avalanche stoppers;
b) plantation of *Pinus mugo* saplings and other local shrub species.

In our opinion, even if these prevention measures will be conscientiously applied, it will be insufficient to protect future infrastructure and the tourists.

As it was demonstrated in the case of past debris flows (Stoffel and Bollschweiler, 2009b), the past events reconstruction based on a small number of samples *„may yield valuable data on past events"*. The weakness of such a study are an incomplete frecvency due to unidentified past events and the lack spatial extension for identified events.

Further it is necessary to analyze more samples from the entire avalanche path located on Scărița valley, in order to do accurately reconstruct the avalanche activity history along the entire Scărița avalanche path. The dendrogeomorphic reconstruction could be useful for the avalanche hazard zonation in the studied area.

3. CONCLUSIONS

As a result of our study we affirm that certainly 13 avalanches were produced in Scărița avalanche path even the historical records mention only one event.

We want to warn the tourists and the infrastructure owners or developers about the fact that the avalanche activity is an intense one in this area so it must be seriously taken into consideration in the deployment of all winter tourism activities.

For the following studies, the sampling must be extended. A complete dendrogeomorphological study must include both types of samples, increment cores and stem discs in order to get the utmost information possible. The discs provide the maximum information and the cores complement them efficiently.

Acknowledgements

This study is dedicated to the memory of our colleague researcher dr. Titu Anghel (1979-2014) who tragically passed away without being able to complete the team in the fieldwork as he made it so many times.

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IDENTIFYING THE INFLUENCE OF MORPHOMETRY ON THE URBAN MORPHOLOGY OF ZALĂU USING GIS

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ABSTRACT. - Identifying the Influence of Morphometry on the Urban Morphology of Zalău Using GIS. The topography is considered to be the main component lying at the basis of human activities and settlements. Its analysis can highlight the territories which are favourable or restrictive for urban expansion and city development. The present study used cartographic databases and geoinformation software to identify the present distribution of edilitary constructions on elevation and slope angle intervals, two morphometric characteristics which have the strongest influence on the urban development of Zalău Municipality. In order to highlight the geomorphological processes which influence in a negative way the city expansion, the study has identified the building distribution in each neighbourhood on landslide probability classes, these specific categories being identified using the methodology described in the Governmental Decision 447/2003. Starting from these databases, the geomorphological risk map was created. This type of analysis, which relies on the current territorial expansion of the city, offers an overall image on the future development options and enables a sustainable planning of the analysed territory.

Key-words: *morphometry, urban development, G.I.S. modelling, Zalău*

1. INTRODUCTION

The evaluation of the current situation from the Zalău Municipality illustrated in the General Urban Plan and the Zonal Urban Plan has identified a series of dysfunctions between the urban development possibilities and the related costs for making the Zalău Municipality a functional European city of the 21st century (Vâtcă, 2014).

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The aim of this study is to identify the morphology of the Zalău urban area in relationship to the morphologic potential of the territory, by analysing the geomorphological factors which determine the favourability and restrictiveness of city development. This endeavour relies on valuable databases used with the help of geoinformatic softwares previously used in similar studies (Petrea et al. 2014, Vâtcă et al. 2014, Roșca et al. 2015).

It is a well-known fact that, at national level, most cities have expanded on the territory of main valleys which developed mono-laterally, with a visible impact on the urban morphology. In many cities the underlying landforms play an important role in the urban aesthetics (Petrea, 1998).

After a first analysis, the topography was highlighted as a main factor in the development of Zalău by determining its longitudinal shape according to the morphology of the Zalău Valley, while the restrictive slope processes limited its east-west development. The morphology of the Zalău built-up area is characterised by three morpho-hydrographical convergences (Mac, 1996) which have a highly valuable potential as habitats. The maximum expansion of the built-up area was made on the terraces, especially on the 8-10 m and the 30-35 m terraces of the Zalău Valley, which had the most favourable setting. The characteristics of the valley determined the whole urban morphology. The main built-up area is built on the alluvial fan of the Meseș stream and it has a favourable setting at river and road convergences. However, its expansion is also limited by the morphology of the region. The expansion of the municipality on topography levels, each having different elevation and expansion area, has had an influence on the city aesthetics. In the built-up area of Zalău there are different morphometric levels on which the neighbourhoods have been developed: flood plain, terrace, glacis and foothill (Fig. 1).

The urban area of Zalău corresponds to the *Zalău Depression*, which evolved after the retreat of the Pannonian Sea through the river fragmentation of the seaside plain located at the boundary of the Meseș Mountains. The flow direction of the rivers was western and north-western and their erosional action is proved by the presence of the Aghireș-Panic, Crișeni-Ortelec hill saddles (Mac, 1996). The Zalău Depression has the shape of a not very extended, prolonged gulf developing on the south-north direction, with elevations between 250 m and 450 m. From a tectonic point of view, the depression consists of both permeable rocks (sand, gravel) and impermeable rocks (clay, marl) (Nicoară, 1998). The Zalău Municipality expanded on the submontain hills of Meseș which border the upper part of the Zalău Valley and developed up to the widening sector of the valley.

The morphology of the Zalău urban and suburban area is included in the category of hills, foothills and glacis. The topography underlying the Zalău Municipality belongs both to the Meseș Mountains and to the Zalău Depression, as a consequence there is a vast variety of landforms including elements of sculptural topography (or morphosculptural), structural topography (folded and monoclinal forms), petrographic topography, as well as fluvial and denudational landforms (glacis).

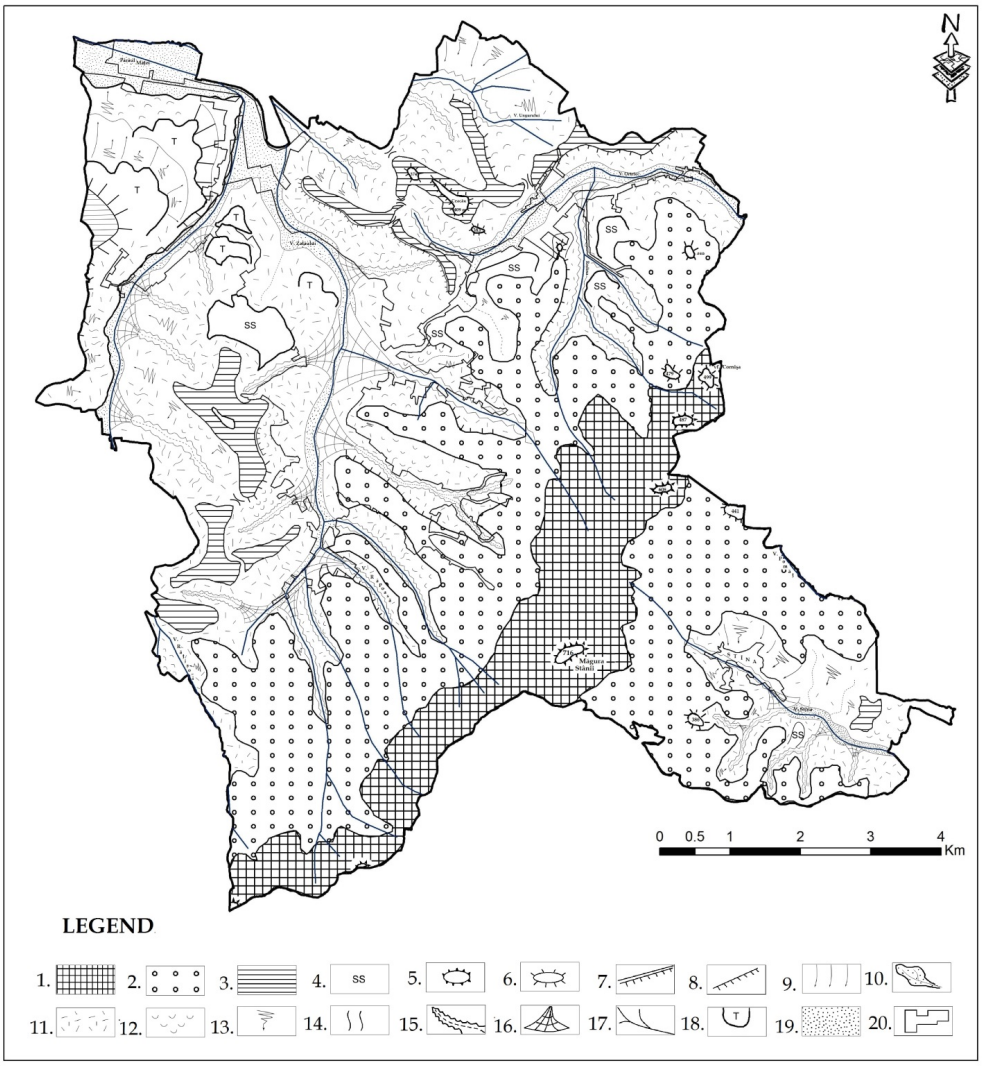


Fig. 1: Geomorphological map of the urban Zalău area (where 1 – mountain surface (600-750m), 2 – foothill surface (400-550m), 3 – erosion level (300-350 m), 4 – structural surface, 5 – structural remnant, 6 – erosion remnant, 7 – cuesta front, 8 – morphological hillslopes (scarps), 9 – connecting slopes and surfaces, 10 – erosion basin (depression), 11 –delluvial-colluvial glacis, 12 – landslides, 13 – rills, 14 – gullies, 15 – torrents, 16 – alluvial fans, 17 – permanent stream, 18 – fluvial terrace, 19 – flood plain, 20 – settlement).

2. DATABASE AND METHODOLOGY

In order to identify the influence of the main morphometric characteristics on the morphology of the Zalău urban area, a *primary cartographic dat*abase was used to extract the present spatial expansion of Zalău and it was represented by recent satellite images (Google, 2012) and topographic maps 1:25000, the latter being used for digitising contour lines. The *derived database* was created using geoinformation software, including the Digital Elevation Model (DEM) and the slope angle map. The *modelled database* included the results of applying the semi-quantitative model of determining the potential of landslide occurrence according to the methodological recommendations included in the Governmental Decision 447/2003 (Vâtca et al., 2014).

Another valuable database is represented by the geomorphological map of the Zalău urban administrative area which was created in a GIS environment starting from the analysis of the topographic map and the detailed inventory of geomophological processes in the study area, especially the main causing factors which are present in the field. Creating the inventory and the measurement of instability indices (phytogeographic, hydric, geological, anthropogenic) and of some variables of the present morphodynamic processes were necessary endeavours as there are direct concordances among tectonics, lithology, structure, morphology and morpho-climatic and morpho-hydrological contexts in which these processes occur.

3. RESULTS AND DISCUSSIONS

As previously illustrated, the development of the Zalău Municipality has been highly influenced by geomorphology, the settlement expanding more in the area of morpho-hydrographical convergences. It has thus resulted in a longitudinal form of the built-up area with a few lateral digressions (Porolissum Street and Crasnei Street). Progressively, the main built-up area expanded by adding new urban areas, inevitably more distant from the centre. After the '60s, the industrial development determined an important spatial expansion of the city, even the landforms which had previously represented building obstacles being intensively used for new buildings. However, the most densely build-up area remains the flood plain, which is the most accessible area having low elevation and slopes.

The Zalău Municipality was constrained in its territorial development in a longitudinal shape with consequences on the urban aesthetics, accessibility, transport etc. There are few morphological units which are favourable to constructions (the flood plain and the terraces), therefore the built-up area was expanded even on the slopes. This aspect has determined additional costs and investments and a future direction of necessary building development is towards Meseşeni – Aghireş (PUG, 2007).

The topography has restricted the expansion of the main built-up area, of the edilitary constructions as well as the development of economical activities. The accessibility is low on the surfaces with high declivity and fragmentation, as well as on the ones prone to geomorphological processes, hindering the expansion of buildings and

several activities. The flood plain, the terraces and the terraced slopes are favourable for building dwellings, for the transport infrastructure and the technical-edilitary infrastructure. These landforms are accessible and enable the mobility of the population, as well as a wide range of activities.

The layers representing the edilitary constructions and the streets from the built-up area of Zalău, which were created by digitising the recent satellite images provided by the Google Earth database, were included in a spatial analysis performed in a GIS environment and resulted in a global, general view on the building density from the entire city.

The built-up area of Zalău Municipality includes 11 neighbourhoods: Dumbrava Nord, Dumbrava, Simion Bărnuțiu, Păcii, Traian, Centru, Stadion, Brădet, Meseș, Porolissum, Ortelec and 11 new areas: Dealul Morii, Grădina Dochiei, Coada Lacului, Sub Brădet, Sub Dombalja, Merilor, Morii, Grădina Onului, Sărmaș, Între Văi, Valea Miții. The 11 residential areas have been developing since 1990 until present through the construction of individual houses, duplexes and blocks of flats. For these the distribution of buildings per elevation and slope angle class will be identified, as these two morphometric parameters have the highest influence on the building density by favouring or restricting the expansion of the built-up area in certain sectors.

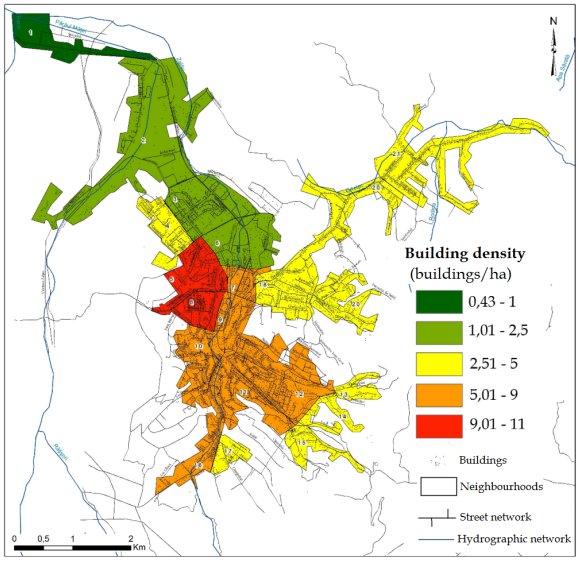


Fig. 2: Distribution of building density in neighbourhoods (where: 1-Între Văi, 2-Valea Miții, 3-Dumbrava Nord, 4-Dealul Morii, 5-Dumbrava, 6-S. Bărnuțiu,7-Păcii, 8-Traian, 9-Centru,10-Grădina Dochiei, 11-Stadion, 12-Brădet, 13-Coada Lacului,14-Sub Brădet, 15-Sub Domblaja, 16-Merilor, 17-Morii, 18-Porolissum, 19-Sărmaș, 20-Grădina Onului, 21-Ortelec, 22- Meseș).

3.1. Density of edilitary constructions in neighbourhoods

In order to determine the number of edilitary constructions located in each neighbourhood and their corresponding density in relationship to the neighbourhood area, functions such as *Zonal Statistic and Intersect* from the ArcMap 10.1 software were used.

High values of the building density were identified (Fig. 2) in the neighbourhoods Traian (11), Dumbrava (9.6), Stadion (8.6), as well as in the residential area Grădina Dochiei (8.04). Low values of the building density characterise the areas Între Văi (0.43) and Valea Miții (3.92). The analysis on neighbourhood *area highlights four areas with* density values between 8 and 11 buildings/ha (Table 1).

A high building density is characteristic to the Traian (11 buildings/ha), Dumbrava (9.60 buildings/ha), Stadion (8.60 buildings/ha) neighbourhoods and the Grădina Dochiei (8.04 buildings/ha) residential area. These high density values are due to low sloped areas, with slope angle values between 2.1-5° which are favourable to buildings, as well as due to a relatively short distance from the city centre and the main transportation route. The neighbourhoods include old and new individual dwellings as well as new semi-collective dwellings (maximum 6 flats). Low density values are present in the areas Între Văi (0.43 buildings/ha) and Valea Miții (1.01 buildings/ha) because here is where the industrial zone of the Zalău Municipality has developed.

Table 1.

Building density and distribution in Zalău Municipality in relationship with elevation and slope angle classes, for each neighbourhood

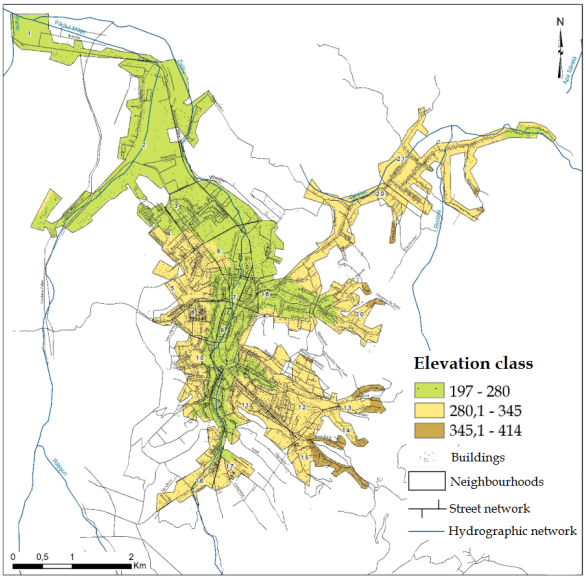
Neighbourhoods and residential areas	Building density (b/ha)	No. of buildings on elevation level (m)			No. of buildings on slope angle interval		
		197-280	280.1-345	345.1-414	0-2	2.1-5	5.1-15
Între Văi	0.43	321	2	0	22	8	0
Valea Miții	1.01	291	1	0	79	137	75
Dumbrava Nord neighb.	2.11	206	16	0	24	123	73
Dealul Morii	3.92	97	111	0	34	155	19
Dumbrava neighb.	9.60	137	359	1	35	262	199
S. Bărnuțiu neighb.	2.48	201	27	0	47	117	64
Pacii neighb.	5.29	148	0	0	46	71	31
Traian neighb.	11.00	155	296	0	9	225	217
Centru	5.52	261	48	0	66	139	104
Grădina Dochiei	8.04	261	286	0	9	143	395
Stadion neighb.	8.60	370	316	0	88	287	313
Brădet neighb.	7.06	190	266	1	3	20	74
Coada Lacului	3.30	0	39	37	0	9	66
Sub Brădet	3.46	21	76	0	69	295	394
Sub Dombalja	4.50	0	101	68	2	60	108
Merilor	5.80	97	196	0	36	149	107
Morii	4.60	13	102	0	6	79	30
Porolissum neighb.	4.32	261	328	0	81	333	175
Sărmaș	4.33	96	180	14	34	119	136
Grădina Onului	4.81	0	111	14	8	69	48
Ortelec neighb.	4.39	33	563	8	164	292	149

3.2. The position of edilitary constructions in relation to elevation

The position of the edilitary constructions in relationship to the elevation and the morphogenetic levels was highlighted through the analysis of minimum, maximum and average elevation for each neighbourhood (Fig. 3). Most of the edilitary constructions from the built-up area of the Zalău Municipality are located on the elevation levels of 197-280 m and 280.1-345 m. The large number of buildings in the elevation class of 197-280 m belong to the Între Văi, Valea Miții, Dumbrava Nord, S. Bărnuțiu, Păcii, Centru and Stadion areas and neighbourhoods. The Stadion neighbourhood has the largest number of buildings from this elevation class, totalising 370 buildings. The Coada Lacului, Sub Domblaja Grădina Onului areas do not have edilitary constructions on the 197 – 280 m elevation level (Table 1). Păcii neighbourhood has no edilitary constructions in this elevation class, while there is one building in the Valea Miții area and two buildings in the Între Văi area.

The number of buildings decreases with the elevation increase as the access is more difficult and the prices are higher. A small number of neighbourhoods and areas have edilitary constructions at the elevation level of 345.1– 414 m. The Brădet and Dumbrava neighbourhoods have one building, the Ortelec neighbourhood - 8 buildings and the Sărmaș and Grădina Onului areas - 14 buildings, Coada Lacului - 37 buildings and Sub Domblaja - 68 buildings.

The Zalău Municipality spans over five elevation and morphogenetic levels, from the flood plain to the mountain level.



The first relief level corresponds to the flood plain, with the smallest elevation at 197-280 m. Through the predominantly monolateral development on the right side of the valley, the flood plain is asymmetrical, with various width and elevation values. Mostly narrow, the flood plain has a few metres on the Crasna Street, expanding to approximately 200 m in the Liberty Square and reaching its maximum width of approximately 600 m at the river convergence with Ortelec Valley.

Fig. 3: The distribution of edilitary constructions in relationship to elevation classes

Downstream from this point, in the northern part of the built-up area, the flood plain of Zalău Valley develops extensively and asymmetrically, while its width is of approximately 400 m in this sector. The flood plain of Zalău Valley offers the most favourable conditions for buildings. Thus, this sector is completely developed for various urban purposes. A large part is built-up with dwellings and storage spaces as well as roads. In the northern part of the built-up area where the Zalău Valley is at its largest, the industrial zone was developed, as well as the railway station, the third street node and the railway.

The second relief level is characterised by an elevation between 280.1 and 345 m and corresponds to the terraces and the terraced slopes. *The terraces* from the study area are characterised by monolateral distribution, a scarce presence of superior levels and the existence of a thick gravel layer. The hilly area with predominantly sloped surfaces, as well as horizontal and quasi-horizontal surfaces, define the terrace treads. In the study area one identifies the terraces of 8-10 m, 25-35 m and 50-55 m (Mac, 1996), on the left side of the Zalău Valley. Dumbrava and Dumbrava Nord neighbourhoods are located on the 8-10 m and 30-35 m terraces, in the north-western part of the built-up area. Some dwellings have been extended up to the upper terraces (50-55 m) and on the slopes, which lead to the development of stepped apartment blocks, edilitary works and access ways which are perpendicular to level curves. This has lead to an increase of the value of investments as well as to an alteration of the terrace shape. The third relief level is set between 345.1 and 425 m and includes the foothill level, in the Parameseşan Foothill. The fourth level expands in the mountain area, forming the foot of the mountain between 425.1 and 534 m. The fifth level continues into the mountain area and belongs to the Meseş Mountains, between 534.1 and 727 m (Vâtca et al., 2014).

3.3. The position of edilitary constructions on slope angle intervals

The position of edilitary constructions on each slope angle class was determined using the *Zonal Statistic and Intersect* functions from the ArcMap 10.1 software. The buildings are distributed on the following slope intervals: 0-2, 2.1-5, 5.1-15 and 15.1-17.2º (Fig. 4). The majority of edilitary constructions in the Zalău built-up area are located on the slope intervals of 2.1-5º and 5.1-15º. The Ortelec neighbourhood has the largest number of buildings on the 0-2º slope angle interval. On the other hand, in the residential area Coada Lacului there is no building in this slope interval. The largest number of buildings in the interval of 2.1-5º is located in the Porolissum neighbourhood, totalising 333 buildings, followed by the Sub Brădet area with 295 buildings and Ortelec neighbourhood, with 292 buildings.

As one can notice in table 18, there is a decrease in the number of buildings with the increase of slope angle. On the slope classl of 5.1-15º there is no building in the Între Văi area, while Valea Miţii and Dealul Morii areas and Păcii neighbourhood own the smallest number of buildings from their total. The exception from this rule is represented by Grădina Dochiei and Sub Brădet areas as well as Stadion neighbourhood which have the largest number of buildings (395, 395 and 313, respectively) from their total number being built on a slope of 5.1-15º.

The slopes between 5.1° and 15° represent approximately 62% of the total surface and are found on delluvial glacis. Higher slope angles (>15.1°) are found in the contact area of the Silvaniei Hills with the mountains, but also at the slope basis. These surfaces are prone to linear geomorphological processes and to landslides and are restrictive to buildings and agriculture.

Slopes are a major part of the urban landscape and represent the landforms on which most of the restrictive geomorphological processes occur inside the built-up area, hindering the urbanising of certain sectors (Mac, I., 2010). Nevertheless, slopes are highly capitalised on in the process of urban development and expansion in the Zalău Municipality.

Cuestas are present on the right slope of the Zalău Valley, but also on the slopes of the secondary valleys, depending on their slope aspect. They have small sizes, their height rarely surpassing 100 m. Cuestas also belong to the Parameseşan foothill landscape, highlighting the steep hillslopes towards the subsequent depressions of Stânei and Ciumărnei.

Cuestas represent the landforms with the lowest favourability for anthropogenic activities. They have a high slope angle, of over 10°, the dynamics of the slope processes is accelerated, the water resources are scarce and the access is difficult. Due to all these, cuesta slopes are used for vineyards and orchards (Ciumărna). The deforestation of these surfaces has also accelerated the activity of slope processes.

3.4. The position of edilitary buildings in relationship to landslide susceptibility

Thematic maps of each factor responsible for the occurrence and evolution of landslides, representing the risk coefficients, were created using an integrated information system (GIS technology). The estimation of value and geographical distribution was performed for each risk coefficient separately: lithologic, geomorphological, structural, hydro-climatic, hydro-geological, seismic, sylvic and anthropogenic, thus generating the map of the average hazard coefficient (Vâtcă et al., 2014).

Further, starting from the database comprising the building and transport infrastructure, the spatial distribution of edilitary constructions on neighbourhoods was analysed according to the potential of landslide occurrence determined through the methodology described in H.G. 447/2003. To increase the applicability of the model, the analysis was performed at neighbourhood level. Thus, for each neighbourhood of Zalău a minimum, average and maximum value of the hazard coefficient was determined according to the present legislation. The maximum value of the medium hazard coefficient for each neighbourhood ranges from 1.693 to 2.146 (Fig. 4). The lowest values of the coefficient are found in the newly-built areas from Zalău: Grădina Dochiei, Sub Brădet, Cascadei, Sărmaş and Grădina Dochiei. Valea Miţii is the area with the highest coefficient value per neighbourhoods.

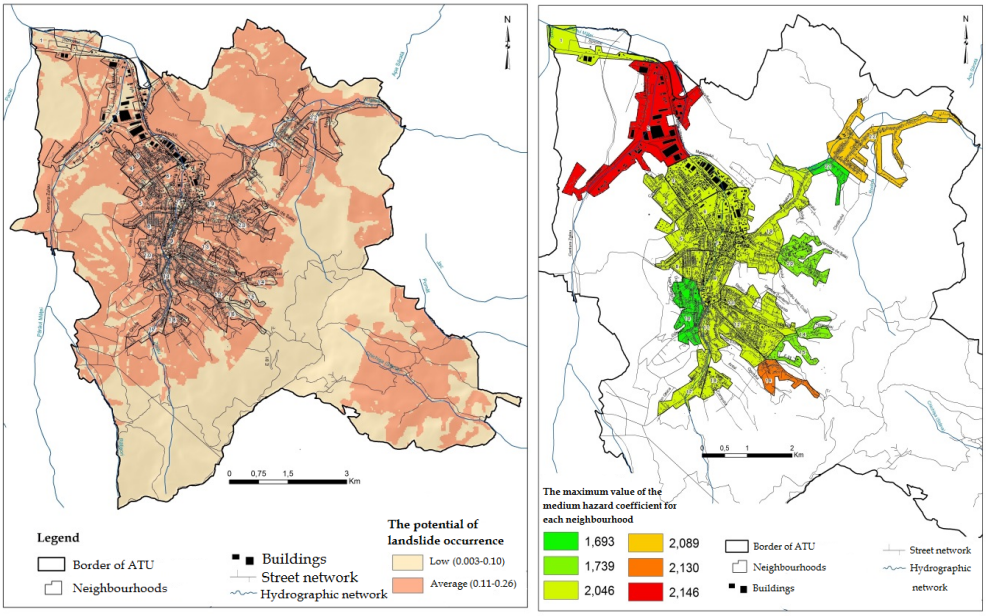


Fig. 4: Spatial distribution of edilitary constructions in Zalău according to the potential of landslide occurrence in each neighbourhood (left) and in each class of medium hazard coefficient (right).

By visually and statistically analysing the average probability of landslide occurrence per neighbourhoods, one notices the largest number of edilitary constructions in the areas with average potential of landslide occurrence (Fig. 4). The smallest average values of the medium hazard coefficient per neighbourhood are found in the Ortelec neighbourhood, in the Între Văi and Sub Brădet areas, with values between 0.928 and 1.192. The highest average values of the medium hazard coefficient per neighbourhood are found in the Stadion, Dumbrava Nord, Simion Bărnuțiu and Traian neighbourhoods, with values between 1.541 and 1.619. The rest of the neighbourhoods from Zalău Municipality have an average value of the medium hazard coefficient per neighbourhood ranging between 1.269 and 1.526.

4. GEOMORPHOLOGICAL RISK AFFECTING URBAN DEVELOPMENT

Risk represents "the probability of harmful consequences, or expected losses resulting from interactions between natural or human-induced hazards and vulnerable conditions" (UNISDR, 2001). The study of risks is essential in the planning stage and the development process of a settlement.

Among the risks affecting urban development, the geomorphological and flood risks are pre-eminent in the Zalău Municipality (Fig. 5). The city of Zalău has four categories of geomorphological risk. The flood plain has no geomorphological risk, the average risk is associated to terraces, the mountain area has a moderate risk level, while a high risk level is present in the foothill area.

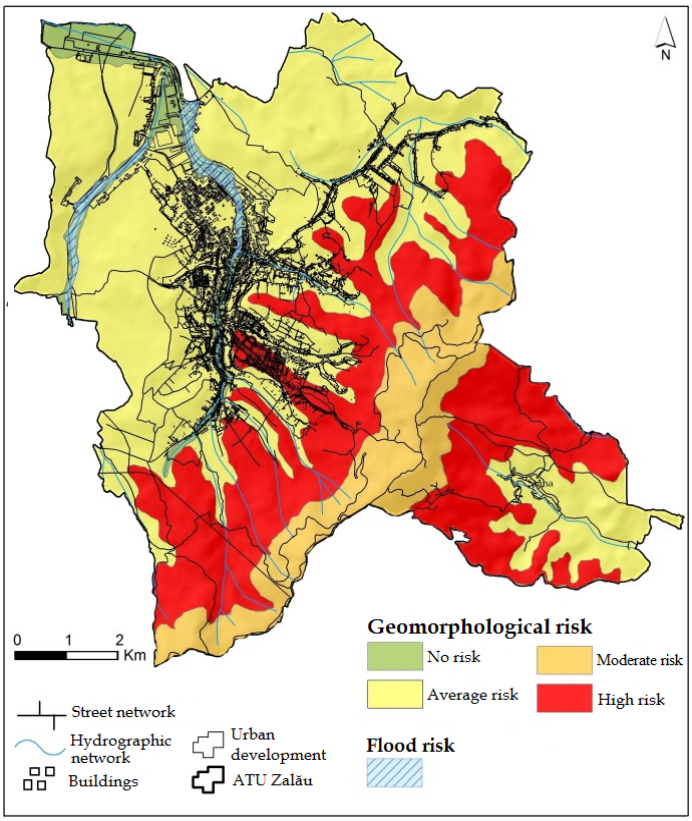


Fig. 5: Geomorphological risk map of the Zalău urban area

When analysing the percentage distribution of the risk classes in the administrative territory of Zalău, the expansion of the high risk class reaches 47% of the analysed surface. This class characterises mostly the foothill area of the analysed territory and has specific morphometric elements (slope angle, elevation).

The slope aspect and land use determine the occurrence of geomorphological processes, such as: landslides, rills, gullies, soil erosion. These processes cause material damages of the building and transport infrastructure.

The moderate risk class mostly characterises the mountain area, representing 8% of the analysed territory. Although specific geomorphological processes occur due to the low density of buildings and infrastructure elements, the effects are moderate.

In the case of the major riverbed of the Zalău Valley and Miții Valley, the geomorphological processes have a moderate intensity. However, this does not eliminate the possibility of other risks affecting these surfaces. The upper sector of the Miții Valley is affected by flood risk, while the central zone of the Zalău Municipality is also included in the flood risk zone due to the presence of flash floods on slopes.

5. CONCLUSIONS

The use of GIS technology in generating the detailed digital maps of the study area starting from the topographic maps of 1:25 000 enabled the creation and analysis of the various morphometric maps of the city topography. The analysis of geodeclivity, hypsometric levels and building distribution on the main landforms per classes of landslide occurrence are all important endeavours in the identification of the favourability to anthropogenic activities for the expansion of build-up area and the assessment of vulnerability.

The morphometric characteristics of the topography are important in the process of urban planning. The identification and analysis of the morphometric data offered important details on the landscape dynamics enabling the sustainable planning of the analysed territory by avoiding the areas prone to geomorphological hazards.

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THE HORTON-STRAHLER RIVER ORDER IMPLEMENTATION RELEVANCE WITHIN THE ANALYSIS OF THE ALMAŞ BASIN RELIEF

MĂDĂLINA-IOANA RUS[1], I. A. IRIMUŞ[1]

ABSTRACT. - The Horton-Strahler River Order Implementation Relevance within the Analysis of the Almaş Basin. The purpose of the present study/research aims at underlining the importance of the enforcement of the river order within the analysis of the Almaş basin relief. The topic was chosen based on the fact that the hydrographic networks hierarchy offers at the same time quality and quantity information, on the relief evolution tendency and also the chance to compare the Almaş tributary sub-basins ones with the others and also with other basins of the same order belonging to other morphological units. The results thus achieved offer information on the rivers order, the confluence report, the river segments density, the form/shape report. The values corresponding to the previously mentioned index, have led us to formulating the following conclusion: the evolution of the Almaş hydrographic network appears therefore strongly influenced by the lithologic sub-layer, by the presence of brittle rocks, by accentuated fragmentation and by the wide energy of the relief, nevertheless by the presence of the local subsidence area/region of Someş, from Jibou.

Keywords: *the Horton-Strahler Order, rivers, Almaş, depression, Transylvania*

1. INTRODUCTION

The present study focuses on the importance of the river order enforcement within the analysis of the Almaş river basin. Therefore, the reason for dwelling on the subject was the fact that the hydrographic network hierarchy offers both quality and quantity information, thus drawing the line of the evolution tendency in the area and also the possibility to compare the sub-basins ones with the others and also with other basins of the same order, belonging to different territories.

The hydrographic basin Almaş is part of the Almaş-Agrij Depression, a sub-unit of the peri-Carpathian Transylvanian area, at the junction between the Someşan Plateau and Meseş Peak. The Almaş Basin is generally characterized by wide, terraced valleys, narrow, low interfluves peaks, in report with the neighboring units.

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2. MATERIALS AND METHODS

In time, there have been a lot of proposals regarding the rivers order system. We find the first attempt, which considered as basis the river flow position as compared to the main collector, by Gravelius (1914), quoted by Horton(1945), who considers that the largest river is of the first order from its spring to its mouth. The tributaries which flow into it are of the second order, while those flowing into a second order water flow, are of the 3rd order and so on. In 1945 Horton reverses this classification system, by attributing the first order to the elementary thalweg. The second order water flow shall be the one receiving at least one or more first order tributaries (Zăvoianu, 1978). This classification system was implemented and developed in Romania by I. Zăvoianu (1978), Roşian (2008).

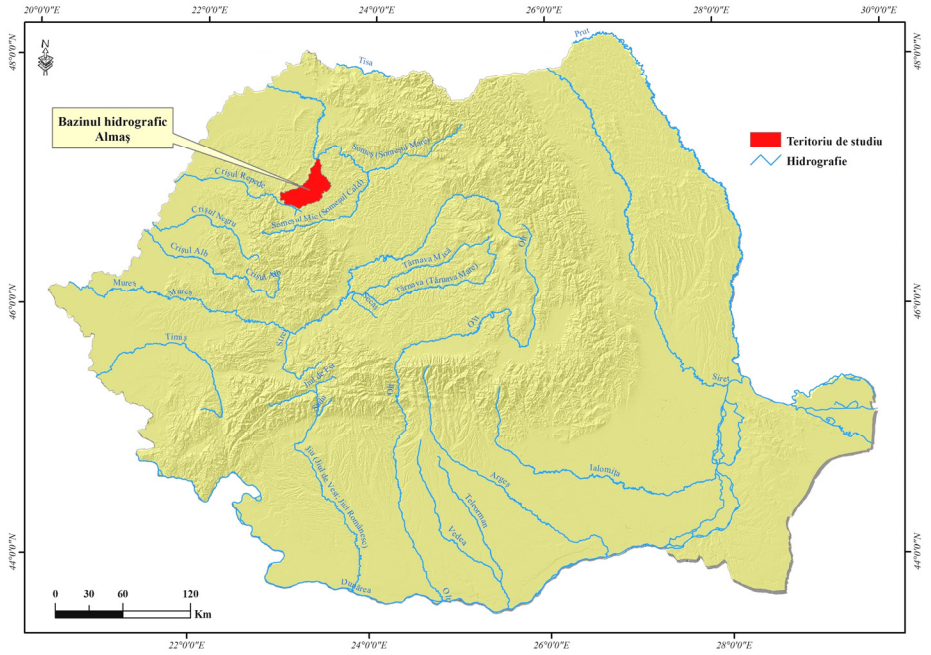

Figure 1. Geographical position of the Almaş Hydrographic Basin

In the present research paper, in order to achieve a hierarchy of the hydrographic network of the sub-basins corresponding to the hydrographic basin Almaş, I have applied the Horton-Strahler classification system. G. Roşian (2009) in his research paperwork "*Verifying the slopes order law in the Transylvanian Depression"* uses the slope order law, this being a derivate of the river order law in the Horton-Strahler system. This, together with "*The hydrographic basins morphometry"* (Zăvoianu, 1978) were used as methodological basis of the present study.

The river order law in Horton-Strahler system allows comparative studies, statistic data processing on value categories, of the various basins, as well as quantity evaluations of the dynamic equilibrium phases (Grecu şi Palmentola, 2003, quoted by Roşian, 2009, p. 84).

a. The Law of the rivers number

It plays an important role in the morphometric analyses, especially in establishing certain relations relative to the evolution of the hydrographic basin parameters, thus contributing to "deciphering" the morphology of the basin object of the study.

R. E. Horton (1945, p. 291) created the law according to which: *the number of the rivers of various orders within a given basin tends towards a reverse geometric progression, in which the first term is the unit, whereas the ratio is formed of the bifurcation report.*

$$\mathbf{R_b=N_u/\ N_u\ +1}$$

where R_b – the bifurcation report;
N_u – the number of segments of a certain order;
u – the segment order.

I. Zăvoianu (1978, p. 40, quoted by Roşian, 2009, p. 85) reforms Horton's river number law, by stating as follows: *the number of river segments of successive orders, within a given hydrographic basin, tends to form a reverse geometric progression, in which the first term(N_1) is given by the number of the river flows of the first order, whereas the ratio is the confluence report (Rc).*

$$\mathbf{R_c=N_x/N_x+1}$$

where: R_c – the confluence report;
N_x – the number of segments of order x;

In order to calculate the confluence report we shall calculate the arithmetic mean of the individual reports (Roşian, 2009, p. 85).

$$\mathbf{R_c=(R_{c1}+R_{c2}+....+R_{cn})/n}$$

where: n – the river order;

Depending on the number of the river segments and on the basin surface we can calculate *the river segments density* (Zăvoianu, 1978, quoted by Roşian, 2009, p. 86), by applying the formula:

$$\mathbf{Dr= N/F}$$

where: Dr – the river segments density
N – number of the river segments
F – surface

In order to determine *the form report* (zav, quoted by Roşian, 2008) we can use the formula:

$$\mathbf{R_f=A_u/\ L_b^2}$$

where: A_u – basin surface
L_b – river length

3. RESULTS AND DISCUSSIONS

The use of these relations has contributed to creating an inventory of the previously mentioned indicators, for each single sub-basin, subsequently for the whole basin of the river Almaş (Table 2), which shall contribute to the analysis of the study territory. In order to identify and trace the first order networks, I have used the topographic maps 1: 25 000, following the method:"*the water course itinerary imprinted by a continuous or interrupted line*" (Ichim et al., 1989, p. 49) by using the methods offered by the ArcMap 10.1 program. The information refering to the water flows within the hydrographic basin Almaş (the confluence position, the length, the average slope, the sinuosity coefficient, the basins surface and average altitude), see table 1, were required for the calculus of the river segments density, the form/shape report, etc.

Table 1

Morphometric features of the main rivers within the Almaş basin

Water flow/course		Water flow/ course information			Information on the Hydrographic basin	
	Confluence position	Length km	Average slope ‰	Sinuosity coefficient	Surface km²	Average altitude
Almaş	**s**	**65**	**6**	**1.56**	**814.5**	**420**
Peştera	d	6	44	1.19	10	608
Dorogna	d	9	11	1.10	24	469
Jebuc	d	9	19	1.41	40	425
Martin	s	5	36	1.21	14	
Băbiu	s	17	13	1.22	70	437
Tăudu	s	9	15	1.08	20	425
Guiaga	s	7	11	1.03	10	390
Valea Cetăţii	d	13	20	1.13	24	457
Meştereaga	s	6	18	1.02	8	431
Petrindu	d	9	25	1.04	36	429
Dincu	d	7	31	1.48	13.5	422
Benaia	s	7	7	1.13	15	385
Bozolnic	d	11	13	1.14	55	417
Arghiş	s	8	26	1.32	17	428
Mierţa	s	6	14	1.08	11	
Sâncraiul Almaşului	d	13	13	1.14	33	391
Dolu	d	9	19	1.16	19	364
Sântă Mărie	s	13	11	1.12	61	335
Valea Mare	s	7	13	1.01	21	332
Ugruţiu	d	10	13	1.13	25	318
Dragu	d	12	8	1.09	67	363
Voievodeni	d	9	13	1.41	21	397
Printre Văi	d	11	13	1.08	47	383
Strâmba	d	6	9	1.22	15	
Jirnău	s	5	7	1.08	20	
Trestia	d	6	33	1.09	13	326

Table 2

Order, number of the river segments, the confluence report for the Almaş basin

Water flow/course	The Horton-Strahler Order	Number of river segments					The confluence report					Number of river segments	Density of the river segments (Dr=N/F)	The form report (R_f)
		N_1	N_2	N_3	N_4	N_5	N_1/N_2	N_2/N_3	N_3/N_4	N_4/N_5	Media Rc			
Almaş	**5**	**820**	**219**	**52**	**12**	**1**	**3.75**	**4.21**	**4.33**	**12**	**6.07**	**1104**	**1.35**	**0.19**
Peştera	**4**	19	5	2	1		3.8	2.5	2		2.93	27	2.7	0.27
Dorogna	**3**	16	6	1			2.67	6			4.3	23	0.95	0.29
Jebuc	**3**	12	4	1			3	4			3.5	17	0.42	0.49
Martin	**3**	11	5	1			2.2	5			3.7	17	1.21	0.56
Băbiu	**4**	45	11	3	1		4.09	3.67	3		3.6	60	0.85	0.24
Tăudu	**3**	17	3	1			5.67	3			4.35	21	1.05	0.24
Guiaga	**2**	5	1				5					6	0.6	0.20
Valea Cetății	**3**	8	2	1			4	2			2	11	0.45	0.14
Meștereaga	**1**	1										1	0.125	0.22
Petrindu	**4**	21	9	3	1		2.33	3	3		2.77	34	0.94	0.44
Dincu	**3**	9	2	1			4.5	2			3.25	12	0.92	0.26
Benaia	**2**	7	1				7					8	0.53	0.30
Bozolnic	**4**	81	13	3	1		6.23	4.33	3		4.52	98	1.78	0.45
Arghiș	**3**	12	3	1			4	3			3.5	16	0.94	0.26
Mierța	**3**	10	3	1			3.33	3			3.15	14	1.27	0.31
Sâncraiul Almașului	**4**	66	16	3	1		4.12	5.33	3		4.13	86	2.60	0.19
Dolu	**3**	29	5	1			5.8	5			5.4	35	1.84	0.23
Sântă Mărie	**4**	63	20	5	1		3.15	4	5		4.05	89	1.45	0.36
Valea Mare	**4**	22	6	2	1		3.67	3	2		2.9	31	1.47	0.42
Ugruțiu	**3**	21	7	1			3	7			5	29	1.16	0.25
Dragu	**4**	63	14	3	1		4.5	4.67	3		4.05	81	1.20	0.47
Voievodeni	**4**	44	12	3	1		3.67	4	3		3.55	60	2.85	0.26
Printre Văi	**4**	72	16	3	1		4.5	5.33	3		4.27	92	1.95	0.39
Strâmba	**3**	34	4	1			8.5	4			5.5	39	2.6	0.42
Jirnău	**3**	24	6	1			4	6			5	31	1.55	0.8
Trestia	**4**	41	8	2	1		5.12	4	2		3.7	52	4	0.36

This type of analysis of the hydrographic basin has offered the chance to obtain the river order values, the number of the river segments and the previously mentioned parameters. They were useful in establishing the evolution stage, the river segments density, the form report, the fragmentation degree, the geomorphological processes rate, etc.

"*The actual drainage structure given by the number of the river segments, is the result of a long evolution process, developed by objective laws, according to which the morphometric elements tend to achieve their equilibrium/an equilibrium point, as a result of the interaction between the sub-layer and the hydro-metrological factors."(Roșian, 2008)*

Within the basin object of the study, the 5th size order was achieved (the Almaş river). It is followed by basins of the 4th order (Peştera, Băbiu, Petrindu, Bozolnic, Sâncraiul Almaşului, Sântă Mărie, Valea Mare, Dragu, Voievodeni, Printre Văi, Trestia), of the 3rd order (Dorogna, Jebuc, Martin, Tăudu, Valea Cetății, Dincu, Arghiş, Mierţa, Dolu, Ugruţiu, Strâmba, Jirnău), of the 2nd order (Benaia şi Guiaga) and of the 1st order (Meştereaga). The number of the river segments of the Almaş basin is of 1104, the elementary thalwegs numbering 820, which represents 74.2 % of the total number of the basin segments, which underlines the accentuated torrential erosion in the upper basins of the rivers, the increased fragmentation ratio and the valleys accelerated tendency to reach the dynamic equilibrium state.

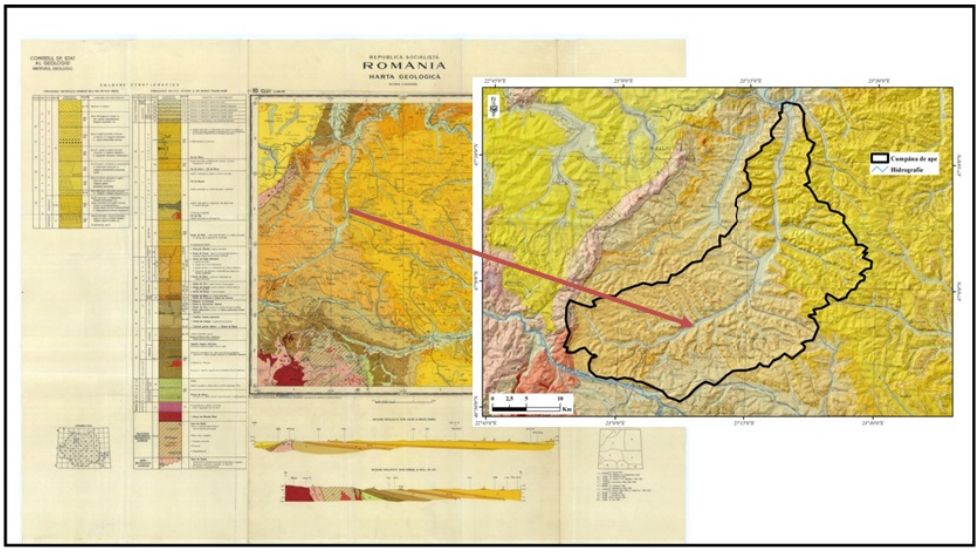

Figure 2. The Almaş Basin geological map

The analysis of the river order map within the Almaş basin and of the geological map confirms that the basin lithologic formations significantly influence the development of the hydrographic network, correlated with the slope.

The Eocene presence in the upper basin, especially the Priabonian, represented by lower coarse limestone, sandstones, upper stripped clays, marls, have determined a slight ramification of the upper flows for the right side tributaries: Jebuc, Valea Cetății and Petrindu. Consequently, the number of the 1st order segments and the river segments density registers reduced values, thus: Jebucu (12, respectively 0.42), Valea Cetății (8, respectively 0.45) and Petrindu (21, respectively 0.94).

Over the Eocene strata there are Oligocene strata in layers of Mera (lattorfian) formed of an alternation of marls and greenish-eggplant sandy clays, slightly stratified, with greenish sands, coarse calcareous sandstones and limestone. They look like a strip,

reduced as dimensions/extension, ensuring the passage towards the second horizon characteristic to the Oligocene: the Rupelian (Ticu layers), with greater extension in the upper basin of the valley. Based on the Rupelian specific geologic formations (clays, sands, sandstones, marly limestone shale) the hydrographic network of Almaş displays a ramification superior as compared to the one of the Eocene. Representative for this areal shall be the basins Băbiu, a left side tributary, of a value of 45 for the order segments 1, and Bozolnic, a right-side tributary of the middle basin, which registered the value of 81 for the number of the river segments of the 1st order. The aquitanian-chattian formations (the Zimbor and Sânmihai layers) are widely spread within the Almaş basin. Updated they appear in the middle basin spread over a wide surface, then they are concealed, downstream of the place Hida, of the more recent formations, reappearing la zi only in the lower course, downstream the place Gâlgău. The Oligocene series terminates with the Sâmnihai layers, red clays with gravels which mark the passage to the Inferior Miocene (Burdigalian and Helvetian)-conglomerates, sand stones, clay marls, with an ample development on the right slope of the Almaş river, beginning downstream the place Hida up to Gălgău. It is on their account that the Almas hydrographic network strongly branched and deepened. What we should mention to this effect are the right side tributaries of Almaş: Dragu with its tributary Voievodeni, Printre Văi with its tributary Strâmba, Trestia. The order reached in the case of basines Dragu, Printre Văi and Trestia is the 4th order. For the rivers Jebuc, Valea Cetăţii and Petrindu, with their upper basins developed during the Eocene and characterized by average slopes of 19 %, 20%, respectively 25 %, the number of the 1st order segments is 12 (Jebuc), 8 (Valea Cetăţii), respectively 21 (Petrindu), which indicates the fact that the slope and the rock type influence the hydrographic network development.

4. CONCLUSIONS

As for the river bed networks, the slope is an element of outmost importance by its dynamic tightly connected to the sub-layer resistance to erosion, drainage basin access and exits. We shall therefore notice that the rocks which form the hydrographic basins sub-layer play an important role in dimensioning the morphometric elements. The hydrographic network hierarchy in Horton-Strahler system appears important in order to achieve the drainage model/pattern, the analysis of the water drainage on the slope, the soil risk exposure map, etc. The present study is precursory to the complex demarche of achieving the risk exposure map of the soils within the Almaş hydrographic basin.

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IN SEARCH OF IDEAL FORM- RATIO OF TRIANGULAR CHANNEL

B. C. DAS[1]

ABSTRACT. – In Search of Ideal Form-Ratio of Triangular Channel. Cross-sectional form of a natural channel is a two dimensional variable which is thoroughly studied by scholars from different fields on natural sciences like hydrology, geology, geomorphology, etc. Average river channels tend to develop their channel-cross sectional form in a way to produce an approximate equilibrium between the channel and the water and sediment it transport. But how far it is deviated from the ideal cross-sectional form can only be determined by knowing the ideal form which was calculated by Hickin for *rectangular channel.* This ideal cross-sectional form of 'maximum efficiency' is virtually a theoretical one and attaining of which the river transports its water and load with least friction with its bed. '*Ideal form ratio*' provides numerical tools for *triangular channel* to determine the degree of deviation of a cross-sectional form from that of an ideal one.

Keywords: *channel asymmetry, cross-sectional area, hydraulic radius, ideal form ratio, wetted perimeter.*

1. INTRODUCTION

The cross-sectional form of natural stream channel is characteristically irregular in outline and locally variable (Knighton, 1998). Commonly two groups of aspects are considered to describe channel cross-sectional form – i) channel size and ii) channel shape. The first group includes width (w), mean depth (d), cross-sectional area (A), wetted perimeter (P), hydraulic radius (R), maximum depth (d_{max}), and bed width (w_b) while the second group of variables are width: depth ratio (w/d), maximum depth: mean depth ratio (d_{max}/d), channel asymmetry, bank slope (Ø) and bed topography. About 9/10 meandering channels cross-sections are asymmetric (Leopold and Wolman, 1960) and symmetry is assumed to be found at cross-overs (Knighton, 1981) although cross-sectional asymmetry is found in so-called straight channels (Einstine and Shen, 1964; Keller, 1972). For the study of channel's cross-sectional form, it is indispensable to know the ratio and Hickin (2004) calculated it for rectangular channel. The present paper is related to the cross-sectional shape of triangular channel and aims to formulate indices on channel form to determine the magnitude of deviation of a cross-sectional shape from the ideal one.

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2. EVALUATION OF EXISTING MEASURES

Asymmetry of natural features has been studied from the view point of processes of action (Kranck, 1972; Clifton, 1976) and shape (Sharp, 1963; Tanner, 1967; Kennedy, 1976). The cross-sectional form of a river is primarily adjusted by bank erosion and lateral channel migration (Simon and Castro, 2004) and represents dominant measures of channel response (Simon, 1992; Simon and Darby, 1997). Channel shape is rarely explained in a single measure like width: depth ratio (w/d), maximum depth: mean depth ratio (d_{max}/d), channel asymmetry, bank slope (Ø), etc. **Width: mean-depth ratio** (w/d) does not define cross-sectional shape (Hey, 1978) yet it is a widely used index. **Maximum depth: mean depth ratio** (d_{max}/d) is another measure which gives no better expression than that of Width: mean-depth ratio (w/d).

Form ratio w/d or w/d_{max} (Schumm, 1960) and section asymmetry a_l/a_r (Milne, 1979) regarding cross-sectional form give an absolute measure. These measures do not tell about the quality of the ratio i.e. how far the value is deviated from ideal one. That is why ideal value of form ratio of triangular channels is to be known.

2.1. Channel asymmetry: Channel asymmetry is a measure of the degree of asymmetry of the two halves of the cross-sectional area demarcated by the central line drawn vertically from the mid-width point of the channel. Three channel asymmetry indices were defined (Fig. 1) by Knighton (1981).

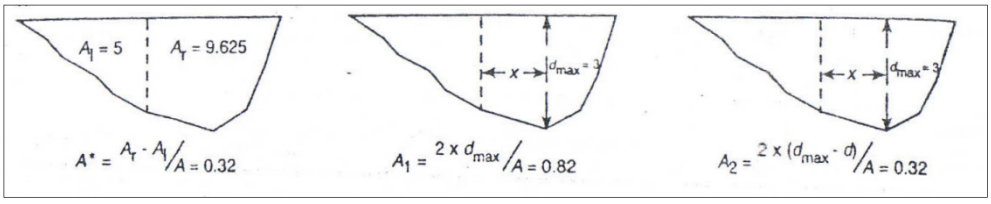


Fig. 1. Definitions of Asymmetry Indices
Source: Knighton (1998)

1. $A^* = (A_r - A_l) / A$

Where A_r and A_l are the cross-sectional areas, respectively, to the right and left of the channel centerline, A (= $A_r + A_l$) is the total area. Zero (0) value of the index indicate perfect symmetrical channel cross-sectional form while +1 and -1 indicates the maximumlimits of asymmetry to the left and right respectively.

2. $A_1 = (2x\ d_{max}) / A$

The equation is derived as $(2x/w)\ (d_{max}/d)$. Now, w × d is replaced by A. x is the distance from the centerline to the centroid of maximum depth, $d_{max}$is maximum depth, and d is mean depth.

3. $A_2 = 2x(d_{max} - d) / A$

The equation is simplified form of $(2x/w)(d_{max} - d/d)$. Here depth of the channel is given appropriate weightage. To show the comparison amongst asymmetry in terms of width and depth of channels of equal area, Knighton (1981) used the term 'vertical asymmetry'. For knowing degree of vertical asymmetry, calculation of ideal depth of a channel of given cross-sectional area is precondition. Ideal form ratio provides that tool.

2.2. Bank slopes: Bank slopes measured in degrees are essentially concave in nature with rare variations like rectilinear or convex. Banks of Type- C and Type- B (Fig. 2) channels (Knighton, 1998) are rectilinear (Knighton 1998) while Type- A is more concave in nature. Degree of curvature (concavity or convexity) of a bank slope may be measured by the ratio of arc length to the angle in between lines of radii joining two ends of that arc. There is a opposite relation between the ratio and the degree of curvature of slope.

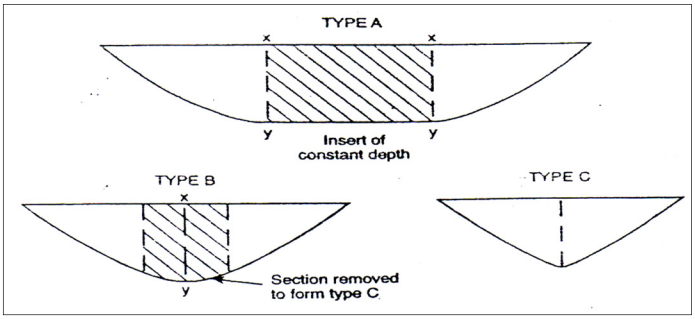


Fig. 2. Different Type of Cross-sectional form
Source: Knighton (1998)

2.3. Bed Topography: The last but not the least consideration of the channel cross-sectional form is its **bed topography**. Riffles-pool, step-pool, ripple, bar, shoal etc gives every channel a unique cross-sectional form which is beyond the capacity of a uniform measure to explain the shape as it is.

3. IDEAL CROSS-SECTIONAL FORM

The conventional belief of the v-shaped cross-sectional form of the rivers is far from the reality (Sen, 1993). Circular (Leopold et al, 1969) and parabolic (Lane, 1955) forms are also theoretical. Rather trapezoidal form represents the reality (Sen, 1993). But all these forms, whether theoretical or practical, are not obvious for all the channels or the entire reach of the same channel. The straight course of a river is impossible (Leopold and Langbein, 1966) which makes another impossibility of uniformity of cross-sectional form of the channel. Width increases faster than depth in downstream and cross-sectional form becomes increasingly rectangular (Sen, 1993). But sometimes the opposite is also the reality (Knighton, 1998; Das, 2013).

The conditions of efficiency of the cross-sectional characteristics of the channels are closely related to their capacity for allowance of maxium flow. Maximum flow (water + sediment load) is only possible when the cross-sectional form attains the semi-circular or parabolic shape (Knighton, 1998) or equilateral-triangular. These shapes generate the minimum turbulence and shear stress hence the 'most efficient' channels. Thus this ideal condition of channel form is considered as the 'best convayence characteristics' (Crickmay, 1974). Arcs of circles and parabolic curves may be simple devices for the explanation of the channel cross-sectional form. The relationship between channel form and processes operating in the channels has been studied as hydraulic geometry of the stream channels by Leopold and Maddock (1953), Wolman (1955), Leopold and Miller (1956) and others. They computed cross-sectional forms in terms of mean-depth (d) and width (w) in terms of hydraulic parameter discharge (Q).

$$w = {}_aQ^b$$
$$d = {}_cQ^f$$

Different average exponent values for ^{b} and ^{f} of different rivers have been calculated by Leopold and Maddock (1953), Wolman (1955), Leopold and Miller, (1956), Lewis (1969), Wilcock (1971) and Harvey (1975).

Manning (1891) flow resistance equation $v= k (R^{2/3}S^{1/2})/n$ (Knighton, 1998) or $v= (1/n) R_h^{2/3}S_b^{1/2}$(Simon and Castro, 2003) suggests that channel form and flow resistance determine the velocity of a river. To built up his equation, Manning utilised seven different open channel flow equations and the findings were field tested (Chaw, 1959; Fischenich, 2000). In this equation, v = velocity of flow, R or R_h = hydraulic radius of the channel, S or S_b = slope, and n = manning resistance co-efficient. With given volume, velocity is proportional to hydraulic radius ($R_h^{2/3}$) and slope ($S^{1/2}$) but inversly proportional to shear resistance. Valley slope and floodplain slope is generally greater than channel slope (Simon and Castro, 2003). If all other variables of the equation are constant, the equation implies that the velocity over flood plain is greater than in the channel. But reality is opposite because of- i) Roughness, hence shear strength over flood plain is much greater than in the channel; ii) Hydraulic radius is lesser over floodplain.

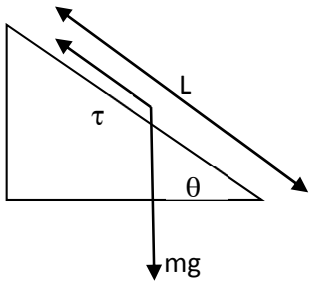


Fig. 3. Definition of bed friction stress

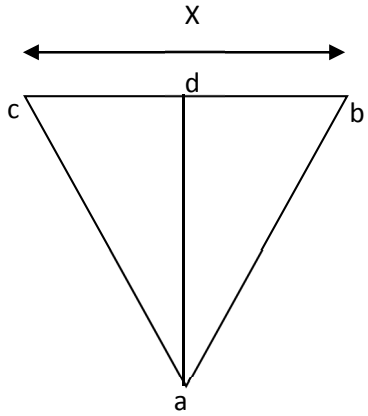
Fig. 3 is showing bed friction stress 'τ' of a stream length 'L' with mass of water 'm' under gravitational pull 'g' on a slope 'θ'.

$\rho mgSin\theta=\tau PL$ Where ρ= co-efficient of friction
$\rho ALgSin\theta=\tau PL$ {m=AL}
Or, $\tau=\rho g(A/P)sin\theta$ {as m=AL}
Or, $\tau=\rho g(R_h)sin\theta$ {as $A/P= R_h$}

Average velocity (V) is proportional to $R_h^{2/3}$ and Quantity of flow $Q=VA= (1/n) AR_h^{2/3}\sqrt{}$slope. Therefore, lesser the 'P', lesser the 'τ' and higher is the R_h.

4. THE MOST EFFICIENT TRIANGULAR CROSS-SECTION

Let cross-sectional shape be like an Equilateral Triangle (fig. 4. i), like wide Isosceles triangle (Figs. 4. ii) and like narrow Isosceles triangle (figs.4.iii). In all cases, cross-sectional area is 'A' and length of wetted perimeter is represented by 2ac, 2pr and 2mo respectively. Type i. channel has a width of x, type ii. channel has a width of 2x and type iii. channel has a width x/2. Now let ratio of wetted perimeters of three types of channel be determined.



Equilateral Triangle

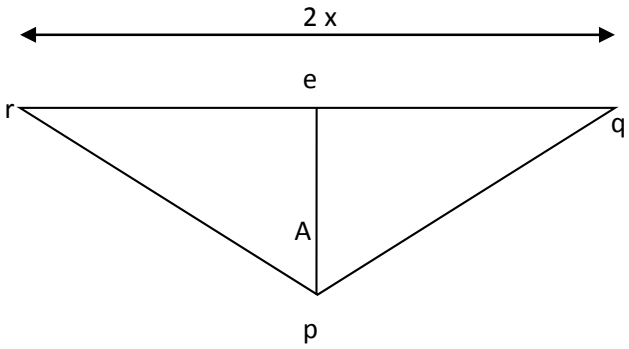
Fig. 4. (i)ab=bc=ca, Equilateral Triangular cross-sectional form with constant area but minimum wetted perimeter

However, if triangular cross-sectional form is the case, then ideal shape is equilateral triangular with 'best convayence characteristics'. From following calculation, it can easily be derived that, isolateral triangular cross-sectional form has the least hydraulic perieter with maximum effiency.

Suppose, area of the equilateral Δ abc (Figs.4.i) is A.

Therefore, $A = \frac{\sqrt{3}}{4}(ab)^2$

Or, $A = \frac{\sqrt{3}}{4}x^2$ [as ab = x]



Isosceles triangle

Fig. 4. (ii)pr=pq and qr=2bc, Isosceles Triangular cross-sectional form with constant area but more wetted perimeter

In Δ pqr, area = A and pq=pr

Area of Δ pqr = ½ qr ×ep

= ½ 2x × ep [as qr= 2x]

= x × ep

Therefore, $x \times ep = \frac{\sqrt{3}}{4}x^2$

$ep = \frac{\sqrt{3}}{4}x$

In Δ per, $(pr)^2 = (ep)^2 + (er)^2$

$= (ep)^2 + x^2$ [as er= x]

$= (\frac{\sqrt{3}}{4}\ x)2 + x2$ [as $ep = \frac{\sqrt{3}}{4}x$]

$= \frac{3}{16}x^2 + x^2$

$= (3x^2+16x^2) \div 16$

$= (3x^2+16x^2) \div 16$

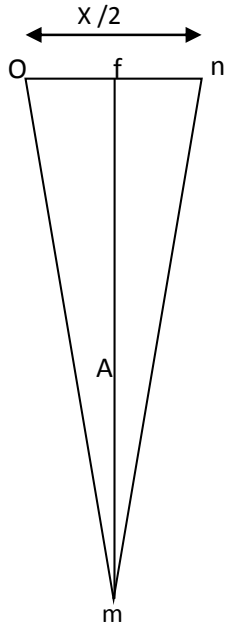
$pr = \frac{\sqrt{19}}{4}x$

$= \frac{\sqrt{19}}{4}x$

$= \frac{4.3}{4}x$

$4pr = 4.3x$

$\frac{x}{4} = \frac{pr}{4.3}$ (i)



Isosceles triangle

Fig. 4. (iii)pr=pq and qr=2bc, Isosceles Triangular cross-sectional form with constant area but most wetted perimeter

In Δ mno, mn = mo

Area of Δ mno = ½ on × fm

$$= \frac{1}{2} \times \frac{x}{2} \times fm$$

$$= \frac{x}{4} \times fm$$

Now, $\frac{x}{4} \times fm = \frac{\sqrt{3}}{4}x^2$ [as Area of all three triangles are equal]

$$fm = \sqrt{3}\, x$$

In Δ fmo, $(om)^2 = (fm)^2 + (fo)^2$

$= (fm)^2 + (x/4)^2$ [as fo= x/4]

$= (\sqrt{3}\, x)^2 + (x/4)^2$ [as fm= √3x]

$= 3x^2 + x^2/16$

$= (48x^2 + x^2) \div 16$

$= 49x^2/16$

$= 49x^2/16$

om = 7x/4

$$\frac{x}{4} = \frac{om}{7} \qquad \text{(ii)}$$

Therefore, $\frac{x}{4} = \frac{pr}{4.3} = \frac{om}{7} = k$ (iii)

x=4k, pr=4.3k and om=7k

Therefore, ratio of wetted perimeter of channel types i:ii:iii = 8:8.6:14.

So, hydraulic radius with given cross-sectional areaof wide V-shaped and narrow V-shaped triangles are smaller than that of an equilateral triangle. So, ideal cross-sectional form of a river is either semicircular or equilateral triangular.

5. IDEAL FORM RATIOS FOR TRIANGULAR CROSS-SECTIONAL FORM

5.1. Ideal width (ẃ) : width index (I_w)

Ideal width provides tool to compare width of a cross-section of a channel with given area to that of the ideal width which the channel tries to attain for best conveyance. Width index (I_w) is defined as $I_w = w/ ẃ$.

$$I_w = w/ẃ.$$

Here, ẃ is derived as follows-

ẃ = x, [x is the length of a side of an equilateral triangle]

Now, if the cross-sectional area of the concerned channel is 'A', then

$$A = \frac{\sqrt{3}}{4}x^2$$

Or, $x^2 = 4A/\sqrt{3}$

Or, $x^2 = 2.3094A$

Or, $x = 1.52A$

Or, $ẃ = 1.52\sqrt{A}$ (1)

5.2. Ideal mean depth (Ď): depth index (I_d)

Ideal mean depth provides tool to compare mean depth (d) of a cross-section of a channel with given area to that of the ideal mean depth (Ď) which the channel tries to attain for best conveyance.

Depth index (I_d) is defined as $I_d = d / Ď$.

$$I_d = d / Ď.$$

Here, Ď is derived as follows-

$$Ď = A/1.52\sqrt{A}$$

Or, $Ď = \sqrt{A}/1.52$ (2)

5.3. Ideal form ratio (C_fI)

$$C_fI = ẃ / Ď$$

Or, $C_fI = \frac{1.52\sqrt{A}}{\sqrt{A}/1.52}$

Or, $C_fI = 2.31$ (3)

If the channel is like triangular in shape and if the C_fI = 2.31, the cross-sectional form is equilateral triangular which represents the form of middle course or mature stage. Lesser the value, narrower the shape and implies the channel of upper course or youth stage. If the value is greater than 2.31, it implies the wider v-shaped channel of lower reach or old stage.

6. CONCLUSIONS

The relative rates of increase of width and depth are functions of channel shape. But mere width: mean-depth ratio (w/d) does not define cross-sectional shape (Hey, 1978) even though it is a widely used index. So to have comparison, instead of simple width to mean-depth ratio, Ideal form ratio-3 (C_fI = 2.31) may give better explanation. Even, with a given area of channel cross-section, how far its width and depth are deviated from the ideal value can be determined by Ideal form ratio-1 (ẃ $=1.52\sqrt{A}$) andIdeal form ratio-2 (Ď = √A/*1.52*).

Acknowledgement

No word is enough to express my gratitude to my teacher Prof.Sandip Kumar Choudhury, worthy but far away from lime light, and who enabled me to think about these numbers. Ideal form ratios, named after him, is my hearty homage to him. I acknowledge my friends from different disciplines and my students who helped to materialize this paper.

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RELEVANT HYDROLOGY ELEMENTS IN TERMS OF REGIONAL GEOGRAPHY ANALYSIS. CASE STUDY: THE LAND OF HAŢEG

G. HOGNOGI[1], ROXANA VĂIDEAN[1]

ABSTRACT. – Relevant Hydrology Elements in Terms of Regional Geography Analysis. Case Study: the Land of Haţeg. By the diversity of the territorial system components that need to be analyzed, a regional geography study requires a continuous approach of the specific character of these components, which is also valid for the hydrological component. First, it is necessary to highlight the role of potamology, limnology and hydrogeology features in the evolution of the region, as related to three temporal levels (past, present and perspective). The change of population's notion of the extreme hydrological events by specific and/or general analyses of the changes occurred in the territory (hydrotehnical facilities, impoundment and drainage works). The graphical representation of the analyzed elements and phenomena, which varies in terms of scale and necessity, comes as a supplement and enforcement of the above statements.

Keywords: *region, potamology, limnology, hydrogeology, extreme hydrological events, water mills.*

1. INTRODUCTION

The Regional Geography study on the Land of Haţeg finds its purpose in the context of the existence of no less than 16 presented and/or published research works on the "land" type of regions in Romania and of other land use plans (at various levels), coordinated by professor Pompei Cocean, Ph.D. The former are mostly analyses of the existing state resulting from the evolution over time, without elaborating the evolution perspectives, which is not the case for the land use plans where the proposal part represents half of the materials. Both types of researches look for the specific elements of the territory supporting its development. The hydrology elements analysis perspectives vary depending on the author, but the potamology, limnology and hydrogeology features must be highlighted in temporal context (past, present and future), focusing on the extreme hydrological events and the quality of water resources.

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In order to improve the applicability of a research, the spatial representation (by GIS methods) of the quantitative and qualitative values characterizing these elements is more than necessary. The evolution of software facilitates the highly esthetical mapping of a wide range of geographic information (raster and vector spatial data, graphs, images, etc.), meant to support these statements and to improve understanding of these phenomena in other fields (i.e. administration). A high quality graphical material can be a way to summarize the information (even in the absence of a detailed data base), while the unfortunate or incomplete representation of some processes and phenomena does nothing more but helps the achievement of the quantitative standards, lacking a real scientific value. A frequent example in the regional Geography works is the flash flood graphic, together with the generating values (sometimes even of the levels), without any representation (map, elevation, image, etc.) of the section where it was measured. It is thus left to the reader to "imagine" the implications of the graphically represented value.

The values of the Land of Haţeg were considered particularly interesting by specialists in various fields. However, three authors are worth mentioning in terms of their approach of the hydrology elements: Vuia (1926), Popa (1999) and Margin Felicia (2011). The most recently published work is the only hydrological monograph of the Strei river basin, while the first two are models used to identify the interconnections established between the components of the territorial system.

2. MATERIALS AND METHODS

In order to highlight the temporal evolution, regardless of the area, the availability of cartographic resources is ideal, together with those of other nature (written, photographs and others). Starting from the assumption that cartographic resources are, especially for geographers, more than relevant, our purpose is to cartographically represent the researched phenomena and processes as completely as possible.

The oldest cartographic resources on the Land of Haţeg date back since the 18th century (the first land survey performed during the Hapsburg monarchy 1769-1773). In the 19th century there are the other two Hapsburg land surveys[2], while in the 20th century there are the Master Plans (1:20,000), the Soviet maps (1:50,000) and the topographic maps (1:25,000, 1:5,000). The relation to the present time is established based on the ortophotoplans (2005 and more recent).

All these cartographic resources have contributed, along with the field campaigns and study of other types of reference resources, to the final material, whose graphical part was performed by means of the Arc Gis10.1, Corel Draw X7 and Microsoft Office Excel 2013 programs.

[2] *http://mapire.eu/en/map/collection/firstsurvey/?zoom=5&lat=47.89035&lon=14.76556*

3. RESULTS

3.1. Assessment of the Land of Haţeg water resources

The assessment of hydrological resources is the subject of extensive hydrology papers and especially in the case of a regional Geography research, it must capture the constant (in historic time, at least) of the water resource. In the selected research area, this is determined by the geological evolution in the given paleoclimate context and by the present result, the relief.

Located mainly in the middle (without the Şes River upstream of Corciova rivulet) and upper (without the sector upstream of Pravăţului Valley) Strei basin, the Land of Haţeg has a dense hydrographical network (0.91 km/km^2). Beside the main collector, other significant water courses in terms of flow are the left-bank tributaries draining the Northern slope of the Retezat Mountains, the North-Eastern slope of the Ţarcu Mountains and the South-Eastern slope of the Poiana Ruscă Mountains and mainly the Haţeg Depression: Râu Mare (with Sibişel, Râuşor and Galbena), Râu Bărbat, and Râu Alb. The right-bank tributaries do not have large flows, but they do have impressive endo and exokarst formations generated in Jurassic limestones (caves, polje).

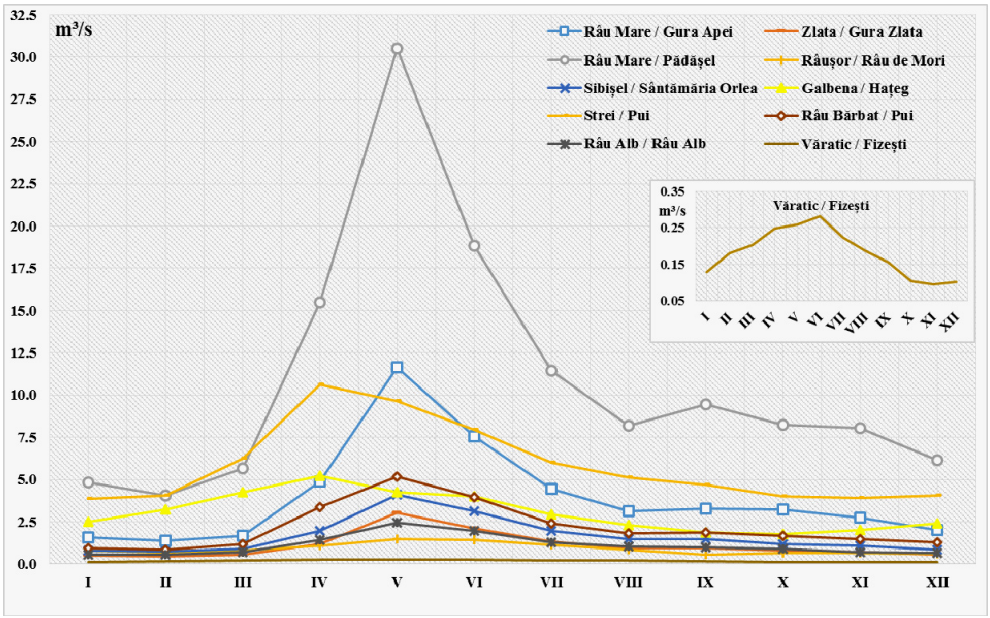


Fig. 1. The monthly average evolution of runoff in the middle and upper basin of the Strei River

The evolution of runoff has three types of regimes. One is specific to the rivers that drain the high Southern mountain area (Retezat, Godeanu and Ţarcu Mountains) and presents two maxima and two minima. The main maximum is recorded in May (due

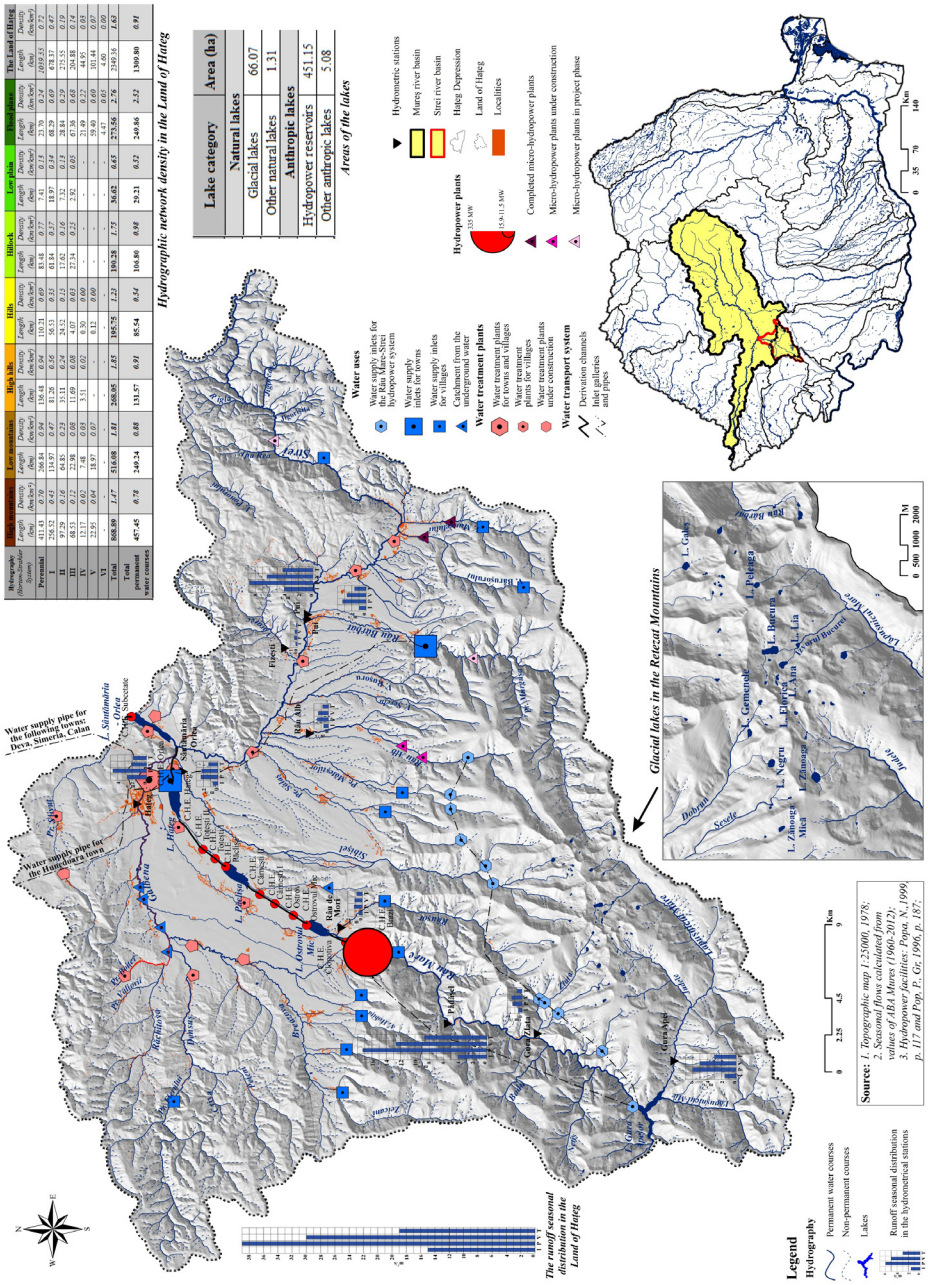
to snow melting), and the secondary maximum is in October. The main minimum is recorded during winter, when rainfalls are stored at heights in solid form, and the second in August-September, when low rainfalls correlate with high evaporation and evapotranspiration (Fig.1). Until its confluence with Râu Bărbat and the right-bank tributary of the Râului Mare, Galbena, Strei River fits the second type of regime which presents a maximum in April, when snow is melting in the low mountains (Şureanu and Poiana Ruscă). In case of the Galbena River, one can notice an increase of flow also in June (which indicates the torrential character). Low runoff values are recorded during the autumn and at the beginning of winter (the minimum value in October – Galbena and January – Strei). One notices the low amplitude of runoff in case of the Strei River, mainly supported also by the retention of a significant volume of water in the existing endokarst formations. The hydrometric station on the Văratic is representative for the small rivers, where the maximum is given by the torrential rainfalls during the summer, while the minimum in November is caused by their absence in anticyclonic regime. The seasonal situation of runoff is represented in Figure 2, which is the reason we do not consider necessary to present it in more details.

In all hydrometric stations, spring is the season with the maximum runoff (Fig. 2). The situation is different when it comes to the minimum runoff, where there are differentiations depending on the water supply regime. This is the case with Galbena and Văratic Rivers, where autumn is the season with a minimum runoff value, not winter as in case of rivers supplied from the high mountain area. Moreover, in the first case, winter is the season with the second recorded runoff value. The reason for this is nothing else but the frequent melting of snow, the frequency of liquid or mixed rainfalls in the context of a much lower average altitude as compared to the other significant rivers in the Land of Haţeg and an alleged action of foehn. Strei River is in an intermediate position, with two seasons (autumn and winter), with close minimum values.

Having an ephemeral existence in terms of geologic time, lakes are well represented in the research area, by the 87 glacial lakes (79 in Retezat Mountains, 5 in Godeanu and 3 in Ţarcu Mountains)[3]. Their presence was, among others, the reason for founding the first national park in Romania (Retezat Mountains National Park), some of these holding national records regarding various parameters (Bucura – area, Zănoaga – depth). Peşteana swamp is also included in the category of lakes. This swamp was originally a lake whose siltation process was accelerated by the anthropogenic factor by drainage and abundantly populated with a glacial relict (Drosera rotundifolia), which led to its declaration as a botanical reserve.

The spring of 1986 (Pop, 1996) represented a decisive moment in the typological diversification of lakes in the Land of Haţeg, by the development of the Gura Apelor Lake hydropower facility at the confluence of Lăpuşnicul Mare and Râu Şes. Subsequently, other 3 reservoirs were developed on the Râul Mare, in the depression area (Ostrovul Mic, Păclişa and Haţeg). The latest presence in the lymnological landscape of the Haţeg area is the Sântămăria Orlea reservoir on the Strei River, where other "[...] 4 such reservoirs were planned" (Popa, 1999, fig. 14).

[3] *http://retezat.ro/*



Lake category	Area (ha)
Natural lakes	
Glacial lakes	66.07
Other natural lakes	1.31
Anthropic lakes	
Hydropower reservoirs	451.15
Other anthropic lakes	5.08

Areas of the lakes

Petrographic (lithomechanical) units	High mountains		Low mountains		Big hills		Hills		IntraCA		Low plains		Flood plains		The Land of Hațeg	
	Length (km)	Density (km/km²)	Length (km)	Density (km/km²)	Length (km)	Density (km/km²)	Length (km)	Density (km/km²)	Length (km)	Density (km/km²)	Length (km)	Density (km/km²)	Length (km)	Density (km/km²)	Length (km)	Density (km/km²)
Crystalline	411.43	0.70	366.84	0.94	158.48	0.94	110.21	0.69	83.48	0.77	7.41	0.13	23.70	0.24	1059.55	0.72
Perennial	258.52	0.43	134.97	0.47	81.26	0.56	56.53	0.53	61.84	0.57	18.97	0.34	68.29	0.69	678.37	0.47
I	97.29	0.16	64.85	0.23	33.31	0.24	24.52	0.23	17.65	0.16	7.32	0.13	28.84	0.29	275.35	0.19
II	48.11	0.08	38.98	0.14	16.68	0.12	12.04	0.11	12.34	0.12	2.92	0.05	20.34	0.21	151.41	0.10
III	12.17	0.02	7.48	0.03	3.51	0.02	0.30	0.00	-	-	-	-	21.49	0.22	44.95	0.03
IV	23.95	0.04	18.97	0.07	-	-	0.12	0.00	-	-	-	-	59.40	0.60	101.44	0.07
V	-	-	-	-	-	-	-	-	-	-	-	-	4.43	0.05	4.80	0.00
VI	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00
Total	868.89	1.47	514.08	1.81	268.85	1.85	195.75	1.22	190.28	1.75	36.62	0.65	226.56	2.29	2360.16	1.62
Total permanent water courses	457.45	0.78	240.24	0.88	133.57	0.91	85.54	0.54	106.80	0.98	29.21	0.52	240.86	2.52	1309.80	0.91

The hydrogeological resources are quantitatively and qualitatively good, with no less than 7 groundwater bodies within the limits of the research area, some of these are included completely in this territory (Haţeg and Răchitova Depressions), others are mainly located in this area (Picuiu, Zeicani and Ohaba Ponor) or with less than 50% (Godeanu and Mureş corridor). The anthropogenic pressure has moderate to low values, the water bodies in the Haţeg Depression and Mureş Valley are the only ones with various ways of water use and with significant polluters (Fig. 3).

3.2. The role of hydrological elements in individualization of the Land of Haţeg

"A basic condition for the society to exist, as the main support of life, of hygiene and health" (Popa, 1999), water must have played one of the main roles in the occurrence and development of the habitats in this space where age and consistency of habitation represent one of the specificity elements. The result of the water action in a calcareous petrography context, the caves in the North-East of the Land of Haţeg: Cioclovina – Peştera Uscată (outside the borders of the region, Boşorod commune), Bordu Mare, Peştera de pe Scoruş, Ponor, Piatra Poienii developed as human habitats, starting with the middle Paleolithic, the many archaeological discoveries being proof in this regard[4].

In the context of the proximity of the religious and political – military centre in the Şureanu Mountains (1st century B.C. – 2nd century), we are entitled to imagine the importance of this depression area of Haţeg and the surrounding mountains, most probably together with the Mureş corridor in supporting the capital (agricultural products, soldiers, etc.) which offered peace at the same time. Exercising our imagination, "although one cannot imagine all" (Vulpe, 2012[5]), we could see permanent localities in the depression area whose inhabitants value the qualitatively superior lands, but also the proximity of the water courses.

The conquest of Dacia in 106 A.D. and the founding of the capital in the South-West of the depression requires significant amounts of water both for the capital and for the numerous "[...] pagus, vicus and villae rusticae of some landlords" (Tudor, 1968 cited by Popa, 1999), focused on agriculture. Since the times of Roman domination, we suspect the existence of Pârâul de Câmp and Odoraşniţa (Conea 1940, cited by Popa, 1999), branches of the Râului Mare within the piedmont plain. Together with supplementing the water necessary for agriculture, these two works have played a significant role in the drainage of the vast areas affected by sloughing and in taking over some flows, under flash floods circumstances, from the main course. Moreover, an aqueduct was identified on the present route of Odoraşniţa, which was presumed to supply the new capital from the Râul Mare, which was possible given the Romans' high water needs. In addition, the flow of the Hobiţa would not have been enough for 20 – 25,000 inhabitants, the water

[4] *http://map.cimec.ro*

[5] *http://www.historia.ro/exclusiv_web/general/articol/sintagma-stramosii-nostri-daci-ar-trebui-discutata*

inlet must have been located in the mountain area to meet the level difference necessary for the free fall of water, and the number of the catchments must have been large, as each vicus or villa rustica benefited of this facility.

The first data related to the use of the hydrographic resources in the medieval period (271 – 1600) occur late, in the 16th century, in various donation documents of the kings of Hungary to the knyazes in the Land of Haţeg. The objects of these donations were among others "[…] meadows, […], underwoods, thornbush areas, hills, valleys, […], ponds, fishing places and mills, as well as places for mills, etc." (Lazăr and Tămaş, 2003). Even if the rural technique facilities occurred only later, the use of ichthyofauna, under natural or built conditions, cannot be denied. The "iron fishing hooks from Sarmizegetusa Regia" are proof in this regard (Glodariu and Iaroslavschi, 1979 cited by Bara et al., 2012).

In the modern age (1600 – 1821), the number of information on the hydrographic resources management increases, with the occurrence of the first unitary cartographic sources (the Josephine topographic survey – 1769 – 1773), which provides a clear image of the spatial distribution of the surface waters, fountains as an alternative of using groundwater as well as of the land use. It is possible to perform a spatial analysis of wetlands distribution, of the inhabited area/water course ratio, location of traditional industry facilities using water energy and so on. Along with this cartographic database we get much other written information which offers us an improved overview of the evolution of the manner man relates to water resources. The damages incurred to the access infrastructure by the hydrographic network stand out "[…] the bridge over the Strei River at Simeria Veche, which is often broken by the river strong current" (Bara et al., 2012, IV) or the damages to the agricultural yield: "The year 1771 was a poor year in terms of agriculture due to floods and hail" (Bara et al., 2012, IV); "the prolonged drought during 1813-1818 and the heavy rainfalls in short intervals have affected the cereal crops and have caused marked imbalances", which represents a real problem in the maintenance of the communication routes (Bara et al., 2012, IV).

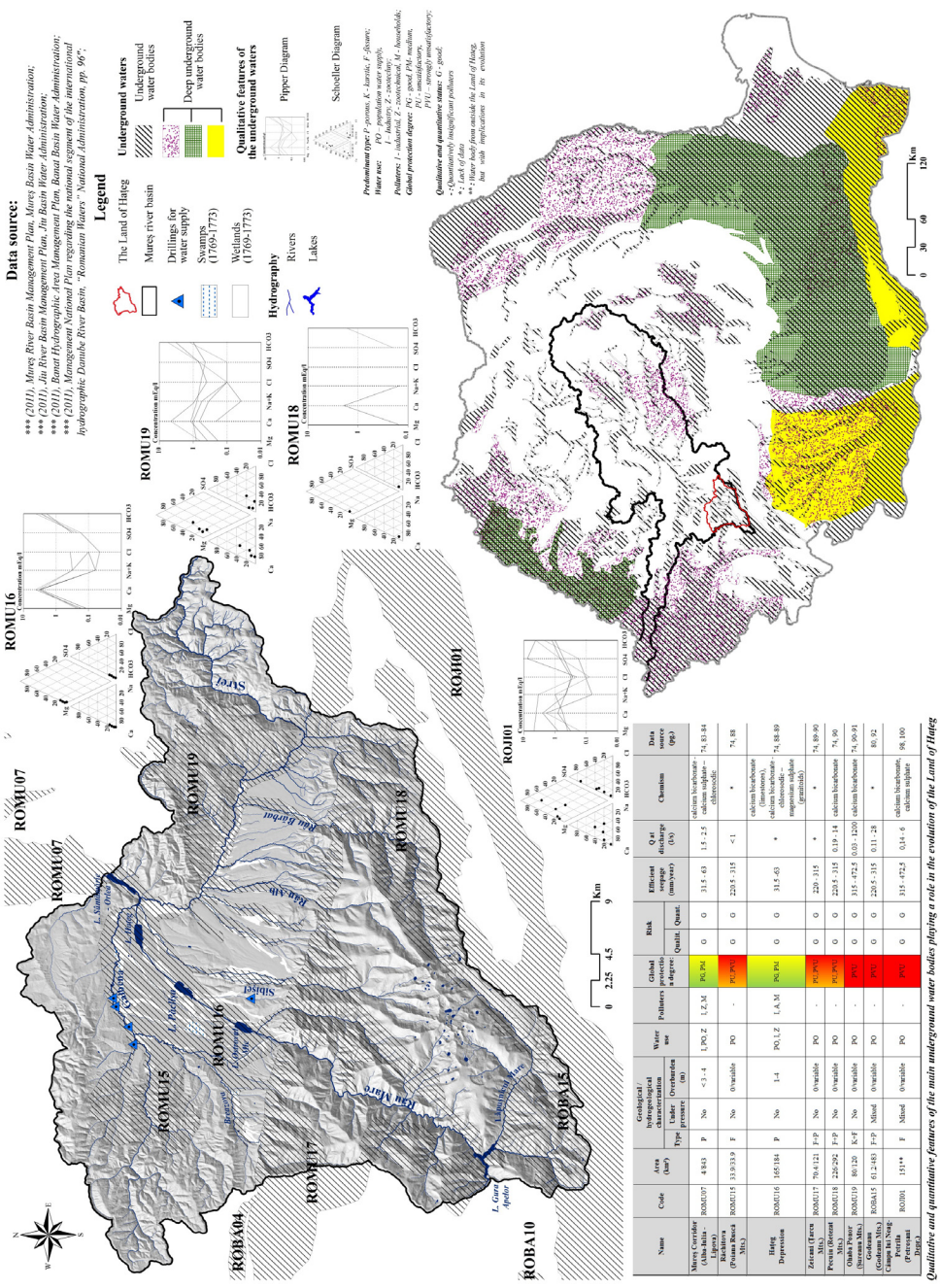
Regarding the use of river energy, we found that in 1785, on the Hobiţa, Sibişel and Paroş rivers, belonging to the localities Hobiţa (Sarmizegetusa), Nucşoara and Paroş, there were operating "saw mills" (Bara et al., 2012, IV) for wood processing. In a free or planned manner, the rivers were also used for timber rafting. These woods were intended for the production of charcoal used in the ore-based iron production facilities on the territory of Hunedoara domain. "[...] [private companies with heaps were mentioned in various locations, in our case in Petros" (Bara et al., 2012, IV). Also in the modern age there are mentioned, together with the "river species (several types of Salmonidae) and trout in the glacial lakes in Retezat used for fishing" (Benko, 1778 cited by Bara et al., 2012, IV). One of the environmental protection measures used by the authorities at that time might be considered the order of Transylvanian Governorate in August 28, 1767, which "[...] strictly prohibited under harsh punishment, the melting of hemp and flax directly into the river and lake waters in the Princedom"; to avoid the destruction of aquatic fauna, the inhabitants had to dig special holes near water courses (Benko, 1778 cited by Bara et al., 2012, IV).

The contemporary period (1821 – present time) brings the most important changes in the management of the hydrological potential of the Land of Haţeg, whose evolution can be traced in the cartographic, photographic, written resources and/or the local memory, which makes it possible to faithfully restore the territorial system at each component level. Three types of attitudes can be distinguished in terms of the water resources management: before 1947, between 1947 – 1990, and after 1990. Until 1947, there is an increase of community attention on the aquatic resource, which is why we find cases where "[...] local communities rent the fishing rights on a given period of time to supplement incomes" (Bara et al., 2012, IV). Starting with the second half of the 19th century, "the intensive fishing practices (use of dynamite and natural poisons), expansion of poaching, numerous traditional industry facilities" (Bara et al., 2012, IV) and timber rafting (this is widespread also on Râul Mare after 1850) drastically reduce the diversity and amount of the ichthyofauna.

The inhabitants of the villages in Haţeg begin to be aware of the hydrological risk events, due to the magnitude and frequency of these events. Relevant examples in this direction could be the objection of the representatives of the communes General Berthelot, submitted to the state representative in 1919 concerning the prices of lands on the banks of the Galbena River "[...] the rent for the 15 yokes on the river bank is too high, because it is exposed to floods" (Bara et al., 2012, IV) or the statements of the inhabitants of Clopotiva, which confirm the frequency and damages caused by the flash floods on the Râu Mare: "When the high mountains (Retezat, Godeanu, Ţarcu) roar, heavy rain comes and Râu Mare overflows. One year, there came a large flood that filled the corn fields with dead fish and mud. One summer, it flooded the field and the hemp; it causes much damage when it overflows" (Conea, 2010). In the same paper, referring to the quality of soils, one resident mentions the occurrence of extreme hydrological events: "[...] it is sandy soil, brought by the flood". The local memory mentions flash floods causing material damages "Sălaş River […] is almost dry during the summer, and in spring […] it carries everything in its way […] It breaks all bridges and carries them away, as if they had never been there" (Pocanschi, 1967), sometimes also human victims (Strei Valley, Muncel).

Between 1957 – 1990, the hydrographic elements underwent the most significant changes. The large hydrotechnical works on Strei River or its tributaries, especially on Râul Mare but also on upstream tributaries stand out. Generally speaking, this system is composed of 4 reservoirs on the Râul Mare and one on the Strei river, a pipe taking over a part of the water flow of rivers on the Northern slope of the Retezat Mountains to supplement the volume of Gura Apelor Lake, 11 hydropower plants with a total power of 495.5 MW[6], water inlets to supply rural and/or urban localities and many pipes and channels. The implications of these reservoirs are diverse, from flood risk reduction, especially on the Râul Mare (however, events like that from July 11, 1999 is difficult, if not impossible to avoid). A significant anthropogenic intervention was represented by "[...] the drainage works affecting the Western compartment of the depression and the Valea Lupului – Valea Verde interfluve between 1970-1985" (Popa, 1999), increasing the production potential of these lands (Fig. 3).

[6] *http://www.hidroelectrica.ro/Details.aspx?page=38*



Name	Code	Area (km²)	Type	Under pressure:	Geological hydrogeological characterization Overburden (m)	Water use	Polluters	Global protection degree	Risk Quant.	Risk Qualit.	Efficient recharge (mm/year)	Q at 95% dispersion (l/s)	Chemism	Data source (pg.)
Mureş Corridor (Lăpuşnicu - Ilighia)	ROMU07	4/843	P	No	<3 - 4	I, PO, Z	I, Z, M	PG; PM	G	G	31.5 - 63	1.5 - 2.5	calcium bicarbonate - calcium sulphate - chlorosulphate	74, 83-84
Richidava (Poiana Rusca Mts.)	ROMU15	53.9/353.9	F	No	0/variable	PO	-	PG; PM	G	G	220.5 - 315	<1	*	74, 88
Haţeg Depression	ROMU16	165/184	P	No	1-4	PO, I, Z	I, A, M	PG; PM	G	G	31.5 -63	*	calcium bicarbonate (limestones), calcium bicarbonate - chlorosulphate - magnesium sulphate (granitoids)	74, 88-89
Zeicani (Tarcu Mts.)	ROMU17	70.4/121	F+P	No	0/variable	PO	-	PG; PM	G	G	220 - 315	*	*	74, 89-90
Pecuia (Retezat Mts.)	ROMU18	226/292	F+P	No	0/variable	PO	-	PG; PM	G	G	220.5 - 315	0.19 - 14	calcium bicarbonate	74, 90
Oslea Peaner (Sureanu Mts.)	ROMU19	80/120	K+F	No	0/variable	PO	-	PM	G	G	315 - 472.5	0.03 - 1200	calcium bicarbonate	74, 90-91
Geoagiu (Godeanu Mts.)	ROBA15	61.2/483	F+P	Mixed	0/variable	PO	-	PM	G	G	220.5 - 315	0.11 - 28	*	85, 92
Cimpa lui Neag (Poiana Rusca Mts.)	ROJ01	151**	F	Mixed	0/variable	PO	-	PM	G	G	315 - 472.5	0.14 - 6	calcium bicarbonate, calcium sulphate	98, 100

Qualitative and quantitative features of the main underground water bodies playing a role in the evolution of the Land of Haţeg

Fig. 3. The hydrogeological features of the Land of Haţeg

The pressure on the underground water becomes higher as agricultural activities require significant water volumes, while they become representative polluters in the surrounding areas. Starting with 1953, an important polluter occurs on the Boița valley, the pyrite mine. Even if the activity is ceased, this site continues to damage the quality of the Galbena River, as the treatment plant cannot cope with the concentration or the flow. As an example of the water quality importance in the life of the communities, we mention "water hardness and the lack of iodine and fluorine as causes of endemic thyreopathic dystrophy – endemic goitre – in the Paroș and Peștera villages until the first half of the 20th century. This time, the cause was a natural one, the presence of limestones at the contact of the depression with the Retezat Mountains.

After 1990, the polluting activities (mining exploitations, intensive agricultural activities and other industrial activities) reduce significantly. Local administrations access funds for the development of mostly local water supply systems (one or more villages), whose sources are represented by the nearby rivers or underground water bodies (communes Răchitova and General Berthelot). In this context, the sewage systems, frequently unfinished, become polluters of the surface hydrographic network.

The idea of building micro-hydropower plants is very current and full of perspectives, not favorable to the environment, communities or the state, but beneficial only to the project owners. Bărușor and Alb Rivers are already affected by such facilities, while Râu Bărbat and Strei River are about to meet the impact of such criminal ideas.

4. CONCLUSIONS

The Land of Hațeg holds a significant quantitative and qualitative hydrologic potential, which facilitated its continuous habitation since Paleolithic. It was considered more appropriate that this potential was better highlighted graphically than in writing, as the second option was used to accentuate the manner in which the hydrological elements have contributed over time to the individualization of the territorial system.

The settlements system could not be built without the existence of a transport network during the modern period, which became widespread mostly along the valleys. The "plotting" of the access routes along the main valleys represents nothing else but the overlapping of the anthropogenic axes with the already existing natural ones. Two main axes are thus highlighted: one from the East (on the Strei Valley) and another one from the West (on the Breazova Valley and the high piedmont plain), which combine in the North, where the main collector leaves the depression. These two main axes sent in all directions secondary axes which often enter the mountain area, with direct implications in the systemic cooperation between the depression and the mountain areas. The evolution may also be represented graphically, but mostly by case studies and only if cartographic resources are available (in our case barely from 1769 – 1773), otherwise only geologic studies on the river bed deposits, the archaeological evidences, the written information help us imagine the overall state over a longer period of time (several centuries).

Each of the three hydrologic elements categories, by certain features, improves the specificity degree of the Land of Haţeg, as follows:

- potamology: the rivers supplied from the Southern high mountain area generated, by their large flow, fluvial relief forms highlighted in the landscape (granite fields), chosen to be the location for the inhabited areas of the settlements;
- limnology: the inheritance left by the Quaternary mountain glaciers to the mountain areas, consisting in 87 glacial lakes and the Râu Mare – Strei hydropower system, by its technical features and the impact on the territory;
- hydrogeology: the Ohaba Ponor water body has carved in the Jurassic deposits a complex karst system which developed into a human habitat ever since the Paleolithic.

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FROM BROWNFIELD TO GREENFIELD. MAJOR ECOLOGICAL IMBALANCES IN BAIA MARE. SĂSAR MINE RECLAMATION AND RECONVERSION

ANDRA CONDOR[1]

ABSTRACT. - From Brownfield to Greenfield. Major Ecological Imbalances in Baia Mare. Săsar Mine Reclamation and Reconversion. This article is an extract of a more exhaustive study of the Săsar mine based on a multi-level approach of the environmental degradation caused by the long-lasting activities of the mining industry in the city of Baia Mare and the reconversion methods of the underutilized and contaminated properties into green spaces. The presence of brownfields in this city is a matter of great concern to the administrative bodies due to insufficient and ineffective measures for environmental protection, precarious expertise and lack of initiative to regenerate former mining sites. Furthermore, the industrial pillars refuse to get involved and take responsibility for the problems many of them have caused despite state efforts to ease liability fears. But viable projects and solid action are indispensable for overcoming this hurdle. As such, this work is an attempt to cover these exact issues as follows: after setting on the legal framework and the fundamental regulatory considerations, the vulnerability of the enviroment will be assesed in order to determine the level of pollution in the area surrounding the Săsar mine. Then the premises for a cultural landscape reconversion will be established through direct field observations and interpretations, the examination of scholarly studies and the use of GIS tools and social data. This project will try to offer a coherent transformational model of a brownfield area into a useful space for the community and the environment in compliance with the economic purposes.

Keywords: *environment, mining industry, reconversion, urban planning, Baia Mare*

1. INTRODUCTION

Baia Mare was one of the most important industrial areas in Romania and one of the most polluted too. The city has been a major mining centre for more than 100 years with a great capacity of resources, especially non-ferrous minerals which were vital for the local economy. The downfall of the mining and metallurgical sectors in the last decay together with the relinquishment of large industrial areas have generated major economic, social, health and environmental problems. The city is now marked by the historical pollution generated during the industrialization period with insufficient financial resources and technologies needed for decontamination strategies and actions.

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In the present, the mining activity is closed but Remin (the National Company of Precious and Non-ferrous Metals) still runs its activity in the city. This company is the former state owned Baia Mare Mining Corporation, assigned with the extraction and processing of raw materials from all the mines surrounding the city of Baia Mare, including Săsar. This mine has 5 perimeters: Sofia, Borzaș, Wilhelm, Valea Roșie and Dealul Crucii, developed on NV-SE axis. The expansion of the cross-cut access and connection galleries reaches a total length of 16-17 km (Beregic, V., Cosma, N. and Bogdan M., 2001). The ores extracted at the Săsar mine were processed by the Aurul S.A company. The Romaltyn Mining plant, a descendant of the Transgold group (the one involved in the ecological accident from the year 2000), has now the headquarters in the building of the former Aurul. The new company of Romaltyn is in negotiation terms with the local council to restart the exploitation activity of gold extraction and processing from the remaining tailings of the Central Flotation (with 10.5 million tons of gangue) and Aurul (with 9.5 million tons of gangue). However, the exploitation of this type of deposits for the obtainment of useful minerals implies many dangerous and hazardous physical and chemical operations, which could result in the massive contamination of the natural environment and the human health. The effects of the past exploitations of the Săsar mine are still visible today and can be summarised as follows:

– Pollution of surface water and bed water with chemical substances and solid suspension particles. Rain and ground water infiltrate in the abandoned mines and are gravitationally collected by the river courses without being treated and therefore pose a constant threat for the clean water sources of the local population. In addition to that, the discharges of used water in the Săsar River from the 28 polluted tributary streams have caused its permanent degradation.

– Air pollution with gases coming from the oxidation and burning of the minerals contained in the tailings ponds. The transportation of gangue and useful materials with cable railways, transportation bands, dumpers or railway wagons, were all generating industrial dust and gases which polluted the atmosphere. There were many cases in which the admitted limit of silicon dust release has been exceeded. Beside the employees, the vegetation was also affected by the dust, which slowed down the process of photosynthesis.

– Soil pollution with heavy metals. The acidification of the soil inhibited the activity of the bacteria and therefore, the content of nutrients decreased considerably. This had direct repercussions on the specific micro flora and fauna, which in the affected area are almost non-existent. The surface covered with waste dump and unexploited ore in the yard of the Săsar mine still lays unprotected. This can lead to the spreading of the harmful dust with direct consequences on the agricultural crops and human health.

– Negative visual impact due to altered landscapes. The deallocated buildings of the Săsar flotation left unreaclaimed after the mine closure have been partly demolished. However, a large part of these dilapidated buildings are still standing, together with stock-piled gangue which is left unexploited, unsafe and in direct contact with the soil.

– Unused economic potential. Occupying large surfaces of land with destructing buildings for a long period of time causes the stagnation of the city development.

As such, the surrounding environment of the Săsar mine has suffered and continues to suffer many ecological imbalances. The challenge nowadays is to re-establish the equilibrium between the natural and anthropogenic components, between the past and present.

2. RESEARCH METHODS

The rehabilitation of the site, guided by an ecological conception should be a primary concern for the city, where the public opinion is the most important actor and the private sector is open to changes. Although it is extremely difficult and costly to address the remedial measures, a field ecologization and reclamation of this former mining site is needed. But first the vulnerability of the environment has to be assessed in order to determine the pollution degree, the resistance and potential of transformation of every element affected. The disappearance of this industrial site would thus allow the expansion of the Baia Mare city and the development of new spaces of public utility which could bring new perspectives for the local economy. The preservation and reconversion of the historical particularities in the form of cultural and artistic commodities will be part of the urban regeneration and also a strategy of attracting investments. The identity of Baia Mare will be reiterated by reinterpreting the mining culture which has characterized the city and the entire county for centuries. Also, the study requires the analysis of the human settlement models in correlation with the communication networks in order to determine the spatial relations of the industrial landscape within the urban fabric and redesign the functionality of the mining site in the neighbourhood. So the future reconversion proposal will be based on aspects like the relationships with the wider context, the movement and linkages, the land use, the facilities and accessibility illustrated with the help of the GIS data and analysis.

2.1. Study area

The brownfield site of the Săsar mine proposed for reconversion is located in the western industrial zone, on the upper shore of the Săsar River. It is split by the Victoriei Street into two parts. The lower part embodies the land of the former Săsar flotation and preparation plant, which is now partly demolished. The main building of the flotation belongs now to the Romaltyn mining plant. A hostel, a restaurant, a sports ground and a block of flats are located in the southern proximity of the former factory. The upper part of the site comprises the main entrances of the Săsar mine, the Tarna and the adjoined galleries, through which the transportation of workers and ore has been made in the past, the office buildings of the Săsar mining exploitation which belong now to Remin, many annexes of the mine, industrial equipment, storing places, the former shunting yard, tailings, a deposit of unexploited ore, houses belonging to the former miners and a small electrical power station.

The study area is considered to be a brownfield land because it was previously used for industrial purposes and although the land is contaminated by hazardous waste, it still has the potential to be reused once it is cleaned up. Adaptive re-use and disposal of a brownfield site require the site to be analysed in relation to the close proximity and

to be integrated into the functional zonification of the area. Consequently, the studied area has been expanded up to the Săsar River in the south, Victor Babeș St. in the east and the two roundabouts on Victoriei St. and Independenței Blvd. in the west. This area integrates individual and collective housing, a few small industrial businesses, a shopping mall, the Romaltyn plant, public facilities such as a restaurant, a polyclinic, a high school (with sports field and gym) and a university (with student dorms, sports ground and other facilities).

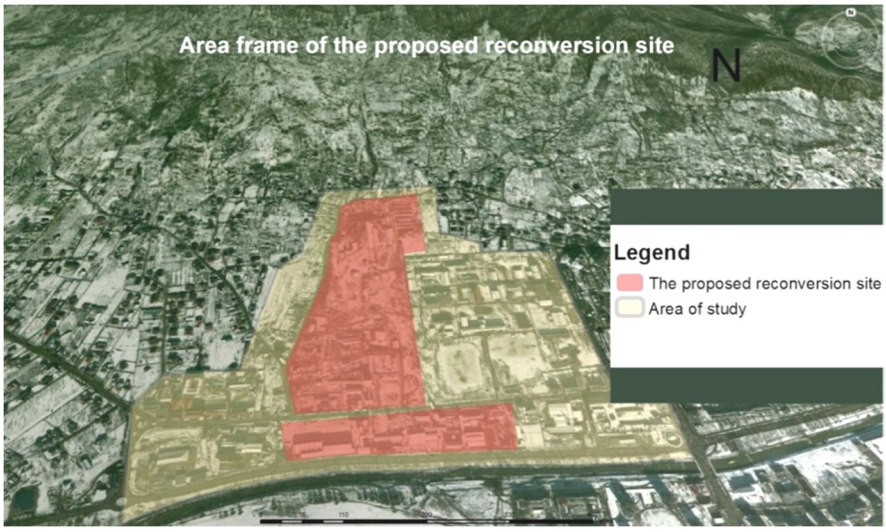

Fig. 1. Forefront of the study area

In 2006, a closure plan was elaborated for the Săsar mine, which can be seen below. The buildings belonging to the exploitation have been proposed either for decommission or capitalization. From the northern buildings, only the administrative body and offices are being used by Remin. The remaining buildings and deposits are dismantled. The dispensary has been converted into a student dorm, belonging to the North University. The aerial railway does not exist anymore, but its route is illustrated in the below map. The Săsar cyanidation plant belongs now to the Romaltyn company, which intends to restart the exploitation activity. The buildings proposed for decommission, have been partially demolished, and from the buildings proposed for capitalization, only two have been valorised. One building has been transformed into a hostel and the other one into a club and a restaurant.

The impact of the reconversion project will reflect upon the whole city of Baia Mare as a unitary system. As such, it must be integrated into the urban fabric and be in accordance with the development strategy. In relation to the character of the mining site there is the potential to strengthen distinctiveness by re-using the buildings and equipment which have industrial heritage, vary the building typology to integrate and connect with

the existing context as well as create a new character founded on the need of green and sustainable solutions for the people and environment, imperatives on which the proposed project is built.

2.2. Assessment of environmental vulnerability

With the gathered data, we managed to build an impact matrix which provides a comprehensive review for the investigators of the variety of interactions involved in the industrial process in order to evaluate the environmental hazards and identify potential solutions for the ecological amelioration.

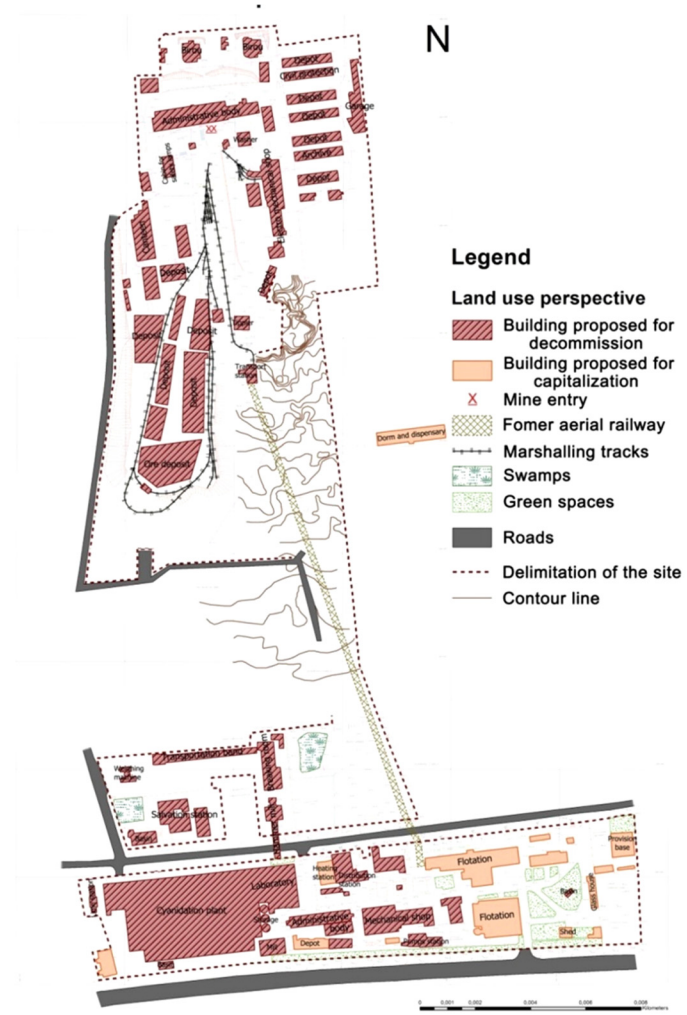

Fig. 2. Closure plan of the Săsar mine (based on the confidential official map of REMIN)

The impact was numerically evaluated in terms of magnitude and importance, using a degrees system in order to determine whether the interactions were deemed sufficiently important:

- 1 = unaffected environment/component/system by the mining activity;
- 2 = environment subjected to negative impact, but without exceeding the admitted limits;
- 3 = environment affected by mining activity and being induced in a discomfort state;
- 4 = environment affected by the mining activity, producing disturbances to life forms;
- 5-6 = severely affected environment by the mining activity, endangering the life forms.

Table 1.

The impact matrix for the exploitation activity of the Săsar mine

Impact Matrix					
Environmental system components/industrial processes	Emplacement of tailings	Industrial site and buildings	Underground exploitation	Mineral processing	Spills and leaks
Air	3	1	1	3	1
Soil and geomorphology	5	4	4	1	2
Surface and ground waters	6	3	3	5	2
Biosphere/biodiversity	4	1	2	3	3
Agricultural production	3	1	1	1	1
Human health	3	1	4	2	1
Climatic factors	3	1	1	1	1
Landscape	6	6	3	1	3

The landscape and the scenic view together with the surface and ground waters are the most seriously impacted by the former exploitation activities and were accordingly given the highest number in magnitude. The quality of the landscape is very low, with almost no vegetation and impaired views ofthe abandoned industrial buildings and unused transmission lines which give you the impression of an apocalyptical city. There is also a very high contrast between the recently built shopping mall on the nearby perimeter and this scenery which degrades the entire neighbourhood. Furthermore the excavations and emplacement of tailings which lie unprotected possess a real threat to the people living in the surrounding area.

The ground and surface waters have been polluted for so many years that the harmful chemical substances and suspensions still exceed the maximum limits admitted by the environmental institutions. Within the Săsar mine perimeter, the evacuation of mining waters is made through traverse cavities with access from the main gallery. These waters come from the external infiltrations in the remnants holes of the mine or from the infiltration of rainfall in the soil. Therefore, the waters accede in the mine, wash the unexploited mineral deposits, get charged with heavy metals and many times are directly released in the tributary streams, without being neutralized.

2.3. Social analysis

The following information has been extracted from the social analysis conducted by myself for the reconversion project. It is based on the interviews applied on the people living in the neighbouring area of the Săsar mine. All the interviewed people have stated that they were living in the area when the Săsar mine exploitation was still functioning. Almost half from the families live in the area for 15-30 years and the rest of the families live in the area for 45-60 years. More than 80% from the people living in the proximity of the mine admitted that at least one member of the family has been working in the mine and that all of them had health problems. More than a half of the former workers still have health problems. Breathing problems and headaches are the most common impairments among the former employees. I have also encountered a few cases of heart failures during the time some of the family members have been working in the mine. Other negative effects with impact on the population living in the area were phonic pollution (during the period of the exploitation activities, the ore transportation band passed through a few people's backyards and the anti-breakage installations were located near their homes), bad smell from a polluted nearby river and tailing deposits and soil pollution which impeded the growth of their vegetables.

In the present, the bed smell of the river still persists because it has not been cleaned. Additionally, unexploited ore deposits lie unprotected in the yard of the Săsar mine, which have a negative visual impact and a bed smell. The tailing dust is carried into people's yards in the windy days and affects the vegetation. The soil gets polluted from the rainfall water which washes the tailings. Also, in the rainy periods the valley overflows people's yards and has a great health risk potential. 20% of the people declared that during flooding some of their animals died. Despite the complaints they made to the local administration, no measures have been taken. When asking about the future perspective of the Săsar mine site, 30% from the interviewed people were in favour of the mine reopening because they considered this action would create working places for the unemployed population. Nonetheless, they also enjoyed the idea of a green place for recreation with playground for children and giving a touristic value to the area. A percentage of 70% of the people agreed that there is a need for green spaces and recreational activities in their neighbourhood.

2.4. Functional zonification of the studied area

The studied site is situated in the western part of the city which was predominantly an industrial area. A large part of the surface area is still occupied by the constructions and material deposits of the former Săsar mine and exploitation. The area which surrounds the mine field is more dinamic, with mixed functions, such as individual housing and public use. The headquarters, student dorms and a sports ground of the North University are located in the eastern proximity of the site. Also, the „Gheorghe Lazăr" high school, with all the annexed buildings and sports field is located near the North University campus. In the south east of the studied area, there is the new shopping mall of the city, Gold Plaza. In the northern and western proximity of the studied area, the predominant function is individual and collective housing, with a few public facilities. In the south of the area,

there are the remnants structures of the old buildings, the Romaltyn plant based in the former building of the Săsar flotation, a recently built block of flats, a hostel and a restaurant. From the configuration of the functionalities in the studied area, illustrated below, we can observe that the Săsar mining site is in contradiction with the surrounding areas. The industrial profile of the site is in conflict with the main housing and public functions of the area and we can observe the impetuous need of a green space in the area.

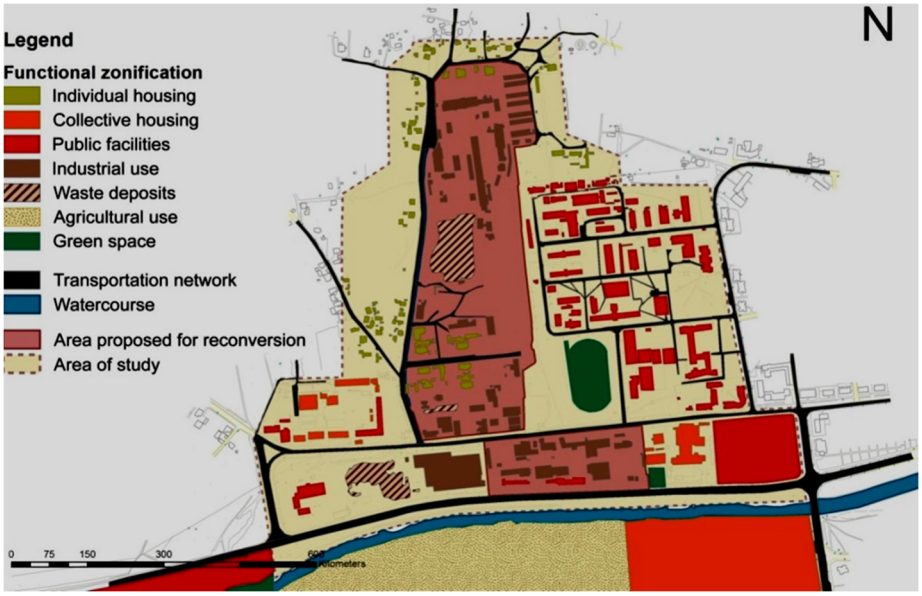

Fig. 4. Functional zonification of the analysed area

2.5. Transportation network analysis

This part of the analysis looks at the movement framework which sets out the main connections into and through the study area and the main arrival points. It also studies the connectivity of the area. The main traffic flow runs on the Independenței Boulevard, which is an integrated part of the E58 which crosses the city longitudinally and connects Baia Mare with Satu Mare. Independenţei and Decebal Boulevards, which form a junction at the eastern limit, are the only streets of category II in the studied area. The majority of the streets which surround the area are of category III and the streets located in the inner area of study are of category IV.

In the area there are no footpaths or pedestrian nods, only a few small streets with mixed circulation. There are two major circulation nods in the studied perimeter. The first one includes the two roundabouts of Victoriei and Independeţei streets, which form the western limit of the studied area, where the traffic spreads in the direction of Satu-Mare and Borcutului Valley. The second one is formed by the traffic-lighted junction of

Independeței and Decebal boulevards and the the junction between Decebal boulevard and Victoriei St. The latter presents a discordant zone with traffic congestions due to the location of the Gold Plaza shopping mall, the lack of traffic lights, the short distance between the junctions and the proximity of a small traffic nod. This transportation nod is determined by the junction between Victoriei and Victor Babeș streets, with low sight distance and tight traffic beds. The Nucului and Victoriei streets do not form a transportation nod due to the low traffic flow on the Nucului St. This street forms the western limit of the proposed area for reconversion. Despite the good maintenance of the street, the adjacent arteries, with individual houses, do not have asphaltic floors.

Fig. 5. Analysis of transportation connections and nods

2.6. Landscape and open space character

A deeper analysis of the landscape character is provided in this section, with a deeper look at habitat and ecological value of the study area and provides a strong visual analysis of the sites characteristics. The landscape character type of the site is that of a riverside meadow in the south and a hill in the north. However, the environment has undergone significant alteration of the topography, hydrology and vegetation mainly due to hundreds years of heavy industrial use, mineral extraction and land filling. The Săsar mining site is split into two parts analysed individually in relation to their proximities. The north side has a mixed use of land, with industrial areas, housing areas, small surfaces of green spaces with a protection belt and spontaneous vegetation. However, the largest surface of the site is unused and presents severe soil erosion. A compositional and visual contrast between the industrial space and housing space is also present.

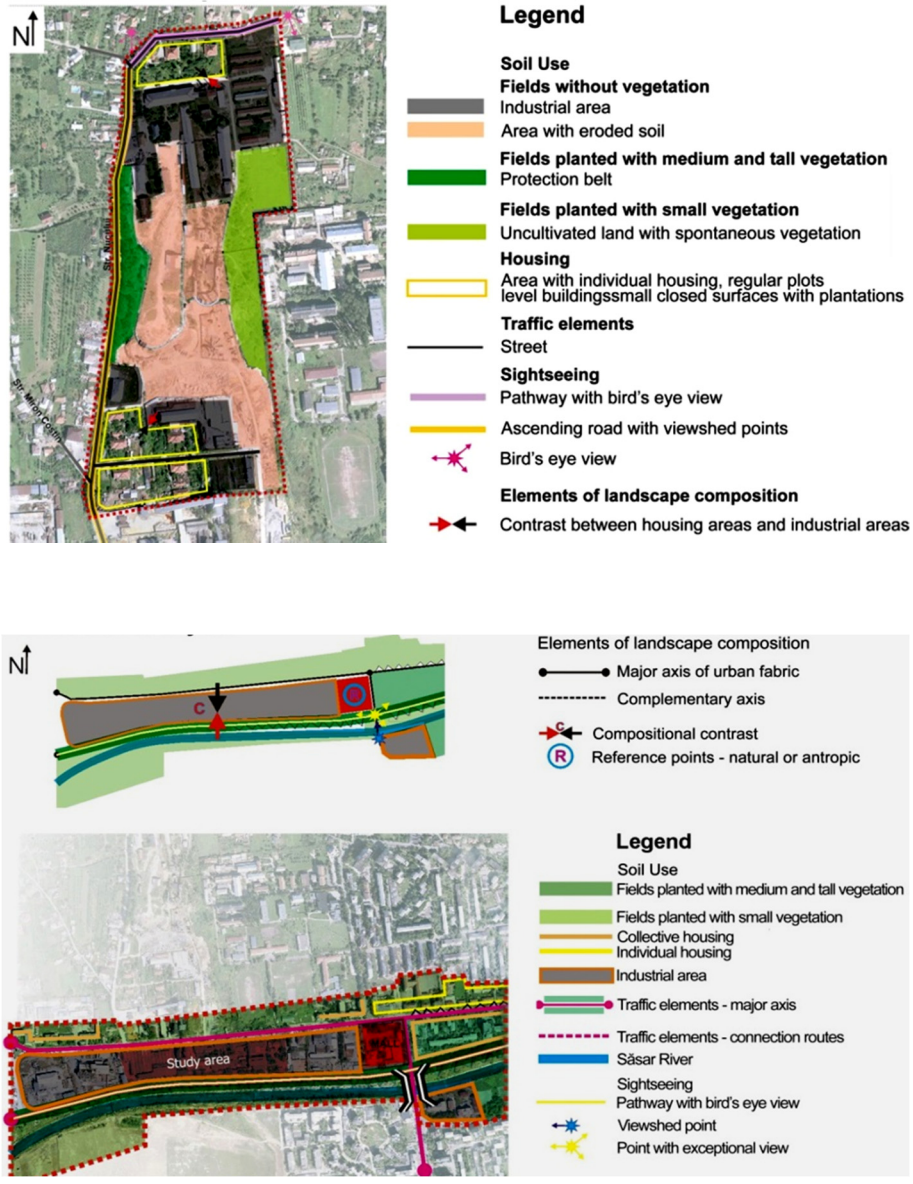

Fig. 6. Landscape and open space character of the northern and southern areas of the Săsar mining site (based on the official maps of the local administration)

3. RESULTS, RECOMMENDATIONS AND DISCUSSIONS

3.1. Environmental rehabilitation procedures

In general, the physical rehabilitation of the Săsar mine site will include:

- restoration of surface land including clean-up of the premises, levelling the ground and re-vegetation;
- establishing the nature of any water remaining in the open pit and treat it;
- ensuring that there is easy access to the water in the open pits;
- backfilling the open pits;
- rehabilitation of waste dumps including surface drainage, redesign of slopes to an acceptable angle and re-vegetation;
- rehabilitation of natural water courses directly affected by mining operations;
- collection and treatment of polluted mine water;
- treatment of surface soil wherever affected by mining activities;
- monitoring the results for a specified period after the completion of the remediation.

In order to minimise the risk of contaminated water leakage from the tailings dam, good management and active monitoring processes, such as the installation of piezometers and regular structural assessment around the existing tailings during and after rehabilitation processes, has to be implemented. The mining waters of the Săsar mine which are now discharged in the Săsar river course have to be collected in one point and treated. Water depollution in Baia Mare can be done with water treatment installations, but the existing ones don't function at their highest capacity and the technologies used in the process are old. The researches regarding new methods of water purification, have demonstrated that 'the cyan ion has the capacity of ozone oxidation until it can reach the admitted concentration limit estimated in the water management agreement' (Damian, 2008). Another solution could assert the supplying of water for the industrial plants from downstream. Maybe by applying this measure, the plants will be forced to maintain clean water.

The reconstruction of soils can be achieved by 'inserting nourishing substances and vitamins for the stimulation of micro flora multiplication, mineral and organic fertilization and the correction of acid by embedding calcareous and dolomitic amendments' (Damian, 2008). Clay is also recommended for re-establishing and increasing soil productivity. Vegetation is a natural barrier, and also a regenerative component for the soil. The growth of suitable and rational vegetation can favour the stability of tailings and can also provide protection against erosions and dust. Moreover, gangue can be used in other activities, such as: material for road bed or railway bed, construction of dams or dykes, filling underground cavities from the extraction industry, etc.

3.2. Premises for a cultural landscape

The possibilities of generating new socioeconomic dynamics of the former Săsar mine and 'performing actions to conserve the heritage and the cultural identity, are based on the exploitation of the potential of the cultural tourism' (Padró-Werner, 2000).

In the industrial sites there is a 'change in the perception of the resource, from a productive raw material to a consumptive viewing of the past' (Pretes, 2002). Moreover, this heritage represents 'the identity of the local community, the testimony, the signs and emblems from one prosperous and glorious past that helped strengthen the image and self-esteem of these populations' (Carvajal, 2002). According to Armesto-Peña there are 'in Europe at least five hundred sites in old mining exploitations which have been converted into mining museums, natural protected areas, leisure sites', etc., but in Romania I am not aware of any such reconversion project. The mining site and its related elements are considered to be a part of the local heritage because of their historic values. Nevertheless, the potential mining heritage tourism has four problematic points according to Edwards and Llurdés, which can also be applied to the Săsar mining site:

- the low attractiveness for people due to a different standard of beauty;
- the large size of the mining exploitation which make it very expensive to restore;
- the degradation of the environment due to the historical pollution;
- the location of the site is not included in the traditional tourist circuits of Baia Mare.

The buildings, refining centres, old machinery, factories, smelters, pit head frames are all elements present in the Săsar mining area which reflect the history of the human technology. There are some inventories of the mining heritage of the area which include mining machinery, underground galleries, open pits, etc. The mine has managed to preserve some of the old processing infrastructure, especially in the perimeter of Dealul Crucii. The uniqueness of its characteristics favours the preservation and the integration of these elements in a larger project for touristic and scientific purpose, with great benefits for the local community, administration and investors.

3.3. Reconversion and reintegration

Following the imposed restrictions and the possible opportunities, as well as the public opinion and research methods, the reclamation and revitalization project I have proposed in the Săsar mining area consists of a science centre with a mining museum and open green spaces. The science centre will offer educational programs for pre-school through primary and secondary students. These will consist of workshops, live science shows, competitions, etc. which will be related to the school curriculum or day to day curiosities. A specialized team could tour in the remote area of the county and work with under-privileged children. The centre could also offer games and experiments on various topics, which children will be able to do by themselves. The local planetarium could be moved and improved within the science centre. Agreements of collaboration could be made between the science centre and the local schools.

The centre will be expanded with a mine museum which will exhibit all types of material related to the history of mining in the county and it will be connected with the mine galleries of the Săsar mine through the old aerial railway route, which will be rehabilitated. People will have access in the mine through a railway track which will reach the Dealul Crucii perimeter, where preserved medieval dikes and installations can be seen. Hence, the Săsar mine will be given a touristic value with a great potential of attraction, but the local needs will be also taken into consideration. The northern part of

the Săsar site will be revegetated. A small park, green fields with playgrounds, bicycle tracks and skateboard ramps will be enhanced. The bicycle tracks could be connected to hill cycling routes and tracking paths because the area is very beautiful and has many bird's eye views. I have opted for a green space due to the small percentage of green surface in the city of Baia Mare. The total green spaces in the city sums up 80 ha, from which parks and recreation areas are around 14 ha. At the moment, the surface for each inhabitant of Baia Mare is of only 5.67 square meters, a very low value in comparison with the requested limit. Therefore, due to the lack of natural resources of the city and the environmental and health risk of the former exploitation activities, there is a need of expanding the green spaces and recreational areas in this neighbourhood.

A mining research centre with new technologies for industrial reconversions and sustainable landscapes, environmental and safety hazard control, waste management, etc., will be incorporated in the project. The centre will be the first kind in the country and will offer working places for PhD students and researchers. This initiative intends to teach the next generation of designers, geographers and planners to adaptively reuse waste and incorporate it into the urban fabric, to discover new forms of emerging waste and conduct projects with all types of landscape waste.

3.3.1. Functionality

The proximity of a sports base, the citizens' discontentment with the quality of the natural environment and the need to integrate the Săsar mining site into the functionality of the area, assert the necessity of a green space in the area. I would argue that the proposed project, which combines the green space functionality with the public utility, meets these requirements. The heterogeneous and discontinuous urban fabric in the area allows a certain liberty in organizing the building volumes of the science centre. The present connections between the elements of the urban frame are solved by the urban planning. Also, the buildings which are in an advanced state of degradation must be demolished because they represent a public risk and visually pollute the area. In relation to the character of the mining site there is the potential to strengthen distinctiveness by re-using the buildings and equipment which have industrial heritage, vary the building typology to integrate and connect with the existing context as well as create a new character founded on the need of green and sustainable solutions for the people and environment, imperatives on which the proposed project is built.The touristic industry could be sustained by the accommodation and food offered by the existing facilities in the nearby proximity. Also, the unused building of studio apartments located in the upper part can be converted into an accommodation facility for students, researchers or tourists.

3.3.2. Transportation

In relation to movement there is good access to public transport on the Victoriei road. A bus station could strategically be located in the proximity of the science centre. There is the potential of expanding the transportation network with appropriate connections into the site as part of the new development. New green pedestrian and cycle routes can also be supported, in particular in the northern part, which will be connected with theproposed park and integrated in the forest landscape of the nearby hill.

3.3.3. Landscape

The contrast between the industrial space and housing space could be ameliorated by creating new frontages which would open up the site. These could also be green frontages showcasing the potential green character of the site and use the new development project of the science centre and mining tourism to improve the physical and visual relationships with the existing land uses. The site must be given a new commercial character but the vivification of the green areas is also a priority. This could be done by combining leisure oriented spaces with the use and value of the mining galleries which would increase the local attractiveness of the area.In relation to the landscape there is also the potential to develop green infrastructure as a multi-use resource to include educational, water and mining heritage conservation and sustainability objectives by the programmes offered by the science and research centre. The existing landmarks and sightseeing can be highlighted from pathways and view shed points. Hence, new views and experiences of the site from the surrounding areas will be created.

By all these sustainable means, the importance of the area is highlighted and the levels of rationalization and awareness of the local population and tourists regarding the pollution effects and the need to protect our environment will increase and will be directed towards better alternatives for the development and planning of our natural resources. I think that this project meets the objectives of the local strategy of sustainable development through the diversification of the recreation means which do not endanger the surrounding environment and which consolidates the relation between humans and nature. Furthermore, it could become a main attraction for tourists of all ages from all over the country and could bring great benefits for the local economy.

4. CONCLUSIONS

The necessity of searching for economic alternatives in traditional mining sites has found in the cultural aspects of the mining a good source to attract tourists. However, the steps are difficult due to the numerous constraints that appear in the mining communities. In Baia Mare this projects could have the potential to attract tourists on diverse aspects such as: industrial heritage, artistic, cultural and scientific aspects. The proposed project would be useful in order to preserve the identity of the town and also to generate economic flow. Authorities see the tourism like the key for the economic development of the county, but new touristic values need to be defined if the town is going to play an active role and/or a collateral role. The implementation of rehabilitation measures will lead to a geo-ecological balance in the area of the Săsar mine, affected by the extraction activities. The complexity and magnitude of the reclamation works in the mining zone have to be integrated into a well-structured local and regional program in order for the degraded fields to regain economic value. The short term costs have to be set off against the long term benefits, primarily for the benefit of the local community.

I believe that the mine closure planning will evolve into an integrated model which incorporates all three 'pillars' of sustainable development: environmental protection, economic and social development. Mining offers more solid material than any other industry.

'This should create the opportunity for imaginative post-mining land forms that either fit specific recreational or economic activities or that catch the eye and attract tourist visits (Conesa, 2010). The project is in conformity with the character of the area, meets the requirements of the regulatory framework, aims to increase the green area in the city, preserves the mining heritage, brings innovative research and opportunities for young people, encourages the educational programs and is built on sustainable development principles. The project supports the existing food and accommodation facilities and promotes the local economy. Following all the above arguments, I can state that the proposed reconversion project would be an asset for the city of Baia Mare.

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THE NIGERIAN GAS MASTER-PLAN, INVESTMENT OPPORTUNITIES, CHALLENGES, ISSUES AFFECTING POWER SECTOR: AN ANALYSIS

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ABSTRACT. The Nigerian Gas Master-Plan, Investment Opportunities, Challenges, Issues Affecting Power Sector: an Analysis. The objective of this article is to contribute towards understanding of the Nigerian Gas Master Plan (NGMP/Plan) and its bifurcations with key socio-economic development factors. I applied the method of discourse to bring to being some points that have hitherto been unknown about the Master-plan and its inter-relationships and bifurcations. Elaborated here are the spectacular gains that have accrued to the Latin American country, Trinidad and Tobago, from its recent development of natural gas resources. This was considered suitable and significant here for highlighting that if such spectacular achievements could be realized from Trinidad and Tobago's relatively smaller gas deposit (15.3 tcf), probable reserves (8.4 tcf), possible reserves (6.2 tcf) would be by far greater considering Nigeria's larger natural gas reserves (184 tcf) wealth as earlier stated. I show that the Plan is well designed relevant to addressing Nigeria's current development needs generally. It presents potentials for stimulating Nigeria's economic growth by harnessing the country's abundant natural gas reserves. The Plan enumerates/ elaborates huge investment opportunities. Some challenges likely to be faced in the implementation/management of the Plan are already being surmounted as recent reports show that some of its key investments have been realized and the required infrastructure are being provided. Regarding the issues in the Master-plan that are likely to affect and are affecting Nigeria's power sector development, I reckon that they are mostly positive factors due to the way the plan promises to stimulate electricity generation in our country.

Keywords: *Master-plan, Nigeria, power, challenges, investment opportunities, power.*

1. INTRODUCTION

1.1. The spurt in gas consumption in Nigeria and matters arising

The trend in energy consumption in Nigeria since 1975 has been characterized by increasing demand for natural gas. In 1975, gas demand experienced a surge while by 2005 an explosion in gas demand occurred and has experienced increases thereafter.

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Forecast show that the extent of global gas demand level was going to exceed 20bcf/day by 2011, exceed 25,000 MMS of gas volume utilized by 2015 (Yar'Adua, 2007). The foregoing explosion in gas demand led to the conception of the Nigerian Gas Master-plan. Those who view the Nigerian Gas Master Plan (hereafter NGMP) describing the documents that have launched by NNPC (Ige, 2008, Yar'Adua, 2007) for promoting the country's natural gas development and myriad related follow-up activities afterwards as well as activities undertaken and ongoing concerning management including implementation) represents the "renaissance" for Nigeria's socio-economic and environmental resuscitation. Although, dedicated exploration for gas is yet to be done as systematical mapping and purposeful way rather than estimated through exploration activities aimed at discovering petroleum oil, Nigeria's natural gas reserve has been acknowledged to be very large (Ige, 2008). With proved reserves of 182 trillion cubic feet (tcf), Nigeria has been ranked at the seventh position of the world largest. Nigeria's natural gas wealth is not only so adjudged in terms of the large quantity, its zero per cent sulphur content and richness in natural gas liquids makes it to be reputed to be of the highest quality that is fondly described as "sweet".

Therefore, the above assertion that the Nigerian Gas Master-Plan represents a renaissance for socio-economic and environmental development arises from an informed study and understanding of the Master plan's mission, vision, and commitment of its engineers and architects. The visionary and promising contents of the NGMP are exactly what Nigeria has required and ought to have undertaken many years previously to replicate "the Gas Revolution" that started bearing fruits in the USA, among others are accomplishing through application of new technologies (hydraulic fracturing or "fracking") for transforming their economies/societies. The latter involves strategic energy sector planning and management that have facilitated accomplishments or caused turns-around involving dynamisms in institution, processes, structures, and attitudes, acceleration of economic growth, reduction of poverty (Kolb, 2014; Todaro, Smith, 2005) among other achievements that persuade concerned scholars to described the foregoing changes as "the Gas Revolution" in other economies that have undertaken to manage natural gas resources by utilizing strategies capable of harnessing natural gas resources to achieve socio-economic-environmental development goals and objectives thereby raising living standards considerably (Kolb, 2014). Rather than undertaking energy revolution, Nigeria's energy landscape has for too long been kept to either stagnate, decline or "submerge in a quagmire" that has trapped or captured attempts and opportunities for achieving economic growth and socio-economic development to the extent that it could be tolerated if someone say that any attempt at change is permissible. However, attempts at changing Nigeria's energy landscape have been few. If any, they have either been scams or belonged to categories of the mediocre: not effective.

1.2. Objectives

The general objective of this article is to contribute towards understanding of the Nigerian Gas Master Plan (NGMP) and its bifurcations with key socio-economic development factors.

1.3. Organization

In the rest of this article, I present (in appropriate section, as labeled) materials relevant for achieving the following specific objectives drawn from the title of this study/article. I begin by elaborating a theoretical-conceptual framework of innovative (economic development) planning/management as befitting the natural gas revolution and in fact any comparable innovative large-scale undertaking. I follow on by showing the huge gains that have accrued to the Latin American country, Trinidad and Tobago, from its recent development of natural gas resources. This is significant for many reasons including highlighting that the spectacular achievements realized from Trinidad and Tobago's relatively smaller gas deposit (15.3 tcf), probable reserves (8.4 tcf), possible reserves (6.2 tcf) would be by far greater considering Nigeria's larger natural gas reserves (184 tcf) wealth as earlier stated.

Then, I relate the latter to the former i.e. the natural gas revolution to innovative planning/management by elaborating the latter almost immediately after the former. However, I present the method adopted for implementing this study before the natural gas revolution. I follow on by examining investment opportunities capable of being spurned by the NGMP (as has been known/experienced by other economies that planned-managed-implemented large-scale gas revolutions). I examine challenges: those generally associated with the NGMP and more specific challenges in the nexus of Nigeria's embattled electricity/power sector. Afterwards, I conclude the paper by summarizing its key points and recommending strategies for enhancing the NGMP management such that the expected benefits to the power sector are realized for the facilitation of national economic growth.

2. THEORETICALLY AND CONCEPTUALLY FRAMING THE NIGERIAN GAS MASTER-PLAN ON NEO-LIBERALISM

This study presents features that make it amenable to elucidation by drawing from the perspectives offered by the doctrine of neo-liberalism. However, considering the need to avoid repeating my earlier espousals of the violent character of this doctrine, (neoliberalism) (e.g. Ingwe, Ukwayi, 2014, among others), I adopt only two of its multiple perspectives here. Of the four major understandings/interpretations of neoliberalism recently clarified, the following are brief elaborations of the two selected versions.

2.1. Ideological hegemonic project perspective

Neo-liberalism in this sense denotes organized class-based alliances whereby the elite who apply their dominance (influence) to contrive programmes that are usually designed to foist on the weaker majority images of the world preferred by them (elite). Some people of central interest under this neoliberalist conception include: those who willingly consent to domineering influences; people who conceive neo-liberalism and the specific ideas they create; and people who lead in consenting to or adopting the ideas and actions foisted by dominant groups (Springer 2012, p. 136 citing Cox 2002; Dumẽnil and Lẽvy 2004; Harvey 2005; Peet 2002; Plehwe et al., 2006).

2.2. Policy and programme

This dimension of neo-liberalism connotes systematic reworking of certain specific categories including ownership and management of economic activities and production systems by either the State (or public sector) and/or private (businesses) in such a way that the latter –who are most related to or are themselves business owners – make themselves heirs "qualified" to take over the wealth, corporations and establishments hitherto owned and controlled by the public/State. The motives usually employed in the systematic reworking of socio-economic and political re-configuration of societies include: privatisation, liberalisation, deregulation, depoliticisation, and monetarism (Springer 2012: 136 citing Brenner and Theodore 2002; Klepeis and Vance 2003; Martinez and Garcia 2007; Ingwe, Ukwayi, 2014).

3. SOCIO-ECONOMIC CONTEXT FOR UNDERSTANDING URGENT NEED FOR SOCIAL DEVELOPMENT POLICY MAKING IN NIGERIA

Nigeria's population projected at 169 million has been nearly 20 percent of sub-Saharan Africa (SSA)'s total population (732.5 million, 2005) (Nigeria, 2007, 2007b, WRI, UNDP, UNEP, World Bank, 2005, p. 177). Nigeria has been better known for oil than gas for many reasons. First, emphases on exploration for oil has led to discoveries of large proven oil deposits (4,635 million metric tones of oil equivalent (*mtoe*) of oil and 4497 *mtoe* of natural gas (WRI et al, 2005: 201). Second, Nigeria's has occupied enviable positions of being one of the world's leading oil producers/exporters. Third, oil export has earned for Nigeria an average of between US$15-US$20 billion annually since the 1970s to the present (Adams, 1991). Unfortunately, a disproportionately large part of these earnings have been stolen by the elite (who constitute less than one percent of the total population). It is reported that Nigeria's US$1 billion was stolen in 1978 by military dictators who were in power between 1976 and 1979. Between US$50- US$ 210 billion was reportedly stolen by the Sani Abacha dictatorship between 1993 and 1997 (Ingwe, 2014, Lombardi 1986 cited in Adams, 1991, Omojola, 2007: 20-35, Ribadu, 2009). The consequence of this high level of corruption on the health sector is gross under-funding and mass poverty. About 70.2 and 90.8 percent of the nation's population lived on less than US$1/day and US$2/day respectively in 1997 (WRI et al, 2005, Ingwe, 2009). Nigeria's ranking on the human development index (where the most developed country was represented as "1") was only 0.47.

Electric-power production and supply oscillated between 2,000MW to 5,000MW daily for distribution to the nation's population projected at about 161 million (Ingwe, Anwunah, Ojeigbu, Martins, 2014, Business Day, 2011, p. 21, Sambo, Garba, Zarma, and Gaji, (no year)). At this moment of expectation (Nigeria's gas sector is being constructed and yet to realize its full potentialities, we can only project the gas sector's job creation potentials by drawing from its track records in nations that are reaping from the ongoing "…Gas Revolution" (Kolb, 2014). Following brief reports of direct and indirect jobs created by gas in the US were: 37,000 new direct jobs (2011); the latter direct jobs in the United States' oil and natural gas extraction activities were responsible

for creating (or drove) the creation of another 111,000 U.S. jobs related to industries that supply the energy industry with goods and services. That is, "for every one new job in the U.S. oil and gas industry, three more new U.S. jobs were created elsewhere" (ExxonMobil Perspectives, 2012).

4. COMPARING WITH TRINIDAD AND TOBAGO'S NATURAL GAS SECTOR

This Latin American country provides a lesson for understanding the potential of Nigeria's Gas Master Plan to fuel economic transformation. A 2014 update of this economy's characteristics revealed that oil and gas contributed about 40% to the GDP and 80% of exports while employment got only 5%. Over the last decade, the country's economic planning has focused much more of its efforts on natural gas sub-sector development implying decline of its oil production. However, the decline in oil sub-sector contribution or share is attributed to declining reserves, itself resulting from reduced (or lack of) government investment in the sub-sector, and the changing global gas market (provoked by the unconventional gas growth in the USA and spreading elsewhere) –issues that are have raised (are raising) concerns for the long-term growth of the country's gas (and other general energy) (sub)sector.

The country's non-associated natural gas reserves were reported by Ryder Scott (as at 2009, 1st January) to possess the following: Proved reserves (15.3 tcf); Probable reserves (8.4 tcf); possible reserves (6.2 tcf). Additionally, "exploratory resources" were reportedly (29.6 tcf). Trinidad & Tobago's natural gas derived from its fields is primarily classified as "sweet" gas -comprising 0.1% - 0.35% carbon dioxide and negligible sulphur compounds (Hamel-Smith & Co, 2013). Some important achievements of Trinidad and Tobago's gas sub-sector deserve mention here. First, Trinidad and Tobago's population have been enjoying cheap electricity, which is derived from its natural gas applications in the context of the country's increasing renewable energy sector's recent garnering of momentum for growth thereby strengthening the overall energy sector. Second, many products derived from natural gas constitute major exports of the economy. The include petroleum oil and natural gas-based industrial products such as liquefied natural gas (LNG), methanol, ammonia, urea, that add to other export products (steel, beverages, processed food, cement, cotton textiles). Third, the economy's gas sub-sector contributes towards the low unemployment rate (5.6% 2012 estimate) in comparison to the higher rate for the world (56) 5.5% (2011 est.) as well as a good scenario of population living below poverty line (17%, 2007 estimate. Fourth, that this economy receives one of the highest rates of investment globally, exhibits one of the highest levels of per capita incomes in Latin America has much owed to the gas (and oil) economies (Theodora.com, 2014). Fifth, I present in the following the approximate gas use by sector in the country of Trinidad & Tobago: Petrochemicals 27%, Power Generation 7%, Iron & Steel 3%, LNG 60%, Own use (Field) 1%, Gas Processing 1%, and Light industrial and others 1% (Hamel-Smith & Co. 2013). We realize from the foregoing uses how gas has been applied in manifold sectors of the economy. It is apposite to examine the objectives of the Nigerian Gas Master-Plan with a view to noting how it addresses or how it promises to address the foregoing problematic scenarios.

5. THE NIGERIAN GAS MASTER-PLAN

I now turn towards analyzing the Nigerian Gas Master-plan.

5.1. Objectives of the Nigerian Gas Master-Plan

The general objective of the Nigerian Gas Master-Plan is to stimulate the country's economic growth through natural gas sub-sector development. This strategy was decided on following the economic histories (studies) of similar strategies and success stories of gas development in other countries (see, lessons from Trinidad and Tobago, in this article). Following are specific objectives of the Nigerian Gas Master-Plan. To maximize the multiplier effect of gas in the Nigerian economy, some key strategies would (are being undertaken). Some of those include using gas to facilitate the performance of electric-power generation (this aspect shall be elaborated in one of this paper's sections later). Up-scaling of domestic LPG and public transportation based on compressed natural gas, and stimulation of wide-ranging industrial development using natural gas products such methanol, ammonia, urea, chemical fertilizers, among other products that can both be consumed locally and exported to obtain foreign exchange.

To optimize Nigeria's share and competitiveness in high value export markets, some more specific thoughts/plans were considered. These include discriminatory participation in high value markets and strategic positioning of relevant aspects of these economies/products in the market as a means of achieving economic growth.

To achieve the third specific objective (of guaranteeing long term gas-security in Nigeria), a sustainable development approach involving consideration of ensuring trans-generational needs are met through the application of ecological principles of gas (resource) management (Yar'Adua, 2007).

5.2. Investment opportunities in Nigeria's gas Master-plan

Manifold and massive investment opportunities are both presented and promised by Nigeria's larger and growing natural gas sub-sector of the energy sector. Detailed data and information gathered from the Nigerian Gas Master-Plans road-shows in multiple locations (London, Singapore and Abuja, between 15th May to 23 May 2008) reveal distinct categories of investment opportunities in Nigeria's rapidly evolving gas market that have been identified. The natural gas infrastructure blueprint comprises two key investment categories. They include: gas gathering and processing facilities, CPF, and gas pipeline transmission systems (plus compressor stations). The strategy for the latter deserves brief statement.

Strategies for gas infrastructure development

Since there are two key investment categories of the gas infrastructure (gas gathering and processing facilities, CPF, and gas pipeline transmission systems (plus compressor stations), these briefs on the strategies shall cover both as follows.

Strategy for development of gas gathering and processing facilities, CPF

This involves developing dedicated to gas gathering and processing to form three gas hubs in Nigeria. Their labels/designations and locations are: West Delta (Warri and Forcados environs); Obiafu (West Port Harcourt); and Akwa Ibom and Calabar axis. The plan is to constitute these into centres for treating wet gas, extracting LPG/NGLs, exporting lean gas into transmission systems. The organization of investment is based on plants' ownership and operation as tolling facilities serving the needs of third party gas actors. Third party gas can also be purchased and accessed.

Strategies for development of gas pipeline transmission systems (plus compressor stations)

This involves developing infrastructure dedicated to gas pipeline transmission systems (plus compressor stations) to distribute gas areas of need e.g. Nigeria. Two major features of this infrastructure category are: development of three gas transmission systems based on independent operation; and, management of an inter-connected gas transmission system.

5.3. Challenges in Nigeria's Gas Master-plan

The major challenge of Nigeria's gas master-plan is supply. This problem that is viewed as particularly relevant to the domestic market is underlain by five factors. They include: availability, affordability and commerciality of supply, deliverability and its cost-effectiveness, legal and regulatory framework, and funding. Some expatiation of the foregoing specific challenges would enhance clarity. The challenge of supply availability pertains to three aspects. First, export orientation of the gas sub-sector since inception (the NLNG establishment mindset as was foisted on dictators by some IOCs or "Seven/ Eight sisters", which own the NLNG company. Others concern the proven reserves of rather short-term and medium term; and development of gas reserves. Regarding the affordability and commerciality of supply challenges, three concerns are also highlighted. The latter pertain to: pricing of gas (products); securitization of revenue; and, inadequacy of bankable gas business agreements. Concerning the challenges in the nexus of deliverability and its cost-effectiveness, their two dimensions are: adequacy of gas infrastructure and costs and flexibility of infrastructure. Legal and regulatory framework poses challenges in terms of gas legislation. Funding challenge relates to guaranteeing gas infrastructure and developments. The strategic solution of the Nigeria's gas master-plan to this challenge is the decision to address them in a holistic way.

5.4. How Nigeria's Gas Master-plan affects Nigeria's power sector development

For the avoidance of doubt, Nigeria's ongoing power sector resuscitation is anchored on gas supply as capital for powering independent power producing plants (IPPs) that are expected to cause substantial increases in the amount of electricity. How the Nigerian Gas Master-Plan affects the country's electricity sector could be comprehended through the related and the specific gas development programme known as the Nigerian

Electricity and Gas Improvement Project, NEGIP, or "Gas-to-Power" and the gas supply and aggregation involving IOCs (SPDC, Chevron, and others), the Nigerian Government electric-power company, Power Holding Company of Nigeria, PHCN. The latter is financed by a World Bank credit of US$400 million for the purpose of providing a series of partial risk guarantees. It is a component of Nigeria's Government Power Sector Reforms and CPS that was inaugurated in 2005 and has run through 2009 up to the present. The CPS advocated development of key infrastructure including power, gas, and transport (World Bank, 2009). The Master-plan's launching was in conformity and bodes well with Nigeria's electric power policy (inaugurated in 2001), Nigeria's Electric Power Sector Reform Act (EPSRA) enacted in 2005 that outlined clear power reform objectives and launch of the electricity sector reform road-map in August 2010.

The conformity is specifically marked by the Gas Master-plan's design to stimulate and offer enormous investment opportunities that could be complemented by those investments from the power sector undergoing reforms. The gas-to-power component of the Nigeria's Gas Master-plan is guaranteed through the provision of private risk guarantee (PRG) valued at US$ 1.2 billion by the World Bank and additional US$ 184.2 million by the African Development Bank. Additionally, the gas-to-power is also guaranteed or assured by the legal mechanisms of "pay-or-take" obligation, among other risk aversion schemes (Ayoola-Daniels, 2014).

6. CONCLUSION

This study has analyzed –after examining three issues categories in the nexus of the Nigerian Gas Master-Plan: the investment opportunities contained in it, the challenges it faces, and issues in the Master-plan that are affecting and would affect Nigeria's power sector development. I conclude as follows: the Nigerian Gas Master-plan is a well designed document that is relevant to Nigeria's development generally. Specifically, it presents potentials for stimulating Nigeria's economic growth by harnessing the country's abundant natural gas reserves. It offers huge investment opportunities as enumerated above and elaborated in the document. Although, some challenges are likely to be faced in its implementation and general plan management, there are problems that are being surmounted as recent reports show that some of its key investments have been realized and the required infrastructure are being provided. Regarding the issues in the Master-plan that are likely to affect and are affecting Nigeria's power sector development, I reckon that they are mostly positive factors due to the way the plan promises to stimulate electricity generation in our country. The implication of the plan for policy is that its objectives and goals are sufficiently laudable making it to deserve to be implemented to its logical conclusion such that all of its purposes are achieved.

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GROWTH POLE DEVELOPMENT AND 'METROPOLIZATION' IN POST-SOCIALIST ROMANIA

J. BENEDEK[1], M. CRISTEA[1]

ABSTRACT. – Growth Pole Development and 'Metropolization' in Post-Socialist Romania. During the transition period the spatial planning institutions of Romania have undergone a constant and radical change from the communist system, based on state led industrialization and urbanization to a more flexible and democratic system. Among this changes are those induced by the creation and implementation of new forms of territorial governance, like the metropolitan areas, initiated in 2001. Since then the 'metropolization' process has advanced, more than 10 metropolitan areas being created, while many others have been proposed and are still in a pilot phase. One of the main features of this new spatial category is that it is based on major urban centres, which plays also the role of national growth poles. Therefore, we are asking in this paper for the linkages between the construction of metropolitan areas and the selection of growth poles, two questions which apparently differ, but they proved to be strongly interconnected in Romania.

Keywords: *growth poles, metropolization, polarization, spatial planning, regional policy.*

1. INTRODUCTION

In the last two decades, the planning system in Romania has undergone a strong europeanization process (Stringer, Scrieciu and Reed, 2009; Tănăsoiu, 2012; Benedek, 2013). As part of this process the general guidelines and principles of the European spatial planning documents have been overtaken in the Romanian spatial planning system (Puşcaşu, 2009; Cotella, Adams and Nunes, 2012; Benedek, 2013). One of them is represented by the growth pole concept which was widely used not only in the selection process of the urban centres as growth poles but in the delimitation of the metropolitan areas as well. The Regional Operational Programme (ROP) 2007-2013 has incorporated the above logic, with the priority axis 1 sustaining the urban growth poles with 30% of the total budget (MRDT, 2012).

In fact, the combination of these two concepts: growth poles and metropolitan areas, among others, gives a certain specificity to the Romanian spatial planning system. Therefore, the main aim of the paper is to analyse the introduction and development of the concept of metropolitan areas in Romania.

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Among the investigative themes for metropolis building: policy, democracy, governance, space, planning and finance (Jurczek, 2008, Bunker, 2009) we will focus on questions related to space and territorial planning, assuming the hypothesis, that there is a distinctive style of using the concept of metropolitan areas in the Romanian spatial planning practice In a different context Bunker considers that metropolitan strategies may have different features reflecting space, society and governance (Bunker, 2009). He argues that these three characteristics shape spatial discourses embodied in metropolitan plans, or, in other words, in the planning practice. We assume in this paper the same logic, rooted in the institutional arrangement of Romania, where urban space development and metropolis building are embedded in the wider planning institutional practice.

The conceptual debate about metropolitan areas started late in Romania, following the adoption of the Law nr. 315/2001 for Spatial Planning and Urbanism. In the last years it has meanwhile become a constant in spatial planning and urban geography research (Groza, Coudroy de Lille and Paftală-Ciubotărița, 2010; Popescu, 2011; Ianoș, Peptenatu, Drăghici and Pintilii, 2012; Rusu, Moldovan and Petrea, 2012; Georgescu I., Mitrică B., Kucsicsa G., Popovici E.A., Dumitrașcu M. And Cuculici R., 2012; Benedek, 2013). While in the past geographical and spatial planning studies areas of metropolitan character were described as 'conurbations' or 'systems of cities' (Cucu, 1970; Ungureanu, 1980, Ianoș, 1987; Ianoș and Tălângă, 1994), the concept of 'Metropolitan Areas' first has been introduced in 2001 in the New Spatial Planning and Urbanism Law. They are defined as 'territories surrounding major urban agglomerations, where strong transportation, economic, social, cultural and infrastructural interrelations are established' (RP, 2001a). They differ from the 'Suburban Areas', which are 'territories surrounding cities, where economic, infrastructural, commuting and leisure interdependencies are established' (RP, 2001a). With other words, major cities are considered as cores of their influence zone, being able to form metropolitan areas, while medium-sized or smaller cities can build suburban areas.

Following the EU admission of Romania the Law of the Urban Growth Centres prescribes new role and responsabilities for the metropolitan areas of the Capital and 1 tier cities. In this new context, Romanian urban growth poles are defined as polarizing cities, transport hubs, concentrating economic and cultural activities, which will benefit with priority from European and national financing (MDRPA, 2008, MRDT, 2012). This process of institutionalization of certain urban agglomerations in Romania as metropolitan areas and growth centres reflects the dynamic characteristic of the definitions. On this legal basis the metropolitan areas have been assigned in a bottom-up approach, as local initiatives, unlike in Germany, for example, where they have been appointed by a central body (Jurcek, 2008). Although the Law 350/2001 foresees explicitly that metropolitan area in Romania should be 'delimited on the basis of special studies', there is no such empirical foundation.

But taking a further critical view on the unreflected und uncritical takeover of planning instruments like the metropolitan areas, we can note that Romania has one single urban agglomeration (Bucharest) corresponding to the international standards of the metropolis definition. For the rest of the urban centres the most appropiate concept would that of urban regions, as defined by Jerome Pickard: regions with high concentration of urban activities and urban population (Pickard, 1966).

Although some coliding tendencies are evident in the case of some larger cities (Galați-Brăila, Hunedoara-Deva, Arad-Timișoara), facilitated by short distances between them, as are in the case of conurbations dominated by a larger urban center (Brașov and

Valea Jiului conurbations), but we are still far from the „megapolitan regions as integrated networks of metropolitan areas, principal cities and metropolitan areas" (Lang, Knox, 2009, p. 795) of the post-industrial societies like the USA.

In the following parts we will give an overlook about the major transformation processes (concentration, polarization, local and regional cooperation) which affected the urban space in Romania (part two); the building process and current legal status of the metropolitan areas, understood as a process of institutionalization of multiple relations establiseh between major urban centres and their suburban rural area, resulting in the creation of metropolitan area („zone metropolitane" in Romanian), as a tool of territorial governance and spatial planning (parts three and four); and finally we conclude with the future prospects related to the use of this concept in spatial planning and regional policy (parts five and six).

For the empirical part of the paper we use the data offered by the National Statistical Institute, but the paper highly relies on the analysis and evaluation of spatial planning documents, legal framework and regional policy document.

2. TRANSFORMATION OF THE ROMANIAN URBAN SPACE

Following the collapse of socialism in 1989, as in all Central and Eastern Europe countries, the conditions of urban development in Romania have changed radically. In the 1990's the transformation of the cities was determined by processes like the political democratisation (stronger local power over the economic development), the increased globalisation of the economy, the privatisation of the enterprises and of the real estate market (market forces becoming predominant in the transformation of the urban space), European integration, deindustrialisation and structural transformation of the economic base (Benedek, 2006). The transformation of the society followed the changes in the economy: there is a significant social polarisation between large marginalised social groups (retired, unemployed, Roma) and an emerging middle and upper class.

The ensemble of these significant processes lead to the transformation of the settlement network and a significant change in the spatial structure of towns in a very short time. The major shift is represented by a strong differentiation in the hierarchy of urban settlements. This major changes led to the dismantling of Romanian cities, to the dissolution of compact cities with more varied housing forms, and mixed land uses, varying densities, increasing car ownership and use, high reliance on the car in the urban transport, lack of a good urban design and shaping places in suburbia.

In the same time - after a long period of non-planning when urban planning was in the doldrums - we assist to the revival of a controversial urban planning, with two generations of plans (1999 and 2012), trying to counterbalance the dominant market forces of urban development. The urban development plans are prescriptive, dominated by land use considerations, and lacking considerations for the infrastructure needed.

The cities has chosen different adaptation ways to the new macroeconomic and political situation, according to their potential and the development level of their institutional network. The geographical location has played an important role in attracting foreign investments, which are concentrated in Bucharest, in the large cities in the Western part of the country (Transylvania) and in a few large cities concentrating innovative and attractive large industrial enterprises (Galați-Mittal Steel, Pitești-Renault, etc.). As a consequence, a strong differentiation in the settlement hierarchy has emerged: the large

cities (Bucharest, Timişoara, Cluj, etc.) with developing services are in a favourable position and can be considered the winners of the transition period, as well as the towns where the manufacturing industries producing a high added value are dominant (Piteşti, Sibiu, Târgu Mureş, Alba Iulia etc.), the seaside urban agglomeration (Constanţa-Năvodari-Mangalia) and the urban regions at the western border. On the other hand, the small and medium-sized towns, the declining industrial centres, the mining towns and the county centres with artificially inflated population, with limited local resources are in an unfavourable position.

The morphology of the cities is still characterised by the dominance of nucleated forms, with clear tendencies to a deconcentrated development in the post-socialist period, especially at their edges. We can identify in metropolitan areas all of the six types of nodes identified by Hall (Hall, 2001): historical centres (traditional downtown centres by Hall); newer business centres, developed at the city edges or in older residential areas with high population densities and, therefore, with an importan local consumer market; new residential districts (internal edge cities by Hall) as a result of pressure for space; suburban centres (external edge cities), situated alongside of major transportation axis, which permits facile linkages to the urban centre; outermost edge city complexes, situated at 10-20 km from the main urban centre, near to major transport axis, in form of large space consuming logistical centre sor offices for research and development; specialized subcentres for entertainment and sporting complexes. This is an expression of the intensifying polycentricity of the metropolitan areas and the „valorization" of certain residential or old industrial districts.

New types of **connectivities**, new **commuting patterns** between urban centres and the rural countryside has emerged, resulting in the suburbanisation of population and services. There have been major changes int the real estate investment, the spatial structure and functions of metropolitan areas. New urban and suburban landscapes have emerged driven by neoliberal policies, demographic shifts, economic restructuration, spread of digital telecommunication, **increased automobility**. As a consequence, the functional relations, the economic interdependencies of the urban networks have been reshaped, the classical policentricity models have been contested and challenged.

Paralell to the economic restructuration of the cities, a counterurbanization process has emerged, a process of population deconcentration, starting with the year 1996, when the urban-rural migration become the dominant form of internal migration (fig. 1).

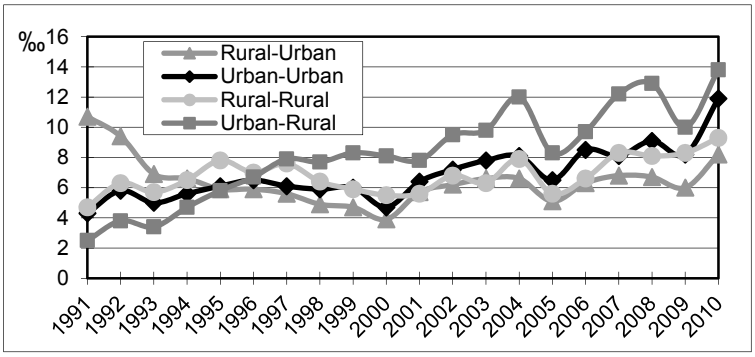

Fig. 1. Intensity of internal migration by settlement categories
Source: National Institute of Statistics, TEMPO-Online time series

Generally, the demographic conditions for the development of the Romanian cities during the transition period were not favourable. The strong fall of the total population of the country, from 23 millions in 1992 to 20 millions in 2011, has influenced the cities population as well. The dynamic of urban population has been marked by constant negative natality rates (under 9‰) since 1995 and mortality rates (over 9‰). As a concequence, all cities have lost population, but the most affected have been the medium sized cities (20 000-100 000 inhabitants), where the industry has lost many workplaces and the most cities from this category are unattractive for new residents. The forecasts are showing in the same direction: while the urban centres will loose population their suburbs will gain new residents, strenghtening the metropolisation.

3. THE "METROPOLIZATION" PROCESS, AND SOCIO-ECONOMIC CHARACTERISTICS OF THE METROPOLITAN AREAS

The spatial organization of Romania has undergone major transformations during the past twenty years. The new demographic trends (international out-migration and urban-rural internal migration) and the structural changes in the romanian economy resulted in a new territorial distribution of population and economy. The dual character of the Romanian spatial structure (capital city/provinces) has been further strengthened, dominated by the core regions of the capital city Bucharest and a few regional urban centres (Timişoara and Cluj in particular), which are regarded as the main engines of the deepening regional disparities. As a consequence of the post-socialist urban territorial expansion and of the establishment of the supralocally administrative cooperations they form the basis of the 'metropolization' process.

We assume that the 'metropolization' in Romania has taken a particular character reflecting the distinctive features of the Romanian society, space and governance. Under the circumstances of neoliberal economic measures (privatization, market liberization, etc.) an important factor of the metropolization is represented by the increasing transportation, the development of the tertiary sector (retailing played a crucial role), the upgrading of the suburban settlements.

The key moment of the 'metropolization' process in Romania is considered to be the adoption of a new territorial planning document in 2001, *National Spatial Development Plan – Section 4: The settlement network*, (Law no. 351), which has differentiated 12 cities in Romania ranked 0 and 1, that are allowed to establish metropolitan areas. The list of such cities includes the capital-city Bucharest (rank 0) and another 11 cities ranked 1, namely: Cluj-Napoca, Iaşi, Timişoara, Constanţa, Craiova, Galaţi, Braşov, Ploieşti, Oradea, Brăila şi Bacău.

Since 2008, on the basis of a new legal document, the local public authorities have gain a new plan-making authority, being able to elaborate territorial development strategies - considered as integrated spatial planning documents - for metropolitan and suburban areas. The latest aims to assure coherent and sustainable development, the correlation of development priorities, the use of natural and cultural resources, and to assure the efficiency of public investments (GR, 2008).

Few weeks after adopting the New Spatial Planning Law, the Law of the National Spatial Development Plan, Section 4: Settlement Network defines again the Metropolitan Areas as "areas formed through the voluntary association between the major urban centers (the Capital and tier 1 cities) and urban and areas areas situated at maxim 30 km from

these urban poles, with strong cooperation in many fields" (RP, 2001b). Furthermore, the modification of the Law of Local Public Administration (RP, 2011) have extended the right to form metropolitan areas from tha capital and tier 1 cities to all cities, which are county seats.

At the moment, only 9 of these cities have established functional metropolitan areas that are NGOs of public interest, the so-called "*intercommunity development associations*", created through the voluntary association of the cities and of the surrounding settlements. The only cities that have not established metropolitan areas are Bucharest, Galaţi and Brăila, the last two actually forming one conurbation since they are located at a distance of about 20 km from each other.

The definition of the 9 functional metropolitan areas in Romania was made, in most cases, without a sound scientific basis, but starting from the existing cooperation relations between municipalities and even the mayor's political affiliation. The only metropolitan areas that were established based on the previous feasibility or strategic planning studies were Oradea, Iaşi and Ploieşti. Most of the metropolitan areas were created after 2007, since the 7 growth poles designated by the Romanian Government (Law 1149/2008) were obliged to establish such associations in order to apply for ERDF funding, through the 2007-2013 ROP for urban integrated development projects. The fact that is requirement did not apply in the case of Bucharest, Galaţi and Brăila is actually one of the explanations for which the corresponding metropolitan areas were not established by this moment.

The analysis of the population growth rate between the last two censuses (2002 and 2011) indicates a trend of concentration in metropolitan areas, since their share in the total population of the country increased from 15 to 15.4. However, this concentration phenomenon could be noticed only in the case of the Cluj-Napoca and Timişoara Metropolitan Areas, fast growing economic and university centers, benefiting from significant inner migration, whereas the other 7 metropolitan areas saw a demographic decline, resulting from massive inter regional migration (especially Bacău, Craiova, Ploieşti şi Braşov). Economic structural differences can also be noticed between the growing metropolitan areas, with a smart specialization tendency (software development, engineering, automotive, financial services, high-tech industries, etc.) and the declining ones, dominated by low-competitive sectors (apparel, machinery building, clothing, wood processing, agro-food, etc.).

The housing boom in the mid 2000s was also concentrated in metropolitan areas, together with the capital-region, Bucureşti-Ilfov. However, it was more pronunced (and even higher than in the capital-region) in the case of the Cluj-Napoca Metropolitan Area, supported by a large share of young population, increasing number of jobs and revenues, but also by a speculative market. On the other hand, cities with ageing and declining population (Craiova, Ploieşti, Braşov) saw only a very small increase in the number of new dwellings, caused by low demand. The real estate market has yet a significant growth potential since the average living floor per person in metropolitan areas is still below the national average.

The job market had also a differentiated dynamics in the last decade, showing a tendency towards a concentration of jobs in growing metropolis – such as Bucharest, Cluj-Napoca and Timişoara, with a strong tertiary sector (IT&C, financial services, real estate, higher education, etc.) and restructuring local economies in cities with a traditional industrial background (Braşov, Ploieşti, Bacău, Iaşi).

Table 1.

The main demographic and socio-economic indicators at metropolitan level, 2011 vs 2002

The metropolitan area	Total population	Population growth rate (%, 2002 = 100)	Density (per km^2)	% of the county (NUTS 3) total population	Internal and external migration balance	The number of dwellings (%, 2002 = 100)	The number of employees (%, 2002 = 100)
	2011	2002-2011	2011	2011	2002-2011	2002-2011	2002-2011
Cluj-Napoca	418,153	108.3	272.0	60.5	25,034	121.5	110.7
Timișoara	384,609	104.7	359.3	56.3	17,262	107.9	108.4
Iași	382,484	96,1	459.6	49.5	-15,316	110.2	90.0
Constanța	425,916	95.4	420.2	62.3	-20,679	105.8	100.3
Brașov	406,611	92.5	297.1	74.0	-32,966	103.2	83.9
Ploiești	318,192	90.1	665.7	41.7	-34,808	102.0	92.5
Oradea	245,537	97.6	317.6	42.7	-6,060	107.4	99.7
Craiova	306,930	89.8	527.6	46.5	-34,743	102.2	100.1
Bacău	216,649	86.4	309.3	35.2	-34,127	105.1	83.6
METROPOLI-TAN AREAS (Subtotal)	**3,105,081**	**95.8**	**371.6**	**52.1**	**-136,403**	**107,3**	**96.6**
BUCUREȘTI-ILFOV	**2,172,163**	**97,6**	**1,199.4**	**100.0**	-54,294	**107.6**	**122.9**
ROMANIA	**20,121,649**	**92.8**	**84.5**	**-**	**-1,159,325**	**103.6**	**95.2**

Data sources: *Own calculations based on the National Institute for Statistics databases*

The motorization rate saw a significant growth in the last decade, based on the growing average revenues and massive imports of second-hand cars from Western Europe. However, this growth was not accompanied by sufficient investments in urban infrastructure resulting in frequent traffic jams, air and noise pollution and the lack of parking lots.

The office area stock is highly concentrated in the capital-region, where most multinationals and Romanian companies have their headquarters, followed by Cluj-Napoca, with a growing demand for office buildings coming from the IT&C sector, whereas in cities such as Bacău and Craiova there is a very low demand for such infrastructure.

In what concerns the governance of metropolitan areas in Romania, most of the inter-community development associations that were created in this respect (excepting Oradea and Brașov) do not have their own financial, human or informational resources, as they depending on the resources made available by core cities. Moreover their lack of administrative and financial capacity is accompanied by a scarce number of attributions delegated to them by the members, but also by a lack of planning documents (such as

spatial plans, development and promotion strategies, etc.). Even if some steering committes for these metropolitan areas were created, they still function as artificial financial vehicles for core-cities.

4. IMPLEMENTING NEW REGIONAL POLICY INSTRUMENTS IN ROMANIA: THE GROWTH POLES

As indicated above, the Romanian Government designated in 2008 a list of 8 urban growth poles (including Bucharest), 13 urban development poles and 170 urban centers (above the threshold of 10,000 inhabitants), in a polycentric regional development policy. One criteria for selecting these growth poles was the fair distribution of EU funding for urban development under the 1st Axis of 2007-2013 ROP between the 8 development regions (Law 1149/2008).

The selected growth poles received ERDF financial support to implement the so-called *Integrated Urban Development Plans*, planning documents that were supposed to identify the urban and metropolitan areas in need of urban integrated development investments (urban, transport, social and economic infrastructure).

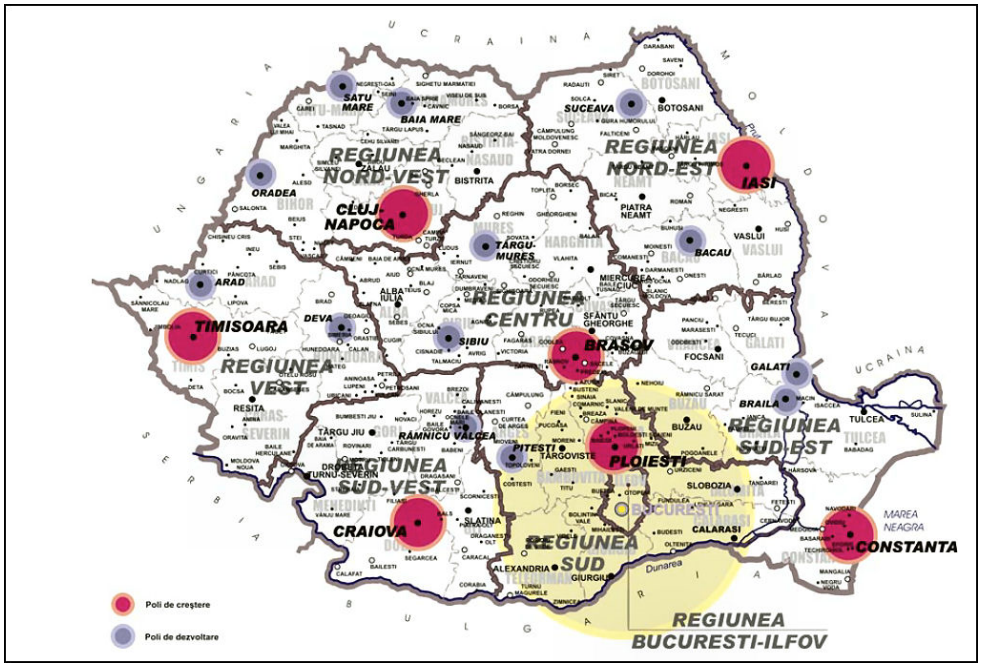

Fig. 2. The urban growth poles in the 2007-2013 programming period
Source: *The Romanian Ministry for Regional Development and Public Administration (2012)*

The projects were implemented in the framework of the 2007-2013 ROP, Axis 1, and the total budget allocation was of around 2.26 billion Euros, out of which 621 mil. Euros only for the 8 growth poles, one in each development region. As Table 3 shows, Iaşi and Craiova have benefited from the largest amount of investments co-financed by the ROP, with around 200 mil. Euros each, whereas Constanţa and Ploieşti have managed to attract only 50 mil. Euros. The different rate of EU funding absorption can be explained by the number and size of projects (big infrastructure projects are harder to implement compared to the smaller ones), but also by the fact that the allocation of EU funds was bigger for growth poles located in regions with a lower GDP/capital than the national average (such as Iaşi and Craiova).

As concerns the structure of these investments, we can distinguish 4 categories of metropolitan areas:

- metropolitan areas investing especially in business infrastructure: Oradea and Timişoara;
- metropolitan areas investing especially in urban renewal and support for SMEs: Constanţa and Ploieşti;
- metropolitan areas investing especially in transport and urban infrastructure: Cluj-Napoca, Braşov, Craiova;
- metropolitan areas investing especially in transport and tourism infrastructure: Bacău şi Iaşi.

This distribution is especially relevant for evaluating the development stage of each growth pole but also for its strategic vision.

Table 2.

Projects co-financed through the 2007-2013 ROP in metropolitan areas, by type Thousand lei

Project type	Iaşi	Timişoara	Constanţa	Cluj-Napoca	Braşov	Craiova	Ploieşti	Oradea	Bacău
Transport infrastructure	457,700	88,702	33,672	220,639	161,551	377,364	43,912	28,605	170,442
Urbane space planning	0,0	75,745	90,047	40,055	68,141	76,079	93,685	25,070	0,0
Health services	3,100	6,965	33,577	5,889	0,0	34,506	0,0	4,482	0,0
Social services	10,600	6,708	20,721	26,310	26,340	18,294	21,206	22,181	10,996
Educational infrastructure	66,500	0,0	8,267	13,118	14,772	71,103	0,0	21,819	0,0
Business infrastructure	84,200	190,423	25,463	88,220	0,0	138,618	0,0	162,748	0,0
SME support	63,600	56,152	41,371	47,636	34,941	66,712	39,051	30,923	26,999
Cultural heritage	90,300	52,488	10,559	0,0	10,972	82,313	7,949	36,780	0,0
Tourism infrastructure	229,300	0,0	20,395	0,0	19,975	86,066	0,0	96,492	85,034
Tourism promotion	2,800	0,0	6,612	5,436	7,051	3,763	10,374	4,005	2,940
TOTAL	**1,008.1**	**477,183**	**290,684**	**447,303**	**343,743**	**954,818**	**216,177**	**433,105**	**296,411**

Data sources: *The Romanian Ministry for Regional Development and Public Administration. 2012*

Since most of the urban development projects are still in the implementation phase (until 2015), it is difficult to evaluate, at present, the impact of the ERDF support on the socio-economic development of the metropolitan areas. However, it has to be noticed that the 2007-2013 ROP has represented the most important source of public investment for most of the metropolitan areas in Romania after 2008, when public budgets started to shrink. In this sense, an impact analysis after 2015, once all the projects would have been implemented, will likely indicate growing disparities between the growth poles and the other settlements in Romania.

On the other hand, the analysis of the projects supported by ERDF at metropolitan areas, shows that more than 90% of the investments were made inside the city, whereas the surrounding settlements will benefit largely indirectly from their effects. This state of art raises concerns about the viability of the metropolitan areas in the future, considering the high level of dissatisfaction of local authorities and citizens in the small communities with their marginal position inside the metropolitan area.

5. FUTURE PROSPECTS: METROPOLITAN AREAS AND GROWTH POLES IN THE NEW PLANNING DOCUMENTS

Considering the raising criticism with the concentration of public resources in a small number of growth poles in the 2007-2013 programming period, the Romanian Regional Development Strategy for the 2014-2020 cycle proposes a new approach, in which more attention is given to medium-size cities, especially the ones with the capacity to spread growth in their surroundings.

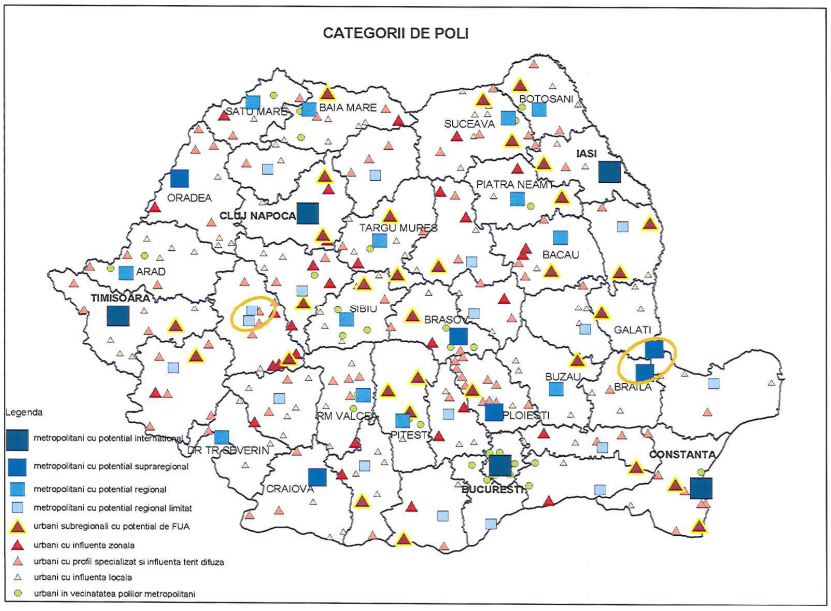

Fig. 3. – The network of urban poles proposed for the 2014-2020 programming period
Source: *The Romanian Ministry for Regional Development and Public Administration (2012)*

In this sense, a new urban ranking methodology was suggested by the Romanian Ministry of Regional Development and Public Administration, the one in charge with the implementation of the 2014-2020 ROP, but also with the territorial cohesion policies.

The main criteria for the urban settlements ranking are:

- the total population and the population growth rate;
- the history / continuity of the administrative functions (county seat, etc.);
- the functional diversity – specialization (the structure of labor force);
- the accessibility to major transport systems (TEN-T);
- the level of general services provided to the surrounding areas (e.g. high-school and university education, medical services, etc.);
- the availability of RDI units;
- the geographical position and the distance to other urban areas;
- the existing rank, according to the National Spatial Development Plan.

According with the new classification of urban settlements, Romania will have a network of growth poles comprising:

I. Metropolitan Poles (including metropolitan areas – maximum 30 km around the core city) – divided in 4 categories:

- with international potential: Bucharest, Timisoara, Cluj-Napoca, Iasi, Constanta;
- with supra-regional or inter-regional potential: Brasov, Craiova, Galati-Braila (urban system), Oradea, Ploieşti;
- with regional potential: Bacau, Arad, Sibiu, Tg. Mures, Baia Mare, Satu-Mare, Suceava, Drobeta Turnu Severin, Pitesti, Buzau, Botosani, Rm. Valcea, Piatra Neamt;
- With limited regional potential: Resita, Tg. Jiu, Slatina, Alexandria, Targoviste, Giurgiu, Slobozia, Calarasi, Tulcea, Focsani, Vaslui, Deva-Hunedoara, Alba Iulia, Zalau, Bistriţa, Miercurea Ciuc, Sfantu Gheorghe.

II. Urban poles/centers (a total number of 243**)** – generally towns with less than 50.000 inhabitants.

New financial instruments and investment priorities for metropolitan areas are also envisaged for the 2014-2020 programming period, namely:

- the **Integrated Territorial Investment** – a new financial tool that will allow local authorities to combine different programmes and axis (for example ESF and ERDF), in order to tackle the specific needs of an urban area (for example a deprived neibourghood);
- the implementation of the growth poles **mobility plans** – under elaboration with the support of JASPERS;
- a special attention given to inclusion and poverty reduction in urban and metropolitan areas, also by **urban renewal** projects;
- increasing the **energy efficiency of public and residential building;**
- etc.

We have to note here that the 2014-2020 Romanian Regional Development Strategy is still under consultation and negociation with the E.U. structures and changes to the criteria, urban ranking and investment priorities can be operated until the beginning of 2015.

6. CONCLUSIONS

We have seen in the papaer that there are two major metropolitan areas in Romania. One is represented by the capital city, Bucharest, the only metropolitan area of the country in european comparison, and a varying number of regional centres, including cities like Cluj, Timişoara, Iaşi, Craiova, Constanţa etc., where 'metropolization' in form of urban expantion and emerging governance was an important spatial process int he post-socialist period.

At the beginning of the transition period from state socialism to market economy Romania has inhereted an uneven spatial structure, with the capital city in dominant position. During the transition the country has rapidly taken over the european discourse and the instruments of european spatial planning. The connection of such two planning concepts like the metropolitan areas and the growth centres to few major urban centres represents a specific feature of the Romanian planning, resulting in increasing regional disparities (Benedek, Kurkó, 2010), and failing in this way the achievement of the main goal of regional policy: the reduction of regional differences in the development level.

The current round of strategic planning suggest that urban agglomerations in general and metropolitan areas in particular remain in the focus to the detriment of peripheral regions. The high prioritization of the urban growth poles development has increased the level of regional disparities in Romania. As a recognition of this fact the new prospects for the following programming period are proposing a new view by keeping the old concepts: growth poles will include a larger number of urban centres. In fact, each county (NUTS 3 level) will have one metropolitan pole, including a metropolitan area, and a varying number of urban poles. The allocation of different financial instruments for supporting this new spatial planning categories should be a powerful instrument for the reduction of regional disparities.

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GEODEMOGRAPHIC CHARACTERISTICS OF MUREŞ DEFILE

G. B. TOFAN[1]

ABSTRACT. – Geodemographic Characteristics of Mureş Defile. This study begins with a short introduction regarding the exact limits of this area, which extends on a 38 km stretch between Vâgani (component of the Town of Topliţa) and Bistra Mureşului (component of Deda), in order to have a unitary perspective on this area, situated on the contact line between the volcanic massifs of Căliman (to the north) and Gurghiu (to the south). As required for every study concerning geodemographic characteristics, an analysis of the evolution of the number of inhabitants was presented, followed by complex issues on population quality (structure) (gender, age, habitat, proffesions, ethnic groups and religions), with interpretations, and graphical and cartographical representations for more than a century and a half (1850-2011). Alongside defining the concrete limits (east and west), the study brings another novel element, which is establishing the surface area for the entire area (26.17 km^2), together with the four compartments (Vâgani-Ciobotani, Stânceni, Lunca Bradului and Răstoliţa), numbers which allowed for more thorough calculations, in terms of population territorial distribution.

Keywords*: small depressions,defile, population quality, Mureş.*

1. INTRODUCTION

As any classic study, emphasizing the main geodemographic components of any territory, implies a wide perspective on the following issues: *evolution of the number of inhabitants, territorial distribution of population,* as well as *populationstructure* (*quality*) (gender, age group, habitat, proffesions, ethnic groups and religion).

I will begin with some aspects regarding the limits of the defile. I considered that the most pertinent view, as well as the most justified and close to reality, is that the defile starts at Vâgani (component of Topliţa) and ends at Bistra Mureşului, thus having 38 km in length.

That is why, in the study at hand, I will also include the two settlements situated at the defile's extremities (more precisely two parts of them, Vâgani şi Bistra Mureşului), which belong to other major relief forms (to the east, Topliţa, Giurgeu Depression, the northern compartment, Topliţa-Subcetate Plateau), to the west Deda, part of Reghin Hills, and Vălenii de Mureş Depression (Deda-Porceşti), from Transilvanian Depression.

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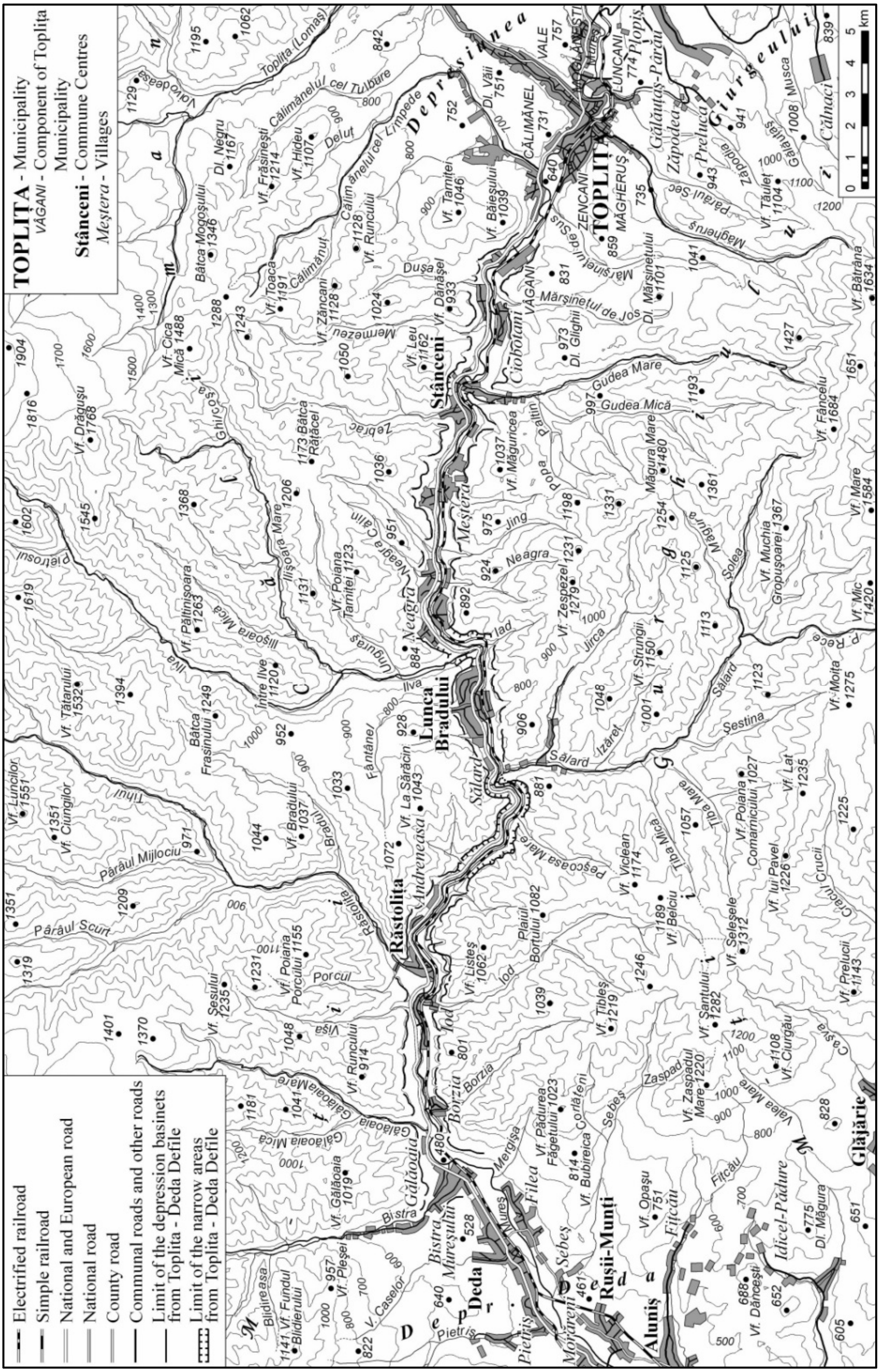

Fig. 1. Mureș Defile. Physical - geographical map.

This sector is the largest piercing valley of the volcanic range, where, due to the alternation between lavas with pyroclastitesand confluences, there are many narrow sectors, with steep slopes, with numerous alluvial conesmade of volcanic boulders, plus a series of enlargements,which favoured the emergence of depressions: Vâgani-Ciobotani, Stânceni, Lunca Bradului and Răstoliţa.

The settlements found in the defile, major centers of logging industry, are situated at the mouths of Mureş' tributaries: Deda and Bistra Mureşului, on Bistra River; Răstoliţa on Răstoliţei Valley; Lunca Bradului on Ilvei Valley, Stânceni on Zebracului Valley and Gudea Valley, while Topliţa on Topliţei Valley and Măgheruş.

2. POPULATION EVOLUTION

Topliţa-Deda Defile, during 1850-2011 period, registered a 322.0% increase in population, from 1 582 inhabitants in 1850 to 6675 in 2011, taking into consideration solely the settlements found in the defile.

In the first 60 years, population increased to 5458 inhabitants, in 1910, dropping to 4220 in 1930 due to the First World War, corroborated with a drastic decrease in births caused by many men leaving for war.

If we compare the censuses of 1910 and 1930, we observe a population regress from 2133 inhabitants to 1735 inhabitants, at Stânceni, and 907 inhabitants to 820 inhabitants, in Răstoliţa, while Lunca Bradului experienced a population increase from 1552 inhabitants to 1665 inhabitants due to the development of rafting, railways and roads, and especially due to the establishment of a logging mill, leading to the emergence of seven hamlets: Bradul, Fântânele, Ilva, Andrineasa, Jirca, Sălardul and Luncani, which were later integrated in other settlements (Neagra and Sălard).

After 1930, the defile's population increases once again, registering 5860 inhabitants, in 1941, respectively 6244 inhabitants in 1956, with significant increases solely in Răstoliţa, where population doubles, from 820 inhabitants (1930) to 1614 inhabitants (1956), while in Stânceni and Lunca Bradului, the largest number of inhabitants being registered only in 1941, followed by a population decrease due to the start of the Second World War, in conjuction with other factors (drought, famine, the emergence of communism, etc).

Starting in 1956, a series of hamlets were declared villages (Meştera, Neagra, Sălard, Gălăoaia, Răstoliţa, Bistra Mureşului), and due to the fact that, in 1956, Topliţa became a town, more rural areas were integrated, such as Vâgani.

The increasing population trend lasted until 1977, 7842 locuitori, Stânceni and Răstoliţa communes still having positive growth rates (5.4% and 9.6%), as well as Bistra Mureşului (21%), while Lunca Bradului lost population, with a negative rate of -0.5% and -0.7% in Vâgani.

From 1977 onwards, the microregion's population began to decrease, especially in 2002 (7296 inhabitants), followed by a pronounced decrease, as, at the last census of 2011, population numbering only 6675 inhabitants, due to well known causes (low birth rate and increased mortality, unemployment, forcing young people to find work in Topliţa or Reghin).

Consequently, population dynamicsbecame negative, for most settlementsfrom the defile (Stânceni -25.1%, Lunca Bradului -24.8%, Vâgani -21.1%, Bistra Mureşului -14.0%), with an atypical situation found in Răstoliţa, with a population growth of 463 inhabitants in 1992 in comparison to 1977, due to population immigration towards the construction sites of the hydroelectrical complex found here (V. Mara, 2004).

Table 1

Population evolutionin Topliţa-Deda Defilein the 1850-1956 interval

No.	Settlement	1850	1880	1900	1910	1930	1941	1956
1	Vâgani[1]	-	-	-	-	-	-	-
2	**Stânceni Commune**	**972**	**1369**	**1615**	**2133**	**1735**	**1998**	**1774**
	Ciobotani	-	-	-	541[2]	-	-	362
	Stânceni	972	1369	1615	2133	1735	1998	1110
	Meştera	-	-	-	-	-	-	302[3]
3	**Lunca Bradului Commune**	**246**	**657**	**946**	**1552**	**1665**	**2462**	**1917**
	Neagra	-	-	-	104[4]	-	-	477[5]
	Lunca Bradului	246	657	946	1552	1665	2462	1322
	Sălard	-	-	-	-	-	-	118[6]
4	**Răstoliţa Commune**	**364**	**429**	**560**	**907**	**820**	**1400**	**1614**
	Andreneasa	-	-	-	522[7]	-	-	59
	Iod	-	-	-	300[8]	-	-	505
	Borzia	-	-	-	98[9]	-	-	103
	Gălăoaia	24	-	-	**116**	-	-	56[10]
	Răstoliţa	340	429[11]	560	907	820	1400	891[12]
5	Bistra Mureşului	-	-	-	866[13]	-	-	939[14]
TOTAL		**1582**	**2455**	**3121**	**5458**	**4220**	**5860**	**6244**

[1] Componentof the Town of Topliţa, Harghita County,since 1956.
[2] Hamletthat used to belong to Topliţa, since 10thJanuary 1956 belonging to Stânceni.
[3] Declared village, separately registered,until 10thJanuary 1956 hamlet of Stânceni, Stânceni Commune.
[4] Hamlet of Stânceni, Stânceni Commune.
[5] Declared village,separately registered,until 10thJanuary 1956 hamlet of Stânceni, Stânceni Commune.
[6] Sălard, declared village, separately registered; until10thJanuary 1956 hamlet of Lunca Bradului, Lunca Bradului Commune.
[7] Hamlet ofLunca Bradului, LuncaBradului Commune.
[8] Hamlet of Filea, Deda Commune.
[9] Hamlet of Filea, Deda Commune.
[10] Gălăoaia, declared village, separately registered,until 10thJanuary 1956 hamlet of Răstoliţa, Răstoliţa Commune.
[11] Registered together withGălăoaia hamlet.
[12] Declared village, separately registeredsince 10thJanuary 1956.
[13] Registered together with a part of Deda village.
[14] Declared village, registered separatelysince10thJanuary 1956.

Construction for the Răstoliţa complex began immediately after the 1989 events, after which works significantly decreased, due to sporadic financing. This issue is reflected in the evolution of the settlement's population, having a descending trend (from 2325 inhabitants in 1992 to 2053 inhabitants in 2011).

By analysing the data from table 2, we observe that, during 1966-2011, most villages of the four communes registered a significant drop in inhabitants (Sălard -67.6%, Stânceni -30.2%, Neagra -24.3%, Vâgani -21.7%, Andreneasa -21.6%, Iod -21.6%, Lunca Bradului -20.7%, Meştera -12.8%, Ciobotani -6.7%), while only three villages gained population (Răstoliţa, 45.4%; Gălăoaia, 22.7%; Bistra Mureşului, 3.9%).

Source: *the 1850, 1880, 1900, 1910, 1930, 1941, 1956 censuses;*

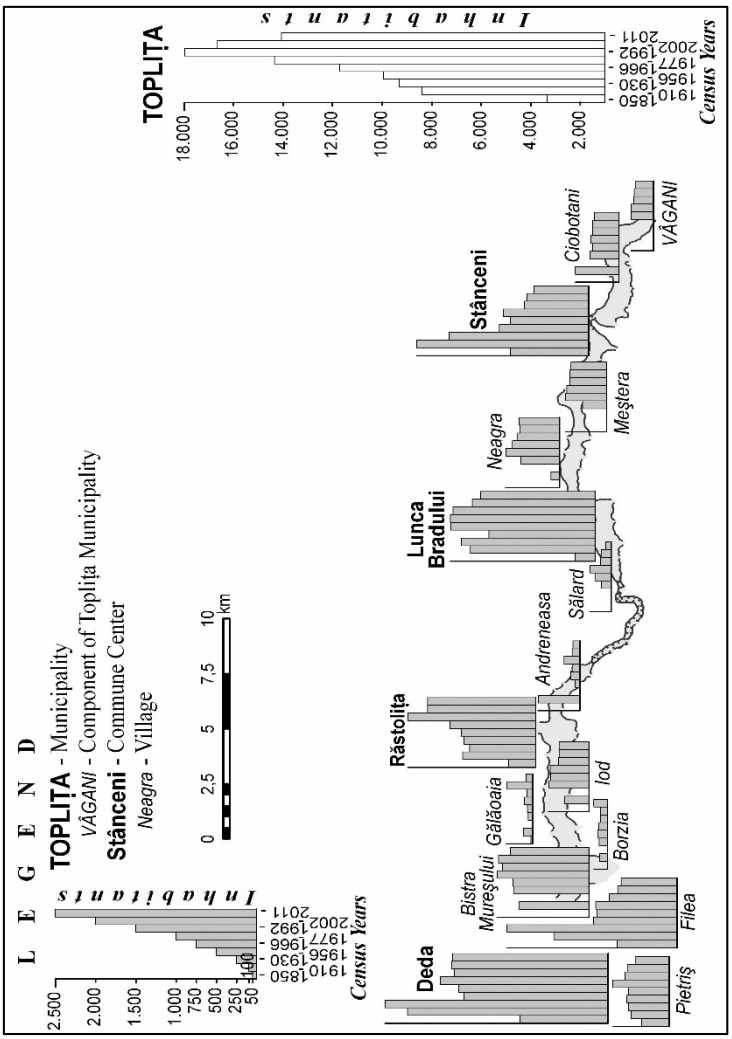

Fig. 2. The population of Mureş at the 1850, 1910, 1930, 1956, 1966, 1977, 1992, 2002 and 2011 censuses.

Table 2

Population evolution in Topliţa-Deda Defile during 1966-2011

No.	Settlement	1966	1977	1992	2002	2011
1	Vâgani	281	279	249	241	220
2	**Stânceni Commune**	**1812**	**1911**	**1592**	**1547**	**1430**
	Ciobotani	327	351	329	324	305
	Stânceni	977	1065	804	766	682
	Meştera	508	495	459	457	443
3	**Lunca Bradului Commune**	**2665**	**2650**	**2431**	**2150**	**1992**
	Neagra	666	584	528	495	504
	Lunca Bradului	1795	1801	1768	1530	1422
	Sălard	204	264	135	125	66
4	**Răstoliţa Commune**	**1699**	**1862**	**2325**	**2230**	**2053**
	Andreneasa	111	97	197	95	87
	Iod	477	485	381	376	374
	Borzia	122	110	85	91	169
	Gălăoaia	66	105	74	326	81
	Răstoliţa	923	1065	1588	1342	1342
5	Bistra Mureşului	943	1140	1079	1128	980
TOTAL		**7400**	**7842**	**7676**	**7296**	**6675**

Source: *1966, 1977, 1992, 2002, 2011 censuses*

3. TERRITORIAL DISTRIBUTION OF POPULATION

The general density of the three administrative units (Stânceni, Lunca Bradului and Răstoliţa) decreased from 8.4 inhabitants/km^2 in 2002 to 7.8 loc/km^2 in 2011.

The biggest density can be found in Stânceni, 11.5 inhabitants/km^2, followed by Răstoliţa with 7.7 loc/km^2 and Lunca Bradului with 6.4 loc/km^2, as this rural settlement has a relatively small population (1992 inhabitants) compared to its administrative territory (310 km^2).

After using GIS to calculate the surface area of the entire defile, 26.17 km^2 to be more exact, the population density was also determined for 2011, reaching a relatively high value of 255.0 inhabitants/km^2. Settlements are situated along Mureş River, as well as at its confluence with streams that flow from Căliman and Gurghiu mountains.

There are significant changes, if we compare the population of the four depressions (in 2011) to the surface of their territory, resulting the following situation: 106.0 inhabitants/km^2 in Vâgani-Ciobotani Depression (its surface area being 4.95 km^2), 208.0 inhabitants /km^2 in Stânceni (5.41 km^2), 687.0 inhabitants /km^2 in Lunca Bradului Depression (2.90 km^2) and 265.1 inhabitants /km^2 in Răstoliţa (11.44 km^2).

4. POPULATION STRUCTURE

The presentation of this indicator involves, like in any other geodemographic study, the analysis of its quality, expressed as follows: gender, age groups, habitat, profession, ethnic background and religion.

4.1. Population structure in terms of gender

For the last three censuses, in the area at hand, there were no significant oscillations, male population experiencing a slight increase, with values of 50.3% (1992), 50.5% (2002) and 51.6% (2011).

At urban level, only one settlement was analysed, a component of the Town of Topliţa (Vâgani), also with a higher percentage of men (54.2% in 1992, 54.3% in 2002, followed a slight decrease to 53.2% in 2011, which means a greater feminisation of the urban environment, with 46.8%, compared to 45.7% in 2002.

Table 3

Population structure per gender inMureş Defile (1992, 2002 and 2011 censuses)

Years	1992	%	2002	%	2011	%
Total	**7676**	***100***	**7296**	***100***	**6675**	***100***
Male	3863	*50.3*	3685	*50.5*	3446	*51.6*
Female	3813	*49.7*	3611	*49.5*	3229	*48.4*
Urban	**249**	***100***	**241**	***100***	**220**	***100***
Male	135	*54.2*	131	*54.3*	117	*53.2*
Female	114	*45.8*	110	*45.7*	103	*46.8*
Rural	**7427**	***100***	**7055**	***100***	**6455**	***100***
Male	3728	*50.2*	3554	*50.3*	3329	*51.5*
Female	3699	*49.8*	3501	*49.7*	3126	*48.5*

When it comes to rural areas, this analysis took the following settlements into consideration: Stânceni, Lunca Bradului, Răstoliţa and Bistra Mureşului village (Deda Commune), where one can observe the same growth tendency of male population, due to the area's economic trends (logging and animal husbandry), the maximum being attained in 2011 with 51.5%, while women reached a percentage of 48.5%.

A sugestive indicator was employed to represent the male/female ratio -*the feminity index*, with a decrease from 98.7 women/100 men in 1992 to 93.7 women/100 men in 2011.

For each commune, during the analysed period, we have the following situation: in Stânceni (98.0 women/100 men in 1992, 99.3 W/100 M in 2002 and 96.1 W/100 M in 2011), Lunca Bradului (98.7 W/100 M in 1992, 98.3 W/100 M in 2002 and 94.0 W/100 M in 2011), Răstoliţa (99.0 W/100 M in 1992, 94.5 W/100 M in 2002 and 88.7 W/100 M in 2011) and Bistra Mureşului (Deda commune), where the feminity index reached values of more than 100 women/100 men (102.4 W/100 M in 1992, 105.8 W/100 M in 2002 and 102.0 W/100 M in 2011).

4.2. Population structure per age groups

Represents one of the most important indicators of population „quality", due to its demographic and social-economic implications.

For emphasizing the evolution of this geodemographic component, corresponding to 1850-2011, three representative threshold moments were chosen, that is 1992, where all the settlements from the area were taken into account, including the component of Topliţa, Vâgani, and Bistra Mureşului village, belonging to Deda village, while for 2002, age groups were analysed in rural areas only, and 2011, for which population structure was analysed for the entire territory (with the exception of Bistra Mureşului).

Table 4

The main population age groupsin Mureş Defile, in 1992, 2002 and 2011

Years	Category	Total population	0-19 years	%	20-59 years	%	60 years and over	%
1992	**Total**							
	Total	7676	2643	*34.5*	3822	*49.8*	1211	*15.7*
	Male	3863	1300	*33.6*	2009	*52.0*	554	*14.4*
	Female	3813	1343	*35.3*	1813	*47.5*	657	*17.2*
	Urban							
	Total	249	76	*30.5*	128	*51.5*	45	*18.0*
	Male	135	45	*33.3*	67	*49.7*	23	*17.0*
	Female	114	31	*27.2*	61	*53.5*	22	*19.3*
	Rural							
	Total	7427	2567	*34.5*	3694	*49.8*	1166	*15.7*
	Male	3728	1255	*33.7*	1942	*52.1*	531	*14.2*
	Female	3699	1312	*35.5*	1752	*47.4*	635	*17.1*
2002	**Rural**							
	Total	7055	1962	*27.8*	3757	*53.2*	1336	*19.0*
	Male	3554	1006	*28.3*	1946	*54.7*	602	*17.0*
	Female	3501	956	*27.3*	1811	*51.7*	734	*21.0*
2011[15]	**Total**							
	Total	5927	1319	*22.2*	3392	*57.3*	1216	*20.5*
	Male	3068	710	*23.1*	1821	*59.4*	537	*17.5*
	Female	2859	609	*21.3*	1571	*55.0*	679	*23.7*
	Urban							
	Total	220	45	*20.5*	130	*59.0*	45	*20.5*
	Male	117	21	*18.0*	76	*65.0*	20	*17.0*
	Female	103	24	*23.3*	54	*52.4*	25	*24.3*
	Rural							
	Total	5707	1274	*22.3*	3262	*57.2*	171	*20.5*
	Male	2951	689	*23.3*	1745	*59.4*	517	*17.5*
	Female	2756	585	*21.3*	1517	*55.0*	654	*23.7*

[15] For rural areas, the stable population of 1st January 2011, at communal level, was taken into account.

The percentage of the *young population group* (0-19) for the entire defile, in 1992, was 34.5%, after which in 2011, it dropped to 22.2% out of a total of 5927 inhabitants. In the case of settlements, in 1992, the percentage of young people was close to the 30.1-37.0% range, the highest frequency being found in Răstoliţa (37.0%) and Lunca Bradului (36.0%), the lowest in Stânceni (30.1%). In 2002, census data allowed for a presentation of age group from rural areas only, situation in which young people held 27.8% of the total 7055 inhabitants. At settlement level, we have the following situation: Stânceni (24.7%), Lunca Bradului (27.6%), Bistra Mureşului (28.6%) and Răstoliţa (29.7%).

19 years later, the decrease in young population accelerated, so that, in 2011, the highest values can be found in Stânceni (26.6%), Lunca Bradului (24.0%), Răstoliţa (21.9%) and Vâgani with only 20.5%.

Adult population (20-59 years) registered, in 1992, a 51.5% in urban areas out of the total of 249 inhabitants of Vâgani, and 49.8% in rural areas out of the total of 7427 inhabitants. The three settlements have a balanced situation, its frequency being around 49%, Lunca Bradului (48.9%), Răstoliţa (49.5%), Bistra Mureşului (48.4%), while in Stânceni and Vâgani, adults had over 50% (52.2% and 51.4%).

In 2002, in rural areas, out of the total of 7055 inhabitants, adults held 53.2%, (higher than in 1992, 49.8%), 54.7% being male (out of 3554 people), while 51.7% are female (out of a total of 3501 people).

In 2011, if we sum up the population, with the exception of Bistra Mureşului, adults were more numerous that 19 years ago, that is 57.3%.

Senior population (≥ 60 years) roughly follows the regional and national trend, in 1992 having the lowest values with 15.7%, and in 2011 the highest, with 20.5%.

After almost two decades, following the evolution of this age group, one can see an acceleration of the population aging process, in all settlements with the exception of Vâgani, where the same number of senior citizens was registered both in 1992 and in 2011 (45 people), while in the other three settlements, using statistical data that emphasize age groups for the stable population of 1st January 2011, there have been considerable increases (Stânceni 17.6% in 1992 and 24.1% in 2011; Lunca Bradului 15.1% in 1992 and 19.9% in 2011; Răstoliţa 13.4% in 1992 and 18.5% in 2011).

In 2011, *the demographic dependency rate* had a value of 74.7%, *the population aging rate* highlighted the acceleration of this phenomenon, while the *young population pressure* (0-19 years) indicated 108.2%, and the *elderly population pressure* (over 65 years) was lower, at 92.2%.

By calculating these indicators one can clearly observe the high dependency of young and old people on the adult population, due to first two high percentages.

4.3. Population structure per habitat

This category structure can traced back to 1956, when Vâgani became part of the Town of Topliţa. Even though the population of this settlement bleongs to the urban, from an economic-social point of view we can clearly say that it belongs to the rural, a situation also found in the other settlements (Călimănel, Măgheruş, Zencani, Luncani, Moglăneşti, Vale and Secu) embedded in the urban settlement mentioned before.

Therefore, in 1966, urban population, taking into account the current organisation of Topliţa, registered 3.8% (281 inhabitants), while the rest of 96.2% was found in the three communes and Bistra Mureşului village, totalling 7119 inhabitants, while, in 1992 the urban/rural ratio was 3.2/96.8% (out of 7 676 inhabitants), reaching 3.3/96.7% in 2011 (6 675 inhabitants).

4.4. The population's professional structure

In the past, the main activity of the people living in this area, alongside sheepherding, was rafting, every settlement supplying significant amounts of timber, an activity which developed especially starting in the second half of the 19th century, when, in 1856, a group of Italian craftsmen, from South Tirol, regularized the course of Mureş River, and after the establishment of rafting companies in Reghin (1865) and Târgu Mureş (1877) (G. Gociman, 1928). Stânceni was one of the most important rafting centres of the area, also hosting several hidraulic saw mills, which attracted workers from neighbouring villages, as well as famous woodcraftsmen from Transilvania Plain and Apuseni Mountains.

The construction of railwaysled to a decrease in this activity, and, as an alternative, several logging millswere established at Lunca Bradului, Răstoliţa and Bistra Mureşului.

Returning to the analysis of this structure category which reflects the activities that take place in this area, one can observe that it registers significant changes from one period to another in relation to the social-economic evolution.

To highlight them,statistical information from 1992 and 2002 was used (only for rural settlements from Mureş County).

In 1992, active population registered 40.0% (2975 inhabitants) out of a total of 7427 inhabitants of the three communes and Bistra Mureşului village, 28.4% being employed in agriculture (844 people), 41.5% in industry (1233 people) and 24.6% (732 people) in the service sector, while the percentage of people searching for a first job is 5.5% (166 people).

A decade later, in 2002, there was a decrease in active percentage with only 34.3% (2425 people) of the total rural population of the defile 7 055 inhabitants.

Their distribution per activity sectors is as follows: 23.3% (566 people) in agriculture, 32.0% (774) in industry, 26.2% (635) in services and 18.5% (450) unemployed.

At settlement level, for the two moments taken into account (1992 and 2002), we emphasize the decrease in actives in Răstoliţa from 37.0% (862 people) in 1992 to 28.8% (643 people) in 2002, due to the decrease in primary activities and the increase in unemployment, as follows: 31.0% in 1992 and 9.8% in 2002 (agriculture, forestry, logging and game industry), while the secondary sector increased from 39.5% in 1992 to 46.3% in 2002 (mainly in constructions, due to the activities from the hydrolectrical complex).

Lunca Bradului also experienced the same decrease from 38.2% active people in 1992 to 32.7% in 2002, due to the insolvency of the logging company (49.9% in 1992 and only 18.4% in 2002), a situation that can also be found in Bistra Mureşului (24.3% in 1992 and 3.0% in 2002). The situation was further exacerbated by layoffs in the transportation sector (mainly railroads) and telecommunications, following the introduction of digital phone services (16.0% in 1992 and 6.1% in 2002, at Lunca Bradului and 8.1% in 1992 and 6.7% in 2002).

Fig. 3. The professional structure of the population from Mureş Defile, in 1992 and 2002.

Table 5

The professional structure ofthe population fromMureş Defile, at the 1992 şi 2002 censuses

Settlements	Years	Inhabitants	Active population	%	Agriculture, forestry and game	%	Industry and constructions	%	Services	%	Unemployed	%
Stânceni	**1992**	1592	655	*41.1*	123	*18.7*	294	*44.8*	190	*29.0*	48	*7.5*
	2002	1547	633	*40.9*	190	*30.0*	219	*34.6*	164	*26.0*	60	*9.4*
Lunca Bradului	**1992**	2431	929	*38.2*	157	*17.0*	444	*47.8*	268	*28.8*	60	*6.4*
	2002	2150	704	*32.8*	116	*16.4*	171	*24.3*	172	*24.5*	245	*34.8*
Răstoliţa	**1992**	2325	862	*37.0*	267	*31.0*	341	*39.5*	199	*23.0*	55	*6.5*
	2002	2230	643	*28.8*	63	*9.8*	298	*46.3*	183	*28.4*	99	*15.5*
Bistra Mureşului	**1992**	1079	529	*49.0*	297	*56.2*	154	*29.1*	75	*14.2*	3	*0.5*
	2002	1128	445	*39.4*	197	*44.3*	86	*19.3*	116	*26.0*	46	*10.4*

Stânceni Commune has an active population percentage which did not change in any significant manner in the selected time frame, being 41.1% in 1992 (1 592 people) and 40.9% in 2002 (1 547 people).

The percentage of people employed in *agriculture, forestry and game*, was 28.4% in 1992 and 23.3% in 2002, at rural level, the lowest values of 1992 being found in Lunca Bradului (16.9%) and Stânceni (18.7%), while the lowest values of 2002 were the ones in Răstoliţa (9.8%) and Lunca Bradului (16.4%).

The secondary sector (*industry and constructions*) employed more people in 1992, with a total of 1233 people (41.5%), registering solely 774 people in 2002 (31.9%), due to massive restructurings in logging industry, and frequent interruptions in constructions for the Răstoliţa hydroelectric complex, the highest percentage being found in Lunca Bradului 47.8% in 1992, and in Stânceni ten years later, as many remained as loggers, and workers in the mineral water bottling industry.

The *service and other unidentified services* sector held 30.1% of the total number of actives in 1992 (2 975 people), the highest values being found in Lunca Bradului (46.6%) and Răstoliţa (39.5%), while in Stânceni (37.6%) and Bistra Mureşului (17.5%), the percentages were lower. In 2002, compared to the active population (2425 people), the analysed sector registered 43.8% in Răstoliţa, an above average value being found solely in Lunca Bradului (59.2%), while a below average value in Bistra Mureşului (36.4%) and Stânceni (35.3%).

Without going into detail, in 2002, in the 44.7% value, found at the level of the entire analysed rural area, most are those who are looking for a job (18.5%), the largest number of unemployed being registered in Lunca Bradului 34.8% (245 people), followed by those in trade (7.3%), transports and communications (7.0%), public administration (3.9%), education (3.0%), health and social services (1.0%) etc.

At the 2002 census, there was a high percentage of *inactive population,* registering 65.6% (4630 people), 30.8% (1429 people) are pensioners, 25.5% (1175 people) were students, 22.7% (1050 persoane) householders, 16.3% (755 people) being cared for by other people, 3.6% (167 people) fitted in other categories and 1.1% (54 persoane) being cared for by the State or by private enterprises.

The largest number of inactiveswas found in Răstoliţa (1587 people), primarily students with 25.5%,and Lunca Bradului (1446 people), where pensioners registered 34.6%, while the lowest values could be found in Stânceni (914 people) and Bistra Mureşului (683 people).

4.5. Population's ethnic structure

In order to follow the ethnic structure of the population from the settlements found inMureş Defile, four crucial threshold moments were chosen, from a period of more than a century and a half, 161 years (1850-2011), that is 1850, 1930, 1992 and 2011, which shows that*Romanians* were always a majority, between 92.2% (in 1850), followed by a gradual decrease: 60.4% in 1930, then an increase, reaching 81.5% in 1992, and 83.3% in 2011.

Presenting the population structure in terms of habitat has only been possible since 1966, when in urban, in Vâgani, Romanians held a majority of 92.2%, while during 1977-2002, they revolved the value of 95.0%. Following the distribution of population at administrative-territorial level, allows us to see that in 1850 all settlements had over 90% (90.8% in Stânceni, 94.3% in Lunca Bradului and 94.8% in Răstoliţa), while in 1930, due to a gradual increase in the percentage of Hungarians in this area, Romanians did not manage to exceed 70%, the highest percentage being found in Stânceni (69.7%), while Lunca Bradului and Răstoliţa held the lowest, with just over 50%.

Table 6

Population's ethnic structure in Mureş Defile, in 1910

Year	Categoria	Total	Romanians		Hungarians		Germans		Jews		Gypsies		Other ethnic groups and undeclared	
			AV	***RV***	**AV**	***RV***	**AV**	***RV***	**AV**	***RV***	**AV**	***RV***	**AV**	***RV***
1850	**Total**	**1582**	**1459**	*92.2*	**78**	*5.0*	**1**	*0.1*	**-**	**-**	**44**	*2.7*	**-**	**-**
	Stânceni	**972**	882	*90.8*	75	*7.7*	-	-	-	-	15	*1.5*	-	-
	Lunca Bradului	**246**	232	*94.3*	-	-	-	-	-	-	14	*5.7*	-	-
	Răstoliţa	**364**	345	*94.8*	3	*0.8*	1	0.2	-	-	15	*4.2*	-	-
1930	**Total**	**4220**	**2548**	*60.4*	**1154**	*27.3*	**84**	*2.0*	**295**	*7.0*	**88**	*2.0*	**51**	*1.3*
	Stânceni	1735	1210	*69.7*	468	*27.0*	7	*0.4*	34	*2.0*	11	*0.6*	5	*0.3*
	Lunca Bradului	1665	896	*53.8*	489	*29.4*	61	*3.6*	175	*10.5*	19	*1.1*	25	*1.6*
	Răstoliţa	820	442	*54.0*	197	*24.0*	16	*2.0*	86	*10.4*	58	*7.0*	21	*2.6*
1992	**Total**	**7676**	**6260**	*81.5*	**1290**	*16.8*	**-**	-	**-**	-	**121**	*1.6*	**5**	*0.1*
	Vâgani	**249**	237	*95.2*	12	*4.8*	-	-	-	-	-	-	-	-
	Stânceni	**1592**	1284	*80.7*	297	*18.6*	-	-	-	-	11	*0.7*	-	-
	Lunca Bradului	**2431**	1893	*77.8*	456	*18.8*	-	-	-	-	82	*3.4*	-	-
	Răstoliţa	**2325**	1854	*79.8*	452	*19.5*	-	-	-	-	15	*0.6*	4	*0.1*
	Bistra Mureşului	**1079**	992	*92.0*	73	*6.7*	-	-	-	-	13	*1.2*	1	*0.1*
2011	**Total**	**5475**	**4560**	*83.3*	**804**	*14.7*	**11**	*0.2*	**-**	-	**97**	*1.7*	**3**	*0.1*
	Stânceni	**1430**	1211	*84.7*	216	*15.1*	-	-	-	-	-	-	3	*0.2*
	Lunca Bradului	**1992**	1628	*81.7*	266	*13.3*	1	*0.2*	-	-	97	*4.8*	-	-
	Răstoliţa	**2053**	1721	*83.8*	322	*15.7*	10	*0.5*	-	-	-	-	-	-

AV = absolute values; ***RV*** = relative values.

At a 81 year interval, one can observe the resurgence of Romanians, with values over 80%, the highest value being registered in Vâgani (95.2% in 1992, urban area), while in Bistra Mureşului, in 1992, Romanians registered 92.0%.

Hungarians had the lowest percentages at the 1850 census (5.0%), reaching higher percentages in 1930 (27.3%), followed by a decrease to 16.8% in 1992, and 14.7% in 2011. The Hungarian ethnicityhad higher values in Lunca Bradului (29.4%), followed by Stânceni (27.0%) and Răstoliţa (24.0%), in 1930, while in 1992, the order was reversed: Răstoliţa (19.5%) and Lunca Bradului (18.8%), and in 2011, Răstoliţa (15.7%) and Stânceni (15.1%).

When it comesto *Germans*and their presence in the area, the censuses register their stronger presence in 1930,with 2.0%, especially in Lunca Bradului (3.6%) and Răstoliţa (2.0%), followed by a continuous drop, which resulted in them being present solelyin Răstoliţa (0.5%, 10 people) in 2011.

The *Jewish population* faced the same situation, since in 1930 they were relatively numerous (7.0%), mainly in Lunca Bradului (10.5%) and Răstoliţa (10.4%), while, at the last two censuses, there was no one representing this ethnicity.

In the analysed period*, Gypsies* registered a maximum in 1992 (1.6%, 121 people), mainly concentrated in Lunca Bradului (3.4%), followed by a steady increase, reaching a percentage of 4.8% just 19 years later, this time found solely in Lunca Bradului commune.

Other ethnicities and those undeclared registered insignificant values during the period at hand, with 1.3% in 1930, and 0.1% in 1992 and 2011.

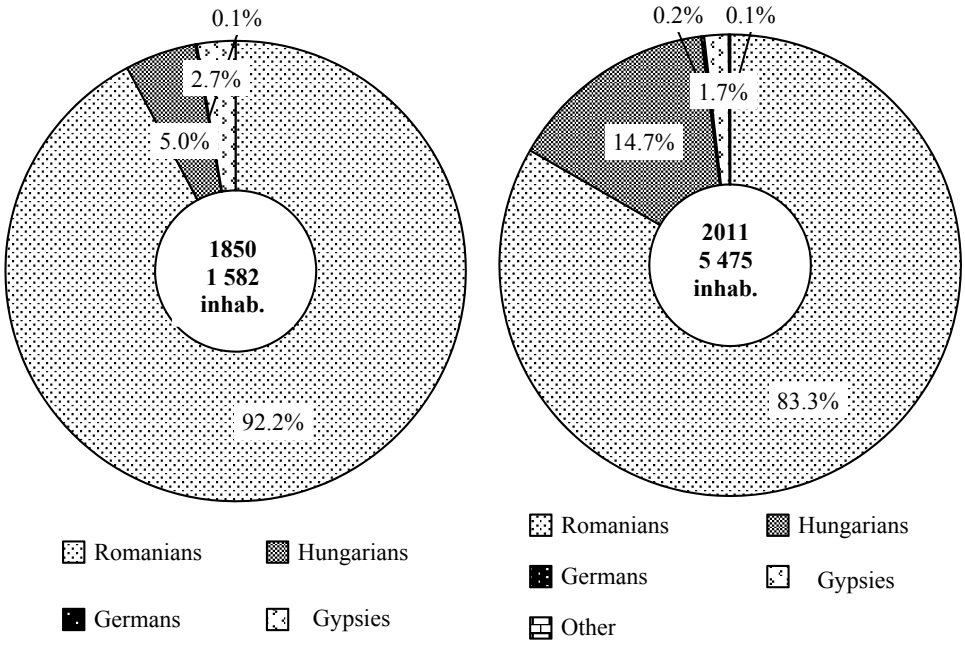

Fig. 4. The ethnic structure of population in Mureş Defile.

4.6. Population's religious structure

In order to emphasize the religious structure of the settlements found in Mureş Defile, four threshold moments were chosen, 1850, 1930, 1992 and 2011, which were also used in the ethnic structure analysis, as there is a strong connection between these two types of structures.

Therefore, I would like to point out the special situationfound during the analysis of the ethnic structure. This means that here we have an exception from the structural-religious modifications imposed by the social-political evolution.

In 1850, there was a very low percentage of *Greek-Catholic* followers (0.4%), Romanians being mostly *Orthodox* (94.3%), in Lunca Bradului the percentage of this religion being 100%, followed by *Roman-Catholics* (3.2%), *Reformed* (2.1%) and *Greek-Catholics* (0.4%).

Table 7

The religious structure of Mureş Defile's population, in 1850, 1930, 1992 and 2011

Years	Settlement	Total population	Orthodox	%	Greek-Catholic	%	Roman-Catholic	%	Reformed	%	O.r. N.r. Und.	%
1850	Total	**1582**	**1492**	***94.3***	**6**	***0.4***	**50**	***3.2***	**34**	***2.1***	**-**	**-**
	Stânceni	**972**	886	*91.2*	6	*0.6*	50	*5.2*	30	*3.0*	-	-
	Lunca Bradului	**246**	246	*100.0*	-	-	-	-	-	-	-	-
	Răstoliţa	**364**	360	*98.9*	-	-	-	-	4	*1.1*	-	-
1930	Total	**4220**	**2362**	***56.0***	**282**	***6.7***	**778**	***18.4***	**444**	***10.5***	**354**	***8.4***
	Stânceni	**1735**	1167	*67.3*	51	*3.0*	359	*20.7*	121	*7.0*	37	*2.0*
	Lunca Bradului	**1665**	696	*41.8*	218	*13.1*	304	*18.2*	238	*14.3*	209	*12.6*
	Răstoliţa	**820**	499	*60.8*	13	*1.7*	115	*14.0*	85	*10.3*	108	*13.2*
1992	Total	**7676**	**6158**	***80.2***	**13**	***0.2***	**744**	***9.8***	**527**	***6.8***	**234**	***3.0***
	Vâgani	**249**	227	*91.2*	-	-	10	*4.0*	-	-	12	*4.8*
	Stânceni	**1592**	1230	*77.2*	1	*0.4*	280	*17.5*	28	*1.7*	53	*3.2*
	Lunca Bradului	**2431**	1937	*79.7*	8	*0.3*	286	*11.7*	144	*6.0*	56	*2.3*
	Răstoliţa	**2325**	1814	*78.0*	3	*0.1*	140	*6.0*	335	*14.4*	33	*1.5*
	Bistra Mureşului	**1079**	950	*88.0*	1	*0.1*	28	*2.6*	20	*1.8*	80	*7.5*
2011	Total	**5475**	**4517**	***82.6***	**17**	***0.3***	**441**	***8.0***	**343**	***6.3***	**157**	***2.8***
	Stânceni	**1430**	1162	*81.3*	4	*0.3*	191	*13.3*	17	*1.1*	56	*4.0*
	Lunca Bradului	**1992**	1710	*85.8*	7	*0.3*	167	*8.5*	75	*3.7*	33	*1.7*
	Răstoliţa	**2053**	1645	*80.1*	6	*0.3*	83	*4.0*	251	*12.2*	68	*3.4*

O.r. = Other religion; N.r. = No religion; Und. = Undeclared.

Eight decades later, in 1930, the total population of 4220 inhabitants was 56% Orthodox, followed by Roman-Catholics (18.4%) and Reformed (10.5%), these last two religions being represented mostly by Hungarians, while Greek-Catholics had only 6.7%, and 354 people belonged to other religions (303 Jewish, 40 Evangelicals, 9 Penticostals and two Unitarians).

The situation from the 1992 and 2011 censuses did not yield significant changes from the one in 1930, for the entire area, Orthodox followers being 80.2% in 1992 and 82.6% in 2011, followed by Roman-Catholics with 9.8% in 1992 and 8.0% in 2011, Reformed with 6.8% in 1992 and 6.3% in 2011, while Greek-Catholics held values below 1% (0.2% in 1992 and 0.3% in 2011).

For the same period of time (1992-2011), *the category of other religions* held only seven Unitarians, after which a low number of neoprotestant followers were registered*: Penticostals* 101 in 1992 (52 in Bistra Mureşului, 24 in Răstoliţa, 19 in Lunca Bradului, 5 in Stânceni and one in Vâgani) and 73 in 2011 (64 in Răstoliţa, five in Stânceni and four in Lunca Bradului), *Baptists*44 in 1992 (17 in Lunca Bradului, 14 in Stânceni, eight in Vâgani and five in Bistra Mureşului) and 19 in 2011(12 in Lunca Bradului and seven in Stânceni), 38 *Seventh-day Adventists* in 1992 (20 in Stânceni, 16 in Lunca Bradului and two in Răstoliţa), and 34 in 2011 (19 in Stânceni, 13 in Lunca Bradului and two in Răstoliţa), *other religions, no religion, atheists and undeclared* with 44 in 1992 and 31 in 2011.

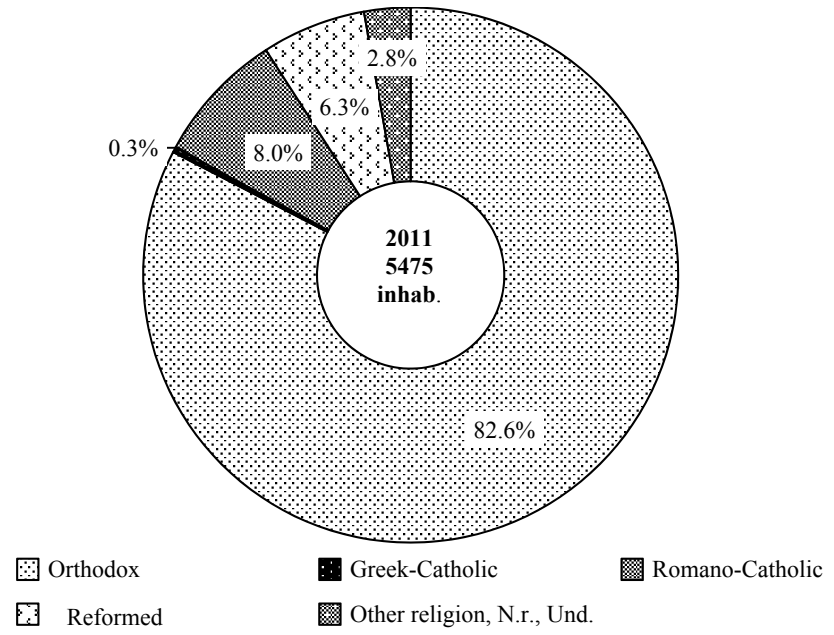

Fig. 5. The religious structure of Mureş Defile's population, in 2011.

5. CONCLUSIONS

In regards to the numerical evolution of population, depending on the demographic processes involved, we have four intervals for the 1850-2011 time frame: the first, 1850-1910, when population increased more than three times, the largest being in 1910 (5458 people), followed by 1910-1930, when the first demographic decrease takes place, -1238 inhabitants, with an annual negative trend of -62 inhabitants, with a -22.6% trend for the entire period. The third period, 1941-1977, is characterised by ademographic growth (1982 people), due to a positive natural and migration growth, while the last period, 1992-2011, defined by the so-called *„demographic erosion"*, characterisedby a continuous decrease, with approximately 1000 inhabitants, especially due to low birth ratesand high mortality rates, plus outmigration, leading to a descending evolutionarycurve (tables 1 and 2). The territorial distribution of population was analysedat administrative level, having values between 6.4-11.5 inhabitants/km^2, as well asfor the entire territory, where one can observe significant changes, with values between 106.0-687.0 inhabitants/km^2.

In terms of the population structure per gender, for the three census moments that were taken into account (table 3), there is a slightly higher percentage of males (50.3% in 1992, 50.5% in 2002 and 51.6% in 2011). The second category of structures, age groups (table 4), presented for the last period,show a decrease tendency for young people (0-19 years) from 34.5% in 1992 to 22.2% in 2011, and an increase of adults (20-59 years) from 49.8% in 1992 to 57.3% in 2011, as well as of elderly people (≥ 60 years) from 15.7% to 1992 to 20.5% in 2011.

The third structure category, professional, emphasizes the sametrends that can be found at regional and national levels, which is a decrease in actives, from 2975 people, in 1992 to 2425 peoplein 2002, due to layoffsand lack of employment opportunities (table 5).

The ethnic structurewas presented for the following threshold moments (1850, 1930, 1992 şi 2011), with a Romanian majority (92.2% in 1850, and 83.3% in 2011), followed by Hungarians (5.0% in 1992 and 14.7% in 2011) and Gypsies (2.7% in 1992 and 1.7% in 2011), data that can be found in table 6.

The last analysis of this studyis on religious structure (presented in detailin table 7), which brings forth an atypical case, that is few Greek-Catholic followers (0.4% in 1850, 0.3% in 2011), Romanians beingmostly Orthodox (94.3% in 1850 and 82.6% in 2011), while Hungarians and Gypsies are Roman-Catholics (3.2% in 1850 and 8.0% in 2011) and Reformed (2.1% in 1850 and 6.3% in 2011).

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EVALUATING THE LANDSCAPE ACCESSIBILITY FOR TOURISM ACTIVITIES IN POSTĂVARU MOUNTAINS

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ABSTRACT. – Evaluating the Landscape Accessibility for Tourism Activities in Postăvaru Mountains. Postăvaru Mountains represent one of the main tourism areas in Romania especially because of the location here of Poiana Braşov resort which is the go to destination for winter sports in the country. Because of this the financial return drops massively outside the winter season or if and when the snow layer does not allow for practicing winter specific sports. Thus a priority should be attracting tourism flows all year round by promoting and efficiently valuing the geomorphosites located in the proximity of the resort. The present study intends to analyse the synergy between the tourism infrastructure and the natural (relief) tourism potential of the Postăvaru Mountains in order to identify solutions and opportunities for a uniform flow of tourists all year round in Poiana Braşov resort.

Keywords: *accessibility, tourism activity, geomorphosite, infrastructure, Postăvaru, Carpathians, Romania.*

1. INTRODUCTION

Tourism activity is considered to be an important sector of the country's economy that can generate direct results. The development of tourism areas and the capitalization of the tourism potential (primarily the natural one) must be done judiciously based on the idea that the tourism activities will be durable and the fragile areas must be preserved (*http://www.mtnforum.org/oldocs/1012.pdf*).

During the last few years, tourism in Romania made great steps towards a durable capitalization of the natural and anthropogenic tourism potential which was done both by promoting it and through the development and modernization of the tourism infrastructure. The massive investments made in the country had the goal of aligning Romania's tourism infrastructure to the European quality norms. As such by incorporating certain areas to the urban landscape has allowed for accommodation units (hotels and BBs units) and summer residences to be built inside established tourism areas (Bucegi Mountains, Postăvaru Mountains, Rucăr-Bran Corridor) (NTDMP, 2007-2026; RAPFT, 2008-2013).

Accessibility towards and inside tourism areas has constantly improved by modernizing a series of roads (Gârda de Sus – Valea Ordâncuşa – Scărişoara in Apuseni

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Mountains) and by constructing new modern roads that generated and stimulated tourism flows in the mountain areas (Transalpina in Parâng Mountains, Transbucegi in Bucegi Mountains).

The excessive development of the tourism infrastructure may have negative effects on attracting tourism flows and maintaining the naturalness of an area, for example the alpine area from Italy and France (Val d'Aosta, Vallee de Maurienne) where the development of motorways or large capacity accommodation units resulted in a decrease of tourists. As such tourism planning must be done carefully and to aim to maintain harmony between the landscape elements and the important tourism attraction areas. The correct capitalization of natural tourism objectives by evaluating the existing geomorphosites is another important action meant to generate and control new tourism flows (Godde, P., Price M., Zimmerman F. M., 2000).

Postăvaru Mountains is a top rank Romanian tourism attraction area due both to its rich and varied natural potential and to the developed tourism infrastructure. The high valuing of the morphology has allowed for the development of the biggest and most complex ski area which has led to the establishment of Poiana Braşov resort, which holds a central position inside the Mountains.

The purpose of our approach is to identify solutions for the accessibility issues to Postăvaru Mountains in order to include in the tourism circuit those areas that are currently poorly exploited in spite of having tourism potential. The approach has the ultimate goal of diminishing tourism flow seasonality and implicitly increasing financial return. Both of these reach a peak point during the winter season when the accommodation capacity is overwhelmed by the number of tourists especially during the winter holidays and most weekends.

2. CASE STUDY

Postăvaru Mountains are located in the north-western part of the Curvature Carpathians and stand out for their varied natural and anthropogenic objectives, and a relatively good accessibility (modernized roads: in the West the national road connects Braşov, Cristian and Râşnov and continues through Bran-Rucăr, Râşnov-Pârâul Rece-Predeal corridor; forest roads and railways: Braşov - Zărneşti) and for its well-developed tourism infrastructure (best equipment for winter sports and cableways).

Postăvaru Mountains combine in a limited area a large variety of landforms as this is the major element in the structure of the tourism potential, the material support for the unfolding of tourism activities. They are predominantly made out of conglomerates and limestones as well as sandstones, marl and gravel. Its maximum altitude is of 1799m, in the homonymous peak, located in the central ridge that has a SW-NE orientation. Out of the other ridges span out peaks such as: Ruia (1659 m), Crucuru Mare (1435 m), Varna (1428 m), Crucuru Mic (1050 m) with the northern parts reaching 800 m in extended ramifications that border Braşov Depression. The north-western slope of the main ridge (that dominates over Poiana Braşov) is steeper and as such it is here that a ski area was developed. Among the natural landscape tourism objectives one names: Râşnoavei Gorges (with a length of 250m, steep slopes of 160-170m, covered by climbing routes), the Laptelui Cave (at an altitude of 1350m, with a length of 175m, and a level oscillation of 10m), Pintenul din Schei, Pietrele lui Solomon (M. Ielenicz, L. Comănescu, 2006).

The anthropogenic tourism potential mostly relates to Poiana Braşov. The resort is located at 13km from Braşov, at an altitude of 1030m, it covers 150ha, contains 25 accommodation units and 30 catering facilities. It is located on a surface levelling area, with a low relief fragmentation of 1-2km/kmp, the energy relief is lower than 100m, and slopes are lower than 5°. During winter there are few days with fog and the snow layer is stable, which favours winter sports.

The first chalet was built in 1907, in the northern part of the resort known as Poiana de Jos. In 1909 the first ski contest took place, on a trajectory that nowadays follows the modern road towards Braşov. Between the two world wars several chalets and villas were built in Poaina de Sus. The resort's maximum development moment was 1951 when the World Winter University Games were held here. For this event, ski jumping hills, a lift, a bobsledding course (later decommissioned), a chair lift and a hotel were built here (Ielenicz M., Comănescu L., 2006). Presently it is the mountain resort with the highest degree of equipment in the Carpathians, most of which is winter sports related (table 1).

Table 1.

Ski slopes in Poiana Braşov resort

Name	Difficulty level	Length (m)	Level difference (m)
DrumulRoşu	Easy	3821	630
Bradul	Easy	458	77
Slalom Poiana	Medium	575	217
Camelia	Easy	450	28
Stadion	Very easy	300	32
Lupului	Difficult	2860	775
Sulinar	Medium	2441	645
Kanzel 1,2	Difficult	350	134
Ruia 1,2	Difficult	540	198
Subteleferic	Difficult	1000	280

Source: www.poianabrasov.org; M. Ielenicz, L. Comănescu, 2006, modified)

3. METHODOLOGY

In order to establish the landscape accessibility for tourism activities the authors intended to perform two types of analysis: the proximity of accessibility to geomorphosites and to determine the servicing areas of tourism structures with accommodation functions.

3.1. Proximity of Accessibility to Geomorphosites Analysis

The proximity analysis is conducted through geo-processing that allows for solving issues or finding out spatial relations (in this case the relation between geomorphosites and accessibility in Postăvaru Mountains) (fig. 1).

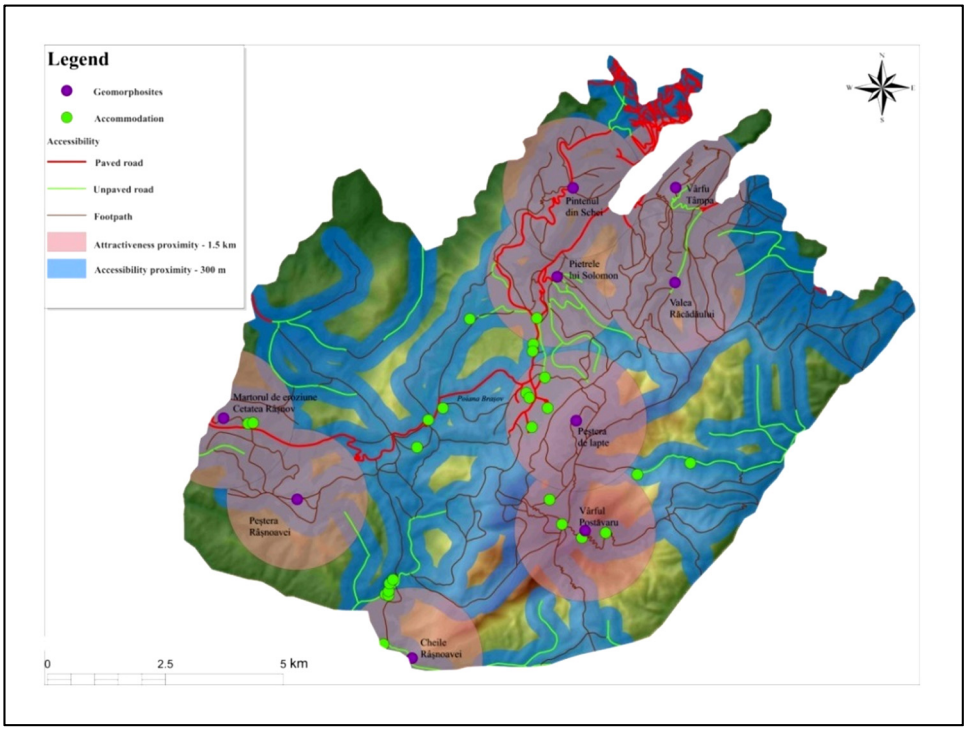

Fig. 1. Proximity analysis

Two methods were used for the proximity analysis:

- Creating *Buffers* from the proximity instruments set of ArcMap, that is areas of 1.5km around spatial objects, in our case geomorphosites, resulting circles with a radius of 1.5km, around the selected geomorphosites.
- Creating *Multiple Ring Buffer* from the proximity instruments set used around liniar spatial objects, in our case a single stratum 300m long.

A data base containing geomorphosites and accommodation units and their accessibility was thus created. The analysis shows which of the accommodation units are located inside the *attractiveness* area of a geomorphosite and can thus serve as reference for tourists in choosing tourism structures according to their accommodation; also by observing the accessibility degree for each geomorphosite different types and forms of tourism can result: visits, hikes, ecotourism.

Proximity areas result from creating *buffers* of 300m along the accessibility route and shows the distance between different interest points to a specific type of road, which in turn can become a decision factor for tourists. Tourists can choose between accommodation units located close to a tourism objective or geomorphosite and a national road in case they want to travel there by car or a country road or trail in case they want to hike.

In order to establish the values of the geomorphosites (M. Panizza, 2001; E. Reynard, 2005) located within the analysed area the authors used the geomorphosite tourism evaluation method, introduced in the specialized literature by J. P. Pralong (2005).

The tourism value is calculated as an average of the four values, according to the formula: *Vtour =(Vsce +Vsci +Vcult +Veco)/4***,** where *Vtour* represents the tourism value, *Vsce* the aesthetic one, *Vsci* the scientific one, *Vcult* the cultural-historical one, and *Veco* the socio-economic one (table 2).

The following criteria were used for the four values:

- for the aesthetic value: number of lookout points, average distance between lookout points, area of the site (km^2) compared to other sites in the same area, slope, colour impact against the surroundings

- for the scientific value (which includes the ecological value): paleogeographic interest, representativeness, surface (%), rarity, integrity, ecological interest

- for the cultural one: cultural and historical features, as presented in iconographic representations and/or in different writings, historical and archaeological relevance, religious and symbolic relevance, art and cultural events

- for the economic one: accessibility, natural hazards, annual number of visitors, official level of protection, attractiveness.

Table 2

Global evaluation of the geomorphosites from Postăvaru Mountains

Name	Code	Type	Scientific value	Aesthetic value	Cultural value	Economic value	Global value
Cetatea Râsnovului Peak	BVed1	punctual	0.5	0.75	0.75	0.5	0.625
Râşnoavei Cave	BVkar2	punctual	0.25	0.5	0.25	0.25	0.312
Râşnoavei Gorges	BVflu3	linear	0.5	0.75	0.25	0.25	0.437
Postăvaru Peak	BVm4	punctual	0.25	0.5	0.25	0	0.25
Laptelui Cave	BVkar5	punctual	0.25	0.5	0.25	0	0.25
Răcădău Valley	BVkar6	linear	0.25	0.25	0	0	0.125
Solomon Rocks	BVed7	punctual	0.5	0.75	0.25	0	0.375
Schei Rocks	BVkar8	areal	0.25	0.25	0.50	0	0.25
Tâmpa Peak	BVm9	punctual	0.25	0.5	0.50	0.25	0.375

3.2. Establishing the Servicing Areas of Tourism Structures with Accommodation Functions

The servicing areas are those located around any given location (in our case the accommodation units). They include all roads / accessible trails (which fall under a series of pre-established parameters). For example, a five minutes serving area for a certain objective that is located within a network includes all accessible points that can be reached in a five minutes trip from that objective.

The actual accessibility of Postăvaru Mountains is offered by national roads, forest roads and trails. Each of these three types of accessibility has specific features that provide a travel speed, a time travel and hence a distance. Interest points are then introduced, which in our case are represented by accommodation units and geomorphosites.

An accessibility network is built by using the *Network Analyst* extension in ArcMap. Once this network is built the *New Service Area* function is used in order to start building the servicing areas. From this network window, facilities (accommodation units) are added as they constitute the points on our built-in network. A tolerance scale is chosen for establishing interest points, preferably higher, and in our case 5km.

Starting from the properties of the *Service Area* function, the optimal analysis rules are chosen:

- The line generator is chosen (it must contain data about the considered parameters: length and time which must differ according to the different values). The lines must not overlap.

- The analysis parameters are chosen, in our case *length* and *time* for which the servicing areas will be created (fig. 2, 3). Apart from the lines that will determine servicing according to the established parameters, we need also to thick the option to generate polygons that will constitute serving areas.

- In the window for analysis settings the breaks of the two parameters are chosen: 1, 2, 3, and 5km for length; respectively 5, 10, 15, 20 and 30 minutes for time.

- For direction the option *from facility* is preferred rather than the *towards facility* one.

After validating all these parameters, lines and polygons are generated. Data must be however exported in shapefile format in order to become separated vectors. After exporting the lines and polygons these *shp*s are loaded and viewed in the *Table of contents* as *layers*. A classification is made according to the chosen rules in the analysis settings window. In the layers properties, a classification is chosen for their viewing according to a specific symbology in our case according to *quantities*. Five classes are chosen (the previously selected *breaks*) specifically: 1, 2, 3, and 5 km for length and 5, 10, 15, 20 and 30 minutes for time, each with a different colour to emphasize the differences.

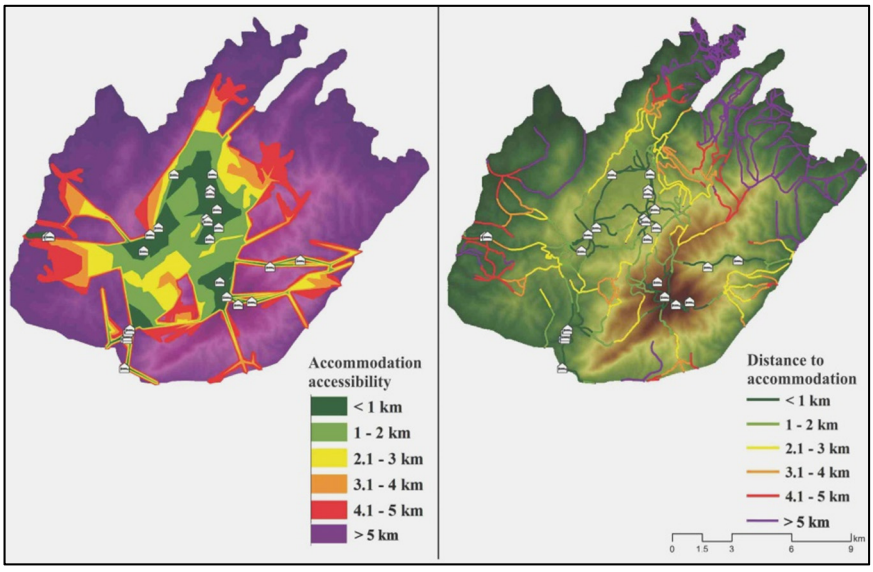

Fig. 2. Service area based on length analysis

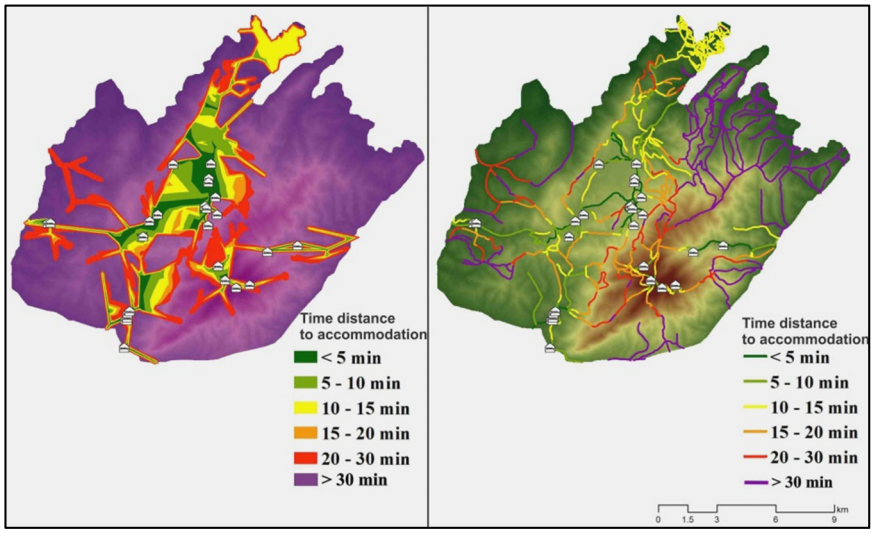

Fig. 3. Service area based on time analysis

4. RESULTS AND DISCUSSIONS

Poiana Braşov resort, well known as a winter sport destination, is trying to diversify its tourism offer range in order to maintain and strengthen its tourism profile in this area. With the reduction of the number of days in which the ski slopes can be used for winter sports (due to global warming) the resort's administrators started looking for alternative ways to attract tourists and rationally employ the natural potential of Postăvaru Mountains.

As such, for the low season time slots and the ones when the snow layer is insufficient for ski, using the values of various geomorphosites located in Postăvaru Mountains can constitute a viable alternative.

The main component for a successful capitalization and management of a geomorphosite is given by effortless accessibility and direct and quick routes between geomorphosites and the available accommodation units.

The analysis the authors made based on GIS tools and techniques underline an inhomogeneous image in terms of tourists' accessibility to the identified geomorphosites (fig. 4, 5):

-***Geomorphosites with easy access to accommodation units.*** Are those geomorphosites located along a modernized road or close (as far as 1.5 km) or close to a cable installation point: *Cetatea Râsnov, Postăvaru Peak, Tâmpa Peak*. Proposed actions and/or interventions: promoting and durable capitalization of these geomorphosites.

-***Geomorphosites with difficult accessibility.*** Are those geomorphosites where the access is provided solely by tourism trails, some of them having increased slopes or difficult fragments, farther than 1.5 km from a modernized road: *Râşnoavei Cave, Laptelui Forest, Racădau Valley.* Proposed actions and/or interventions: improving accessibility by developing forest roads or by building cableways installations. The promotion and durable capitalization of these geomorphosites is recommended.

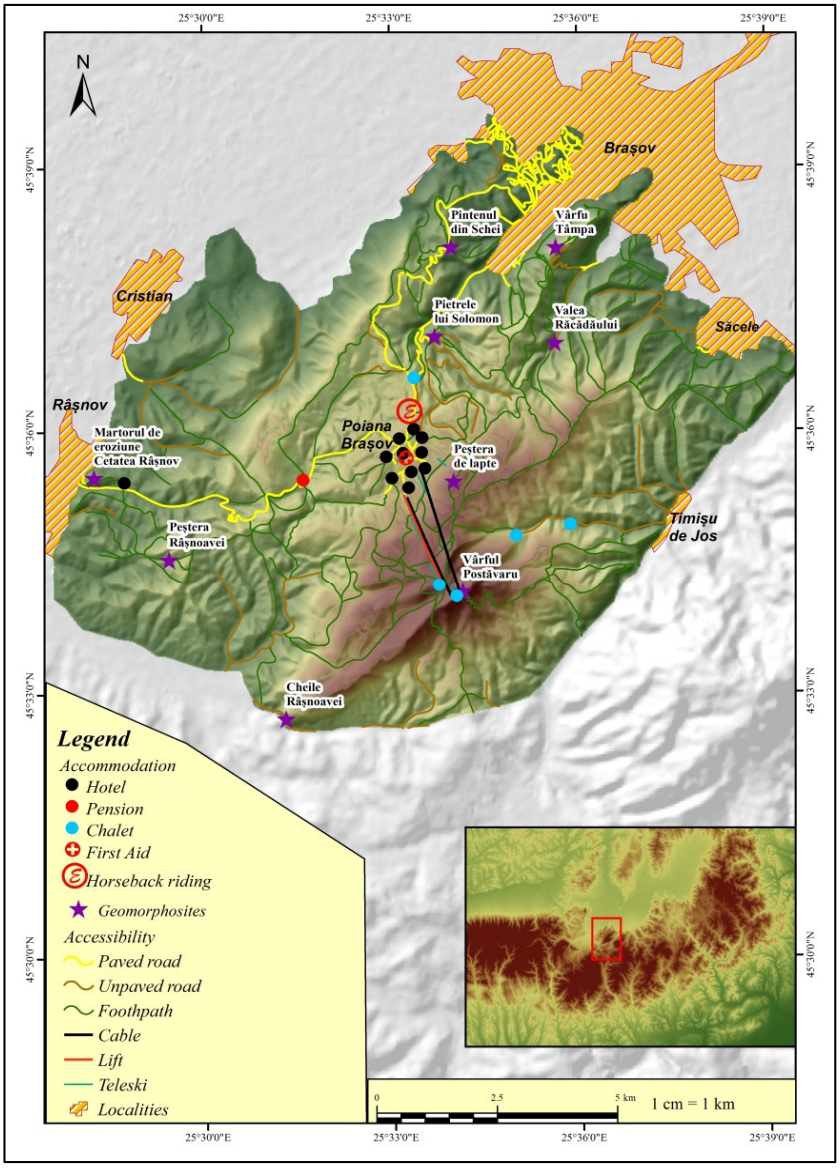

Fig. 4. The synthesis map

-***Geomorphosites without any accommodation possibilities close by.*** Are those geomorphosites that have good accessibility but the accommodation possibilities are limited: *Schei Rocks, Râşnoavei Gorges, Solomon Rocks.* Proposed actions and/or interventions: increasing the accommodation capacity by building small hotels or BBs and respectively promoting and durable valuing these geomorphosites.

Fig. 5. A. Modernized access road in Poiana Braşov, B. Geo-themed forest road, C. Capra Neagră cable used for access to Postăvaru Peak, D. Accommodation units in Poiana Braşov (Aurelius Hotel, 5 stars)

In terms of distance from different areas to accommodation units, an obvious imbalance can also be seen between the central parts of the mountains (Poiana Braşov – Postăvaru Peak) and the peripheral areas. In the central area, the accommodation units are generally dense (numerous hotels and BBs) and have better standards compared to the peripheral areas where the number of accommodation units is small and there are three stars BBs.

The time of servicing can differ from a few minutes for areas situated in Poiana Brasov and Valea Cetăţii, up to 30 minutes for mountain areas located in the eastern and respectively southern parts of the range.

In the present day context, when diversifying tourism attractions and developing the accommodation and transport infrastructure is the main stake of tourism agents, this type of analysis can constitute a viable starting base in realizing local feasibility studies aiming to attract more and more tourists all year long and thus fulfilling the definition of viable and educational tourism.

The results and recommendations standing out from this study include the following actions:

- The judicious capitalization of the natural tourism potential by developing new access routes between modernized roads and geomorphosites;
- Capitalizing of the geomorphosites by developing new smaller accommodation units in their close proximity;
- Promoting geomorphosites and creating educational materials for a judicious development of an eco-educational tourism;
- Diversifying the interest points network that do not depend on the weather conditions in order to use the tourism infrastructure all year long (accommodation units with spa centres, or conference centres, equitation centres, adventure parks, eco-parks),
- Diversifying and decentralization of the accommodation units (constructing new accommodation spaces in other parts of the mountains rather than Poiana Brasov).

5. CONCLUSION

The superior capitalization of the landforms allowed for the development of the biggest and most complex ski domain, which in turn has led to the emergence of Poiana Braşov resort, but tourism activities are still conditioned by the existence of a sufficient snow layer for practicing winter sports. The existence of highly attractive geomorphosites within the area of Postăvaru Mountains creates the premises for a well-balanced developed tourism practice throughout the entire year. Developing new accommodation units and modernizing access routes for other areas rather than the central one (Poiana Braşov) may constitute interventions and actions that will lead to an increase in tourist flows. Recreational as well as eco-educational activities represent a new trend useful for obtaining the desideratum of a durable tourism practice in Postăvaru Mountains.

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TOURISM OFFER IN ROMANIA AND NORTHERN TRANSYLVANIA – TERRITORIAL DISPARITIES

LUJZA TÜNDE COZMA[1]

ABSTRACT. – Tourism Offer in Romania and Northern Transylvania – Territorial Disparities. Explaining spatiality has been in the focus of tourism geographers since the beginnings, and the examination of spatial processes still represents a major challenge for researchers, knowing that there is no segment in the functioning of society in which spatiality is not present. The approach was to consider tourism as a complex spatial phenomenon, in order to explain better its processes. Romanian literature abounds in descriptive research of travel and tourism, discussing quantitative and qualitative issues, attraction classifications, tourism potential and geographic dispersal. However, a serious deficit manifests in explanatory research. Therefore, this paper aims to analyze the territorial disparities in the tourism offer of Romania, in generally and of Northern Transylvania in particularly, in the light of current trends characterizing the national tourism industry. Besides spatial characteristics, this paper also deals with tourism penetration on regional level, and territorial concentration of accommodation capacity in the region of Northern Transylvania. The results show that in the moderately-high saturated destination of Northern Transylvania the accommodation capacity in use is spatially concentrated and only a few localities can be regarded as the strongholds of the accommodation basis. The study brings novel results especially for tourism planning, but also provides a basis for further research.

Keywords: *spatial aspects, regional disparities, tourism penetration, territorial concentration, accommodation capacity*

1. INTRODUCTION

Tourism plays an increasing role in regional development worldwide. Due to its certified socio-economic effects it is considered as a leading sector even in the disadvantaged regions. However, tourism is a spatial phenomenon and "the concept of space is inseparable of the concept of inequality" (Nemes Nagy, 1998: 51) . Tourism, nor as an industry, nor as spatial phenomenon (and nor its spatial, economic and social effects) are not evenly distributed in space, significant disparities occur nationally, regionally and locally (Hall and Page, 2002). Therefore, the analysis of regional tourism disparities provides a comprehensive view of the phenomenon of tourism in that country, in our case Romania, with special regard to Northern Transylvania.

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The palette of research concerning spatial aspects of tourism is very wide and diversified (Cozma, 2012a). Just to mention a few examples, the key concepts in the international literature are: *spatial patterns of supply* (Pearce, 1979; Smith and Mitchell, 1990; Hall and Page, 2002, 2006; Aubert, 2007; Michalkó, 2007, 2008), *spatial aspects of tourism* (Mitchell and Murphy, 1991; Pearce, 1995a; Hall and Lew, 1998; Rátz and Michalkó, 2009) or *space specific tourism products* (Dávid, 2007; Michalkó, 2008). In the Romanian literature researchers have been focusing on the *geographical basis of tourism* (Susan, 1980; Muntele and Iaţu, 2003; Ciangă, 2006; Dombay, 2007; Cocean et al., 2009) and *geographical dispersal of tourism potential* (Dezsi, 2006; Ielenicz, 2009; Miruţ et al., 2009).

Taking into account the opportunities of the travel and tourism industry in Romania (Light and Andone, 1996; Raţiu et al., 2010) and following the "spatial turn" (Benedek, 2011) in scientific research, this paper aims to analyze the territorial disparities in the tourism offer of Romania, with special regard to North-West development region.

The methodology involved desk study for the literature review and database compilation, followed by descriptive research, which meant a comprehensive geo-statistical analysis of the available statistical data[2], and an explanatory research using regional analysis methods, such as building a complex impact indicator and measuring the territorial concentration of the tourism supply. For a better understanding, the obtained results were mapped.

2. THE ROMANIAN TOURISM TODAY

In 2012, in Romania there were 5,821 accommodation units (according to the official statistics), offering 103,160 permanent rooms and 32,773 seasonal rooms, therefore a total capacity of 74,134,614 places-days. 67.2% of the existing capacity was concentrated in hotels and motels, 9.9% in pensions, 9.2% in agro-touristic pensions, 4.6% in villas and bungalows, and the rest of 9.1% in other accommodation types. Regarding tourist destinations, the seaside concentrates 12.8% of the total capacity in use, spas and health resorts 13.3%, mountain resorts 17.8%, the Danube Delta 0.9%, Bucharest and county capital cities concentrate the most of the capacity, i.e. 36.8%, and the rest of 18.3% is located in other localities. In terms of comfort, most of the capacity (71.6%) is concentrated in 2 and 3 star units, while 4 and 5 star units concentrate only 1/5th (20.8%), 4.6% is found in 1 star units and the rest of 3.1% in unclassified structures.

The statistics show a 9.3% growth (to 2011) in the number of registered tourist arrivals (7,686,489 tourists), who spent in 2012 a total of 19,166,122 overnight stays (os.). 82.8% of the accommodated visitors were Romanians and 17.2% were foreigners. Foreigners preferred hotels (2,884,709 os.) and 3-4 stars category of comfort (2.370.202 os.). Romanians preferred hotels (1,229,602 os.), followed by pensions (956,482 os.) and agro-touristic pensions (828,541 os.), and more modest categories of comfort, of

[2] official statistical data from: Tempo database of the National Institute of Statistics and the National Tourism Authority database

mainly 2-3 star units (12,115,896 os.). In terms of overnight stays, Romanians preferred the following destinations: Bucharest and county capitals (4,380,521 os.), spas and health resorts (4,156,939 os.) and the seaside (3,299,224 os.) while foreigners preferred Bucharest and county capitals (2,405,550 os.), followed by other localities (345,292 os.), and mountain resorts were on the third place on their list (242,224 os.).

The majority (70.1%) of the accommodated tourists came from the EU, mostly from the following countries: Germany (230,116), Italy (181,962), France (118,083), United Kingdom (91,867) and Hungary (90,573). Most tourists from outside the EU come from Turkey (34,240). 8.8% of the foreigners come from Asia, 7% from USA, 0.9% from Africa, 0.7% from Australia and Oceania and the rest from unspecified countries and territories.

The net use index of the accommodation capacity was 25.9% in 2012, dropping from 33.4% in 2005. The highest net use indices were registered by hotels (32.1%) and 5 star units (34.6%). The average length of stay on country level was 2.49 days, while regarding tourist destinations it was: 6.13 days in spas and health resorts, 4.28 days on the seaside, 2.16 days in mountain resorts, 1.78 days in the capital and county capital cities, 1.52 days in the Danube Delta and 1.82 days in other localities.

The main indicators of the accommodation capacity and activity for the period of 2005-2012 were summarized (table 1).

Table 1.

Main indicators of the accommodation capacity and activity for 2005-2012

	2005	2006	2007	2008	2009	2010	2011	2012
Tourist accommodation units	4226	4710	4694	4840	5095	5222	5003	5821
nr. of Hotels	989	1059	1075	1104	1159	1233	1308	1384
Functioning accommodation capacity *	54978	56499	57137	59187	61104	63808	68417	74135
in Hotels *	37007	37728	38432	39889	40586	42551	45204	47095
Number of accommodated tourists **	5805	6216	6971	7125	6141	6072	7031	7686
nr. of foreigners **	1430	1380	1551	1466	1276	1346	1516	1656
Overnight stays **	18372	18991	20593	20725	17325	16051	17979	19166
of foreigners **	3464	3242	3586	3359	2668	2767	3067	3297
Net use indices ***	33,4	33,6	36	35	28,4	25,2	26,3	25,9

Data source: NIS, 2014
* thousand places-days
** thousand number
*** percent

As can be seen, the number of units and capacity in use have been increasing during this period, to 137.7% in the case of units and 140% in the case of capacity (to 2005). Regarding the number of tourist there was a significant decrease in the years 2009 and 2010, mainly due to the global economic crisis. In 2011 this indicator began to grow again, reaching 109% in 2012 (to 2011). The same trend can be observed in the case of overnight stays, reaching 106.6% in 2012 (to 2011). In contrast to the rest of the indicators, the net use indices and the average length of stay are declining significantly since 2007-2008.

Analysing statistical data for 2000-2009 Bucurescu (2011) concluded that there was an important decrease in the interest of tourists in the seaside resorts, manifested especially in the case of foreigners, although the increasing number of tourism structures led to a constant accommodation capacity in the region. Furthermore a significant growth was observed in the tourism activity of the destinations "Danube Delta" and "other localities and tourist routes". The later destination, which excludes the capital city and county capitals, spas, seaside and mountain resorts as well, had the strongest positive evolution.

For 2012, The World Economic Forum ranked the travel and tourism competitiveness of Romania on the 68th place out of 140 countries, five positions lower than the previous year and far behind Hungary (39th) and Bulgaria (50th). According to this report the competitive advantages of Romania are its tourist infrastructure and cultural resources (WEF, 2013).

From an economic perspective tourism is as important in Romania as for the rest of the world. According to the WTTC[3] the economic impact of this industry is growing in Romania. Although the direct contribution to the GDP (1.4%) and Employment (2.2%) is quite low, the total contribution is much higher. The forecasts for 2022 are promising: 5.6% total contribution to GDP, 6,6% total contribution to Employment, 3.7 % to Visitor exports and 7.6% to Investments (WTTC, 2013).

In conclusion, although Romania has a high tourism potential, in international comparison the sector's performance is considered poor. On European level the Romanian tourism market is in development, but it relies mainly on the domestic tourism.

2.1. The place and role of Northern Transylvania in Romania's tourism

Northern Transylvania is one of the 8 development regions of Romania, composed by 6 counties: Bihor, Bistriţa-Năsăud, Cluj, Maramureș, Satu-Mare and Sălaj. It covers 14.3% of Romania (i.e. 34.159 km^2) and gives home for 13% of its population (2,744,914 inhabitants). The region has a strategic geographical position, being situated at the borders with Hungary and Ukraine, and also with the Centre, North-East and West regions of Romania. It's position on national and wider European context is further strengthened by its natural resources and values, the developed transportation system, its attractiveness from economic point of view, its cultural diversity and valuable tourism potential (Horváth, 2006). If we would to characterize the regions of the country with only two words, then Northern Transylvania could be described with "innovation" and "latent development potential" (Kurkó, 2011: 442).

[3] World Travel and Tourism Council

The historic cities and urban cultural centres(such as Cluj-Napoca, the future European Youth Capital), the ancient thermal baths (such as Felix), ethnographic regions (Maramureş or Kalótaszeg), picturesque villages, National Parks, UNESCO World Heritage sites and so on contributed to the development of health tourism, cultural tourism, rural tourism, religious tourism, and even ecotourism and business tourism lately.

In terms of accommodation capacity in use, North-West region is situated on the third position (9.4 mil. places), after Centre and South-East regions (Fig. 1).

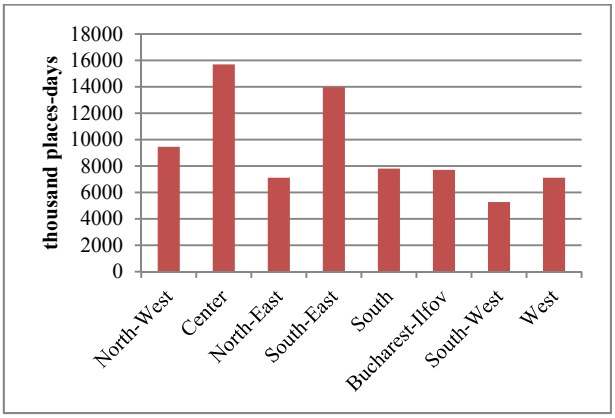

Fig. 1. Accommodation capacity in use in Romanian development regions, 2012 (Data source: NIS, 2014)

Regarding the quality of services, the situation in North-West exceeds the national average, but still remains low on international level. In terms of tourist turnover, North-West region is situated on the fourth place (2.1 mil. overnight stays), after South-East, Centre and Bucharest-Ilfov regions (fig. 2).

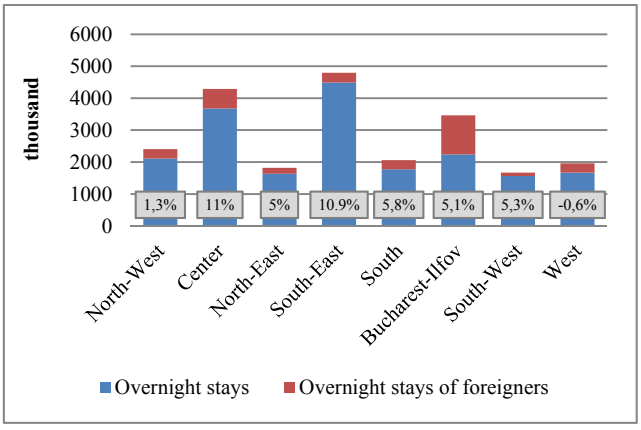

Fig. 2. Overnight stays in Romanian development regions, 2012 (Data source: NIS, 2014).

The international tourist's share of the tourism market, though improved in recent years, it remains low (292 thousand overnight stays of foreigners, i.e. 14%) It is noticeable that the increase in overnight stays to the previous year was only 1.3%, the second most lower on regional level. The net use indices in the region is lower than the country average, i.e. 22.3% and shows a declining trend (Cozma, 2012b).

On national ranking, regarding the overnight stays, the counties of Northern Transylvania occupy the following positions: 5. Bihor (1.03 mil.), 10. Cluj (510 k.), 25. Maramureş (186 k.), 28. Bistriţa-Năsăud (164 k.), 32. Satu-Mare (130 k.) and 37. Sălaj (90 k.).

All in all the most important competitor for Northern Transylvania is the Centre region, which has a much more efficient tourism performance.

3. THE TOURISM SUPPLY IN ROMANIA – TERRITORIAL ASPECTS

The tourist accommodation units have undergone serious typological transformations in the last 2 decades. The dominance of hotels and motels was put to an end by pensions. While straight after the regime change, in the early '90s, Romania had an accommodation capacity of more than 360 000 places, in 2000 this indicator showed a 20% decline. The cause of this subsidence is believed to be the consequence of physical and moral depreciation of traditional units, like villas and chalets, which were the specific units of health tourism and mountain resorts (Ciangă, 2006), preferred by the domestic tourists of the Communist regime (Light - Andone, 1996). After the new millennium, the accommodation capacity increased continuously and new types of accommodation units appeared, such as youth hotels, hostels, apartment hotels and vacation villages.

In 2012, on regional level, the Centre region concentrated the most accommodation units (25%), followed by South-East (19%), North-West (13%), North-East (12%), South and West (10% each), South-West (8%) and Bucharest-Ilfov (3%). Centre and South-East concentrated the most of the capacity in use as well (20% and 19%), followed by North-West (13%), South (11%), North-East, West and Bucharest-Ilfov (10% each), and South-West only 7%.

Three types of units dominate in the majority of regions: hotels, pensions and agro-touristic pension. There are two exceptions: South-East, where hotels, villas and bungalows are the most numerous, and Bucharest, where hotels are the most numerous.

Among other components of the tourism offer, we discuss the following: hospitality units, tourist information centres and tourism agencies (fig. 3).

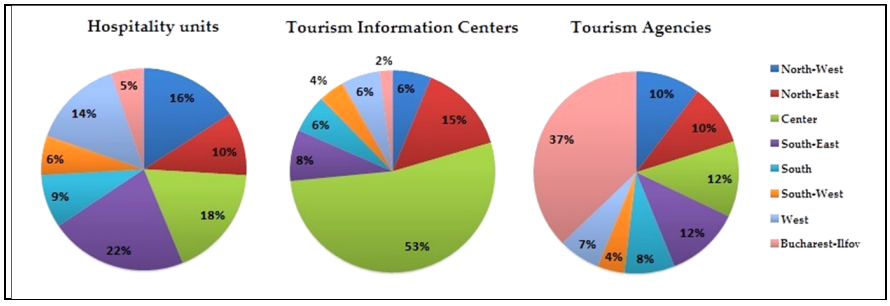

Fig. 3. Regional distribution of main tourim services, 2012 (Data source: NTA, 2014).

According to the National Authority of Tourism 22% of *catering establishments* (restaurants, bars, fast-foods, bakeries, pancake shops etc.) are found in South-East region, followed by Centre region with 18%, and North-West with 14%. *Tourist information centres* are not very numerous, a total of 49 centres are located in 22 counties, so half of the Romanian counties do not have such centres at all. Most of these centres are found in Centre region (53%, 11 only in Sibiu County). The capital city had at the moment of the research only one tourist information centre, compared to other European capitals and cities, where more such information points are placed strategically. In contrast, travel agencies are found in Bucharest (37%), followed by South-East (12%) and North-West and North-East (10% each). An estimation is that about 20 tourism agencies have predominantly incoming in their business structure[4].

The spatial distribution of units and functioning capacity on county level shows the following. In 2012, the most accommodation units functioned in Constanţa County (12.7%), followed by Braşov (11.1%) and Harghita (5.9%) counties. In comparison the highest capacity was registered in Constanţa County again (14.4%), followed by Braşov County (10%) and Bucharest City (9.4%). The latest three concentrated 33.8% of the total capacity in use. The counties with the fewest unit number were Giurgiu and Teleorman (0,2% each) and Olt and Botoşani (0,3% each). The counties with the lowest capacity were Călăraşi and Teleorman (0,3% each) and again Giurgiu and Olt (0.4%). The highest concentration of units per square kilometer was in the Municipality of Bucharest (0.55 units/km^2), Braşov (0.12 units/km^2) and Constanţa counties (0.1 units/km^2). The largest accommodation capacity per capita was in Braşov (13.5 places-days/inhabitant), followed by Vâlcea (7.7 places-days/inhabitant) and Covasna (6.2 places-days/inhabitant) counties.

In terms of tourism services, the City of Bucharest and Sibiu, Cluj, Constanţa and Braşov counties are the richest offer, while the poorest from this point of view are Botoşani, Călăraşi, Giurgiu, Ialomiţa, Mehedinţi, Olt, Sălaj, Satu-Mare, Teleorman, Vaslui and Vrancea counties.

Most of the accommodation units show a close connection between the tourist attractions of that destination and the landscape characteristics (Michalkó, 2007). Space undoubtedly influences the development of tourism supply and there are destinations where geographical space defines the type and characteristics of the units that can be established (Kökény, 2009). For example, wellness and spa hotels have developed in the spa and health resorts of the country; or motels have developed primarily on the main trunk roads, serving mainly the automobile transit tourism; chalets are specific to mountain resorts, where there are possibilities for winter sports and hiking; and agro-touristic pensions fit perfectly into the landscape of the countryside. In the case of hotels and pensions there is no evidence of such territorial attachments. there are, however, situations when using the opportunities given by the geographic space special accommodations are developed, even unique ones, such as the ice hotel on the shores of Lake Bâlea (at 2000 m altitude, in the Făgăraş Mountains, rebuilt annually since 2005 and attracting 5000-8000 tourist per season) or the castle pension Haller (the first of its kind, in Ogra, Mureş County).

[4] Wall Street [*http://www.wall-street.ro/articol/Turism/166288/turistii-straini-cheltuiesc-635-de-euro-de-persoana-intr-o-vacanta-in-romania.html*]

Fig.4. provides a comprehensive view of the accommodation base in Romania and the concentration of the capacity in different zones of the country. For a better visualization the capacity in use was divided into 5 groups: localities under 10 thousand places-days (308 loc.), 10-80 thousand (349 loc.), 80-110 thousand (24) – these are the ones around the country average, between 110 thousand and 1 million (97 loc.) and over 1 million places-days, i.e. localities with the highest capacity (13 loc.). The localities with a capacity under 5 places of no accommodation capacity at all were left white. As the map shows, only a limited number of localities participate in the reception of tourists (795 territorial administrative units).

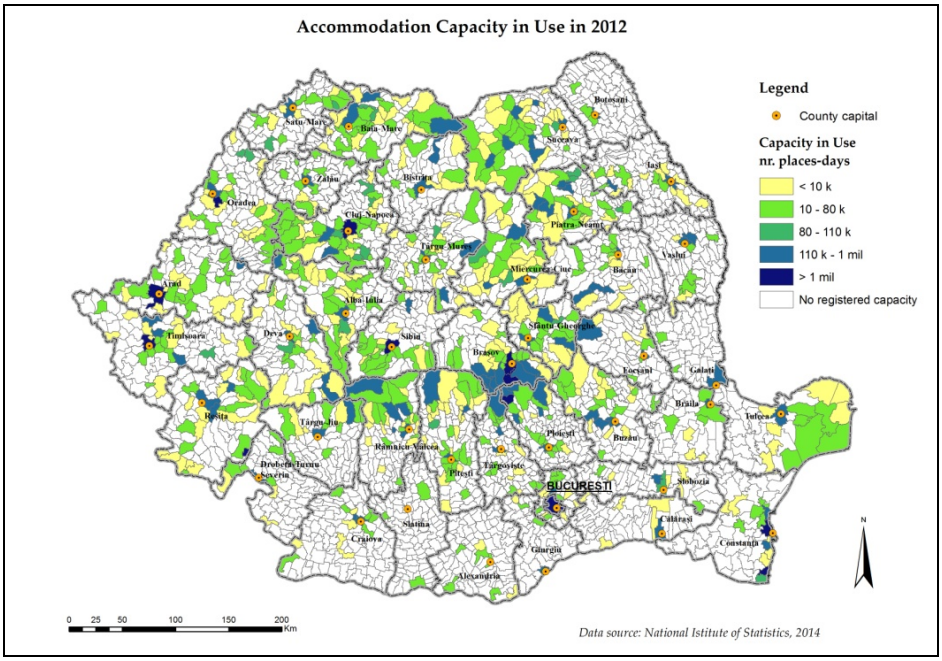

Fig. 4. Accommodation capacity in use in the territorial administrative units of Romania, 2012 (Source: author, data from NIS, 2014).

In 2012 the 795 localities in Romania offered *total capacity* of 74.135.614 functional accommodation places-days. The highest capacity was recorded in Bucharest City (6,987,502), followed by Constanța (4,299,183), Mangalia (3,496,043), Brașov (2,887,930) and Cluj-Napoca (1,873,338). The poorest capacity was registered in Zam, Șoimuș, Hărău and Baia de Criș (Hunedoara County, 248 places-days each) and Dărmănești (Argeș County, 350). On the first 10 places on the country ranking were cities and towns, except Sânmartin commune (position 7). It is important to mention that 77 cities in the country (24%), did not offer any accommodation capacity in 2012.

In 2012 *the hotel capacity* was found in 257 localities, the highest concentration being in Bucharest (6,684,313 places-days) and the lowest concentration in the City Berbeşti (Vâlcea County, 1.260). On the first 10 places on the country ranking were regional centres (cities of Constanţa, Braşov, Cluj-Napoca and Timişoara), seaside resorts (Mangalia and Eforie), mountain resorts (Sinaia), and one commune with spa resorts occupying position 6 (Sânmartin, in Bihor County). While almost half (46.9%) of hotel capacity Romania is concentrated in cities and towns, nearly half (48.7%) of the cities and towns do not offer any hotel accommodation capacity. Bucharest itself holds 14.2% of the total hotel capacity, county capital cities hold 22.8% (Constanţa in the most advantageous, Alexandria in the worst position), and the rest is divided among 123 cities and towns and 93 communes.

There were 465 localities in 2012 with *agro-touristic pensions* (6.864.934 places-days). On the top of the country ranking there were the communes Moieciu (672.170) and Bran (532.211) in Braşov County, followed by Sanmartin (207.670, Bihor county), Alexandru cel Bun (105.254) and Agapia (102.438) in Neamţ county. These 5 communes concentrate 23.6% of the total capacity in rural pensions in Romania. The communes Zam and Baia de Criş (Hunedoara County, 248 each) were on the last positions, followed by Borsec (Harghita County, 310) and Dărmăneşti (Argeş County, 350).

All in all 80% if the capacity in use in Romania is concentrated in only 97 territorial administrative units, the first 10 from the country ranking offering 37% of the total accommodation capacity. Thus we can conclude that the countries tourism offer is focused in a limited number of localities, with large regional disparities. Comparing the map with the geographic dispersal of natural and anthropogenic tourism potential, at first glance, there is a close connection between the geographic characteristics of the country, the natural and the anthropogenic tourism resources.

3.1. Tourism Penetration Index

When analysing regional disparities, the multi-dimensional nature of inequalities makes their expression with a single indicator impossible (Benedek, 2004). Whereas tourism is also a complex, multidimensional phenomenon, it is useful to measure its effects with complex indicators. Therefore, for the study of tourism's territorial effects, the researchers of the ESPON 1.4.5. Project in 2006, developed a complex impact indicator, the TPI index (Tourism Penetration Index). The advantages of this indicator are that it creates a single variable of uni-dimensional measures of economic, socio-cultural and environmental penetration and a number of destinations can be compared.

In the original concept the economic impact is given by tourist expenditure per capita, the social impact by density of tourists per 1000 population and the environmental dimension by the number of bed spaces or rooms per square kilometre (McElroy – Albuquerque 1998; Sütő 2007; Tóth – Dávid 2010). The tree individual indices are calculated by the following formula:

$$TPI_{eco} = (x_{eco} - x_{eco}min) / (x_{eco}max - x_{eco}min)$$
$$TPI_{env} = (x_{env} - x_{env}min) / (x_{env}max - x_{env}min)$$
$$TPI_{soc} = (x_{soc} - x_{soc}min) / (x_{soc}max - x_{soc}min)$$

where:

TPI_{eco} = economic; TPI_{env} = environmental and TPI_{soc} = social impacts;
x_{eco} or $_{env}$ or $_{soc}$ = the value of the variable for that destination,
x_{eco} or $_{env}$ or $_{soc}$ min and x_{eco} or $_{env}$ or $_{soc}$ max = the minimum and maximum values of the variable of all destinations in the sample.

$$TPI = (TPI_{eco} + TPI_{env} + TPI_{soc}) / 3$$

Although the results of the ESPON project are not flawless, due to methodological errors (Sütő, 2007), tourism development was classified into four groups: mature destinations (Austria, Switzerland, Greece, Spain and France), medium-high penetrated destinations (Denmark, Italy, UK etc.), medium-low penetrated destinations (Hungary, Bulgaria, Slovakia etc.) and minimally penetrated destination (Poland, Romania, Latvia etc.). It was indicated that it would be important to carry out the research on NUTS II and III levels as well, therefore our aim was to model the TPI index in Romania on regional level (Cozma, 2012b).

In Romania, to act upon the available statistical data on regional level, the individual indices were modified as follows: TPI_{eco} – accommodation and hospitality units generated GDP for 2008, TPI_{env} – accommodation capacity per square kilometre in 2008, TPI_{soc} – number of domestic and foreign tourists per 1000 inhabitants in 2008.

The obtained results led to two maps (Fig. 5), one using the ESPON standardization, and one using own standardization, which better shows the Romanian regional differences and taking in account the natural break points of the data set. The latter shows that North-West, together with Central region belong to the second category: moderately-high saturated destinations.

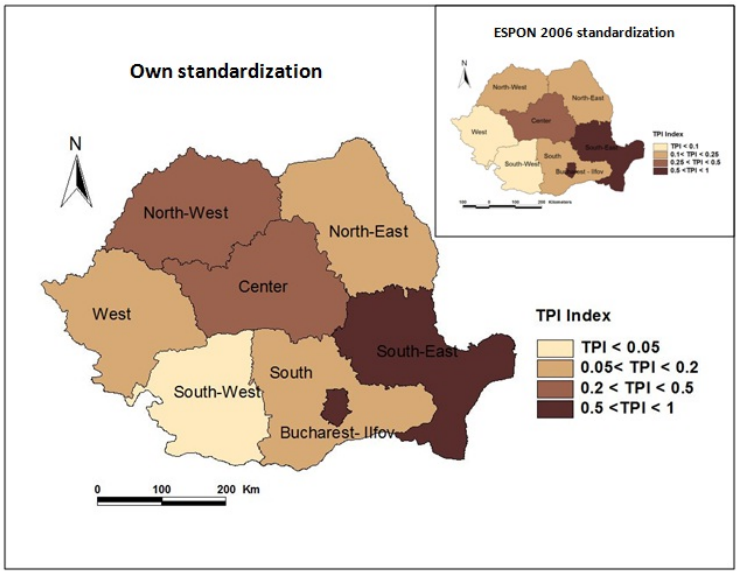

Fig. 5. TPI index in the Romanian development regions (Source: author, data from NIS)

Apart from lack of territorial data and other distorting factors, the indicator fulfils its purposes, namely the areas with the highest tourist arrivals and with the largest tourist load in the country are clearly shown out. The highest TPI index values were achieved by the internationally competitive South-East and by the capital region. On the bottom of the list lies the peripheral South-West region (Cozma, 2012b).

The use of this index needs further refinement, especially database completion and making the dataset more territorial. This is an important task for the Romanian tourism statistics, which must take place coordinated with EU institutions and meet international comparability requirements.

4. THE TOURISM SUPPLY IN NORTHERN TRANSYLVANIA – TERRITORIAL ASPECTS

The territorial characteristics of the tourism supply in Northern Transylvania is are not very different from those on national level.

In 2012, there were 730 accommodation units in the region, offering a total functioning capacity of 9.4 million places-days, almost 13% of the countries capacity. By the official statistics there were 2.1 million overnight stays, only 13.8% of it being registered by foreigners.

Fig. 6. shows the level of comfort in hotels, pensions and agro-touristic pensions (i.e. the three most popular unit types) and the capacity distribution in these units. In the southern part of the region 3-4 star hotels dominate, while in the northern part, the more modest 2-3 stars. The highest hotel comfort (5 star establishments) are entirely missing from Satu-Mare, Maramureș and Sălaj counties. Regarding the classification of pensions the dominance of 2-3 star pensions is observed. Agro-touristic pensions are classified with flowers, and the situation is similar than in the case of urban pensions. 5 star pensions and 5 flower agro-touristic pensions are almost entirely missing.

Fig. 7. shows the distribution of capacity in use and overnight stays on localities level. We see that the highest capacity and overnight stays are registered by the county capitals and the localities in the metropolitan area of Oradea, Cluj-Napoca and Baia-Mare. There is also important tourism activity in the following zones: Apuseni Mountains, Maramureș, localities with thermal baths in the west of the region or salt baths in the south-eastern part.

The statistics show that the tourism of North-West Region is *two poled.* Cluj-Napoca municipality and Sânmartin commune are the two most important centres of the region. By tourist arrivals Cluj-Napoca has the 1st place, but by overnight stays Sânmartin. This opposition is due to length of stay, which is 1.7 nights in Cluj and 7 nights in the thermal bath resorts of Sânmartin. The former is the region's most important cultural and business centre, while the later is an international thermal holiday destination. These two centres serve the 55.4% of the regions' tourism. The role of the other settlements is visibly much smaller. The most visited cities in the region are: Cluj-Napoca (240.029 arrivals), Oradea (110,900 arrivals) and Baia-Mare (60.736 arrivals), while the most visited rural localities outside the metropolitan areas are: Șieu-Măgheruș (5,969 arrivals), Tiha Bârgăului (5,095 arrivals) and Boghiș (4,540 arrivals).

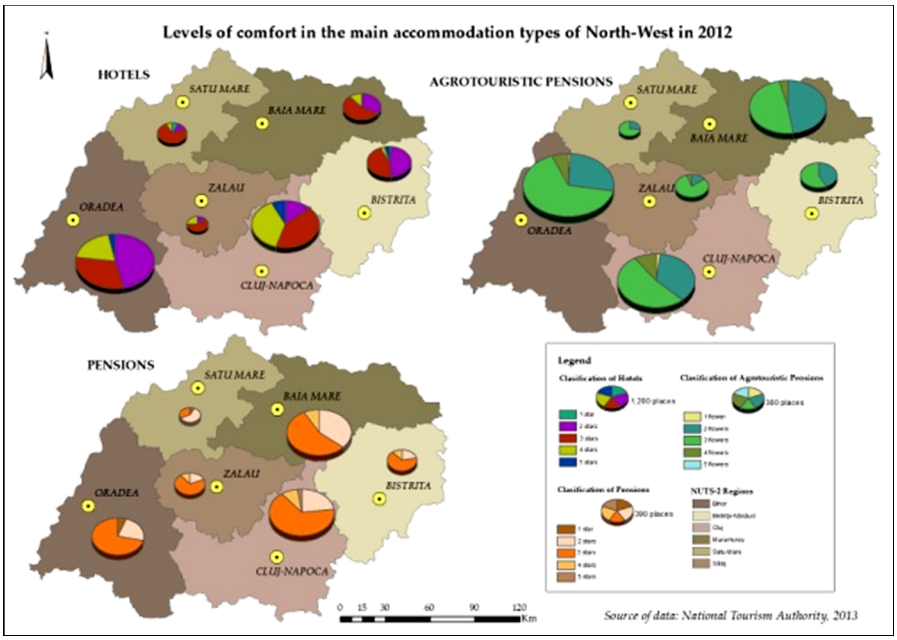

Fig. 6. Levels of comfort in Northern Transylvanian counties, 2012 (Source: author, data from NTA).

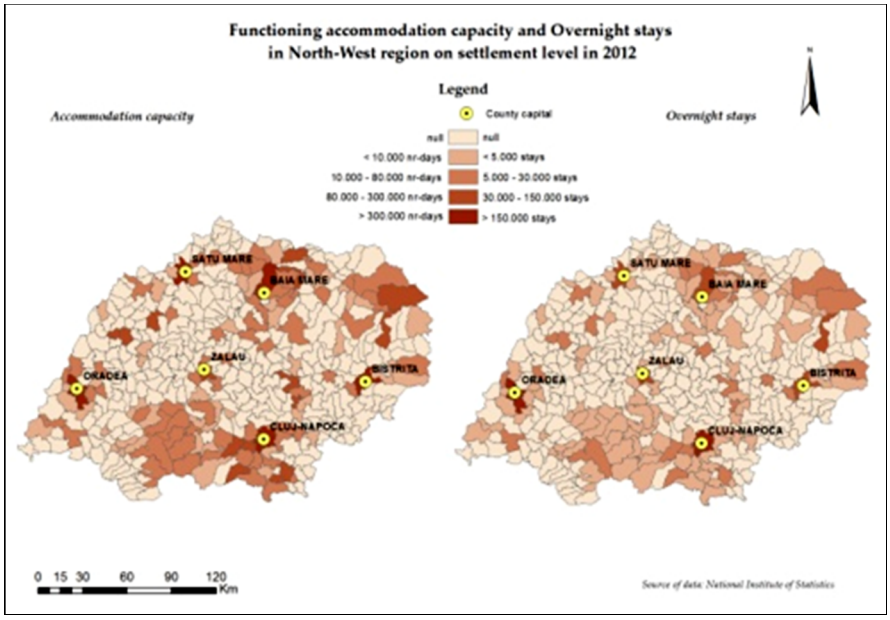

Fig. 7. Accommodation capacity in use and overnight stays in Northern Transylvanian localities, 2012 (Source: author, data from NIS).

4.1. Territorial concentration

When analysing regional disparities we often encounter with the concept of *territorial concentration,* which means concentration, condensation of phenomena in a small area of the national territory. In our case the analysed phenomena was the accommodation capacity in use for 2012 on localities level in North-West development region (data from Tempo database of NIS, Romania; 140 territorial administrative units, with registered minimum 5 places). The rest of the region's localities were omitted from the analysis because of the distorting effects of the zero values.

A conventional way of analysing territorial concentration is using the *Lorenz-curve,* a specific graphical tool for visualization and interpretation of concentration. This method displays only the fact of concentration, it is not suitable to determine the extent of spatial inequality. It is often used in territorial analysis, because representing the same phenomenon in different time intervals, it gives information on the changes in regional disparity. The Lorenz-curve is in fact a two-dimensional graph, which plots the cumulative relative frequencies against the cumulative relative value sums (Nemes Nagy, 2005). Before preparing the curve, the data has to be ordered in ascending or descending way. If ordered in ascending, the curve will fall below the diagonal. If the distributions are the same the curve falls on the diagonal and means lack of concentration. In the extreme case of total concentration the curve coincides with the coordinate axes.

Fig.8. shows that there is no equality in the geographic distribution of accommodation capacity in use, but there is no total concentration either. The curve shows strong geographical concentration of the analysed phenomena, but does not provide quantitative data.

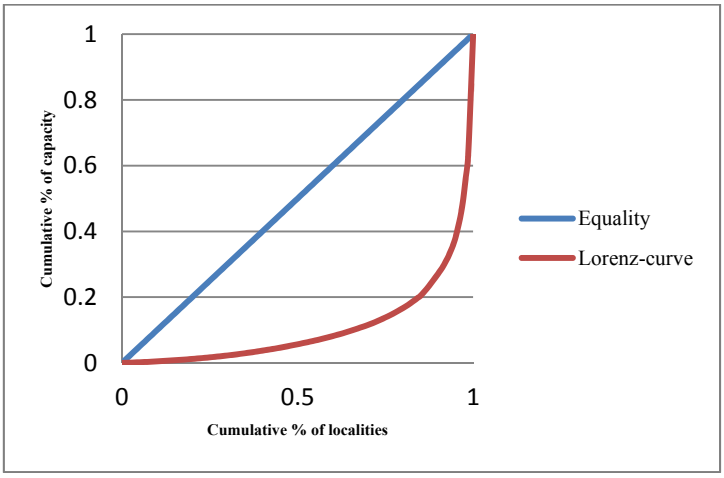

Fig. 8. Lorenz-curve for territorial concentration of accommodation capacity in use in Northern Transylvanian localities (Source: author, data from NIS).

In the following we intend to quantitatively measure this concentration using to acknowledged measurement tools: the Hirschman-Herfindahl index and the Hoover index.

Firstly, the main characteristic of the *Hirschman-Herfindahl index* is that is takes it's minimum value when the analysed socio-economic phenomena is distributed evenly in space (the minimum is not 0, it depends on the number of elements) and values above 0,6 indicate high concentration, even monopoly. The calculation formula is the following (Nemes Nagy, 2005), where x_i is the given spatial feature in natural unit of measurement of i spatial unit:

$$HHI = \sum_{i=1}^{n} \left(\frac{x_i}{\sum_{i=1}^{n} x_i}\right)^2$$

The Hirschman-Herfindahl index in our calculations equals 0,086. In the interpretation of the indicator it becomes visible, in quantitative terms, what the Lorenz-curve already showed in the previous step, namely that territorial concentration of capacity in use in the region exists and as previous analysis and maps showed, a few localities can be regarded as the strongholds of the accommodation basis.

Secondly, the *Hoover-index* is one of the most popular, most commonly used indicator in regional disparities analysis. The index shows the percentage of criteria that needs to be transferred between the territorial units in order to have the same spatial distribution as the characteristics of the other (Nemes Nagy, 2005). The calculation formula is the following (Nemes Nagy, 2005), where x_i and f_i are two distribution rates, which maintain the following characteristics: $\sum x_i = 100$ and $\sum f_i = 100$

$$H = \frac{\sum_{i=1}^{n} |x_i - f_i|}{2}$$

The Hoover index in our case equals 34,75%, meaning the 34,75% of the accommodation capacity should be transferred in order to have the same distribution as the resident population.

5. CONCLUSIONS

The tourism sector in Romania has been in development in the last two decades, but although Romania has a high tourism potential and extraordinary diversity of natural and human environments, in international comparison the sector's performance is considered poor. The concentration of the accommodation capacity in just 27% of the country's territorial administrative units is not surprising. All things considered, not all the territories can and have to become tourist destinations and not all localities are suitable for the reception and entertainment of tourists.

The "innovative" region of Northern Transylvania can be considered as a competitive tourism destination, on Romanian level, and as such, occupies an important place in the countries tourism. Overall, regarding the tourism penetration, North-West belongs to moderately high-saturated destinations, which means opportunities for regional tourism development, and at the same time, more attention towards, and better management of tourism activities. The analysis showed that the tourism supply of accommodation units and capacity is territorially concentrated in the region, namely tourism is two poled**:** Cluj-Napoca municipality and Sânmartin commune are the two most important centres of the region, which serve 55.4% of the regions' tourism. The role of the other settlements is

visibly much smaller. The Lorenz-curve, together with the elaborated maps, visually confirmed what the statistics had suggested at first glance. Furthermore, the Hirschman-Herfindahl index enabled us to quantitatively measure the territorial concentration in Northern Transylvania.

The results of this study led to the conclusion that, besides the spatial characteristics of the tourism offer, the factors influencing these disparities are also very important to understand. Furthermore, in order to identify the growth factors and possible growth strategies for Northern Transylvania, this kind of exploratory research is crucial. Therefore our future research plans involve the analysis of possible factors influencing these territorial disparities.

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RURAL AREA OF MARAMUREŞ SUPPORT FOR THE DEVELOPMENT AND PRACTICE OF VARIOUS FORMS OF TOURISM

ALINA SIMONA SIMION[1]

ABSTRACT. – Rural Area of Maramureş Support for the Development and Practice of Various Forms of Tourism. In Maramureș the tourist can find a comprehensive tourist offer based on the diversity of tourism potential, natural and anthropogenic, which can be exploited throughout the year regardless of the season for all age groups. Here are all types of tourism (recreational, cultural, curative and mixed), conducted under various forms, the importance of this is variable spatial and temporal through the volume of tourists and socio-economic effects induced. The predominant types of tourism are cultural and recreeativ tourism, this are associated with most forms of tourism (rural tourism, sports tourism, religious tourism, school, etc.).

Keywords*: Maramureș, rural area, form of tourism, development, entrepreneurs.*

1. INTRODUCTION

It is impossible to differentiate between the various forms of rural tourism as this type of tourism itself cannot be defined through one single type of activity. The number of variables used in this endeavour is relatively high, including intensity of practice, location, management, community integration etc. In addition to this, many forms of tourist activities are suitable both for rural and urban settlements. On the same day, tourists can take both rural and urban activities. In the rural area the extended availability of space makes possible for tourists to have activities of intermediary character (urban-rural): ski, fishing, sports which require an artificial semi-natural infrastructure (tennis, football etc.), educational and school activities, ecological activities, acquaintance with heritage elements, trips, or specific urban activities (conferences, reunions etc.).

The review of the activities and types of tourism from rural areas has a guiding and inevitable character. The tourist activities with a generally rural character are: trips around the village, mountaineering, climbing, "explorations" of wild areas, rafting, cross-country skiing, ski on courses of low and medium difficulty, strolls on vehicles drawn by animals, cycle tourism, horse riding, nature observation, photo shooting (vegetation, fauna), landscape viewing, acquaintance with rural heritage, acquaintance with rural inhabitants and holidays, fishing, hunting, nature sports (tourist orientation, delta paragliding, zip-line gliding etc.).

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2. TOURISM FORMS OF MARAMUREŞ

In the analysed area one can find all types of tourism (recreational, cultural, curative and mixed) having various shapes and with spatially and temporally variable importance, according to the tourist volume and its socio-economic effect. The predominant tourism types are the cultural and recreational tourism, which include the majority of tourism forms which are being practiced or are practicable in the near future (extreme sports tourism, religious tourism, school tourism etc.).

2.1. Recreational tourism

On general terms, the recreational tourism capitalises on the attractive factors of the landscape which vary spatially inside the Maramureş County. It can be practised in every season and the natural potential of the area enable its development. This form of tourism mainly capitalises on the aesthetic characteristics of the tourist resources included in this natural environment. It rebuilds a connection between man and nature, giving the former the possibility to free himself of the daily pressure in a new environment. This type of tourism combines the characteristics of nature tourism and health tourism (Pompei, C., 1999). Recreational hikes can take place both in the summer, on foot, on carriage or only on horseback, and in the winter, on foot or on horse-drawn sleigh; in the autumn these hikes offer the magnificent view of a multitude of colours while in the springtime the tourist is filled with the energy of the nature's rebirth. However, this type of tourism still needs a number of new paths to be opened and marked on the hills and the mountains from the area, while the old ones need to be maintained and special places for picnic need to be created where fire can be controlled. In addition to these, the building of medium-sized holiday cottages for the development of weekend tourism is also necessary.

In Maramureş the recreational tourism is practised in a non-organised form and is represented by the activities related to spending a part of or the entire holiday individually or with the family, in a form of accommodation which is available in the rural area (acquired in various ways: by inheritance, by renting it for varied periods of time, or by being accommodated by friends or relatives etc.).

2.2. Cultural tourism

Being considered the main type of tourism in the Maramureş region due to its rich cultural and historical legacy received from our ancestors, the cultural tourism involves various age and social categories and can be practiced both individually and as a group. A large percentage of the people practicing this type of tourism are represented by young pupils and students.

Although it is the most frequent form of rural tourism from the county, the tourist infrastructure is precarious and suitable tourist offers are absent, making it an exclusively transitory tourism. However, the traditional customs associated to various occasions and holidays represent an important context for the practice of cultural tourism by mainly external but also internal tourists. The specific activities of this form of tourism are: participating at cultural festivals (the festival "Câte flori pe Iza-n sus"/

"All the flowers up on Iza Valley" – Dragomireşti, the festival "Floare mândră de pe Iza"/ "Beautiful Flower in the Iza Valley"- Şieu, the "Wedding festival" - Vadul Izei); craftsmanship activities (evening sittings, crafting workshops); educational activities based on heritage acknowledgement (visits, contests, study case analyses etc.); culinary activities (during festivals, parish fests and other local celebrations); the activities associated with different customs across the year (Christmas and New Year's Eve customs, Cheesafare Sunday, going ploughing, Saint George's celebration, Tânjaua-agrarian celebration, the Milking of the Measure). These festivals are highly important for economically, socially, culturally and touristically revitalising the communities.

A cultural animation can also be performed in the cultural tourism with the purpose of getting acquainted with and educating the tourists, by a large variety of activities: visiting museums and memorial houses, participating at various cultural events and local craftsmanship activities, religious pilgrimages, tourist tours connected with the life and activity of various well-known people from the county, historical tours etc. The cultural animation represents one of the most largely spread tourist-accessible activities, regardless of the tourists' educational level and whereabouts.

2.3. Curative tourism (spa tourism)

Tourism and health are always connected so that, together or separately, they represent an important indicator of the region's social politics, as health is not only a human development indicator, but also an important resource of economic growth, by stimulating the tourism sector, with a capital role in the survival and economic development of a region.

The practice of curative tourism in the rural area is currently very successful as medicine encourages the natural or light therapy. After the glorious period of chemical products, we are nowadays witnessing the employment of natural means for health restoration: medicine plants, internal and external mineral water treatment, acupuncture, hydrotherapy, physical activities, music etc. In this respect, the rural area offers a privileged territory for practicing this type of health-connected tourism. For the elderly, this type of tourism is also a useful way of avoiding loneliness. Their daily isolation from the society could be avoided by practicing this type of tourism for a longer period of time in the rural area. In this way, three aspects would be harmoniously combined: health, social activity and tourism. In time, it might be possible for the curative tourism in the rural area to amplify (with the help of social institutions, retirement homes, mutual help institutions).

The act of therapeutically using natural factors dates from times immemorial in our country, although the knowledge of the physical and chemical qualities of water resources had only an empirical character. In time, other regions have also had rudimentary spas, some of them now completely disappeared, others reborn and successfully used even today. This situation also characterises the Maramureş County, a region with an old tradition in using mineral waters for curative purposes, in the following settlements: Săpânţa, Breb, Botiza, Glod, Câmpulung la Tisa, Crăciuneşti, Vişeul de Sus, Văleni-Feredeaua, Ieud, Crasna, Şugău-Feredeaua, Băile Usturoi, Apa Sărată, Cărbunari, Stoiceni, Dăneşti etc. A moral duty for the Maramureş tradition makes it necessary to mention a resort which disappeared but had a high historical importance, the resort from Breb.

The plethora of curative natural resources which enriches the county of Maramureş offers numerous possibilities of capitalisation. However, some of the current treatment facilities do not rise to the standards of usage and others are not used at all.

The existence of chemically varied hydro-mineral resources with curative value had contributed to the initiation of tourism in Maramureş, however they were eventually abandoned and nowadays they are being used only by the locals which know their benefits by experience. Countless mineral springs from the entire county are not being capitalised for tourist treatment, except for three settlements (external treatment: Ocna Şugătag, Coştiui, Dăneşti). In addition to these, the carbonated mineral springs from Baia Borşa are used for mass production, being bottled and sold in the county, but also at national level. However, the trading company responsible for this is currently in insolvency.

Other constructions for the therapeutic use of mineral waters are present in some other traditional settlements which were old balneo-climateric resorts, however they do not rise to the minimum functional level and are highly degraded (Poienile de sub Munte, Dragomireşti, Crăciuneşti). In the last years some work was invested for revitalising a few settlements with historical use of mineral waters for treatment, for the moment only at local level and less through tourism, however with promising perspectives for being introduced in the category of tourist destinations (Botiza, Câmpulung la Tisa).

An incipient form for the development of this type of tourism is represented by the small resort from Botiza. Beside this development centre, other balneo-climateric resorts could be developed in Bârsana, Onceşti, Slătioara and Glod, in competition with the present resorts Ocna Şugatag and Coştiui. However, the settlements which own natural resources for balneo-climateric tourism have insufficient facilities for attracting foreign tourists.

The curative therapy can also be employed through the use of fresh and natural food products which can be found in every house in the county, through sports and hikes which make use of the ionised air of the broad-leaved and coniferous forests, eating wild berries.

2.4. Religious tourism

Maramureş has a high potential of developing the religious tourism due to its numerous traditional churches and monasteries and the accommodation facilities which developed in their vicinity (ex: Bârsana, Ieud, Săpânţa) and allow the expansion of this type of tourism. The religious tourism can have an important influence on the development of rural tourism as it is favoured by the existence of important and well-known religious attractions: the monasteries Bârsana, Săpânţa-Peri, Moisei, Rohia, as well as the smaller Dragomireşti, Hera, Rohiţa, Boiereni, Suciu de Sus, Şatra, Dumbrava etc. The parish fests associated with these locations annually attract numerous visitors from the rest of the county, but also from entire Transylvania and even from extra-carpathian regions.

2.5. Scientific tourism

Due to the presence of a multitude of protected areas, natural reservations and scientifically valuable morpho-hydrographic components, the ecologic and scientific tourism has a large opportunity for development in rural areas.

According to the classification adopted by Romania (IUCN[2]), all types of protected natural areas can be found in Maramureş. Depending on the protection, usage and management regime. one can identify the following:

• 3 scientific reservations: Pietrosu Mare, the Fossil Reservation "Răzvan Ghivulescu"-Chiuzbaia and Piatra Rea – 1st category IUCN;

• 1 national park: The Rodnei Mountains National Park – Reservation of the biosphere – 2nd category IUCN;

• 17 nature monuments: Creasta Cocoşului, Iezeru Mare, the stone rosette from Ilba, Blue Lake, Tătarului Gorges, the cave from Vălenii Şomcutei, Cave with Bones-Poiana Botizei, the rocks from Sâlhoi-Zâmbroslavele, Vlăşinescu Marsh, Dumitru's Pond, Babei Gorges, Boiu Mare Cave, the columns from Limpedea, the cave from Solovan Hill, Tăul Negru Marsh, Iza Ponor (doline) and Iza Cave;

• 13 natural reservations: Crăiasca Woods, Bavna Woods, Ronişoara Woods, Arcer-Tibleş Reservation, Cornu Nedeii and Ciungii Balasanii, Morărenilor Lake, Poiana Brazilor Marsh, the larch woods from Coştiu, edible chestnut trees from Baia Mare, Lăpuşului Gorges, pine woods from Comja, Farcău Peak - Vinderel Lake - Mihailecu Peak and the narcissi's clearing Tomnatec-Sehleanu;

• 1 natural park: the Natural Park of Mararmureş Mountains, with 10 areas of special conservation.

The total number of protected areas from Maramureş is 34 entities. Some of these, and the most important are streamed on Fig 1.

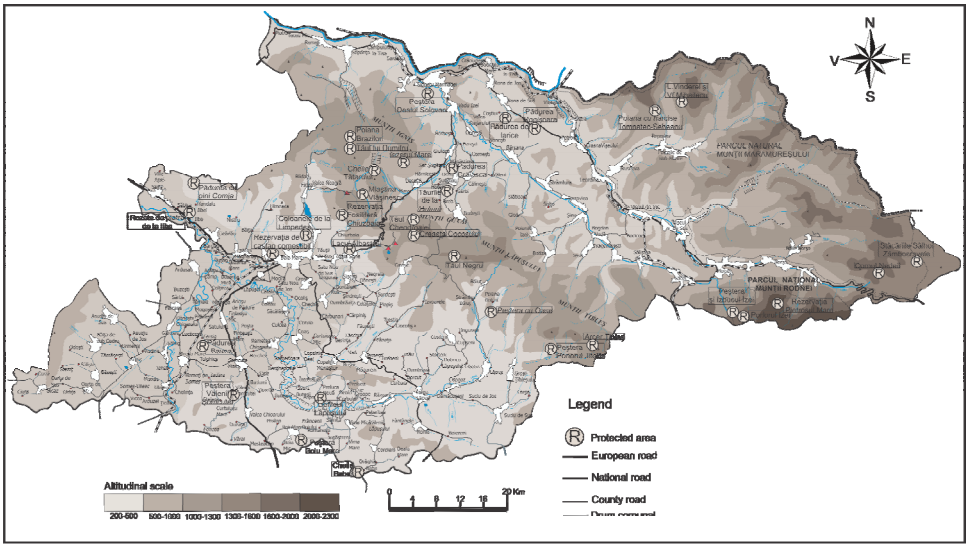

Fig. 1. The most important protected areas from Maramureş

[2] *IUCN - International Union for Conservation of Nature or the World Conservation Union is an international organization founded in 1948 to encourage the preservation of wild fauna, natural environment and living resources. Its members include non-governmental and governmental organizations. The Union's purpose is to promote the research of endangered species preservation, ecology and supporting the development of environmental legislation. http://www.iucn.org*

The presence of such a large number of protected areas represents an important advantage for the development of the scientific tourism in the region. The parks and the natural reservations have been created out of concern for the nature and for the preservation of the endangered species of plants and animals, for scientific research and recreational purposes. However, raising the awareness of the local population towards their scientific value and the necessity to protect them is of utmost importance.

2.5. Cynegetic tourism

Hunting is today a recreational activity. However it is also an ancestral manifestation of the human instinct as it was the main method for providing food in the primitive period. The development of fishing and hunting tourism facilitates a direct connection between tourists and nature, satisfying the tourists' need to relax outdoors in a unique way. This type of tourism requires a few adjustments regarding the multiplication of the number of hunting species from the surrounding woods and the rivers running across them.

The cynegetic tourism requires a detailed preparation and a continuous monitoring of the fauna species, knowing the behaviour of each species for the protection of the hunters, identifying the mating time and areas, the feeding habits and locations, preparing special places for animal observation (with a dual purpose, for "photo hunting"- birds and mammals).

The importance of this activity must not be seen only through the glass of economic benefits, trophies, furs, meat, but also through the perspective of indirect benefits, recreational and aesthetic, which can be gained by practicing this type of tourism: outdoor physical exercise in the unpolluted air of forests, away from the hectic life of large cities, freeing oneself from the daily stress etc. (Dezsi, Ş., 2002).

The variety of cynegetic resources depends on the variety of high landforms (mountain forms are predominant), on vegetation altitudinal zonation and the degree of anthropisation.

Even if the fauna from this county is diverse and numerous, the game is represented by a reduced number of species, including 5 large categories (Dezsi, Ş., 2002): furry non-predator game (common deer, black goat, rabbit, wild hog), furry predator game (bear, wolf, fox, wild cat, wolverine, otter, mink, ferret), feathered non-predator game (mountain rooster, birch rooster, pheasant, dove, grouse, partridge, quail, turtledove, fledgling), feathered predator game (vulture, eagle, lesser kestrel, hawk), night predators (owl, long-eared owl, tawny owl, little owl).

The economic efficiency of this type of tourism for the rural tourism is highly important, both at the level of rural settlements but also at county level, due to hunting fees (reaching quite a high amount). As an example, for authorising the bear hunt in Maramureş in 2014, a fee of 4.000 – 6.000 €[3] was required, and the number of killed animals was limited to two, due to the low number of bears in the county (76 bears, according to the County Association of Hunters an Fishermen from Maramureş). The financial advantages as well as the high demand for this sport can act as encouraging factors against poaching and for the increase of game number (wild hogs, red deer, deer, bears, wolves, foxes, wild cats, rabbits) for tourist purposes.

The high costs and restrictions (permits and authorisations, rules for possessing fire arms as well as their costs) make this sport an elite one, therefore it can be practiced only by wealthy persons who represent a reduced segment of the society.

[3] *http://www.etransilvania.ro/maramures-asociatia-judeteana-a-vanatorilor-si-pescarilor-maramures/*

2.6. Other forms of rural tourism

Business tourism (team-building, workshop, congress, reunion etc.) is still undeveloped in rural areas, but has good perspectives, especially in the existing resorts. In Ocna Şugătag there are two centres for development and recreation, one was created by the Education Union and the second by the Greek-Catholic Archbishopy. In Poienile Izei, La Domniţa bed & breakfast includes in its offer the possibility of practicing business tourism by adapting its available space for business dinners, this thing being also possible in the majority of accommodation facilities which own a suitable dinner serving area.

By including the possibility of organising meetings through presentations of the available services (suitable, well positioned, large meeting area, image projector, flipchart, projection screen etc.), the accommodation facilities from the rural area of the county would contribute to the use of the tourist infrastructure and would promote tourism in the region. This aspect is favoured by the fact that the business tourism is not conditioned by specific seasons and most of the business activities take place in the periods avoided by mass tourism. This important characteristic should be observed and valued as business trips and business tourism have acquired an increasing importance. Furthermore, business tourists are known to return with their families in the places they have visited.

Speleotourism has many chances to become an important form of tourism in Maramureş. It represents the guided visit of a cave, including orientation activities and surpassing various obstacles. People fascinated by the depths, by the unknown, by unique challenges, having a thirst for knowledge and research, can practise their hobby in over 170 caves with different degrees of difficulty, the most difficult, but also the most mysterious and studied one being Izbucul Izei. The practice of this type of tourism does not require any infrastructure, only suitable personal equipment, as there in no possibility to rent one anywhere in the county. In addition to this it is recommended to access the caves with the help of experienced speologists to guide the expedition and who know all the risk areas. Some caves are accessible without any special equipment on certain parts, depending on the cave length, the width of the entrance cavity and its difficulty degree.

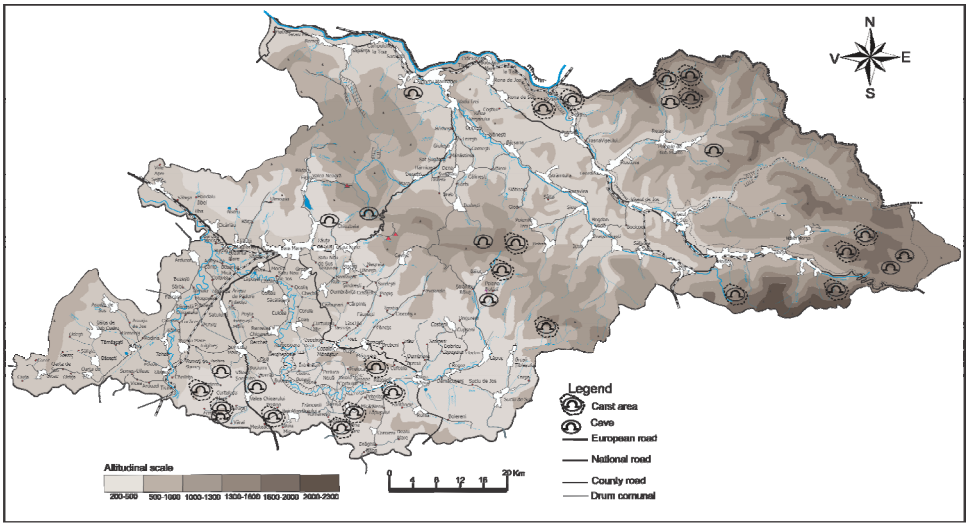

Fig. 2. Regions with a speleotourism potential

In Maramureş there are two organised entities which offer speoturism services and the possibility of renting basis equipment (Montana and Ex-Motion speology clubs). The people practicing this type of tourism have been, until now, Romanian and foreign professional speologists. Besides them, the caves also attract biologists through a vast number of species, among which the most often encountered being different species of butterflies (hibernating) and bats. Caves can also be used for various cultural purposes, like organising musical events.

School tourism can be practiced in natural environments and therefore the large spaces of the rural area can facilitate it by developing suitable accommodation and recreational facilities. At present there are no such facilities available in the rural area and the young tourists can only be accommodated separately in different locations from a rural settlement. There are, however, accommodation facilities of large capacity (for one coach), but they do not provide any sun, adventure and relaxation services for school children. The only exceptions are represented by some closed-circuit facilities created by religious organisations where some minimum requirements for school camps are fulfilled (accommodation, meals, organised areas for sport and cultural activities).

The development of school tourism can be facilitated by organising children camps on differentiated age categories, with specific rural themes (ecologic thematic camps, crafting camps, sports camps etc.). The accommodation infrastructure must also be adapted to this form of tourism with numerous accommodation facilities (for at least one coach), recreational areas, camping areas and sanitary services. There are only a few locations in the county where this type of tourism can be practised, depending on the accommodation capacity: Agriş Lodge, Izvoare Resort, Fereşti, Ocna Şugătag, Glod. In addition to these the other settlements can be used only as areas for rural camping.

The presence of ethnic minorities and their history in Maramureş (the history of the Austrian-Hungarian Empire, Jews, and Ukrainians) represents a valuable opportunity for the development and diversification of the rural tourism in the form of ethnic tourism. This type of tourism is starting to develop in the county because of many people with emotional or blood "roots" in these areas, like Jews or Hungarians, but also Romanians who reside in other parts of Romania or in other countries.

Equestrian tourism can be easily practised in all the rural settlements from the county as there are many horse owners. This form of tourism is accessible both in summer and in winter.

Agrotourism is often identified with rural tourism as both are practised in the rural area, however with different characteristics. Through the means of agrotourism, the tourist comes into direct contact with village life and, at the same time, is given the chance to participate in the daily activities of the local peasant.

Ecotourism is the type of tourism which is practised in natural environments and is characterised by its main objective: environment protection. Due to the presence of large natural and protected areas in the county this type of tourism can be easily practised, similarly to the scientific tourism. There are 35 natural protected areas in Maramureş, out of which one is a national park – The National Park of Rodna Mountains – Biosphere Reservation and one is a natural park – The Natural Park of Maramureş Mountains, with an area of 1596.07 km^2, representing 25.4% of the county territory.

The rural environment can represent an important space for sport activities: fishing, climbing, water sports, winter sports, tourist orientation etc. Some of these require a certain type of product management (water sports, velo-tourism and horse

riding), while others need only a minimal technical improvement to attract tourists, depending, nevertheless, on a favourable natural environment and an appropriate welcoming service (winter sports, fishing, climbing, tourist orientation, speo-tourism etc.). The sport and adventure tourism, also called active tourism, can be divided into easy and difficult adventure tourism and has numerous possibilities of development by capitalising on the natural potential of the region.

The request for active tourism activities has increased significantly over the last years by diversifying and expanding at the same time its target market. More and more people whish to spend their holidays in nature, experiencing adventures.

These types of activities are no longer reserved to professionals, their variety and difficulty degrees make the active tourism activities available for everyone. The active tourism consists of practising sports in a rural environment, relying on a sustainable management which creates compatible activities with the environment, while protecting it.

The concept of active tourism is opposed to passive tourism which is defined by mass tourism and other activities affecting the natural environment. At the same time the active tourism is tightly connected to ecotourism, ecologic tourism and adventure tourism, but also includes cultural attractions connected to history, arts, crafts and architecture. These active tourism activities can be practised individually or as part of a more complex product like the so-called multiple activities in which nature, culture and development mingle in adventure packages which are organised in a natural environment.

The active tourism requires an active involvement of the visitors, physically or emotionally. They have to interact with the environment and the culture, to learn from them and to respect them.

The advertising of sport activities made this type of tourism more accessible and attractive to many people. The request for active tourism can increase even more in the future, provided there is an increase in the number of people involved in organising and performing outdoor activities. It will thus be possible to attract a larger number of tourist typologies searching for adventure and new sensations, but especially those who wish to spend more time in the nature.

The activities included in the category of rural tourism can be classified in aerial activities (paragliding, hot air balloons), terrestrial activities (cyclism, horse riding, trekking, climbing, zip-line gliding), water activities (rafting, canoeing, canyoning) and snow and ice activities (snowboarding, ski, tubing).

The above typological classification, which naturally includes several intersections and overlayings, was created depending on the specific offer of the Maramureș rural area and not according to the tourists' subjective motivation. This tourist offer currently lies at the basis of rural tourism and its various forms.

3. CONCLUSION

Analyzing those presented above and the current condition of tourism development in the region, we can say with conviction that it has not reached a high level of development, despite the rich and varied potential and its development prospects are promising Based on diversified potential can made a diverse tourist offer. The famous history of Maramures, rich cultural heritage and the biodiversity remarkable, make from this land a valuable dowry in

Romania's tourism potential. Although rural areas offers vast possibilities for leisure, this is not organized properly for maximum exploitation of the local resources, regardless of their nature.

The future of rural tourism of Maramureş is promising provided that there should be greater awareness of the public authorities and the private sector, but especially consumers, focused on diversified resources and increasing the value of the Maramureş environment.

A first step in supplementing income is the diversification of the tourist accommodation units and / or entrepreneurs to development and provide tourism services and activities. Diversification of tourism and development of thematic routes, would mean significant sources of income and especially the promotion of the region. The development of new trails with the markings on the hills nearby hills, and even mountains and maintenance of old ones, arranging special places for picknic, where the fire to be controlled, also building of tourist chalets, with medium capacity to develop the weekend tourism in the higher hills, are just some possibilities of increasing tourist traffic and income.

The possibilities of valorification the rural environment of Maramureş are varied, and the revenue would increase considerably as a result of rational management and the ingenuity of population, which they showed over time, combined with the demands and needs of modern tourism.

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THE QUALITY ASSURANCE POLICY OF THE CENTRE FOR TOURISM TRAINING, FACULTY OF GEOGRAPHY, BABES-BOLYAI UNIVERSITY

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ABSTRACT. - The Quality Assurance Policy of the Centre for Tourism Training, Faculty of Geography, Babeş-Bolyai University. The quality assurance (QA) process is a very important aspect in the field of education – including Vocational Education and Training (VET) - where notions like client, market, management, strategy, competitiveness are more and more present. In spite of the minor place it holds in the national educational system, the Romanian VET is centralised, highly regulated and aligned with the EC VET recommendations and directives. The Centre for Tourism Training (CTT) of the Faculty of Geography, Babeş-Bolyai University, Cluj-Napoca, Romania is functioning under the auspices of both the university and the National Authority for Qualifications and it conducted an *empirical* quality assurance policy until 2012. The year 2012 opened up new perspectives on quality assurance issues and policies for the Centre for Tourism Training once it applied for a Leonardo da Vinci partnership project titled "Towards the Reciprocal Recognition of Quality Assurance Systems in VET for Tourism". The paper presents the challenges that CTT faces concerning the QA activity, the roadmap to setting up a QA system for the partner institutions in the project, and the achievements regarding the improvement of the QA process.

Keywords: *VET, quality assurance, EQUARF, CTT, QualVET.*

1. INTRODUCTION

The management of the Centre for Tourism Training (CTT) is well aware of the need for an explicit and systematic effort which should ensure quality and thereby increase the attractiveness and competitiveness of the centre and its educational offer. This, however, needs to be a natural and consistent process as part of a proficient education.

In spite of the functioning of the Centre for Tourism Training under the auspices of both the university and the National Authority for Qualifications (former National Council for Adult Vocational Education), which are to a high extent aligned to European quality

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assurance policies, it conducted an *empirical* quality assurance policy until 2012. The year 2012 opened up new perspectives on quality assurance issues and policies for the Centre for Tourism Training once it applied for a Leonardo da Vinci partnership project titled "Towards the Reciprocal Recognition of Quality Assurance Systems in VET for Tourism". The project has, thus, become an opportunity for the centre to carry out research in the field of QA, collaborate with quality assurance experts, draw up conclusions regarding the European developments regarding QA and implement the most suited strategies that could assist the centre in conducting an efficient process and a customer-oriented QA policy.

CTT used to hire staff when new training modules were introduced or old collaborators withdrew or were no longer co-opted. The recruitment process was mainly recommendation- and competence-based and involved submission of an application (including a CV) and conducting an interview. Each trainer, who is either a member of the academic staff of the university (Faculty of Geography) or a tourism professional and who has acquired the quality of qualified trainer and liable for the training he/she performs. However, presently, as a result of the research undertaken in quality assurance and the exchange of experience with other European tourism training centres, the CTT has revised its training policy (including its trainer recruitment strategy and monitoring of the trainers' performance) which is now more market driven and customer oriented. Finally, its strategy is now adapted to the *quality assurance* strategies and recommendations of the European Commission recommended by the CQAF (Common Quality Assurance Framework), the ECVET (European Credit System for VET) and the EQARF (European Quality Assurance Reference Framework for VET), the tools which have been developed to support national reforms and enhance transparency, recognition and quality in the provision of competences and qualifications'(ENQA-VET, ENQA-VET Indicators, 2009). In addition, all materials and reports issued by the European Network for Quality Assurance in VET (ENQA-VET), a thematic group whose activity is focused on quality indicators, and the CEDEFOP have been examined and followed.

Given the fact that the trainers also carry out research in the fields of VET, adult education, lifelong learning and tourism, the CTT has participated in the *Competition for Excellence* organised by the Babeş-Bolyai University in 2008.

Since the training modules are accredited by the National Authority for Qualifications for a four year period, the CTT has to undergo an accreditation process every four years for the module whose validity expires. The accreditation process evaluates the following aspects pertaining to the training process: the centre and its physical resources, the staff involved in training and their expertise, course curriculum, the syllabi drawn up for the specific curriculum (in compliance with the *national occupational standards)*, training support materials, methods of teaching and evaluation.

In addition to the permanent monitoring carried out by the management team, the centre is controlled periodically by the Audit Department of the university. The CTT was audited in 2010, whereby several aspects pertaining to quality assurance were pointed out.

Presently, the CTT coordinates a Leonardo da Vinci partnership project which seeks to set up a *quality assurance mechanism* for VET in tourism to be used by several European training institutions. The project is titled *Towards a Reciprocal Recognition of Quality Assurance Systems in VET (QualVET)* and brings together 5 European tourism-

focused training providers. The project also investigates the labour market needs and the responsiveness of tourism training to the market needs. The project survey addresses Indicators 2, 6 and 9 of the EQARF (European Quality Assurance Reference Framework for VET). Furthermore, the project is expected to recommend *quality assurance criteria and tools* which will grant an efficient, quality-based, outcomes-oriented tourism training.

The CTT is in permanent contact with the local National Authority for Qualifications from which it receives permanent supervision and teaching tuition. Alco, the Centre collaborates with the Centre for Quality Assurance of the Babeș-Bolyai University in respect of improving the instruments for the quality assurance tools used.

In spite of the few issues underlined by the auditing bodies, the CTT efforts to pursue a quality assurance policy have not coalesced into a real and effective policy until the involvement of the centre in quality assurance projects.

2. CHALLENGES

In Romania, VET occupies a relatively small niche and is overshadowed by other education levels, including the tertiary sector. In spite of the minor place it holds in the national educational system, VET is centralised, highly regulated and aligned with the EC VET recommendations and directives.

In Romania VET is both

1. regulated by the National Authority for Qualifications (NAQ), which works under the Ministry of Education and Research and Ministry of Labour, Family and Social Affairs. The Authority controls the territorial training activities through its local representatives and evaluators
2. enjoys allowable contributions as to how the regulations and directives may be implemented and what quality level the outcomes may acquire.

The NAQ performs the following roles:

- establishes the national professional profiles (jobs) available in the *Romanian Occupational Code*
- identifies and recommends national learning and performance standards as **learning outcomes** for all professional profiles, which build the skeleton for curriculum design
- suggests teaching methods
- establishes forms of assessment/evaluation- thereby creating a relatively unitary assessment system.

The present global recession, the economic and labour market pressures' influence which affect the Romanian VET providers are reflected in a decreased interest in education as fewer young people are capable of paying for their professional qualification, in less interest on behalf of organisations to support further training of their staff and the nature of the VET leadership has become subject to changes. Thus, educational leadership must be anchored in and accompany market, or opportunity-driven leadership.

The challenges posed by labour market are:

- a notable drop in the work opportunities for young people resulting from a decline in the rate of employment
- reductions in apprenticeships and traineeships following falls in investment by firms in education and training
- major job losses in industries and occupations triggering fluctuations in the labour market.

It has been noted that these requisites threaten the revenue of providers that are highly focused on market-based, fee-for-service delivery.

A key challenge for VET providers, and therefore for VET leaders, is capitalising challenges and opportunities posed by economic slowdowns. In particular, this means:

- to develop innovative programs and teaching and learning strategies
- to assist displaced workers, new entrants and
- to re-train existing workers to develop the skills and capabilities to enter a potentially different workforce as the economy recovers.

The CTT is a small organisation which operates within the University Babeş-Bolyai Cluj. It employs around 20 staff as collaborators, offers 5-6 training modules per year, enrols around hundred students annually and generates a moderate revenue. The training offer includes tourism-focused professional courses: tourism manager, tourism guide-agent, national tourism guide, receptionist-concierge, guesthouse administrator, train the trainer courses. Delivery strategies range from traditional face-to-face tutorials, workplace delivery, and blended approaches. Leadership-wise, the CTT started from a visionary leadership and continued with a combination of entrepreneurial and educational leadership.

Finally, given the involvement of the centre in projects focused on quality assurance, it is hoped that it will embrace a *quality driven leadership*.

3. QUALITY ASSURANCE POLICY PRIOR TO THE INVOLVEMENT IN EUROPEAN PROJECTS

Prior to the more recent involvement of the Centre for Tourism Training in European projects, the centre conducted an empirical quality assurance policy based only and exclusively on the quality assurance strategies devised and enacted as a result of (1) its national accreditation process and (2) its permanent collaboration with the National Authority for Qualifications.

The *national accreditation* process involves the submission to the NAQ of a complete set of documents which provide information on: the organization, documents that testify for the provider's capacity to develop training programmes, data about the training programme (identification data, type of qualification, level of qualification, objectives, output competences and skills, admission requirements, duration of training, venue, structure of the training programme, curricula, syllabi, number of participants,

evaluation of the programme and the students' work, the evaluation of the participants (initial, ongoing, final), instruments, scale of assessment, human/teaching resources, financial resources. The accreditation is training programme-based, which means that every training programme must be accredited. The accreditation of a training programme takes place every four years.

It is generally assumed that, once a programme of a centre or training provider is nationally accredited, it complies with all national rules and regulations regarding VET, including quality certification.

The second intervention of the NAQ and its local divisions in the training process conducted by a provider is the assignment of a commission composed of 3-5 qualified local VET evaluators to take part in the final evaluation of the students. The commission, which is, thus, an independent evaluation body, evaluates the students' performance. The evaluation is made up of two components: both a written component (test) and an oral presentation of a project. It is thus taken for granted that, if an independent commission evaluates the students, their acquired competences and skills are beyond any doubt and question and comply with the same standards.

A third intervention of the NAQ in the training process of a training provider consists in the feedback questionnaires it distributes as part of the permanent *quality assurance monitoring* it carries out. The NAQ has devised its own feedback questionnaires which are helpful instruments both for the NAQ and the institution to reflect the training outcomes vis-à-vis the proposed national VET targets.

Apart from the work carried out by the NAQ, the training providing institutions do little to monitor the quality of their training.

The CTT used the questionnaires provided by the NAQ which has been slightly adapted to suit its teaching purposes. The CTT then acted upon the received information in that it always looked for ways to improve the conditions and the methods of training. The management talked to the trainers and recommended solutions to the ensuing situations.

The CTT management always used face-to-face/individual interviews and focus groups to find out more about the courses and the teachers' performance.

As stated before, the CTT used no other instrument to check the quality of the delivered courses. Nor did anybody, by which we mean the NAQ or the university Quality Assurance Department, intervene directly or in any other way to help the centre develop a valid system of quality assurance.

4. METHODOLOGY

The roadmap to setting up a quality assurance system for VET in tourism for the Centre for Tourism Training and the other partner institutions was designed to cover several steps. The project-based roadmap for QA included four steps.

1. The first step was mainly focused on research on (1) EU quality assurance policies and (2) national VET policies and their implementation in each country.

2. The second step of the project integrated the collection of feedback on three of the EQAVET indicators (indicator 2, 6 and 9) and the interpretation of the collected information. Thereby three questionnaires were designed (for employers, students and alumni), each targeting an indicator. The results were interpreted and presented by the partner institutions at the 4th project meeting organised by MaiCh and held in Crete, 2013. The Romanian partner integrated the survey results in a comparative study to reflect the level of EQARF indicators' implementation in the partner countries.
3. The next step was to correlate the survey results of with the SWOT analysis. The partner institutions were, thus, invited to reflect on the suitability and efficiency of their educational management policies and strategies vis-à-vis the EU quality assurance indicators. The conclusions were included in the project report.
4. The fourth step was to identify and agree on common quality assurance criteria that could be adopted by the partner countries for VET in tourism.

The resulting quality criteria, which were mainly in use in most partner institutions, were incorporated in a *framework for quality assurance for VET in tourism*. The framework was the outcome of discussions and debates and comprises broadly the following three categories: *design of an integrated VET strategic vision, design of training activities, monitoring the training activities* and *group dynamics.* In turn, for example, the *training activities* criterion integrates: enhancing learners' participation, content, learner's behaviour, assessment. Each criterion was then broken down into 7-10 sub-items. The framework has become a major project output available as a guide for quality assurance to training providers.

5. DISCUSSION

From the range of operations and processes that the CTT was involved in, it is worthwhile mentioning the *SWOT analysis* which helped the management of the centre focus on the most important issues that could contribute to an increased efficiency of the teaching process. Thus, the management became more aware of the mission statement it serves in the medium-term and long-term perspective, the stated objectives and current activities and their relevance to the quality of the training process. The mission of the CTT is, henceforth, to provide attractive, flexible, high quality, competitive VET for the tourism sector to meet the needs of a changing and demanding labour market. CTT permanently adjusts its VET policy and initiatives to the training demands of the trainees and the sector. Through the training it provides it improves the quality of tourism training and releases to the labour market highly-qualified professionals.

The objectives of the CTT have been: (1) to permanently grow the range of its training offer, (2) to improve the quality of training, (3) to develop and maintain a coherent quality assurance system, (4) to equip young people or tourism workers with the competences and skills needed on the labour market, (5) to achieve national and international visibility and recognition.

The SWOT analysis revealed the following aspects:

Strengths	**Weaknesses**
1. Building and equipment 2. Recognition of credits in the EU countries 6 accredited courses 3. LCCI courses : English for Tourism courses and examinations 4. IATA courses (2) 5. Qualified trainers – most of which are managers working in tourism 6. International collaborations for training purposes 7. Placement opportunities in trusted and good hotels and agencies 8. Annual practice-related, guided excursion 9. Good visibility at home and abroad	1. Administrative staff shortage 2. IT staff shortage 3. Lack of a strategic and operational plan 4. Weak control over the placement/practical activities 5. Lack of a permanent feedback on the employers' satisfaction
Opportunities	**Threats**
1. The existing tourism potential 2. More attractive and friendlier regulations for tourism which will encourage tourism and tourism training 3. The existing QA methods and instruments (BBU, national and international) 4. New collaboration opportunities 5. Relative financial autonomy 6. Development of adult education and LLP	1. Competition from other training centres 2. Lack of interest of young people in VET 3. Candidates shortage (because of the financial crisis) 4. Need to raise taxes which, on the other hand, may be prohibitive to candidates 5. Too great a control of the BBU over the administrative and financial resources 6. Scarce links with the labour market

One of the purposes of the project was to identify the common issues of the five VET partners of the project. In this respect, they were asked to expose their strategic goals and objectives and to carry out a SWOT analysis. For the purpose of verifying the consistency of the objectives *vis-à-vis* the goals, brief *TOP - BOTTOM –TOP* analyses were conducted. The question ***How*** *can it be done*? was used for the *top - bottom* approach and the question ***Why****?/To what purpose?* was used for the *bottom - top* approach. The loops were properly closed, which means that the objectives were consistent with the goals. The results of the text analysis of the goals and objectives show that the partners have many common issues and the most important are:

- The goals and the objectives are defined in terms of the observance of the high quality and/or the excellence of the provided educational services.
- Quality is defined in close relationship with the requirements of the labour market, especially with a successful employment rate of the alumni.
- Mobility opportunities and international initiatives are reflected in the institutional goals and objectives.

- The partners' perception of tourism at present is that it is modern and innovative and thus the professional quality of the students is linked with their *capacity of innovation, change, and creativity.*

Starting from the last mentioned issue, the partners were asked to identify some of the specific aspects that bring novelty to the field of tourism today. The identified core issues were: green tourism, online approaches, computer skills for employees, advanced and personalised services, alternative tourism (religious, rafting), new marketing and management approaches to hospitality, packaging of tourism programs.

As a result, a series of new approaches to tourism training were acknowledged: modern content, methods, materials and resources, improved self-evaluation of training providers, more mobility and exchanges, an improved relationship of the VET providers in tourism training with the employers, more practical training for the trainees, foreign teachers/trainers/instructors, where it is possible and necessary.

As a consequence of the involvement of the CTT in the quality assurance project, its management team became more aware and concerned about the issues that are relevant for the process, i.e. the European indicators in the first place. As part of the project activities, the CTT conducted a survey for which three questionnaires were used: one questionnaire targeted the *employers*, one the *alumni* and one the course *graduating students*. Thus, the questionnaires addressed three indicators: indicator 2, 6 and 9.

The collected data were processed and interpreted by the co-opted expert, the expert working for the Centre for University Development and Quality Management of the university. This practice was extremely helpful as it taught the members of the CTT management team to design questionnaires, to use them adequately and to integrate the results in the ongoing training process.

The SWOT analysis of the activity conducted by each partner institution put forward the following common issues of the tourism training programs (some of them resulted from the applied questionnaires to the students and to alumni).

Strengths: (1) the existence of adequate material conditions for studies (venues, equipment, supplies, course support), (2) the high professional expertise of the trainers, (3) a well organised teaching activity, (4) the use of appropriate curricula, (5) the opportunities to carry out practical/placement activities in tourism agencies and other operators in the field, (6) initiation of international collaborations, (7) the development of the linguistic competences of trainers and trainees (except for Umbria Training Center, Scheggino, Italy), (8) local and national visibility and an efficient marketing strategy (except for the Turkish partner, Mugla Ticaret Meslek Lisesi).

Weaknesses: (1) lack of strategic planning, (2) scarce links and relationships with the labour market (especially with the employers) and with other stakeholders, (3) lack of financial support, (4) staff issues (shortage, age, motivation).

Opportunities: (1) The existing tourism potential in each county, (2) The development of LLL and EU interest for VET.

*Threats: (1)*shortage of candidates, (2) lack of interest of young people, (3) competition from other training centres, (4) the unbalanced labour market and unfair practices regarding the youth employment, (5)influences from national/local institutions (financial, regarding curricula, etc.).

Strategic planning and the relationship with employers and other stakeholders surfaced as common issues that must be improved. In addition, finding solutions for the financial and staff issues, and for the mentioned specific weaknesses (for example, more interactive teaching methods at the Mediterranean Agronomic Institute of Chania, Greece; the improvement of the linguistic competences of the trainers and trainees at the Umbria Training Centre, Scheggino, Italy; having more control over the practical activity at the Centre for Tourism Training, Romania) are common traits that should be pursued by each partner institution.

Another benefit resulting from the project was the *common quality assurance framework* designed by the project partner institutions for tourism training in VET. The framework with its debated items and sub-items was agreed on by the partners as they were all more or less in use in the partner institutions. The advantage of the framework over other instruments is that it refers to tourism training and is as detailed as possible in order to cover all aspects involved in the training process. Given the fact that it has not yet been piloted, it stands to reason that in the next few years the partner institutions will implement it and report on its benefits or shortcomings.

6. CONCLUSIONS

Practically speaking, it is expected that if the management of the CTT uses the feedback questionnaires on a permanent basis and seeks to improve them as the case arises, it will be able to rectify all shortcomings that occur in the system and also make clear, market-driven training forecasts.

If prior to the involvement of the CTT in the quality assurance project much of what has been carried out was rather empirical, less planned and quality assured, now the set mission statement and the training objectives will be carefully pursued and corroborated.

Second, it was for the first time that a research was undertaken whereby many documents were studied and reviewed and a scientific interpretation was given to the results of the questionnaires, which brought to light interesting issues that the CTT was only partially aware of. The interpretation of the findings represents an important springboard for the adoption of future training strategies.

Third, the corroboration of the concepts of mission – process - learning outcomes was critically examined.

Fourth, the setting up of the *common quality assurance framework* enables the centre management members to use the criteria on a common basis, which will guarantee an excellent risk management.

All in all, the project facilitated to the project partner institutions a scientific access to quality assurance principles and strategies, a lesson they all learned diligently.

If the project investigated and used three indicators, it may be the next priority of the CTT to look forward to using other indicators or all indicators to ensure an adequate training process.

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BISTRIŢA ARDELEANĂ CATCHMENT AREA – COORDINATES OF STRATEGIC LAND MANAGEMENT

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ABSTRACT. – Bistriţa Ardeleană Catchment Area – Coordinates of Strategic Land Management. The approach of "creation and execution" / designing of this territorial cut-out of basin type, in the paradigmatic context of the durable development, is subordinate to an (almost)exhaustive investigation of the vocation and potentiality of this area in terms of geographical and spatial organization of the territory.

There may be multiple reasons to justify the existence of a paper which approaches this territory in an integrating and prospective manner. First of all, this area has an "identity card" type of evidence, at the level of the collective memory of the county's inhabitants. Even if many contradictions multiplied along the years, nuances and specificities have been imposed, there is a filiation and a common territorial manifestation for the population and the settlements in this area. Secondly, the building of the settlements from Bârgău area and their later historical evolution was accomplished in a close interdependence, therefore the premise of development cannot be achieved outside the association (the access to different financing sources is easier when partnerships are built). Thirdly, the challenge of developing a study that shows the real prospects of developing a territory from the Bistriţa Ardeleană catchment area was motivated by subjective arguments, and the love of nature and environment played a key role in the effort to complete this action.

Keywords: *connectivity, strategic land management, catchment area, Bistriţa Ardeleană.*

1. INTRODUCTION

The land management strategy of the territory within Bistriţa Ardeleană catchment area emerged onto the support of the following logical "construction" of the research approach:

- Identifying the problems;
- Identifying the dysfunctions arising from the problems;
- Proposing measures in order to fix this dysfunctions;
- Outlining clear measures arising from these proposals.

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The problems and dysfunctions prior defined as conclusions, the strategy sketch involves *the creation of a vision regarding the development (main strategic target)*, seconded by *setting sector strategic targets,* while proposing an action plan aims at identifying the area that rise problems in terms of spatial evolution, identifying the intervention areas, selecting the areas that have priority of intervention.

Paradigmatically dependent of the sustainable development, ***the vision summarizes the idea of an optimum relationship between the resources and their exploitation in order to design the investigated territory of the natural geometrical space of a balanced, harmonious and pan-European evolution.***

Achieving this goal lies with the explicit establishment of sectorial strategic objectives, while refining the proposals and measures to achieve them. In this regard, the strategic planning of the analyzed catchment area has to be based on a few clear directions (sectorial targets):

A. *Extend and improve the territorial infrastructure (transport);*
B. *Strengthen relations within the system of settlements;*
C. *Supporting the tourism;*
D. *Vary the economical activities in rural areas, focusing on harnessing the local specific;*

Some of the initiatives may be supported by the local and county authorities; as for others, the government input is needed. Partnerships of the local economical entrepreneurs and the association of the communal authorities would be required, also the founding of micro-regional associations.

2. OPERATIONALIZATION OF THE PRIORITARY SECTORIAL TARGETS

Furthermore we will discuss about three of the five targets which are considered imperative in the strategic settlement process. These three targets are considered intrinsic vectors of the durable development.

2.1. The extension and the improvement of the territorial infrastructure transport)

The inventory of the state and quality of the road and rail infrastructure revealed functional inconsistencies (lack of functional territorial expressions). The catchment area which was investigated is longitudinally crossed by the main road axis that connects Transylvania to Bucovina.

In view of the fact that the linear arrangement of the rural settlements in the form of an axis is carried out mainly along the transport passage (communal centres except Bistriţa Bârgăului), there is a high connectivity settlement system attached to the mainstream of energy and information transiting this area.

The issues which arise are related to the links within the communal and inter-communal settlements, as well as the links of the neighbouring catchment areas (e.g: The basin of Ilva). These issues may impose some restraint systems, including the transit of the settlement system by this transport road.

The solution of an alternative link as a highway that would avoid crossing the localities from Bârgău and would facilitate the access to these localities may represent a better solution than the territorial planning of transport flow between the two historical provinces.

The links within the intra and inter-communal systems are accomplished through a radial-convergent, undersized qualitative, non-connected road network.

The type of the system layout of the settlement basin system, the links between the villages belonging to different communes, is achieved mainly through the main transport axis, with a few exceptions:

- The link between Colibița and Mureşenii Bârgăului, accomplished through county road 173D;
- Dorolea - Valea Poienii - Rusu Bârgăului, through communal road 6B, really hard to be used;
- Dumbrava and Strâmba, through communal road 6A (which connects to DJ 172C);
- Dumbrava and Rusu Bârgăului, through communal road 6C.

The links to the neighbouring catchment areas are accomplished through DJ 172B - Unirea-Slătinița-Nepos; through the county road 172C - Josenii Bârgăului-Strâmba-Ilva Mică; through the county road 172G - Cuşma-Satu Nou-Orheiu Bistriței.

This system of links, convergent, relatively self-sufficient emphasises the dependence of the villages to the communal control centre. Strengthening this type of relationship can have positive connotations, outlining strong cohesive communal systems, but the difficulty of trans-communal relations and trans-basin relations emphasizes the degree of economical isolation of the villages within the communal settlement systems.

The local and county authorities have more then once initiated projects of rehabilitation and modernization of the roads (permanently postponed); the technical condition of the road network, except E576, is really poor, and does not meet the minimum requirement for the smooth running of car traffic. It is the same situation with the county roads that connect the villages of the catchment area under analysis: DJ 172G, 173A and 173D, totally inadequate in terms of quality of the driving surface, and the same situation with the roads that make the trans-basin connections to Nepos and Ilva Mica. The technical state of the communal roads is even more dramatic.

The railway links are accomplished also longitudinally, the last railway station being Bistrița Bârgăului. This link was heavily exploited before 1989, but it started to lose its meaning once the commuting decreased and the transport means became more comfortable and sometimes even more elegant: people's own car or the bus. Even if the train is obsolete and the railway stations are not properly maintained, we consider that the railways links should be reinforced; first of all by setting agreeable politics regarding the train ticket cost, and secondly by starting an initiative to modernize the railway infrastructure.

The links through the railway within the catchment area of the Bistrița Ardeleană date since the end of the 19th century. There is an emotional component in this aspect (not only functional) related to tradition which justifies the efforts to resuscitate this type of link. Apart from the normal gauge railway, the narrow gauge railway also existed here.

- The narrow railway Prundu Bârgăului-Dorna Helgei-Vatra Dornei (34 km long) was functional between 1914-1935, on the route: Vatra Dornei Băi, Roşu, Candreni, Coşna, Poiana Stampei, Dorna Bârgăului, Dornişoara, Dorna Mica, Şendroaia, Mănăstirea Fântânele, Măgura, Tihuța, Cărare, Cicerea, Valea Străjii, Mureşenii Bârgăului, Tureac, Macaz, Tiha Bârgăului, Prundu Bârgăului. Its role was deminished once the normal gauge railway was finished and started working: Ilva Mică-Vatra Dornei;

- The railway Bistriţa Bârgăului-Colibiţa-Miţa, 18.2 km long;
- The railway Susenii Bârgăului-Tiha Bârgăului, 6 km long.

Even though these days everything is quantified in terms of economical lucrativness, if possible in the shortest time, we consider as mercantile the vision driven only by the pecuniary component. Regaining values related to specificity, corroborated with long term strategic visions, may constitute the premises to ensure an appropriate environment to durable development.

2.1.1. Measures

At a major level, two clear directions should be taken: improve the railway and road transport infrastructure and increase the connectivity degree in the basin and trans-basin context (increased accessibility and quality). The last goal can be achieved by reclassification of some roads (including them in a higher class and treating them as such), by elaborating new road transport alternatives, and also by reinventing the narrow gauge railways (as seen in figure 1). Subordinate to these two directions, attention should be paid to increasing the use of public transportation.

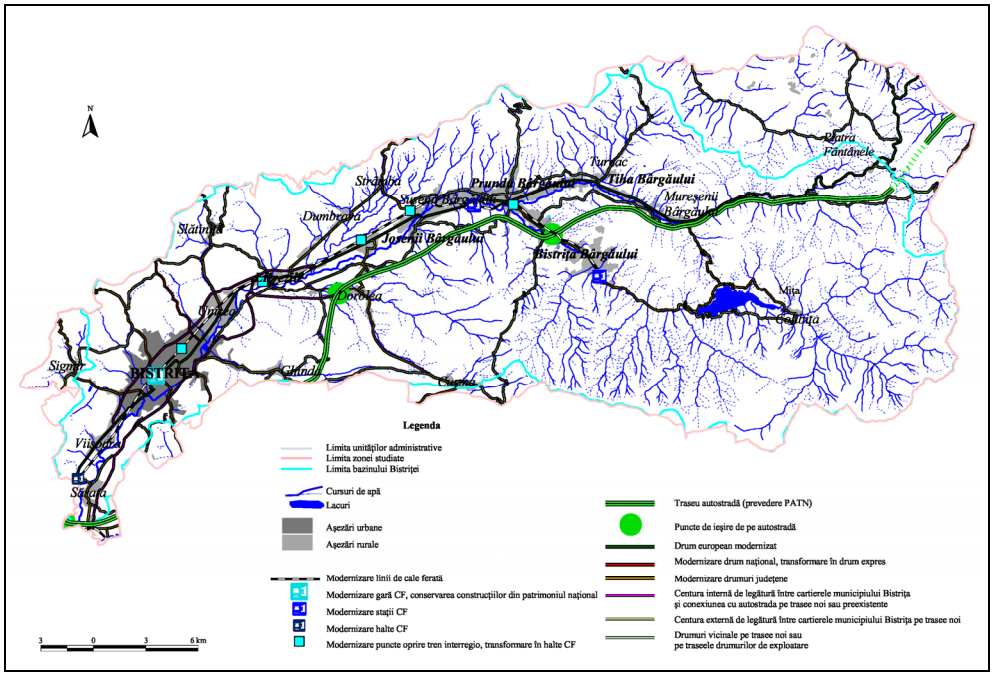

Fig. 1. Proposals to develop and modernize the transport network

One of the most important measures is related to *the accomplishment of the major infrastructure projects, foreseen in PATN, section I, Transport networks*, as follows:

- highway A 1.14. Petea – Satu Mare – Baia Mare – Mireşu Mare – Dej – Bistriţa – Vatra Dornei – Suceava (according to PATN, section I, Transport network).

The local and county authorities must work together in order to motivate the importance of determining the final route of the highway, within the administrative territory of Bistriţa and of the other communes of the basin in discussion.

In the context of major infrastructural achievements it is necessary to *build the south ring road*: *Sărata-Unirea, for Bistriţa (Cocean, P. et al., 2010, p.124)*. The authors motivate the priority of this step for the development of Bistriţa as follows:

- Increases the economical and urban value of the south suburban area of Bistriţa;
- Determines the axial development of Bistriţa on the east-west component;
- Increases the communication potential for the new industrial park type sites, proposed in the south-west of the town. This aspect represents one of the basic requirements to attract investors in the industrial park;
- Contributes to shape the new combined transport terminal in Sărăţel;
- Supports the transfer of the traffic in Bistriţa to the highway A14, on the western component […];
- Leads to shaping a complete ring road […] " (ibid.).

Upgrading and rehabilitation of the county roads through asphalting and landscaping of gutters to collect rainwater, in line with the European requirements:

- DJ 172 B - Unirea-Slătiniţa-Nepos, with the role to increase the availability from the belonging village Slătiniţa to Bistriţa, but also the strengthening of the link with the Someş Basin;
- DJ 172 G - Livezile-Dorolea-Cuşma-Satu Nou-Orheiu Bistriţei, with the role to streamline the access of the inhabitants from Cuşma and Dorolea to Livezile and Bistriţa, but also in the scope of the trans-basin interconnectivity.
- DJ 172 C - Josenii Bârgăului-Strâmba-Ilva Mică;
- DJ 173 D - Colibiţa-Mureşenii Bârgăului, with the role to remove from seclusion the future tourist resort of local interest, so that the turists that cross the catchment area in discussion do not have to avoid virtual access to this area;
- DJ 173 A - Bistriţa Bârgăului-Colibiţa, with the role to facilitate the access of the tourists travelling from Bistriţa to Colibiţa, but also to facilitate the decent movements of the inhabitants of this area to Prundu Bârgăului and furthermore to the centre of the county municipality.

Upgrading and rehabilitation of the county roads through asphalting and landscaping of gutters to collect rainwater, as follows: 6 C - Dumbrava-Rusu Bârgăului, 6 A - Dumbrava-Strâmba, 6 B - Rusu Bârgăului-Valea Poienii-Dorolea, 5 B - Piatra Fântânele-Dornişoara, 5 A - Piatra Fântânele-Ciosa.

These initiatives are desirable in order to avoid overcrowding of the county and national roads, facilitating the access of the farmers inside their properties and preventing the occurrence of traffic accidents.

Reclassification of vicinal and forest roads, by changing their status to communal roads. Here we consider appropriate the strengthening of the inner and trans-basin relation and also the shaping of some roads for tourist circulation, by improving them as communal routes: Piatra Fântânele-Ciosa -Tureac, on one side and Piatra Fântânele-Ciosa-Lunca Ilvei, on the other side.

Arranging the vicinal roads and the forest roads, also in order to enhance inter and trans-basin connectivity: Prundu Bârgăului-Leşu, Tureac-Lunca Leşului, Bistriţa-Livezile, Livezile-Valea Poienii-Josenii Bârgăului-Prundu Bârgăului, Bistriţa Bârgăului-Mureşenii Bârgăului (on the left side of the Bârgăului valley), Josenii Bârgăului-Prundu Bârgăului (on the right side of Bistriţa valley), Mureşenii Bârgăului-Piatra Fântânele and furthermore to the Bâtca Lui Ieremia (Dorna basin), Ghinda-Livezile, Ghinda-Cuşma, Cuşma-Bistriţa Bârgăului, Slătiniţa-Nepos, Livezile-Slătiniţa-Dumitra, Piatra Fântânele-Lunca Leşului.

Upgrading the railway sector Bistriţa-Bistriţa Bârgăului to the European standards of comfort and safety, including the rehabilitation of the railway stations on this route. The purpose is to decently serve the commuters from Bârgău, but also to facilitate the access of the weekend tourists to Colibiţa and Piatra Fântânele, contributing to the road traffic flow of DN 17 and DJ 173 A.

Subsequently to his goal, we consider appropriate *the reinvention of the narrow gauge railway*, including the original locations and routes. The experience of tourist-oriented areas in which they operate efficiently, may constitute a starting point in accomplishing this approach.

*2.2. **Strengthening relations within the system of settlements***

The diagnosis made in the first part of the paper nuances, among other things, setting up a set of dependency relation within the system settlement in discussion. Apart from the administrative dependency relation, specific of the communal systems, we paid more attention to the inter-communal relations, including the trans-basin context. The approach was motivated by the need to highlight the possible forms of association, coagulated around the over-communal control centre.

Considering the facility of the links with the county residence centre (for most of the villages in the investigated territory), the dynamic of the convergent flow to Bistriţa prevents, apparently, the obvious disconnection of an intermediate control centre, to redirect part of it. Despite this, it remains palpable – historical and empirical, the status of over-communal centre Prundu Bârgăului.

Even if the economical transformations of the post-revolution period had the role to undermine the privileged status of the village mentioned above, the higher standard facilities of the health, education, services (e.g. legal) have the purpose to confirm and consolidate the empiric perception of this reality.

This plea was made in order to restore a balance established historically, so that we don't dilute the identity of the Bârgău villages that gravitate around Prundu Bârgăului. The identity coagulation around a recognized, respected and assumed centre of the local community represents a prerequisite in the process of legal association in accessing financial resources.

There are at least two rural subsystems that stand out in the settlement system from the Transylvanian Bistriţa basin: the "Bârgău" subtype and the "German" subtype. There is another subtype we can mention, which is subordinate from the administrative point of view to Bistriţa and Livezile, the interface subtype between the two mentioned above (villages that are not integrated in the two types mentioned above).

The subtype "Bârgău" considered to have a consolidated identity and includes the villages from the Bârgău Valley.

The "German" subtype, located near Bistrița (old medieval burg), includes villages belonging to the municipality on one side: Viișoara, Unirea, Slătinița, and on the other side includes villages belonging to the commune that unites the municipality to the villages from the Bârgău valley: Livezile, Dorolea.

Making a model of cultural association that evokes patterns of affective affiliation within the German population, may constitute a starting point of a virtual strategy of composing and decomposing the identity at basin level.

The belonging villages: Sărata, Slătinița, Sigmir, have a deep rural mark, the first two villages being situated at a considerable distance from Bistrița.

2.2.1. Measures

- Increasing the degree of dependency of the Bârgău villages to the over-communal centre Prundu Bârgăului, by the decentralization of certain administrative positions and services concentrated at the level of Bistrița City;
- Consolidating the transport infrastructure system as described below, in order to multiply the connectivity means in the basin context;
- Accomplishing economical partnerships and cultural associations within the communes from the Bârgău area with the purpose to efficiently promote the common values, to consolidate the identity and acquire funds.
- Promote the cultural German model and use this model at county, regional and national level, through tourist promoting.
- Achieve an identity cluster by associating two cultural models for the purpose of common promotion.

2.3. Support the tourism

One obvious option for the balance economical development of the entire area is promoting the tourist activities. The interest to develop this activity sector is motivated by the diversified, but underestimated offers, which have an intrinsic potential that is extremely attractive from the improvement point of view.

The organized tourism in the area in discussion is related to Slătinița and Colibița. These villages functioned as spas since the end of the 19th century, Slătinița lost this function gradually. Colibița maintained and confirmed this status (children camps were organized here in the communist period), even if it was never declared a tourist place of county interest (local).

The mineral water resources from Sărata and Slătinița are mineral springs irregularly distributed inside the basin may be the start of the tourist locations for balneary purposes. Colibița and Piatra Fântânele are the frame of this tourist project for balneary purpose and they provide a diversified range of tourist alternatives.

The cultural tourism is another direction worth mentioning. In this case there is a double perspective. On one hand, the cultural heritage of the medieval architecture – the architectural vestiges of urban and suburban territories of medieval original, well preserved, can be places for those who want to recreate the historical environment of those times and the cultural traditions of the Bârgău valley (clothing, customs, food, etc), on the other hand.

In the first case, we have to give special attention to creating products that value the affective nostalgic component of the descendants of the German population that emigrated from these locations. In the second case the offer is addressed to the nostalgic of the rural traditional environment.

The offer has to be motivational for the both parties: the recipient on one side and the rural community on the other side (rediscover the identity):

"A few years back I had the opportunity to take part in a series of shows that commemorated 60 years since the emigration of the Germans from North Transylvania. Hundreds of Germans from all over the world that were originally from the city and the villages around gathered in Bistrița. Most of them were called by the memories of their youth years, the places where they lived as children and the voice of the ancestors. It was probably the last time that the evangelical church was full of people. After they took communion they marched through the city in brass band music, and when they reached the cemetery they could hear the music of the choir singing the German hymn „Transylvania, blessed country of abundance and strength". The elders were overwhelmed by emotion. The young – children and the relatives of the elder – who were paying attention to the singing, a bit disoriented and more neutral than the others that did not understand the lyrics were watching the elders burst of emotion and feeling. Then I thought how the elders could determine the young go to their ancestors lands, and get them close to the emotion of those places. What would be the values that would stir their interest, how much of the old could be attractive to them, apart from the remains of their ancestors.

Travelling through the former Nösnerland territory, one cannot but see the remains of the methodical community organization that slowly changed its appearance. The new inhabitants of the place have unwillingly developed an ambiguous identity, that of an immigrant in one side and that of an inhabitant of his country in political and administrative terms. The German location is foreign to them, and the effort to adapt to their own way of life lead to reshaping the architecture and the living conditions.

As a consequence, if the elder German would try to lead the young in a family environment that he keeps in his memory, the odds of making the young vibrate to this lost world are really diminished. On one side, this world is gone, and the young, who was brought up in a totally different cultural environment would not be interested in such a perspective. The changes in the ethnic and social structure did not lead to the disappearance of the space organizing of this community and the proof still exists around the area, rendering the territory an identity built in time. This identity was not the creation of any of its components, it was the creation of the interactions and influences, of the interference of people, community, space." (Corneiu Gaiu, *www.medievistica.ro)*

2.3.1. Measures

- Value the tourist resources of the area and making it individual in relation to the territorial units with similar extensions and functionalities nationally and internationally, through the continuous development of prospecting and handling of the attractive resources, along with the tourist promoting and branding;
- Diversify the tourist activities and make them lucrative;
- Develop the tourist infrastructure and interconnect the components from the primary and secondary tourist offer and of the means that make possible the extension of the tourist period and the extension of the tourist duration (the number of the accommodation days) as well as promoting the image of the area as a unit for the national and international tourist markets;
- Develop the brand tourism (cultural, sport, business, workshop, agricultural, eco-tourism, etc.);
- Create a voluntary public-private environment of reflection, debate, decision and action, between all the sectors with impact on tourism;

- Encourage and support the initiatives to make professional associations among the parties involved in tourism;
- Build a camping in the lake areas to serve the transit tourism, the people who practice the fishing as sports and also people who enjoy the water sports (also building the necessary facilities);
- Build a school camp (boy scout / girl scout camps) in order to have outdoor activities, and also a teambuilding location;
- Build a centre where the locals can sell the products of their lands and farms;
- Use the investments in order to benefit of the tourist value of the mineral water resources;
- Improve the accommodation of the existent tourist guest houses;
- Build ecological sheepfolds and stalls;
- Build crafting centres and markets to sell the handmade products, craftworks and souvenirs;
- Create an yearly event calendar, also in the international foreign languages;
- Use the wood for buildings and dependencies (e.g. wood is well suited for wellness at a small scale: sauna, jacuzzi). Using the wood with other raw materials: teas and traditional resting based on medicinal plants, etc.

3. CONCLUSIONS

The vision on the territorial development in accordance to the desired outcome regarding the strategic landscaping was described with the help of a "choreme" analysis (see figure 2.).

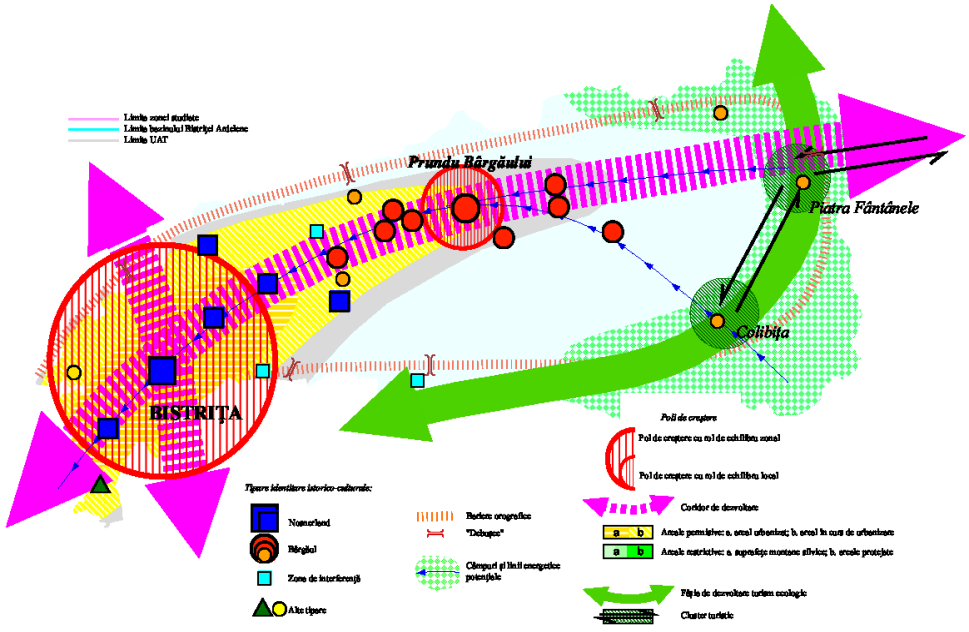

Fig. 2. Choreme analysis

This simplified sketch of the territory has a double meaning: on one side includes the patterns of evolution of the social-cultural component, developed historically on the geographical data, and on the other side prefigures the optimum development trends, adjunct to the durable development.

Expressed as conclusions, the chorema becomes corollary of the joint effort of a coherent, quasi-exhaustive vision.

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